Interreg - IPA CBC
Romania - Serbia

EUROPEAN UNION

STUDY IMPACT FOR THE USE OF INNOVATIVE TECHNOLOGIES ON INCREASING THE QUALITY OF LIFE OF POPULATION IN THE MUNICIPALITY OF THE CITY

Cooperation beyond borders.
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1. ANALYSIS OF THE EXISTING SITUATION

1.1. GEOGRAPHICAL LOCATION

Reșița municipality is the residence of Caraş-Severin County, which together with Arad, Hunedoara and Timiș counties form the West Region.

1.2. DEMOGRAPHIC CHARACTERISTICS

During the period, 2008-2015, most inhabitants registered in 2008 when the population reached 95,356 inhabitants. Starting with the following years, the population level began to decline.

According to the statistical data, at the beginning of January 1, 2018, in the Municipality of Reșița there are 86,658 inhabitants, of which 41,631 male inhabitants and 45,027 female inhabitants.

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2. EMISSION REFERENCE INVENTORY - INVENTORY METHODOLOGY

The Sustainable Energy Action Plan (PAED) of the municipality of Reșița was developed within the project: "Supporting local authorities in developing and integrating PAEDs with energy management systems in accordance with ISO 50001" ("Supporting Local Authorities in the Development and Integration SEAPs with Energy management Systems According to ISO 500001").

PAED is a key document that shows how the signatory of this commitment will reach its commitment by 2020. The development of the SEAP will use the results of the basic inventory of emissions to identify the most important areas of action and the possibilities and opportunities to achieve the CO2 reduction target by at least 20% by 2020. It defines concrete measures to reduce greenhouse gas (GHG) emissions, along with deadlines and assigned responsibilities, which will transform the long-term strategy into action.

The Emissions Reference Inventory (IRE) is the methodology used to assess consumption and the environmental impact associated with these consumptions, an impact highlighted as CO2 emissions locally for a chosen reference year. At the level of Reșița Municipality he represents the starting point or reference point for the future objectives of local energy efficiency, against which the local targets will be set and which will represent a key commitment of the Municipality. The following principles were based on the consumption assessment:

• IRE is based on data related to energy consumption / production, data on mobility, waste, water and others within the territory of the local authority in order to calculate the amount of CO2 emitted.
• Linearity of years spent during the report.
• IRE covers relevant sectors on which the local authority intends to take action to reach the target for CO2 reduction by 2020: municipal buildings and installations, residential buildings and buildings in the tertiary sector, transport, water and waste.
• IRE represents a reasonable view on the reality, the data being collected for the chosen reference year which had a centralization of data at the level of the utility providers.

The minimum target for CO2 emissions reduction set for Reșița City is 20% by 2020 compared to the reference year (2008 - according to the PAED achieved).

3. CO 2 EMISSIONS AT LOCAL LEVEL

Human activities contribute to climate change by causing changes in the Earth's atmosphere through the quantities of greenhouse gases generated from the activities carried out. The greatest contribution to GHG emissions comes from the burning of fossil fuels, which release a considerable amount of CO2 into the atmosphere. Greenhouse gases and aerosols affect the climate by modifying solar radiation.

At the local level, energy consumption in different sectors contributes to GHG emissions, so changes over time are recorded. By carefully analyzing the way these emissions occur at the locality level, the report shows that the significant reduction of gas emissions is within the reach of the local authorities.

Adopting best practices and actions contributes to reducing emissions. The analysis of the current situation from the point of view of the potential for the use of renewable sources has aimed to identify to what extent the natural potential and the existing technologies offer the opportunities to make investments in the production and use of renewable energy systems in different sectors in order to reduce the conventional energy consumption, of reducing CO2 emissions and increasing energy efficiency.

3.1. RESIDENTIAL BUILDINGS

3.1.1. BUILDING FUND

Between 1960 and 1974, 11,017 apartments were built in the municipality of Reșița, contributing to the stimulation of population growth and urban development. In 2008, in Reșița there were 653 blocks with 26,389 apartments and 6,621 houses. Based on the reference year 2008, it is noted that in 2013, the number of dwellings increased by 7.9%. This increase was registered due to the 11.5% increase in the number of private properties due to the local economic development by attracting new investors in the field of production and retail (large stores). While private property is increasing over the years 2008-2013, public property has a downward trajectory over the whole period, so that in 2013 there are 51.6% less public housing compared to 2008, reaching the number 944.

From the perspective of the inhabited area, it is observed that the total area has registered an increase since 2009, reaching a growth of 34% in 2013. The habitable private area increased by 35.8% as a result of the 11.5% increase in the number of private properties. The public area registered the largest area in 2008, 36,593 sqm, while in 2013 it decreased by 23.4% due to the decrease of 51.6% of the number of public properties.

3.1.2. RESIDENTIAL CONSUMPTION

The consumption of natural gas shows fluctuations, registering the highest value in 2011, of 262,583 MWh / year, being at a level close to 2008. Since 2008, the residents of Resita have responded positively to the actions of isolation of the blocks and to the installation of gas-fired power stations in the apartments in the blocks. Since 2011, the inhabitants of the municipality have begun to migrate settling in EU countries. The decrease of the gas consumption is also due to the decrease of the population in 2014 with 5.1% compared to 2008. In 2014 there is a negative variation, with 20.2% compared to 2008.

The quantity of electricity has increased during 2008-2013, due to technological developments and the acquisition of goods registered by the population. The largest amount of energy is presented in 2012. In 2014, the amount of electricity decreases to a value of 30,329 MWh / year, by 24.5% compared to 2008. This decrease is due to the steps taken by the local authorities in view educating the population in the direction of sustainable development.

3.2. PUBLIC BUILDINGS

Public institutions managed by local authorities include educational institutions (kindergartens, schools, high schools, universities), theaters, sports centers, social housing and other buildings managed by the City Hall.

The amount of thermal energy consumed by the buildings managed by the local authority in 2014 was 10,111 MWh / year, 25.3% lower than in 2008 (13,528 MWh). At the level of 2008, the CO_2 emissions due to the thermal energy consumption supplied in the centralized system was calculated at 2,895 tons CO_2, and this value is decreasing considering the switch to another type of heating systems. Starting with 2014, when CET Reșița ended its activity, all the institutions were supported by the local authority in purchasing their own thermal power plants. Of the total educational institutions, 2 kindergartens use biomass as a resource for heating.

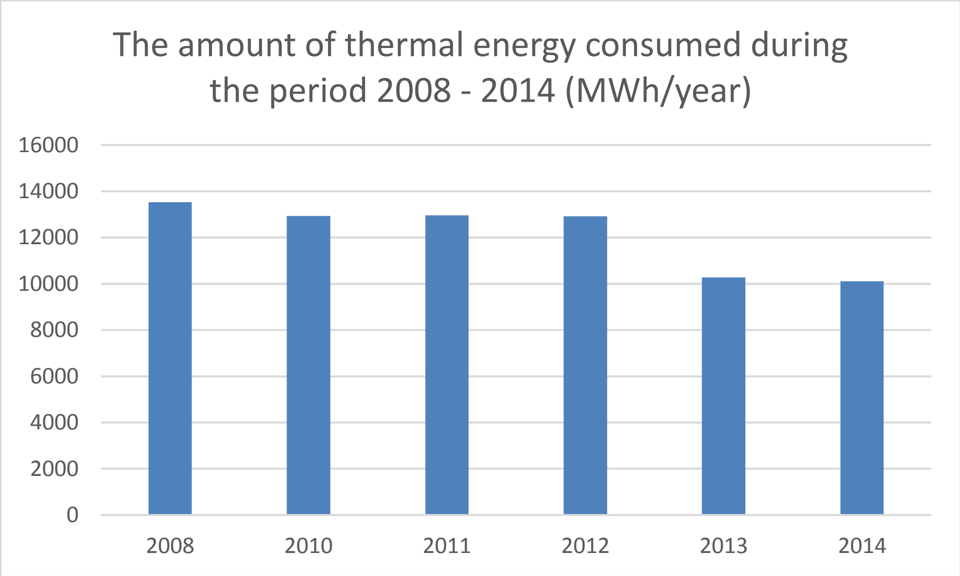


Figure 1 - The amount of thermal energy consumed during the period

4. SYNERGY WITH THE PROJECTS DEVELOPED BY THE MUNICIPALITY OF RESIȚA

Following the implementation of the Sustainable Energy Action Plan, the Municipality of Reșița has run a large company to make public and residential buildings more efficient by submitting financing applications within the Regional Operational Program.

The general objective of the projects is to increase the energy efficiency of the rehabilitated buildings and obtaining the final energy consumption decrease, the reduction of primary energy consumption (from non-renewable sources) and the decrease of the annual consumption of primary energy from non-renewable sources within this public institution.

The interventions within the projects consist of:

- Thermal rehabilitation works that reduce CO2 equivalent emissions (toCO2 / year) and reduce specific annual primary energy consumption (obtained from non-renewable fossil sources) (Kwh / year) and reduce specific annual energy consumption (kwh/year):

- thermal rehabilitation of the tire, the heating system / the hot water supply system;
- installation of alternative systems of electricity / thermal energy production for own consumption;
- modernization of air conditioning systems, natural ventilation and mechanical ventilation to ensure indoor air quality;
- rehabilitation / modernization of the lighting installation in buildings;

• integrated energy management;
• air conditioning and ventilation equipment;
• central thermal equipment;
• solar equipment for hot water production;
• equipment for the production of electricity with photovoltaic panels;Crearea de facilități / adaptarea infrastructurii/ echipamentelor pentru accesul persoanelor cu dizabilități;

- Execution of works in order to conform the existing constructions to the regulations in force regarding the protection against fires;

- Related interventions that contribute to the implementation of the project, with works for repairing the construction elements of the areas with potential danger of detachment, repairing the sidewalks in the immediate vicinity of the building and which have deteriorated as a result of the work on the tire building.

The expected results as a result of the thermal rehabilitation projects are centralized as follows, for the high schools in the municipality of Reșița.

Table 1 - Reduction of the specific annual consumption of primary energy (from non-renewable sources) in the high schools of the Municipality of Reșița

Reduction of specific annual primary energy consumption (from non-renewable sources), kWh/m2/year			
	Value before project implementation	Value at the end of the project implementation	Percentage reduction
Colegiul National Mircea Eliade Reșița	323.78	96.41	70.22 %
Colegiul Economic al Banatului Montan	221.34	88.64	59.95 %
Liceului Teologic Baptist Reșița	393.86	106.61	72.93%
Colegiul Național Traian Lalescu, Reșița	1282.13	276.89	78.40%
Colegiul National Diaconovici-Tietz Resita	662.43	211.58	68.06%
Liceul de Arte Sabin Pauța, Resita	346.5	66.25	80.88%
Liceului Teoretic „Traian Vuia”, Resita	370.75	95.51	74.24%

Table 2 - Reduction of the annual level specific to greenhouse gases in the high schools of Reșița Municipality

Reduction of the specific annual level of greenhouse gases, equivalent CO2 tonnes			
	Value before project implementation	Value at the end of the project implementation	Percentage reduction
Colegiul National Mircea Eliade Reșița	174.59	51.65	70.42%
Colegiul Economic al Banatului Montan	190.06	75.98	60.02%
Liceului Teologic Baptist Reșița	92.06	29.88	67.54%
Colegiul Național Traian Lalescu, Reșița	288.63	75.73	73.76%
Colegiul National Diaconovici-Tietz Resita	198.33	53.42	73.07%
Liceul de Arte Sabin Pauța, Resita	222.429	47.76	78.53%
Liceului Teoretic „Traian Vuia", Resita	413.92	110.89	73.21%

Table 3 - Reduction of the specific annual consumption of primary energy for heating in the high schools of Reșița Municipality

Reduction of specific annual consumption of primary energy for heating, kWh/m2/year			
	Value before project implementation	Value at the end of the project implementation	Percentage reduction
Colegiul National Mircea Eliade Reșița	289.69	73.36	74.68%
Colegiul Economic al Banatului Montan	172.41	50.23	70.87%
Liceului Teologic Baptist Reșița	227.47	46.78	79.43%
Colegiul Național Traian Lalescu, Reșița	961.42	255.84	73.39%
Colegiul National Diaconovici-Tietz Resita	516.92	149.21	71.13%

Liceul de Arte Sabin Pauța, Resita	298.23	54.66	81.67%
Liceului Teoretic „Traian Vuia", Resita	261.92	217.36	17.01%

Table 4 - Reduction of the specific annual level of greenhouse gases within the housing blocks of Reșița Municipality

Reduction of the specific annual level of greenhouse gases (equivalent tons of CO2)			
	Value before project implementation	Value at the end of the project implementation	Percentage reduction
Blocurile de locuințe - Bulevardul Republicii Resița, Etapa 1, Componenta Bloc nr. 20	897.83	319.22	64.45%
Blocurile de locuințe din str. Horea, bl. A2	210.8	98.61	53.22%
Blocurile de locuințe din str. Horea, bl. A3	204.38	97.92	52.09%
Blocurile de locuințe din str. Horea, bl. A4	205.26	98.74	51.90%
Blocurile de locuințe din str. G. A. Petculescu, bl. 15	244.23	111.71	54.26%
Blocurile de locuințe de pe strada Horea, bl. A6	297.53	137.45	53.80%
Blocurile de locuințe de pe strada Horea, bl. A7	205.75	98.52	52.12%
Blocurile de locuințe din Piața 1 Decembrie 1918, bloc 25	184.44	88.84	51.83%
Blocurile de locuințe Centru Reșița, Etapa 3, Componenta Bloc 36, P-ța 1 Decembrie	199.3	95.04	52.31%
Blocurile de locuințe - Centru Reșița, Etapa 3, Componenta Bloc nr A5, strada Horea	209.81	99.88	52.40%
Blocul de locuințe din Bulevardul Republicii, bloc nr. 27, scara 1, 2, 3, 4, 5	715.12	421.62	41.04%

Blocurile de locuințe I.L. Caragiale, Reșița, Componenta Bloc Nr. 1-2	174.11	97.74	43.86%
Blocurile de locuințe I.L. Caragiale, Reșița, Componenta Bloc Nr. 3-4	279.22	143.69	48.54%
Blocurile de locuințe I.L. Caragiale, Reșița, Componenta Bloc Nr. 5-6	152.29	86.32	43.32%

Table 5 - Specific annual energy consumption within the housing blocks of Reșița Municipality

Specific annual energy consumption (kWh/m2/year)			
	Value before project implementation	Value at the end of the project implementation	Percentage reduction
Blocurile de locuințe - Bulevardul Republicii Resița, Etapa 1, Componenta Bloc nr. 20	363.57	126.13	65.31%
Blocurile de locuințe din str. Horea, bl. A2	298.51	137.13	54.06%
Blocurile de locuințe din str. Horea, bl. A3	292.2	137.51	52.94%
Blocurile de locuințe din str. Horea, bl. A4	293.49	138.71	52.74%
Blocurile de locuințe din str. G. A. Petculescu, bl. 15	321.84	144.58	55.08%
Blocurile de locuințe de pe strada Horea, bl. A6	208.03	97.89	52.94%
Blocurile de locuințe de pe strada Horea, bl. A7	294.21	138.4	52.96%
Blocurile de locuințe din Piața 1 Decembrie 1918, bloc 25	322.69	152.89	52.62%
Blocurile de locuințe Centru Reșița, Etapa 3, Componenta Bloc 36, P-ța 1 Decembrie	301.53	141.09	53.21%

Blocurile de locuințe - Centru Reșița, Etapa 3, Componenta Bloc nr A5, strada Horea	300.1	140.35	53.23%
Blocul de locuințe din Bulevardul Republicii, bloc nr. 27, scara 1, 2, 3, 4, 5	246.57	131.84	46.53%
Blocurile de locuințe I.L. Caragiale, Reșița, Componenta Bloc Nr. 1-2	205.23	106.9	47.91%
Blocurile de locuințe I.L. Caragiale, Reșița, Componenta Bloc Nr. 3-4	220.29	110.65	49.77%
Blocurile de locuințe I.L. Caragiale, Reșița, Componenta Bloc Nr. 5-6	178.87	99.1	44.60%

Complementary, following the savings made within the project and for reducing CO2 emissions, the City Hall started the public procurement for electrical bicycles and the bike-sharing system, having as object the supply of 60 electrical bicycles (26 "and / or 28").

Most Europeans' preferred mode of transport is the car. As it turns out, unfortunately it is also the most environmentally unfriendly one. It starts with production. Producing cars is a high-energy industrial process that uses lots of raw material. On average, the production of a car alone accounts for 42 g of CO2 emissions per kilometer driven.

But actually driving your car is what really bumps up greenhouse gas emissions, of course. Considering the average road use of European car drivers, different fuel types and average occupation, and adding emissions from production, driving a car emits about 271 g CO2 per passenger-kilometer.

Taking the bus will already cut your emissions by more than half. Buses have longer life spans and can carry more people, which means that producing them accounts for less emissions per passenger and kilometer. A bus ride will only blow 101 g of CO2 per kilometer into the air, which is less than the majority of even the most modern cars available.

Yet these numbers are based on average occupation, and if twice as much people took public transport regularly, the emissions could be reduced even further.

The production of a bicycle sets you back only 5 g per kilometer driven. That's about one tenth compared to the production of a car. Add to that the CO2 emissions from the average European diet, which is another 16 g per kilometer cycled. In total, riding your bike accounts for about 21 g of CO2 emissions per kilometer – again, more than ten times less than a car!

As new studies were published, they indicates that an increase in transportation cycling could save cities $25 trillion and reduce transportation-related CO2 emissions 10 percent by 2050. The report was commissioned by the UCI, the European Cyclists' Federation (ECF), and the Bicycle Product Suppliers Association (BPSA). According to the study, a combination of investments and public policies could bring the global average of bike and e-bike use up 14 percent by 2050 (of urban kilometers). Savings of around $25 trillion could be achieved by reducing the need for new car-related infrastructure and maintenance.

According the Traffic Survey within the Study Modernizing Public Electricity Transport and Developning the Non-Motorized Transport Infrastructure in Resita, following the simulations of investing in bicycle rental stations in Resita, the number of cyclists would increase from 2347/day to 3066/day in 2024, most of it coming from current users of the car.

This increase would lead to a reduction of 303.104 kg/year of CO2 equivalent emissions, according to modeling results.

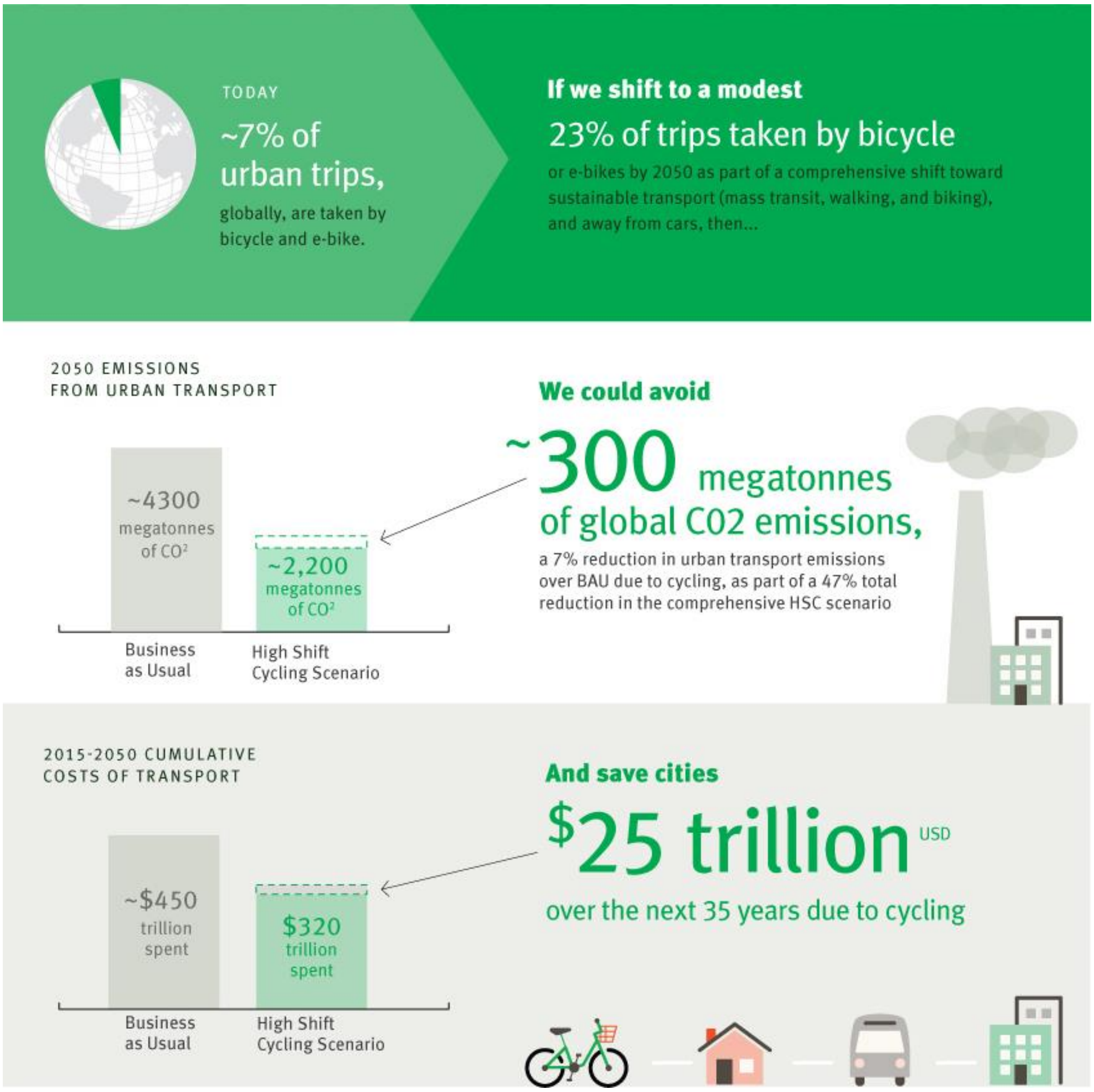


Figure 2- A Global High Shift Cycling Scenario: The Potential for Dramatically Increasing Bicycle and E-bike Use in Cities Around the World, with Estimated Energy, CO2, and Cost Impacts

5. ENERGY EFFICIENCY - THE PREMISES OF A BETTER ENVIRONMENT IN THE ROMANIA-SERBIA CROSS-BORDER AREA

The project ENERGY EFFICIENCY - THE PREMISES OF A BETTER ENVIRONMENT IN THE ROMANIA-SERBIA CROSS-BORDER AREA addressed the common challenges regarding specific aspects of the protection of local and regional environment and the sustainable use of natural resources in the cross-border area.

The project proposed a series of investments in infrastructure and equipment for environmental protection and sustainable use of natural resources.

Energy reduction and environmental protection play an important role in the growth and well-being of the national economy in the region. It creates jobs in many economic sectors, but also creates development in the primary and secondary sectors of the industry, while simultaneously promoting a better environment and a better life for society. In addition, the local population will benefit from a better life and climate and a significant reduction in the cost of energy, helping municipalities to spend their budget more efficiently.

The project will implement modern materials in conjunction with several actions to be taken in order to modernize the energy of public buildings.

The common territorial challenge is to introduce policies that are related to more energy-efficient public buildings. The actions of the project with the creation of an energy efficient building and a renewable energy installation will be a launch (pilot) action to be implemented in several buildings. Energy efficient buildings are greener, have a positive impact on the environment and can be a step for more actions in this area. Evaluating these actions can prove that a small investment in new materials and methods can create value for municipalities, which are responsible for several buildings in their area.

The current function is maintained and it is proposed to place solar panels for the preparation of domestic hot water on the roof of the sports and health complex (swimming pool). The investment was made between 1977 and 1982 and in time became an important architectural landmark of the city.

From an architectural point of view, the building represents an object of modern architecture, in an adequate functional and plastic solution, but which, because of the quality of the finishing materials and of constructive details (especially regarding the system of water collection and drainage from the roof) badly made, it has an inadequate appearance.

6. THE BENEFITS OF USING SOLAR PANELS

Solar panels are the optimal solution for the production of domestic hot water.

Thermal solar panel systems use heat from the sun to heat domestic water. The hot water is obtained by heating the thermal agent (water, antifreeze) inside the plant with the help of solar radiation, providing around 60 - 80% of the hot water needs in winter and 100% in summer.

Based on utility bills for the last 12 months, the centralization of CO_2 consumption and emissions has been prepared, as shown in the following table:

Table 6 – CO_2 emissions consumption in the swimming pool

Month	MC	MwH (1 mc = 10,786 MWh) final energy	MwH (1 mc = 10,786 MWh) Primary energy	Price /KWh (lei)	CO2 [Kg CO2/kWh]
JANUARY	26170	282.66	330.71	50724.30	67796.48
FEBRUARY	20704	222.55	260.38	39936.55	53377.90
MARCH	17295	186.84	218.60	33528.43	44813.09
APRIL	12372	133.30	155.96	23920.23	31971.05
MAY	12818	138.26	161.76	25102.98	33160.46
JUNE	6560	70.94	83.00	12880.56	17014.96
JULY	8367	90.90	106.35	12986.87	21802.13
AUGUST	3026	32.78	38.35	4682.98	7861.80
SEPTEMBER	14276	153.51	179.61	18357.25	36819.37
OCTOBER	17258	186.11	217.75	26483.53	44638.48
NOVEMBER	21565	231.98	271.41	41628.33	55639.20
DECEMBER	25070	269.90	315.79	48434.75	64736.47
	185481	**1999.71**	**2339.67**	**338666.76**	**479631.40**

Solar energy

Number of sunny days per year =	210
Number of solar panels =	90
Power in KWh panou solar=	1.3
Medium number of sunny days per year	2000
Annual energy in Kw produced by panels =	234000

GAS	Mc /year	Mwh/year	Cost/year (lei)	Co2 produced [Kg CO2/kWh an]	
	185481	1999.714	338666.76	479631.4	

Solar energy	Mwh/year	Cost/year (lei)	Co2 produs [Kg CO2/kWh an]
	234	0	0

Savings made

Energy cost/year (lei)		Co2 produced [Kg CO2/kWh year]
3427.70		47970

emission factor CO2 for gas = 0.205 [Kg CO2/kWh]

7. EXISTING INNOVATIVE TECHNOLOGIES

7.1 GENERAL CONSIDERATIONS ON THE ANALYZED AND PROPOSED SOLUTIONS / TECHNOLOGIES

Table 7 – Nomenclature of used terms

Nomenclature of used terms	
COP	Coefficient Of Performance of heating pump
cw	Specific heat water (J/kg K)
DHW	Domestic Hot Water
ηP	Global efficiency of the pump
g	Gravitational acceleration (9.81 m/s2)
HEC	High-Efficiency Cogeneration
Hp	Head of the pump (m)
Iabs	Solar radiation absorbed on the pool (W)
*m*ev, w	Evaporation flow rate of water (m3/s)
*m*r, w	Replacement flow rate of water (m3/s)
PP	Electrical power absorbed by the pump (W)
qcond	Heat loss by conduction (W)
qconv	Heat loss by convection (W)
qev	Heat loss by evaporation (W)
qirr	Heat loss by irradiation (W)
Qp	Volumetric flow rate of the pump (m3/s)
qr,w	Thermal power for heating replacement water (W)
qs,l	Heating power supplied to compensate for heat losses (W)
qtot,w	Total heating power supplied (W)

ρw	Water density (1,000 kg/m3)
Tn	Water supply network Temperature (K)
TP	Water Pool temperature (K)
Vtot	Total volume of water

Swimming pools for sports activities are very much energy-consuming since, in addition to the energy requirements that are common to all types of sports facilities (air conditioning and lighting in large spaces, high levels of water heating requirements, etc.), heating, filtration and continuous replacement of water must be considered, which involve huge consumption of natural resources in terms of primary non-renewable energy resources (according to the local fossil/renewable mix) and drinking water, whose use is mandatory.

For this reason, there are some improvements in terms of efficiency actions that, in general, fit into all sports facilities (or, more generally, all the most energy-consuming utilities) such as the adoption of high efficiency (condensing) boilers, led lighting, installation of solar panels, cogeneration plants, etc.

Furthermore, the solutions analyzed are not alternative to other heat production solutions through high-efficiency systems (condensing boilers, water/air heat pumps, combined heat and power production plants) or by means of renewable sources (solar collectors, photovoltaic panels), therefore achieving economic and energy savings albeit with much higher initial costs.

As regards the below figure it is possible to define a mass and energy balance of a pool for the heating of swimming pools, mass balances have an impact on energy balances since the replacement water must be heated from the water network temperature (about 12 ° C) to the pool usage temperature (averagely 28 ° C).

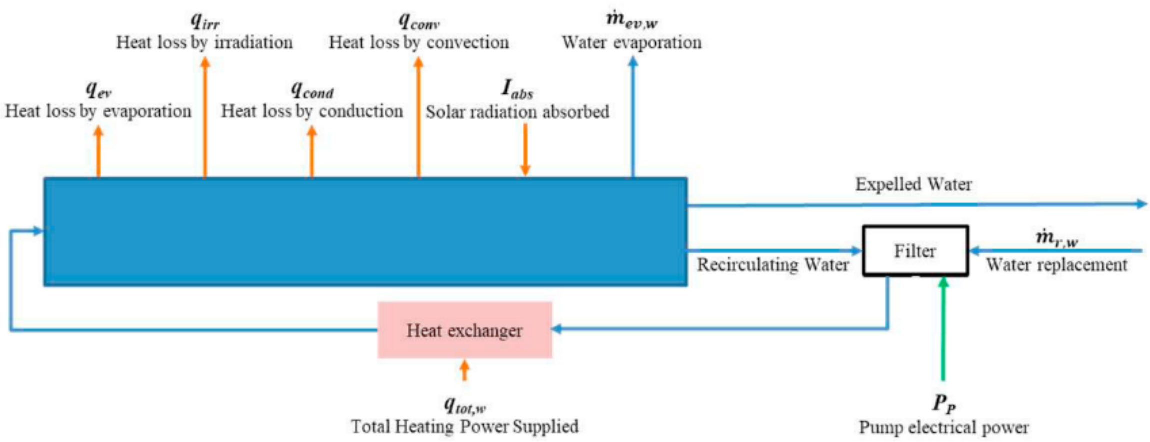


Figure 3 - Mass and energy balance for the heating of swimming pools

Water evaporation flow is calculated from the evaporation coefficient obtained by dividing the heat transfer coefficient for evaporation by the water latent heat of vaporization. The minimum daily water replacement provided by UNI 10637: 2015 for swimming pools with a high daily number of users are expressed as a percentage of the total water volume to be replacement daily. The replacement flow rate will be equal to the sum of the amount of water to evaporate and of the amount needed to reintegrate the minimum daily water replacement. The same legislation provides for the full replacement of water at least once a year.

For energy consumption due to the operation of swimming pools in sports facilities, possible energy efficiency actions can be of two types:

- Reduction of heat needs:
- Reduction of losses;
- Recovery of heat from expelled water;
- Production of energy vectors with high efficiency systems or using renewable sources:
- Heat production for water heating;
- Production of electricity for recirculation and water filtration;
- Simultaneous production of electricity and useful heat:
- Cogeneration plants.

7.2. THE SOFTWARE USED TO PERFORM THE SIMULATIONS OF THE USE OF TECHNOLOGIES TO IMPROVE ENERGY EFFICIENCY

The software used to perform simulations regarding the use of new technologies to improve energy efficiency is EDGE. https://www.edgebuildings.com

The EDGE solution is a green building certification system for emerging markets created by IFC, a member of the World Bank Group. EDGE is a measurable way for builders to optimize their designs, leading to a more investment-worthy and marketable product. By keeping certification fast and inexpensive, EDGE keeps pace with the momentum that developers need to stay at the forefront of the green building trend.

The EDGE software offers a measurable way to cut back on the resource intensity of your building design.

The EDGE software calculates the utility savings and reduced carbon footprint of a green building against a base case.

7.3. THE INPUT DATA REQUIRED

The following input data were used and processed with the EDGE application and other methodologies and standards in force:

- Pool data: size, type of use (recreational, competitive activities, etc), operating conditions (indoor, periods of use, ...) and location.
- Operating conditions for swimming pools (water temperature, temperature and humidity above bathtub for indoor swimming pools, water supply, etc.) and technical regulations (air temperature, humidity, average air speed, irradiation, etc).

- Current energy solutions: modes for heat and electricity supply, presence of solutions to reduce energy demand.

The output data (results) are energy needs (heat and electricity), energy vector consumption (electricity and natural gas) and relevant non-renewable primary energy consumption calculated by the primary energy conversion factor of the energy vectors, besides the CO2 emissions.

7.4. THE PROPOSED MEASURES AND THEIR IMPACT

Next we propose an analysis of the measures and technologies on the market for obtaining energy efficiency, reducing energy consumption and CO2 emissions.

7.4.1. THERMAL INSULATION INFRADOS BASIN

I. General data

For a significant decrease in gas consumption, a solution is to insulate the basin in the basement infrared, which does not disturb its activity.

The thermal insulation will be made with 20 cm expanded polystyrene protected by plaster reinforced with glass fiber.

II. Simulation - Isolation of the swimming pool

Table 8 – Reductions for Isolation of the swimming pool

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Isolation of the swimming pool at the bottom (from the basement) with thermosystem	562.24	95580.00	0	0.00	0	0

7.4.2. INSULATION OF EXTERNAL WALLS

I. General data

Insulation is used to prevent heat transmission from the external environment to the internal space (for warm climates) and from the internal space to the external environment (for cold climates). Insulation aids in the reduction of heat transmission by conduction12, so more insulation implies a lower U-value and better performance. In general, a well-insulated building has lower cooling and/or heating energy requirements.

Please note that many modern insulating materials, such as certain foam-based insulations, as well as air cavities that improve the sustainability and energy efficiency of buildings also spread fire more easily than traditional materials such as concrete and wood.

Insulating the external walls is potentially the most cost-effective way to reduce the energy used for heating a building. Therefore, in cold or temperate climates a strong case can be made for maximizing the insulation before designing the heating ventilation and air conditioning equipment.

By increasing the level of insulation, the heating and/or cooling loads will be reduced. Increasing the levels of insulation could therefore reduce the cost and environmental impact of the heating and cooling plant.

However, by introducing input data into the EDGE application, the reduction of consumption was insignificant, and therefore it is not recommended to obtain major results in terms of the energy efficiency of our building.

II. Simulation - Insulation external walls

Table 9 – Reductions for Insulation external walls

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Insulation external walls	0.2	30.00	0	0.00	0	0

7.4.3. SWIMMING POOL COVERS

I. General data

Such estimate concerns the energy savings achieved through the reduction of energy needs and not through the production of energy carriers with high efficiency systems or by using renewable sources.

This is due to the fact that energy needs reduction interventions:

- the use of the thermal swimming pool covers require no particular conditions.
- Have low investment costs and a low payback period.
- energy needs reduction interventions are in no way alternative to those of energy- vector production through high efficiency systems or by using renewable sources. On the contrary they must be the first step in a proper energy diagnosis procedure.

The actions to reduce heating losses concern only those that occur from water surface, as those from walls are completely negligible. The use of thermal swimming pool cover during night-time (hours of non-use) can reduce heat losses by up to 50%. The daily amount of expelled water is approximately 5% of total volume; the recovery of the heat therein contained entails considerable energy savings. Such heat (expelled water) can be used to heat the replacement water by means of heat exchangers or water / water heat pumps.

In case heat exchangers are used, the expelled water (hot) is sent to the exchanger which, through a cross-flow with cold water (replacement water), provides heat to the latter. Given the low temperatures of the hot fluid (expelled water), the installation of these recovery systems requires special arrangements such as a good calibration of the inlet water flow rates to the heating exchanger to have no high speeds to optimize the heat exchange.

In case water/water heat pumps are used for heat recovery, expelled water and replacement water are heat sources from the pump with very high COPs due to operating temperatures. By means of this system, the entire heat can be virtually recovered, reducing the total heat need to almost 80% with an increase in electricity demand of about 30%. The use of water/water heat pumps with respect to the heat exchanger allows greater savings against higher initial costs.

II. Simulation – Swimming pool cover

Table 10 – Reductions for Swimming pool cover

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Swimming pool cover	19.15	3260.00		0.00	332.15	1448.17

7.4.4. GROUND SOURCE HEAT PUMP - COP OF 4

I. General data

Ground source heat pumps (GSHPs), referred to as geothermal heat pumps (GHPs), are used to heat and cool buildings by absorbing naturally existing heat from the earth. A GSHP/GHP takes advantage of the more constant below-ground temperature within the earth (soil or water) compared to the more variable outside air temperature. Below-ground temperature is warmer than the air during the winter and cooler than the air in the summer. A GHP takes advantage of this by exchanging heat with the earth through a ground heat exchanger. A GHP can reach a high COP of 3 to 5.2 on the coldest winter nights, compared to air-source heat pumps that only reach up to a 1.5 to 2.5 COP on cool days. Ground source heat pumps are a clean alternative utilizing renewable and reliable sources of energy29.

Four major types of ground source heat pump systems (GHPs) are available. Of these four types, three systems – the horizontal, vertical, and pond systems – are closed loop systems. The fourth major type of GHP is the open loop system. A closed loop system recirculates antifreeze or water through a loop of piping that is either buried in the ground or submerged under water. A heat exchanger transfers heat between the refrigerant in the heat pump and the antifreeze/water solution. An open loop GHP system pumps water from a ground or water source, circulates the water and then discharges it once the heat has been transferred into or out of the water.It draws fresh water instead of recirculating the same water again.

The existing GHP technologies available are:

CLOSED LOOP SYSTEM

General data

- **Horizontal Closed Loop System**

A horizontal closed loop is usually the most cost effective for buildings with adequate land space available, in which trenches are easy to dig. This type of installation is composed of pipes that run horizontally in the ground. A slinky method is sometimes used to loop or coil the pipes along the bottom of a wide trench if space is inadequate space for a true straight horizontal system.

Essentially, coiled loops are more economically and space-efficient.

- **Vertical Closed Loop System**

A vertical closed loop installation is usually most cost-effective for building sites with limited amount of land space or where existing landscape is to be preserved. This type of installation is composed of pipes that run vertically beneath the ground. Holes are drilled into the ground, in which each hole contains a single loop of pipe that ranges from 30 to 100 meters deep. Vertical pipes are then inserted and connected to a heat pump within the building. This type is more expensive to install due to the drilling, but less material (piping) and land are required.

- **Pond/Lake Closed Loop System**

A pond or lake closed loop system is used only if a body of water at least 2.5-meter-deep body is in close proximity to the building property. A supply line pipe runs underground from the building and connects to large, coiled pipes that are located deep beneath the water. Due to advantages of water-to-water heat transfer, a pond system is both a highly economical and efficient option for a heat pump.

OPEN LOOP SYSTEM

General data

- **Open Geothermal Loop System**

An open geothermal loop system uses a well or pond to pump fresh water into and back out of the geothermal system. The water is used as the heat exchange fluid that circulates within the GHP. An abundant source of fresh clean water and a water runoff area is essential for a successful open loop system.

When a ground source heat pump is selected as an energy efficiency measure, the heating and/or cooling energy is reduced depending on the load on the building systems. The energy use by pumps is slightly increased due to the operation of the system.

II. Simulation - Ground Source Heat Pump - COP of 4

Table 11 – Reductions for Ground Source Heat Pump - COP of 4

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Ground source heat pump	154.18	26210.00	0	0.00	0	0

7.4.5. SENSIBLE HEAT RECOVERY FROM EXHAUST AIR

I. General data

Recovering sensible heat from the exhaust air helps buildings to reduce fossil fuel consumption, and lower operating costs by providing useful heat for space heating and in some cases for space cooling. Buildings that use energy for heating or cooling with fresh air supply have the potential to benefit from the application of heat recovery systems for ventilation.

Heat recovery aims to collect and reuse the heat arising from a process that would otherwise be lost. In the case of sensible heat recovery in buildings, it involves transfer of energy between an exhaust airstream that preheats (winter mode) or precools (summer mode) the supply airstream. As air contains moisture, the heat contained within the air can be sensible heat (affects the temperature) or latent heat (includes water vapor).

Some energy recovery devices transfer both sensible and latent heat (also called "total heat recovery"), and some only transfer sensible heat, which is the technology covered by this measure.

Sensible Heat Recovery occurs when the temperature of the cooler air stream exchanges heat with the temperature of the warmer air stream. Moisture level is not impacted unless condensation occurs.

It is also convenient for light ventilation systems as it offers low pressure drops.

II. Simulation – Sensible heat recovery from exhaust air

Table 12 – Reductions for Sensible heat recovery from exhaust air

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Sensible heat recovery from exhaust air		0.00	-37	-21.93		0

7.4.6. ELECTRIC HEAT PUMP FOR HOT WATER

I. General data

Heat pump water heaters (HPWH) use electricity to take the heat from surrounding air and transfer it to the water in an enclosed tank. This process is similar to the heat transfer process in a refrigerator but in reverse.

Heat pump water heaters can be used with dual functionality in hotels for example to cool the kitchen, laundry, or ironing area and to generate hot water. Because they move heat rather than generate heat, heat pumps can provide efficiencies greater than 100%.

The efficiency of a heat pump is indicated by the Coefficient of Performance (COP). It is determined by dividing the energy output of the heat pump by the electrical energy needed to run the heat pump, at a specific temperature. The higher the COP, the more efficient the heat pump. Typical heat pump water heaters are two to three times more efficient than standard electric water heaters.

Types of available HPWH available on the market:

Heat Pump Water Heaters

A low-pressure liquid refrigerant is vaporized in the heat pump's evaporator and passed into the compressor. As the pressure of the refrigerant increases, so does its temperature. The heated refrigerant runs through a condenser coil within the storage tank, transferring heat to the water stored there. As the refrigerant delivers its heat to the water, it cools and condenses, and then passes through an expansion valve where the pressure is reduced and the cycle starts over.

Air-source Heat Pumps

These systems are called "integrated" units because they integrate the heating of domestic water with a house space-conditioning system. They recover heat from the air by cooling and transferring heat to domestic hot water. Water heating can be provided with high efficiency with this method. Water heating energy can be reduced by 25% to 50%.

Ground-Source Heat Pumps

In some Ground-Source Heat Pumps, a heat exchanger, sometimes called a "desuperheater," removes heat from the hot refrigerant after it leaves the compressor. Water from the home’s water heater is pumped through a coil ahead of the condenser coil, in order that some of the heat that would have been dissipated at the condenser can be used to heat water. Excess heat is always available in the summer cooling mode, and is also available in the heating mode during mild weather when the heat pump is above the balance point and not working to full capacity. Other ground-source heat pumps provide domestic hot water (DHW) on demand: the whole machine switches to providing DHW when it is required.

Water heating is easier with ground-source heat pumps because the compressor is located indoors. They generally have many more hours of surplus heating capacity than required for space heating, because they have constant heating capacity.

Similar to air-source heat pumps, ground-source heat pumps can reduce water heating consumption by 25% to 50%, as some have a desuperheater that uses a portion of the heat collected to preheat hot water, and also can automatically switch over to heat hot water on demand.

II. Simulation – Electric heat pump for hot water

Table 13 – Reductions for Electric heat pump for hot water

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Electric heat pump for hot water	52.79	8970.00	0	0.00	0	0

7.4.7. ENERGY SAVING LIGHT BULBS

I. General data

Efficient lamps, that produce more light with less power compared to standard incandescent bulbs, reduce the building's energy use for lighting. Due to the reduction in waste heat from efficient lamps, heat gains to the space are lowered, which in turn reduces cooling requirements. Maintenance costs are also reduced as the service life of these types of bulbs is longer than that of incandescent bulbs.

Here, lumens per watt (lm/W) is the measure of lighting efficacy used in the industry, which is the ratio of visible light output measured in lumens to the total power draw from the main electrical supply. e.g. a 40W light bulb has a total power input of 40W and a typical one may produce about 450 lumens. Therefore, the efficacy of this 40 W lamp would be 450/40 or 11.25 lm/W.

Besides efficacy (lumens/watt), the key indicators are the color rendering index (CRI), color temperature (in Kelvin), and service life.

Lamp Type	Description
Compact fluorescent lamps (CFLs)	CFLs are available for most light fittings as a direct replacement for incandescent bulbs. CFLs use a fluorescent tube that has been folded into the shape of the incandescent bulb they have been designed to replace. In comparison to incandescent bulbs, CFLs can last as much as 15 times longer. It should be noted that the service life can be reduced by frequent switching, so CFLs are not always appropriate where lights will be turned on and off frequently. CFLs use only a fraction of the energy of their incandescent alternatives and therefore produce less heat. As with normal fluorescent lamps, CFLs require ballasts in order to operate. Older lamps use magnetic ballasts, but these have largely been replaced with electronic ballasts that operate at a high frequency. Although the efficacy is not affected, electronic ballasts have reduced warm-up times and flickering, which were issues with the earlier CFLs.

Light emitting diode (LED)	LED technology has evolved quickly and there are LED lamps available for most light fittings, and in different color temperatures ranging from warm white to daylight. The efficacy levels of LEDs are much higher than CFLs. The service life of LED lamps can be as much as two to three times the longest life of any available compact fluorescent lamp, and is not affected by frequent on/off cycles. Over the last few years, the performance of LED lamps has improved greatly while prices have dropped sharply, and they are now highly cost-effective.
T5 Lamps	The name of these fluorescent tubes refers to their shape (tubular) and diameter (5 units measured in 1/8s of an inch). T5s have a miniature G5 bi-pin base with 5mm spacing, while T8s and T12s have a G13 bi-pin base with 13mm spacing. Although T8/T12 to T5 conversion kits are available, dedicated T5 luminaires should be specified in new construction projects, as using ballasts designed for T8s and T12s could reduce the service life of T5s.

Although the efficacy of bulbs from different manufacturers will differ, **the table above** gives an approximate range of efficacies that can be expected for different bulb technologies.

Table: Typical range of efficacies for different lamp types36

Lamp Type	Typical Range of Efficacy (Lumens/Watt)	Rated lifetime (hours)
Incandescent – Tungsten Filament	10-19	750-2,500
Halogen lamp	14-20	2,000-3,500
Tubular Fluorescent	25-92	6,000-20,000
Compact Fluorescent	40-70	10,000
High Pressure Sodium	50-124	29,000
Metal Halide	50-115	3,000-20,000
Light Emitting Diode (LED)	50-100	15,000-50,000

II. Simulation – Energy saving light bulbs

Table 14 – Reductions for Energy saving light bulbs

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Energy saving light bulbs	0	0.00	8479.49	5087.69	0	0

7.4.8. LIGHTING CONTROLS FOR CORRIDORS

I. General data

By installing lighting controls in rooms, lighting usage is reduced use. Lighting use may be reduced by using occupancy sensors to reduce the possibility for lights to be left on when the room is unoccupied, or by using photoelectric sensors when sufficient natural light is available. Reduced lighting use leads to a reduction in energy consumption.

The lighting in all the required rooms must be connected to lighting controls. In the case of lighting controls for daylighting, all ambient lighting in "daylight zones" which have access to exterior windows, or skylights, must be connected to an automatic daylight control system using photosensors. Daylight zones next to windows are defined as the perimeter space near a window with a depth = 1.5 x head height of the window from the floor.

Controlling artificial lighting in occupied areas reduces energy consumption. Occupancy sensor controls are effective in saving lighting energy in spaces that have varying occupancy over the working hours. If many of the spaces in a building are expected to be unoccupied during some hours of the day, such as a conference room or a classroom, this measure may be considered.

Selection of the type of sensor and its location is critical for this measure. The sensor should be situated such that it can "see" all the occupants in the room. If the room is small enough, this could be done by placing the sensor in one corner of the room near the ceiling. For larger rooms, multiple sensors may be used.

Table below lists various types of controls with their pros and cons. Typically, occupancy sensors are used to control ambient lighting only. However, task lights, such as table lamps and under-cabinet lights may also be controlled by automatic sensors. Individual power strips equipped with in-built occupancy sensors may be used for this purpose.

Building Type	Spaces required to have lighting controls	Control type required
Swimming Pool	Corridors, common areas, staircases, and indoor areas	Photoelectric switching or dimming, occupancy sensors, or timer controls
Swimming Pool	Bathrooms	Occupancy sensors

Type	Description
Timer Controls	The two types of timer controls are: time delay switches and actual timer controls. Time delay switches are manually switched on and then automatically switch off after a set time, which can be adjusted. Time delay or time lag switches can either be mechanical (pneumatic time delay) where the lighting requirement is less than 30 minutes, or they can be electronic, which can be programmed to provide a longer delay. A time delay switch is most appropriate in spaces where lighting is only used for short periods of time, such as bathrooms in common areas or rarely-used corridors. Timer controls use a built-in clock function to switch on and off at preset times. They can either be used to switch lights off when the lighting is unlikely to be required (such as security lighting during daylight hours), or to switch lights on at a set time (such as decorative lighting). Timer controls should always be fitted with a manual override so that out-of-hours use is still possible if required.
Occupancy or Presence Detectors	Occupancy or presence detectors can be used to switch lights on when movement or presence is detected and switch them off again when no movement or presence is detected. These may be used in areas of infrequent use by staff and public. Some technologies are as follows: • *High frequency ultrasonic sensors*, detect occupancy by emitting a high-frequency signal, which they receive back as a reflected signal using the Doppler effect, and interpret change in frequency as motion in the space37. They can work around obstructions. These are first generation occupancy sensors and not very reliable as they get triggered by any movement including undesirable triggers. • *Passive Infrared Sensors (PIR),* detect human body temperature by sending out infrared beams to detect temperature differences. These are an advancement on ultrasonic sensors. However, PIRs do not always work well in very hot climates, as the background temperature is similar to human body temperature. They also require a direct line of sight38. • *Microphonics sensors*, utilize a microphone inside of the sensor to hear sounds that indicate occupancy. They can learn to ignore background noise such as air conditioners and do not rely on line of sight. So they are especially useful in rooms with obstructions such as bathrooms with stalls. • *Dual technology sensors,* use a combination of technologies described above to reduce the chances of false-on and false-off. As each type of presence-detecting technology has different limitations, many controls use a combination of the three technologies.
Daylight Sensors	Daylight sensors can be used to switch lights on or off, alone or in conjunction with dimmers. Daylight sensors sense the availability of daylight and can switch lights off or trigger lighting dimmers to produce reduced lighting levels to maintain a comfortable level of light.

Natural light is amply available during daytime hours in most climates. Typically, just 1%-5% of the diffused exterior lighting available outside the building is sufficient to light up the interiors to the desired light levels. An intelligent daylight design has the following features:

▪ Optimum glass area: Windows need to be appropriately sized to allow sufficient diffused light into the space, without causing too much heat transfer. Especially in warm climates, a large amount of window area (above 40% window to wall ratio) may result in excessive cooling load, which may outweigh any benefits gained through daylighting control. Location and orientation of glass is also critical. South and North facing glass are more appropriate as they can be shaded easily and do not cause as much glare. Also, windows that are higher on the wall are more efficient in allowing diffused light deeper into the space.

▪ Suitable sun shading: Diffused sunlight is more desirable for daylighting. Direct sunlight should be avoided into regularly occupied spaces, as it causes glare and overheating. Windows on the south and north façades should be shaded with horizontal overhangs, whose depth is dictated by the latitude of the building location. In tropical countries, the required depth of horizontal shading is quite small. East and west windows should be avoided as much as possible. If provided, they should be equipped with vertical shading or full glass shading.

▪ Appropriate glass product: In climates where solar heat is undesirable, glass with low Solar Heat Gain Coefficient (SHGC) should be used. SHGC is the proportion of solar heat that the glass allows to pass through to the interior space. At the same time, care should be taken that the Visible Light Transmittance (VLT) of the product is not too low, as it will reduce the amount of usable light entering the space.

▪ Automated daylight control system: Energy is saved through daylighting only if the electric lights are switched off. It is desirable that the switching be done through automated controls to avoid missed opportunities. The two commonly used daylighting control types are Stepped and Continuous Dimming. A Stepped system turns off some lamps in the space when enough natural light is available by the photo sensor. A Continuous Dimming system dims down all lights to maintain the desirable light levels. Stepped controls are less expensive, while the Continuous Dimming system offers more savings. For both systems, the photo sensor should be appropriately located and calibrated to be effective.

II. **Simulation – Light controls for corridors**

Table 15 – Reductions for Light controls for corridors

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Light controls for corridors	0	0.00	402.04	241.23	0	0

7.4.9. SOLAR PHOTOVOLTAICS

I. General data

Many types of solar photovoltaic systems are available and different technologies convert solar energy into electricity with varying levels of efficiency. Efficiency levels of up to 22.5% can be achieved by some commercially available systems, but others are only capable of delivering as little as 5% efficiency. The majority of panels range from 14% to 16% efficiency rating. Design teams should therefore ensure that the specified system achieves the maximum efficiency possible for the available capital.

To maximize the percentage contribution from the solar photovoltaic installation, the electricity demand must first be minimized by reducing energy consumption (e.g., by using natural instead of mechanical ventilation, or by using automatic lighting controls).

II. Simulation – Solar photovoltaics

Table 16 – Reductions for Solar photovoltaics

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Solar photovoltaics	0	0.00	67430.00	40458.00	0	0

7.4.10. LOW FLOW SHOWERHEADS

I. General data

The flow rate of a shower can be as low as 6 liters per minute or greater than 20 liters per minute. As the flow rate of a showerhead is dependent on the water pressure, manufacturers often provide a chart which plots the flow rate at different pressures.

Many different showerheads are available that meet the flow rate required. In order to maintain user satisfaction at the lower flow rates, some manufacturers mix water with air to cause turbulence in the flow; this in turn gives an increased sense of pressure without increasing the flow rate.

Higher flow rate showers use a significant quantity of hot water. Reducing the flow rate of the shower reduces the energy required to produce hot water. Therefore, both water consumption from showers, and energy consumption due to hot water, are reduced.

II. Simulation – Low flow showerheads

Table 17 – Reductions for Low flow showerheads

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Low flow showerheads	47.71	8110.00	0	0.00	985.5	4296.78

7.4.11. AERATORS & AUTO SHUT-OFF FAUCETS

I. General data

The assumed improved flow rate is 2 liters per minute. If the flow rate is greater than 2 liters per minute but lower than the baseline in liters per minute, the measure can still be claimed if the actual flow rate is entered. The lower the flow rate the greater the water savings.

This measure includes two technologies fitted to the faucet – aerators and auto shut-off valves – which must be purchased as one product.

Aerators are small water-saving devices attached to the faucet that maintain user satisfaction at the lower flow rates. They mix water with air to cause turbulence in the flow; this in turn gives an increased sense of pressure without increasing the flow rate. They are also called flow regulators.

Auto shut-off faucets are activated by a push action or electronic sensors that allow the water flow to last for a programmed length of time, usually 15 seconds. After this period the faucet shuts off automatically, which is ideal for public and unsupervised washing areas.

Flow restrictors or aerators can be added on to the specified faucets to reduce the flow rate, which may be a cheaper alternative to purchasing a low-flow faucet.

Reducing the flow rate of all the washbasin faucets in the building reduces the water demand and the energy required to produce hot water for the faucets.

II. Simulation – Aerators & auto shut-off faucests

Table 18 – Reductions for Aerators & auto shut-off faucests

Proposed measures	Gas consumption		Electricity consumption		Water consumption	
	Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
	MWh	lei	kWh	lei	mc	lei
Aerators & auto shut-off faucests	11.69	1990.00	0	0.00	241.44	1052.68

7.4.12. General overview

As a result of these simulations, central results can be obtained with each proposed solution, by removing *Insulation external walls* because the investment costs are not justified by renting, and also solutions for *Sensible heat recovery from exhaust air,* because according to the results it adds additional expenses in during use.

Nr crt	Proposed measures	Gas consumption		Electricity consumption		Water consumption	
		Reduction	Costs Reduction	Reduction	Costs Reduction	Reduction	Costs Reduction
		MWh	lei	kWh	lei	mc	lei
1	Isolation of the swimming pool at the bottom (from the basement) with thermosystem	562.24	95580.00	0	0.00	0	0
2	Swimming pool cover	19.15	3260.00		0.00	332.15	1448.17
3	Ground source heat pump	154.18	26210.00	0	0.00	0	0
4	Electric heat pump for hot water	52.79	8970.00	0	0.00	0	0
5	Energy saving light bulbs	0	0.00	8479.49	5087.69	0	0
6	Light controls for corridors	0	0.00	402.04	241.23	0	0
7	Solar photovoltaics	0	0.00	67430.00	40458.00	0	0
8	Low flow showerheads	47.71	8110.00	0	0.00	985.5	4296.78
9	Aerators & auto shut-off faucests	11.69	1990.00	0	0.00	241.44	1052.68
10	TOTAL	847.76	144120.00	76312	45786.92	1559.09	6797.63
	Costs reduction			196704.55	lei/an		
	kWh reduction			924075.34	kWh/an		

MwH (1 mc = 10,786 MWh) primary energy	1081.1736
Co2 emissions [Kg CO2/kWh year]	221640.59
Co2 emissions [Kg CO2/kWh year] current	479631.4
Emissions reduction CO2 (%)	46.21

By implementing the proposed measures, an annual savings of 196,704.55 lei and 924,075.34 kWh are realized, which translates into a reduction with 257,990.81 Kg CO2 / kWh / year of CO2 emissions, respectively a reduction of 46.21 % which translates in fulfilling and even exceeding the obligations assumed in the PAED, regarding the 20% emission reduction by 2020.

The costs of realizing the investments regarding the measures proposed previously will be able to be determined following the preparation of specialized technical documentation, and these are not the subject of the current study.

Disclaimer: the results presented within the study were obtained by processing the available inputs using the EDGE application or by using established methodologies for calculating the energetic efficiency of civil buildings. The present study cannot be considered an energetic audit, the values obtained within the study are to be considered approximate values. The exact values of energy consumption reductions, CO2 emissions reductions and reduction of costs are to be established within further feasibility studies and energetic audits elaborated according to the Romanian laws in force; feasibility studies and energetic audits not being the scope of the present study.

ANNEXES

ANNEX 1 - Colegiul Național Mircea Eliade Reșița

Project objectives

The general objective of the project is to increase the energy efficiency at the "Mircea Eliade" Theoretical High School in Resita through an intervention on Corpul A buildings from the three buildings in which this educational unit operates. Through this intervention we follow obtaining the final energy consumption decrease, the primary energy consumption decrease (from non-renewable sources) and the decrease the annual consumption of primary energy from non-renewable sources within this public institution. By increasing energy efficiency in this educational unit, the project will directly contribute to achieving the strategic objectives in the field of sustainable development in Resita City and will bring a direct contribution to the achievement of the strategic objective of reducing at least 20% of CO2 emissions, assumed by the community from this urban center through the Sustainable Energy Action Plan - Resita Municipality.

Specific objectives of the project

1. Reduction of primary energy consumption through interventions on the building and on the installations, so that at the end of the project to obtain a decrease in the annual primary energy consumption.

2. Improving the energy performance of the building subject to intervention through the project, so as to obtain a reduction in the level annual specific for greenhouse gases (CO2 tonnes equivalent).

3. Reduction of the specific annual consumption of primary energy for heating / cooling (from non-renewable sources).

4. The decrease of the annual final energy consumption from non-renewable sources to the level of 21.36 toe at the end of the implementation project.

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of specific annual primary energy consumption (from non-renewable sources)	323.78	96.41	70.22
Reduction of the annual level specific to greenhouse gases	174.59	51.65	70.42
Reduction of specific annual consumption of primary energy for heating	289.69	73.36	74.68
Reducing the annual final energy consumption in the public building (from non-renewable sources)	72.503	21.36	70.54

ANNEX 2 - Colegiul Economic al Banatului Montan

General objective of the project / Purpose of the project

Project objectives

Reducing CO_2 emissions and increasing energy efficiency in public buildings by energy rehabilitation of the College building Economic of Banat Montan.

Specific objectives of the project

1. Reduction of the annual specific consumption of primary energy to a level that will not exceed 115 KWh / m2 / year, following the achievement proposed interventions.
2. Reducing CO_2 emissions to a level that will not exceed 28 Kg / m2 / year, following the proposed interventions.

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of specific annual primary energy consumption (from non-renewable sources)	221.34	88.64	59.95
Reduction of the annual level specific to greenhouse gases	190.06	75.98	60.02
Reduction of specific annual consumption of primary energy for heating	172.41	50.23	70.87
Reducing the annual final energy consumption in the public building (from non-renewable sources)	73.605	31.01	57.87

ANNEX 3 - Liceul Teologic Baptist Reșița

Project objectives

Increasing the energy efficiency of the building for the Baptist Theological High School in Resiþa Municipality, Caras-Severin County, through the rehabilitation and its modernization, by making investments on the C1 building body in the conditions of ensuring the interior and implicit comfort saving financial resources, considering a set of specific actions, after establishing the technical state of the construction and existing facilities in which the educational unit carries out its educational activity.

Specific objectives of the project

1. Thermal rehabilitation works that reduce CO2 equivalent emissions (toCO2 / year) and reduce consumption specific annual primary energy (obtained from non-renewable fossil sources) (Kwh / year) and at the reduction of specific annual consumption of energy (kwh / year): thermal insulation of buildings, replacement of existing installations;

2. Creation of facilities / adaptation of the infrastructure / equipment for the access of people with disabilities through;

3. Execution of works in order to comply with the existing constructions to the regulations in force regarding the protection against fire.

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of specific annual primary energy consumption (from non-renewable sources)	393.86	106.61	72.93
Reduction of the annual level specific to greenhouse gases	92.06	29.88	67.54
Reduction of specific annual consumption of primary energy for heating	227.47	46.78	79.43
Reducing the annual final energy consumption in the public building (from non-renewable sources)	35.73	7.62	78.67

ANNEX 4 - Colegiul Național Traian Lalescu, Reșița

Project objectives

The objective of the project is to increase the energy efficiency in the buildings of the school unit "National College Traian Lalescu" Resita through making investments on buildings C1, C2, C3 in the conditions of providing interior comfort and implicitly saving resources financial, considering a set of specific actions, following the establishment of the technical state of the existing constructions and installations in which they carries out the educational activity Traian Lalescu National College.

Specific objectives of the project

1. The decrease of the specific annual level of greenhouse gases;
2. The decrease of annual primary energy consumption kWh / year.

Touching the object. specif. will be achieved through:

- rehabilitation thermal tire, heating system / hot water supply system.
- installation of alternative systems production of electricity / heat for own consumption.
- modernization of air conditioning systems, natural ventilation and mechanical ventilation to ensure indoor air quality.
- rehabilitation / modernization of the lighting installation in buildings.
- integrated energy management
- equipment for air conditioning and body ventilation C2 + C3;
- thermal power station in C2 and solar panels for hot water production;
- equipment for electricity production with photovoltaic panels;
- Demolition works - C1, C2, C3, Structural interventions - C2, C3, Interior finishes - C1, C2, C3; - Replacement of ceramic tile coverings - C2;
- Detection installations signaling and warning for fire-C2, C3.

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of specific annual primary energy consumption (from non-renewable sources)	1282.13	276.89	78.40
Reduction of the annual level specific to greenhouse gases	288.63	75.73	73.76
Reduction of specific annual consumption of primary energy for heating	961.42	255.84	73.39
Reducing the annual final energy consumption in the public building (from non-renewable sources)	118.181	29.48	75.06

ANNEX 5 - Colegiul Național Diaconovici-Tietz Reșița

General objective of the project / Purpose of the project

Project objectives

Reducing CO_2 emissions and increasing energy efficiency in public buildings by energy rehabilitation of the National College building Diaconovici Tietz, Resita Municipality.

Specific objectives of the project

1. Reduction of the annual specific consumption of primary energy to a level that will not exceed 115 KWh / m2 / year, following the achievement proposed interventions.

2. Reducing CO_2 emissions to a level that will not exceed 28 Kg / m2 / year, following the proposed interventions.

Target group / Direct beneficiaries:

- The students of the National Diaconovici Tietz College (870 students).
- Teachers (74 people)

Indirect beneficiaries:

- The local community by the fact that they will benefit from an example of good practice both from an aesthetic point of view, and especially a example of good practice regarding the economic benefits of energy efficiency;
- The economic sector of the constructions, which will benefit from the project by increasing its competitiveness.
- The parents of the students;
- Future students;
- Participants in the activities carried out within the high school which are not related to the daily functioning program of the educational institution.

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of specific annual primary energy consumption (from non-renewable sources)	662.43	211.58	68.06
Reduction of the annual level specific to greenhouse gases	198.33	53.42	73.07
Reduction of specific annual consumption of primary energy for heating	516.92	149.21	71.13
Reducing the annual final energy consumption in the public building (from non-renewable sources)	79.2	24.93	68.52

ANNEX 6 - Liceul de Arte Sabin Pauța, Reșița

Project objectives

The general objective of the project is to contribute to the fulfillment of the strategic goals regarding the increase of the energy efficiency at national level and to the the level of the European Union Strategy for the Danube Region through an intervention aimed at improving the energy performance of a public buildings in which Sabin Pauta High School of Arts from Resita operates. Also, by increasing energy efficiency in this educational unit, the project will directly contribute to achieving the strategic objectives in the field of sustainable development in Resita City and will bring a direct contribution to the achievement of the strategic objective of reducing at least 20% of CO2 emissions, assumed by the community from this urban center through the Sustainable Energy Action Plan - Resita Municipality.

Specific objectives of the project

1. Improvement of the energy performance of the building subject to intervention through the project, in such a way as to obtain a reduction of the level annual specific for greenhouse gases (equivalent CO2 tonnes) from a value of 222,429 tonnes at the beginning of implementation of the project at a value of 47.76 tons related to the rehabilitated building.

2. Reduction of primary energy consumption through interventions on the building and on the installations, so that at the end of the project to obtain a decrease of the annual primary energy consumption from the level of 1,335,733.25 kWh / year registered before start of the project up to the level of 275.935.89 kWh / year.

3. The decrease of the annual final energy consumption from non-renewable sources to the level of 17.32 toe at the end of the implementation project.

4. Reduction of the specific annual consumption of primary energy (using non-renewable sources) from the value of 346.5 kWh / m2 / year to the beginning of the project implementation at the value of 66.25 kWh / m2 / year at the end of the project implementation.

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of specific annual primary energy consumption (from non-renewable sources)	346.5	66.25	80.88
Reduction of the annual level specific to greenhouse gases	222.429	47.76	78.53
Reduction of specific annual consumption of primary energy for heating	298.23	54.66	81.67
Reducing the annual final energy consumption in the public building (from non-renewable sources)	90.81	17.39	80.85

ANNEX 7 - Liceul Teoretic „Traian Vuia”, Reșița

Project objectives

The objective of the project is to increase the energy efficiency in the buildings of the school unit "Traian Vuia Theoretical High School" Resita through the realization of investments on buildings C1, C2, C3 in terms of ensuring the interior comfort and implicitly saving financial resources, taking into account a set of specific actions, following the establishment of the technical state of the existing constructions and installations in which they carry out educational activity Traian Vuia Theoretical High School "Resita.

Specific objectives of the project

1. The decrease of the specific annual level of the greenhouse gases;
2. The decrease of the annual primary energy consumption kWh / year;
3. Percentage of use of renewable sources of total primary energy consumption after implementation.

The achievement of the specific objectives will be achieved through:

- Rehabilitation of the thermal insulation of the building envelope;
- Facade part glass -1786.50 sqm and facade opaque part - 5114.00 sqm;
- Roof a. (Type hydrobituminous terrace) Corp C2 - 702.00 sqm; b. (snake type) -1745.0 mp;
- Thermal insulation of the floors on the ground floor -2276.73 sqm;
- Modernization of indoor facilities for environmental comfort:
- rehabilitation of indoor and outdoor installations, with an emphasis on heating systems, assembling a system for preparing hot water for consumption with thermodynamic solar panels and storage boilers, mounting system of electricity production with photovoltaic panels, restoration of the installation for hot water supply sanitary, restoration of the installation for interior heating with radiators, making a system of modern lighting with LED lighting fixtures, implementing an integrated energy management system.

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of specific annual primary energy consumption (from non-renewable sources)	370.75	95.51	74.24
Reduction of the annual level specific to greenhouse gases	413.92	110.89	73.21
Reduction of specific annual consumption of primary energy for heating	261.92	217.36	17.01
Reducing the annual final energy consumption in the public building (from non-renewable sources)	165.96	45.59	72.53

ANNEX 8 - Blocurile de locuințe - Bulevardul Republicii Resița, Etapa 1, Componenta Bloc nr. 20

General objective of the project

Project objectives

Increased energy efficiency in residential buildings through the energy rehabilitation of block no. 20 (composed of stairs A, B, C, D, with access from Bd Republicii, respectively stairway 1 with access from Domogled Alley), Resita Municipality.

Specific objectives of the project

1. Increasing the energy efficiency for the housing blocks so that the specific annual energy consumption calculated for heating to fall below 90 KWh / sqm / year useful area for each housing block.

2. The decrease of the specific energy consumption for the heating of the houses must be at least 40% of the consumption highlighted in the energy performance certificate corresponding to the initial state of the block.

3. Reduction of CO2 equivalent emissions by more than 40% compared to the initial emissions.

Target group / Direct beneficiaries:

The members of the owners' associations (584, 412 respectively 610) from block 20 - Boulevard of the Republic, Resita (ca. 160 families).

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	897.83	319.22	64.45
Specific annual energy consumption for heating (kWh / m2 / year)	295.7	58.26	80.30
Specific annual energy consumption (kWh / m2 / year)	363.57	126.13	65.31
Number of households with a better classification of energy consumption (no. Of households)		160	

ANNEX 9 - Blocurile de locuințe din str. Horea, bl. A2, A3, A4 și str. G. A. Petculescu, bl. 15

Project objectives

Increased energy efficiency in residential buildings by energy rehabilitation of blocks A2, A3, A4 -str. Horea, respectively block 15- str. G.A. Petculescu, Resita Municipality.

Specific objectives of the project

1. Increasing the energy efficiency for the housing blocks so that the specific annual energy consumption calculated for heating to fall below 90 KWh / sqm / year useful area for each housing block.

2. The decrease of the specific energy consumption for the heating of the houses must be at least 40% of the consumption highlighted in the energy performance certificate corresponding to the initial state of the block.

3. Reduction of CO2 equivalent emissions by more than 40% compared to the initial emissions.

Target group / Direct beneficiaries:

The members of the owners' associations from blocks A2, A3, A4-str. Horea, respectively the block 15-str.G.A. Petculescu, Resita Municipality (ca.164 families).

Output indicator for component A2

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	210.8	98.61	53.22
Specific annual energy consumption for heating (kWh / m2 / year)	236.52	75.14	68.23
Specific annual energy consumption (kWh / m2 / year)	298.51	137.13	54.06
Number of households with a better classification of energy consumption (no. Of households)		40	

Output indicator for component A3

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	204.38	97.92	52.09
Specific annual energy consumption for heating (kWh / m2 / year)	230.87	74.9	67.56
Specific annual energy consumption (kWh / m2 / year)	292.2	137.51	52.94
Number of households with a better classification of energy consumption (no. Of households)		40	

Output indicator for component A4

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	205.26	98.74	51.90
Specific annual energy consumption for heating (kWh / m2 / year)	230.87	76.09	67.04

Specific annual energy consumption (kWh / m2 / year)	293.49	138.71	52.74
Number of households with a better classification of energy consumption (no. Of households)		40	

Output indicator for the G.A.P. 15

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	244.23	111.71	54.26
Specific annual energy consumption for heating (kWh / m2 / year)	258.72	81.46	68.51
Specific annual energy consumption (kWh / m2 / year)	321.84	144.58	55.08
Number of households with a better classification of energy consumption (no. Of households)		44	

ANNEX 10 - Blocurile de locuinte str. Horea, bl. A6, A7 și Piața 1 Decembrie 1918, bl.25

General objective of the project / Purpose of the project

Project objectives

Increased energy efficiency in residential buildings by energy rehabilitation of blocks A6, A7 -str. Horea, respectively the 25 - str.Piata 1 Decembrie 1918, Resita Municipality.

Specific objectives of the project

1. Increasing the energy efficiency for the housing blocks so that the specific annual energy consumption calculated for heating to fall below 90 KWh / sqm / year useful area for each housing block.

2. The decrease of the specific energy consumption for the heating of the houses must be at least 40% of the consumption highlighted in the energy performance certificate corresponding to the initial state of the block.

3. Reduction of CO2 equivalent emissions by more than 40% compared to the initial emissions.

Target group / Direct beneficiaries:

The members of the owners' associations from blocks A6, A7-str. Horea, respectively the 25-str. Piata 1 Decembrie 1918, Resita Municipality (ca. 120 families).

Output indicator for component A6

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	208.03	97.89	52.94
Specific annual energy consumption for heating (kWh / m2 / year)	234.91	74.84	68.14
Specific annual energy consumption (kWh / m2 / year)	297.53	137.45	53.80
Number of households with a better classification of energy consumption (no. Of households)		40	

Output indicator for component A7

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	205.75	98.52	52.12
Specific annual energy consumption for heating (kWh / m2 / year)	231.59	75.78	67.28
Specific annual energy consumption (kWh / m2 / year)	294.21	138.4	52.96
Number of households with a better classification of energy consumption (no. Of households)		40	

Output indicator for block component 25

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	184.44	88.84	51.83
Specific annual energy consumption for heating (kWh / m2 / year)	250.3	80.49	67.84
Specific annual energy consumption (kWh / m2 / year)	322.69	152.89	52.62
Number of households with a better classification of energy consumption (no. Of households)		40	

ANNEX 11 - Blocurile de locuințe Centru Reșița, Etapa 3, Componenta Bloc 36, P-ța 1 Decembrie

General objective of the project / Purpose of the project

Project objectives

Increased energy efficiency in residential buildings through the energy rehabilitation of block 36, Market 1 December 1918, Municipality Resita.

Specific objectives of the project

1. Increasing the energy efficiency for the housing blocks so that the specific annual energy consumption calculated for heating to fall below 90 KWh / sqm / year useful area for each housing block.

2. The decrease of the specific energy consumption for heating the houses must be at least 40% of the consumption highlighted in the energy performance certificate corresponding to the initial state of the block.

3. CO2 emission reduction by more than 40% compared to the initial emissions.

Target group

The members of the Association of owners from block 36-Market 1 December 1918, Resita Municipality (about 36 families).

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	199.3	95.04	52.31
Specific annual energy consumption for heating (kWh / m2 / year)	240.06	79.62	66.83
Specific annual energy consumption (kWh / m2 / year)	301.53	141.09	53.21
Number of households with a better classification of energy consumption (no. Of households)		36	

ANNEX 12 - Blocurile de locuințe - Centru Reșița, Etapa 3, Componenta Bloc nr A5, strada Horea

Project objectives

Increased energy efficiency for housing blocks - Resiţa center, stage 3, block composition no. A5, str. Horea.

Specific objectives of the project

1. Increase the energy efficiency for the housing blocks so that the specific annual energy consumption calculated for

heating to fall below 90 KWh / sqm / year useful area for the apartment block.

2. The decrease of the specific energy consumption for heating the homes must be at least 40% of the consumption shown in the energy performance certificate corresponding to the initial state of the block.

3. CO2 emission reduction by more than 40% compared to the initial emissions.

Direct beneficiaries:

The members of the Association of owners from block A5, Str. Horea, Resita Municipality (about 40 families).

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	209.81	99.88	52.40
Specific annual energy consumption for heating (kWh / m2 / year)	237.48	77.73	67.27
Specific annual energy consumption (kWh / m2 / year)	300.1	140.35	53.23
Number of households with a better classification of energy consumption (no. Of households)		40	

ANNEX 13 - Blocul de locuințe din Bulevardul Republicii, bloc nr. 27, scara 1, 2, 3, 4, 5

Project objectives

Increased energy efficiency for the housing block - Boulevard Boulevard, block no. 27, scale 1, 2, 3, 4, 5.

Specific objectives of the project

1. 1. Increase the energy efficiency for the housing blocks so that the specific annual energy consumption calculated for heating to fall below 90 KWh / sqm / year useful area for the apartment block.

2. The decrease of the specific energy consumption for the heating of the houses must be at least 40% of the consumption highlighted in the energy performance certificate corresponding to the initial state of the block.

3. Reduction of CO2 equivalent emissions by more than 40% compared to the initial emissions.

Direct beneficiaries:

The members of the Association of owners from block no. 27, Bdul Republicii, Resita Municipality (about 200 families).

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	715.12	421.62	41.04
Specific annual energy consumption for heating (kWh / m2 / year)	174.57	59.84	65.72
Specific annual energy consumption (kWh / m2 / year)	246.57	131.84	46.53
Number of households with a better classification of energy consumption (no. Of households)		200	

ANNEX 14 - Blocurile de locuințe I.L. Caragiale, Reșița, Componenta Bloc Nr. 1-6

Project objectives

Increased energy efficiency in residential buildings by energy rehabilitation of blocks 1-2,3-4,5-6 str. I.L. Caragiale, the Municipality Resita.

Specific objectives of the project

1. Increasing the energy efficiency for the housing blocks so that the specific annual energy consumption calculated for heating to fall below 90 KWh / sqm / year useful area for each housing block.

2. The decrease of the specific energy consumption for the heating of the houses must be at least 40% of the consumption highlighted in the energy performance certificate corresponding to the initial state of the block.

3. Reduction of CO2 equivalent emissions by more than 40% compared to the initial emissions.

Target group

The members of the owners' associations from the block 1-2, 3-4, respectively 5-6 from the street I.L. Caragiale, Resita Municipality (ca. 209 families).

Component block 1-2

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO2)	174.11	97.74	43.86
Specific annual energy consumption for heating (kWh / m2 / year)	168.48	70.16	58.36
Specific annual energy consumption (kWh / m2 / year)	205.23	106.9	47.91
Number of households with a better classification of energy consumption (no. Of households)		54	

Component block 3-4

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO_2)	279.22	143.69	48.54
Specific annual energy consumption for heating (kWh / m2 / year)	149.14	39.51	73.51
Specific annual energy consumption (kWh / m2 / year)	220.29	110.65	49.77
Number of households with a better classification of energy consumption (no. Of households)		98	

Component block 5-6

RESULTS	Value before project implementation	The value at the end of the project implementation	Percentage reduction
Reduction of the specific annual level of greenhouse gases (equivalent tonnes of CO_2)	152.29	86.32	43.32
Specific annual energy consumption for heating (kWh / m2 / year)	142.14	62.36	56.13
Specific annual energy consumption (kWh / m2 / year)	178.87	99.1	44.60
Number of households with a better classification of energy consumption (no. Of households)		57	

ANNEX 15 - THERMAL INSULATION INFRADOS BASIN

Input data

Average annual water temperature 27 0C

The average annual temperature in the basement includes heat from the central 15 0 C

Surface infrared basin 1505 sqm

Thickness of concrete plate basin 12 cm

Period of use of the basin 8760 h / year

The heat dissipates through the concrete slab

$Q_i = A \times U_i(T_m - T_i) \times t$ [W]

$U_i = 1/R_i$ - the thermal conductivity of the concrete slab [W/ (m2K)]

$R_i = R_{si} + R_{se} + \Sigma d/\lambda$ - thermal resistivity [m2K/ W]

$R_{si} = 0.167$ [m2K/ W]

$R_{se} = 0.084$ [m2K/ W]

λ beton = 2.03 [W/(mK)

$R_i = 0.310$ [m2K/ W]

Qi= 1505x 1/0.310 (27-15)x 8760 = 510,34 MW/ year

In case of thermal insulation with 20 cm of polystyrene

$\Sigma d/\lambda$ = 0,12/ 2,03 + 0,2/ 0,04 = 5,06 [m2K/ W]

Ri = 5,311 [m2K/ W]

Qi= 1505x 1/5,311 (27-15)x 8760 = 29,79 MW/ year

Gas consumption

Final variant current energy

510340 / 10,786 = 47315 mc / yr

Current variant primary energy

510340 x 1.17 = 597097.8 KW - primary energy consumed

CO_2 - emitted current version

597097.8 x 0.205 = 122405.049 Kg CO_2

Final energy variant isolated basin

29790 / 10,786 = 2761.91 mc / yr

Primary energy variant isolated basin

29790 x 1.17 = 34854.3 KW - primary energy consumed

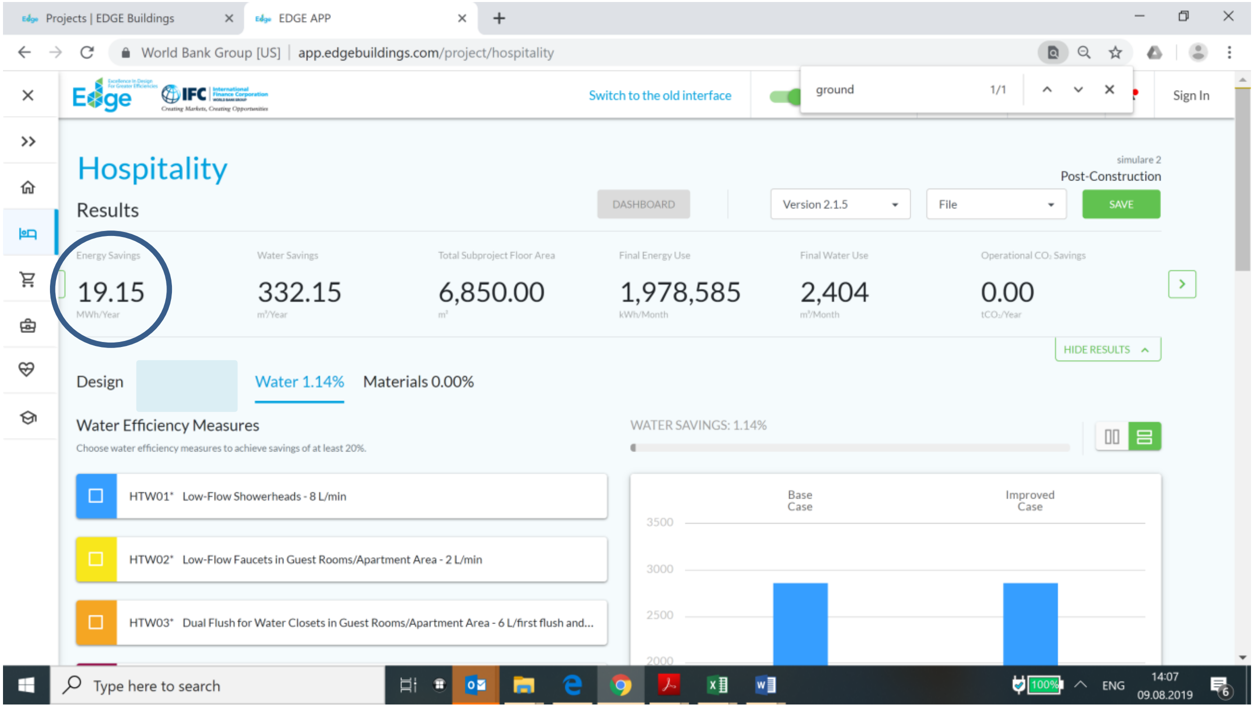
CO_2 - emitted isolated basin variant

34854.3 x 0.205 = 7145.13 Kg CO_2

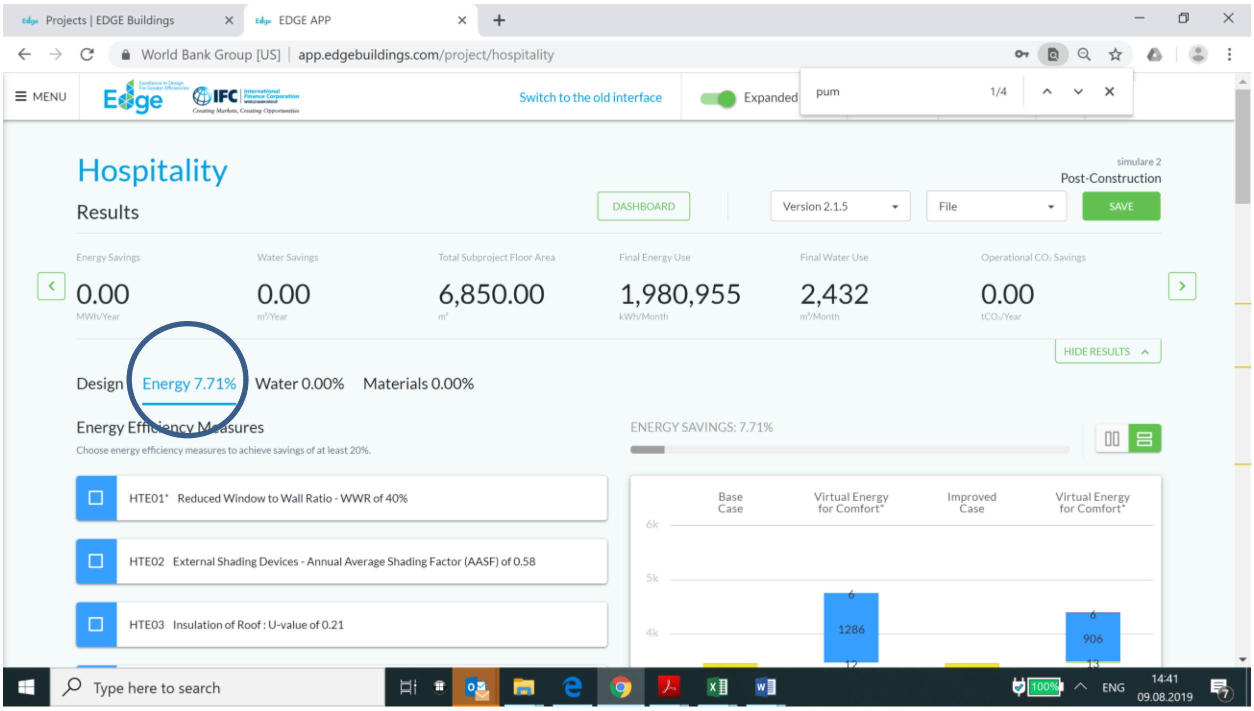
Basin	Heat dissipated [kw/year]	Gas consumption (mc)	CO_2[kg]
Without isulation	510.340	47.315	122.405,05
Insulated insulated with 20 cm expanded polystyrene	29.790	2.761,91	7.145,13
Reduction of gas consumption and CO2 emissions (%)	94,5	94,5	94,5

ANNEX 16 – SIMULATIONS REALIZED WITH THE EDGE APPLICATION

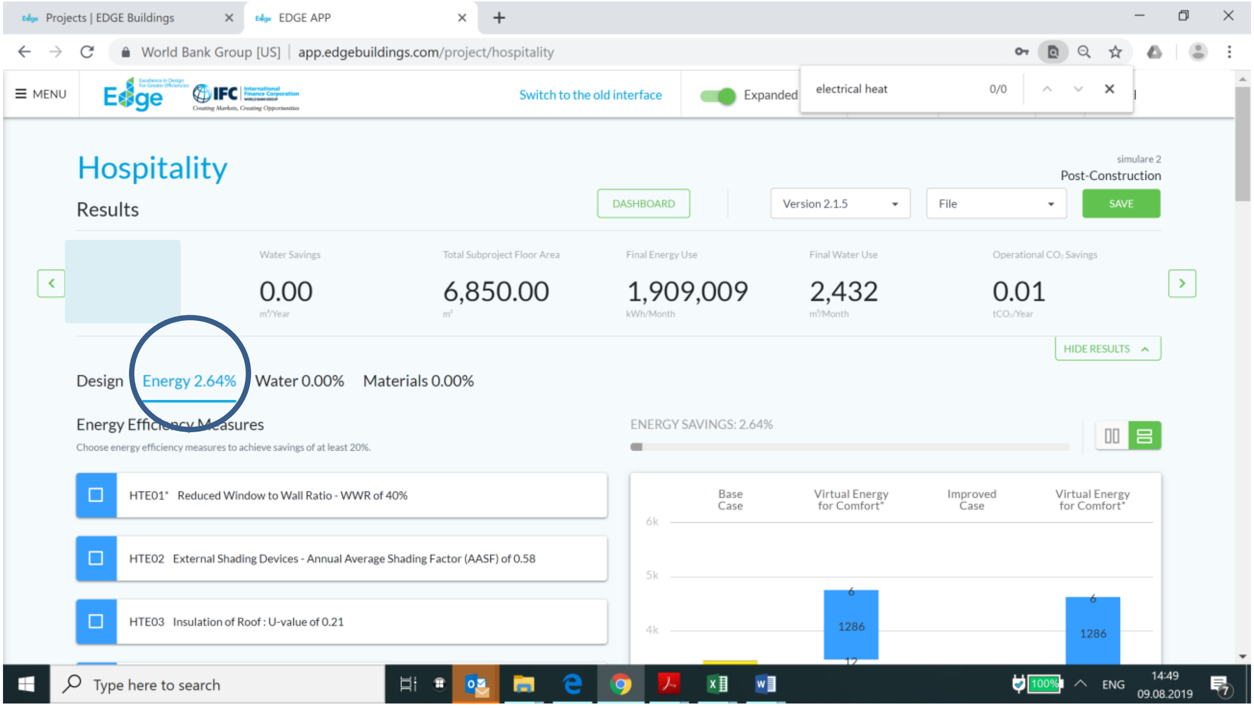
1. Swimming Pool Cover



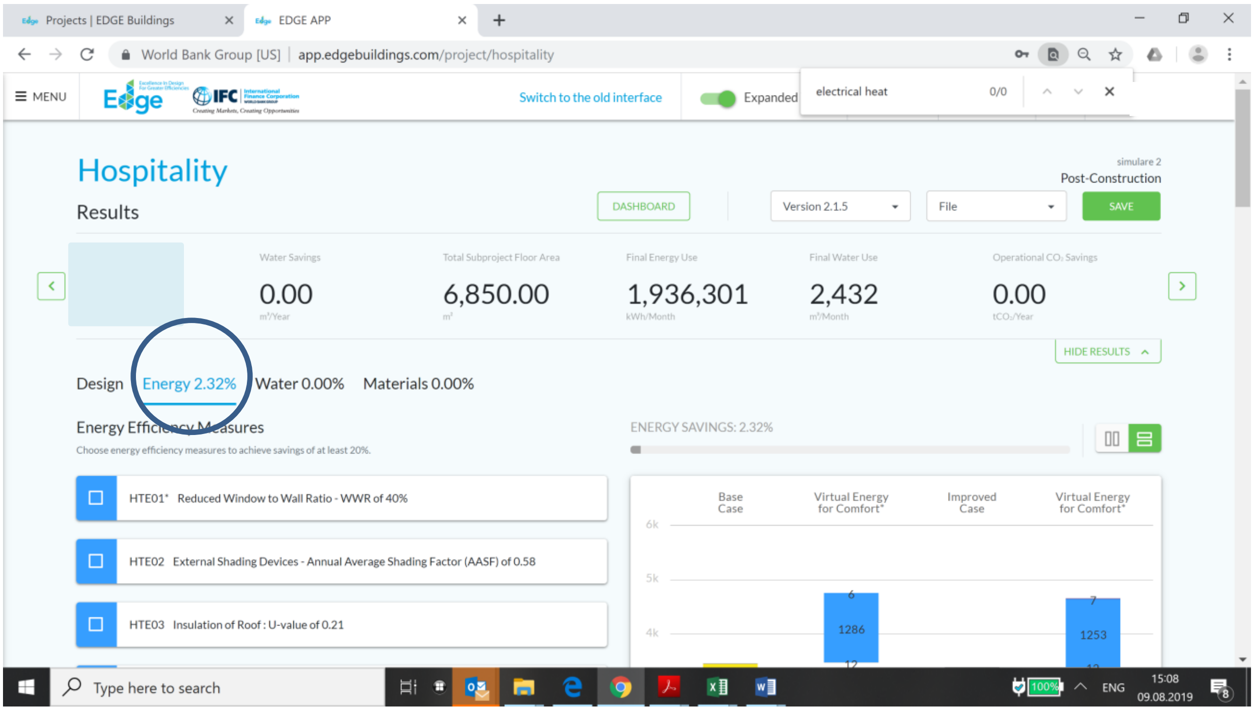
2. Ground Source Heat Pump



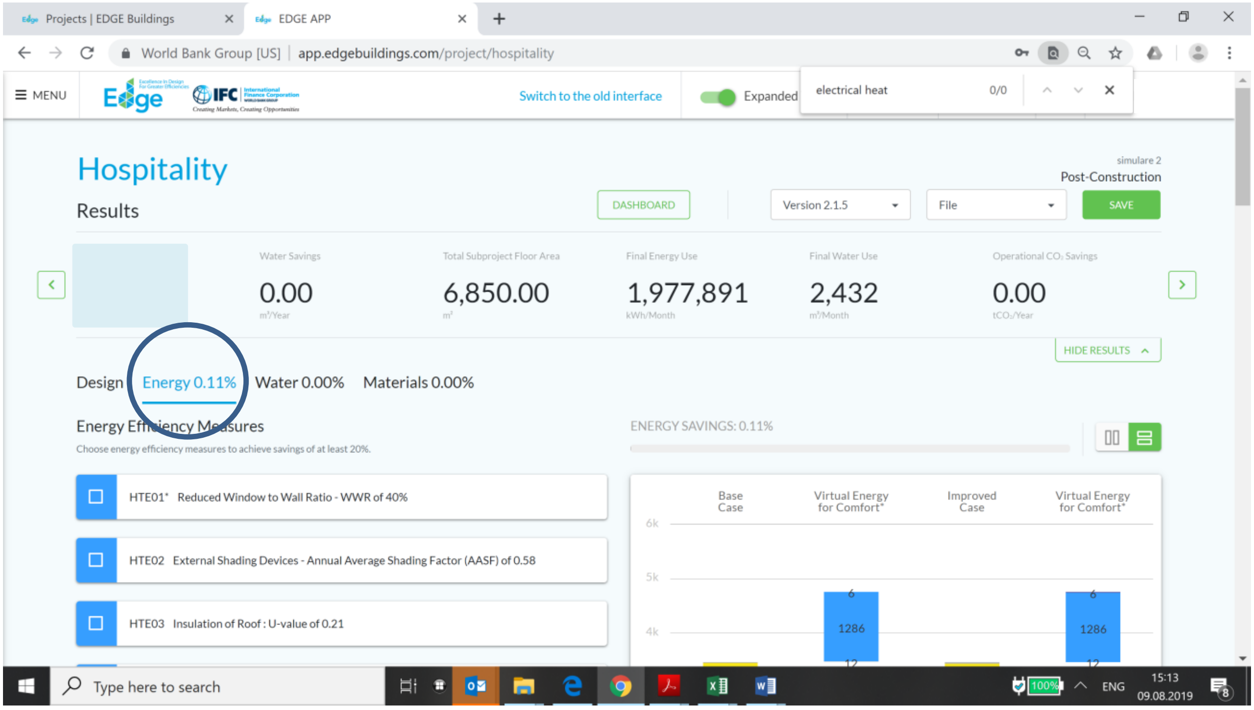
3. Electric heat pump for hot water



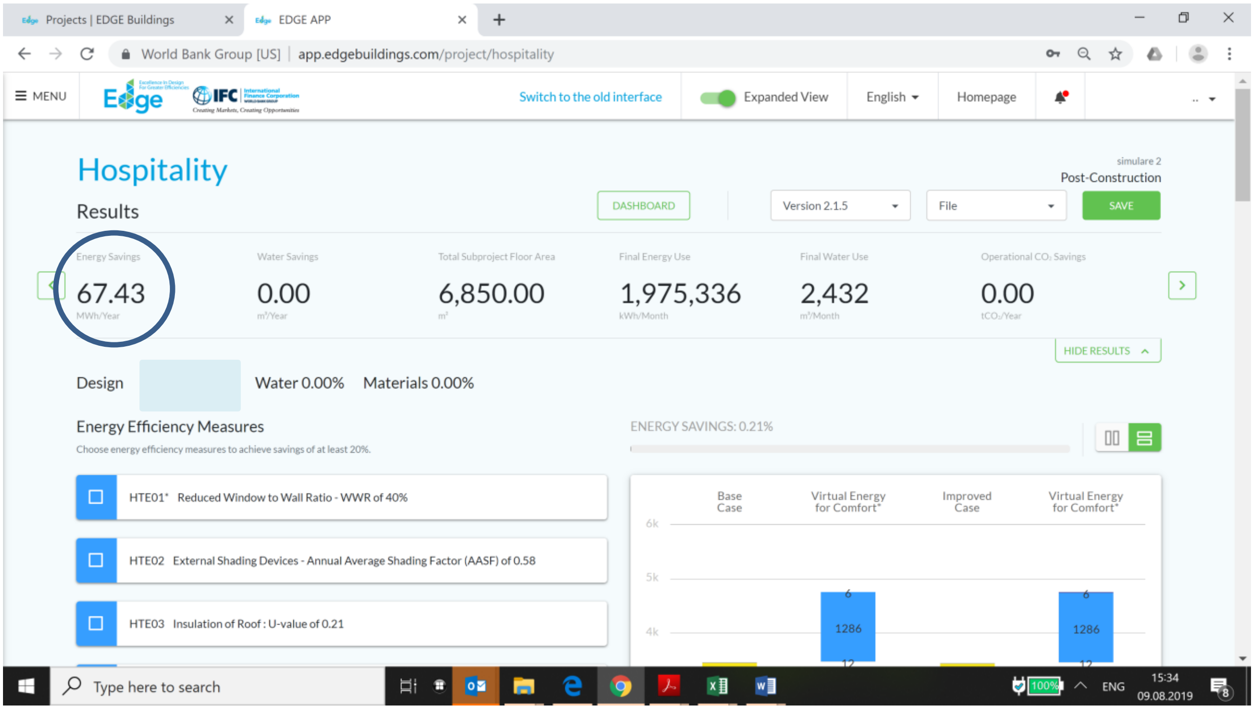
4. Energy saving light bulbs



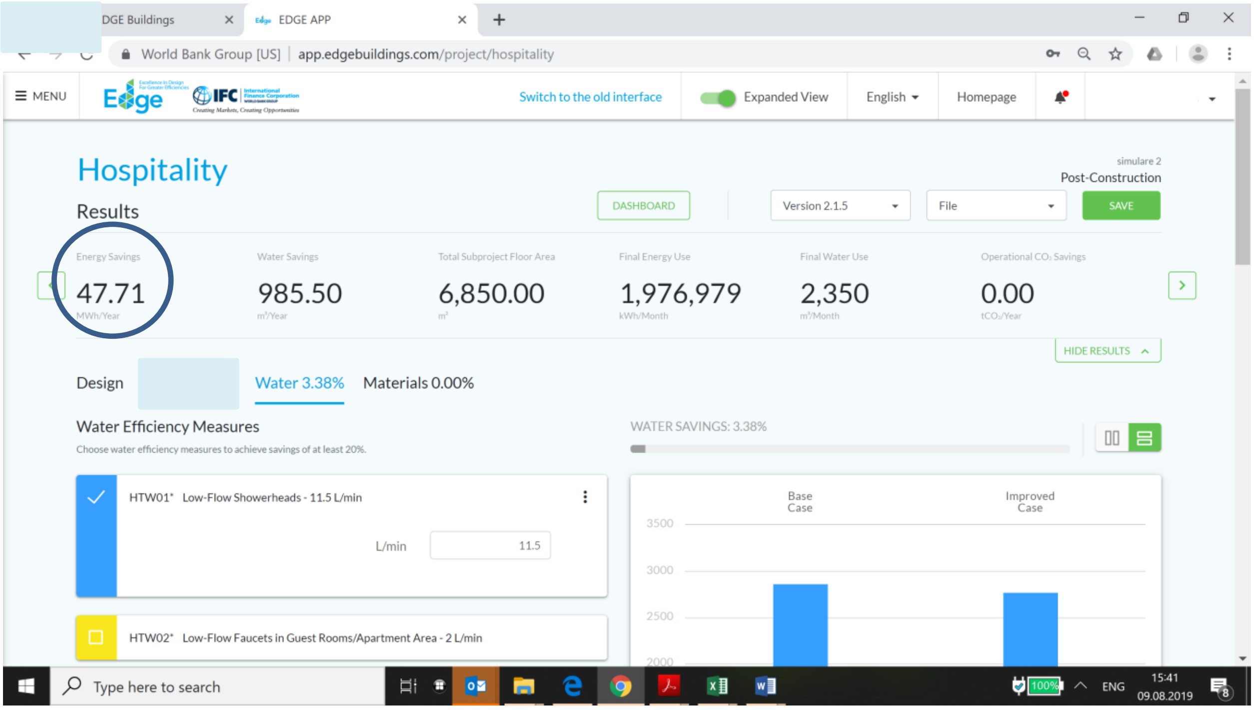
5. Light controls for corridors



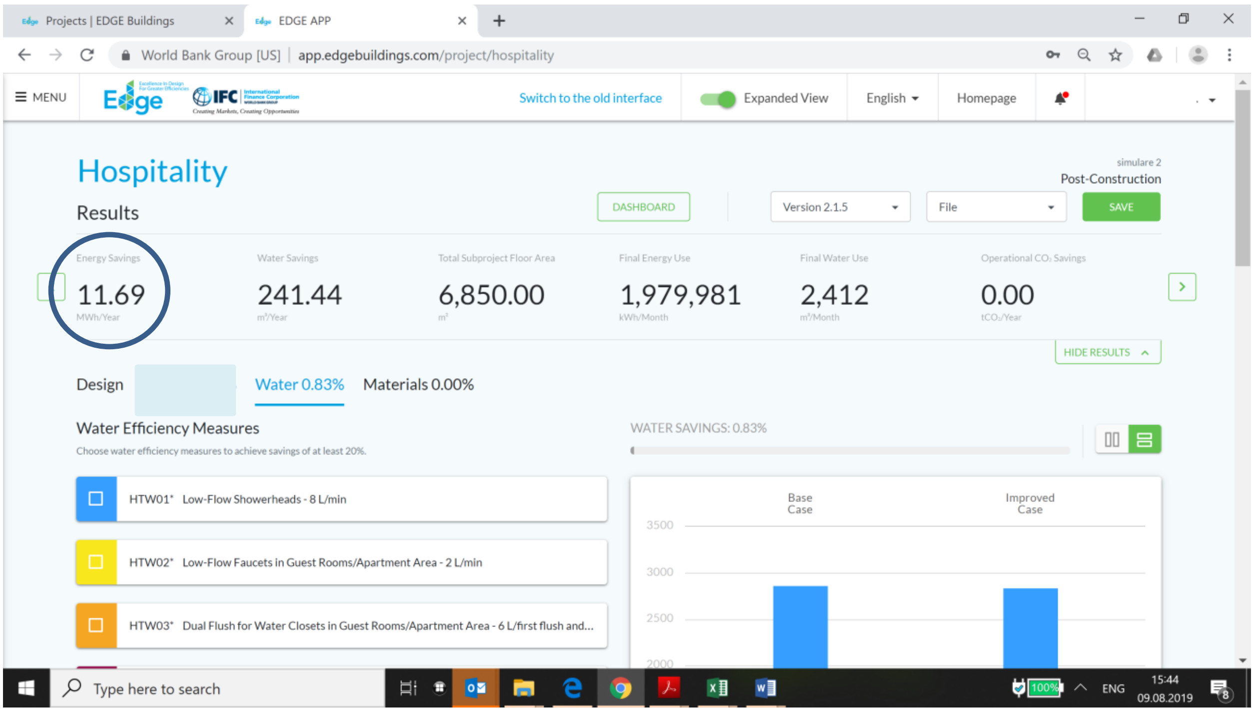
6. Solar photovoltaics



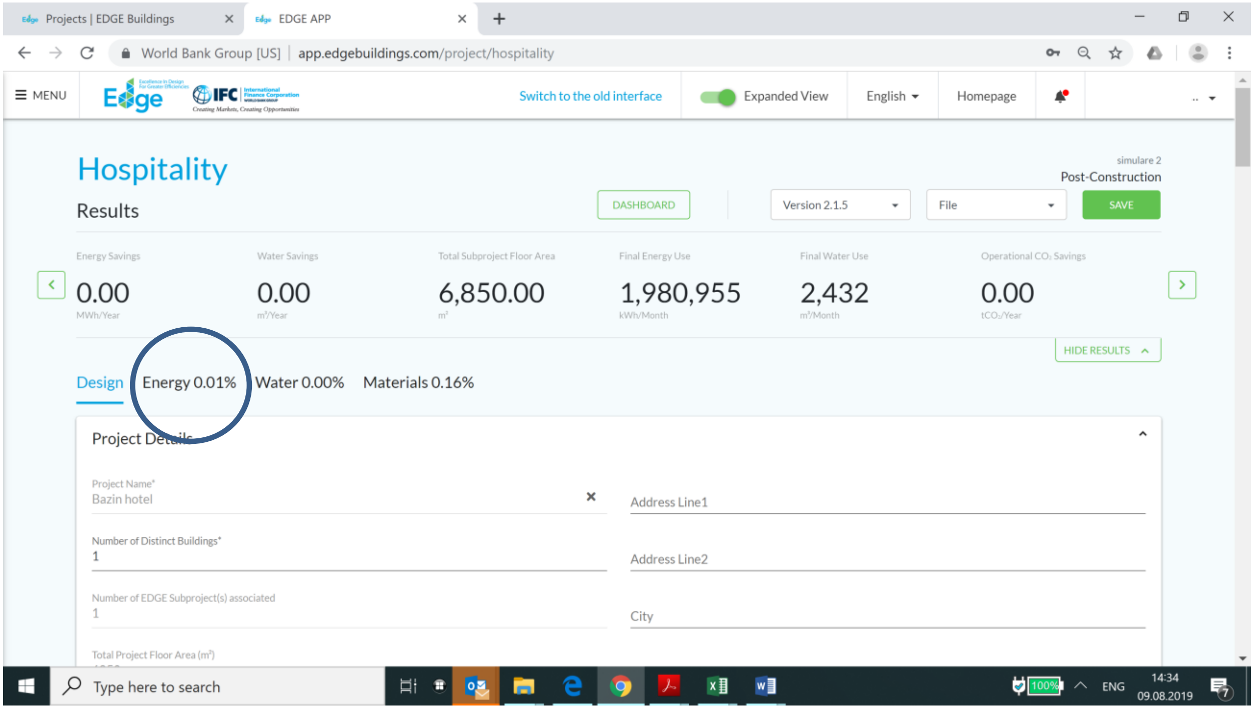
7. Low flow showerheads



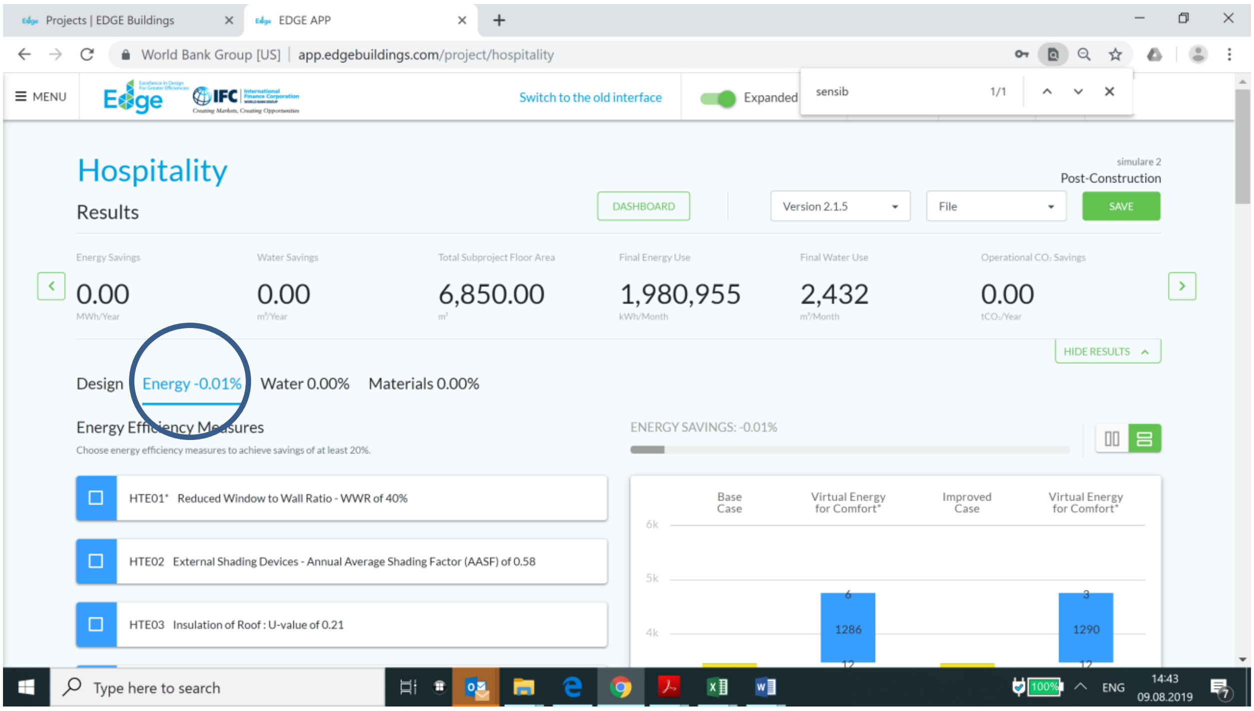
8. Aerators & auto shut-off faucests



9. Insulation of external walls



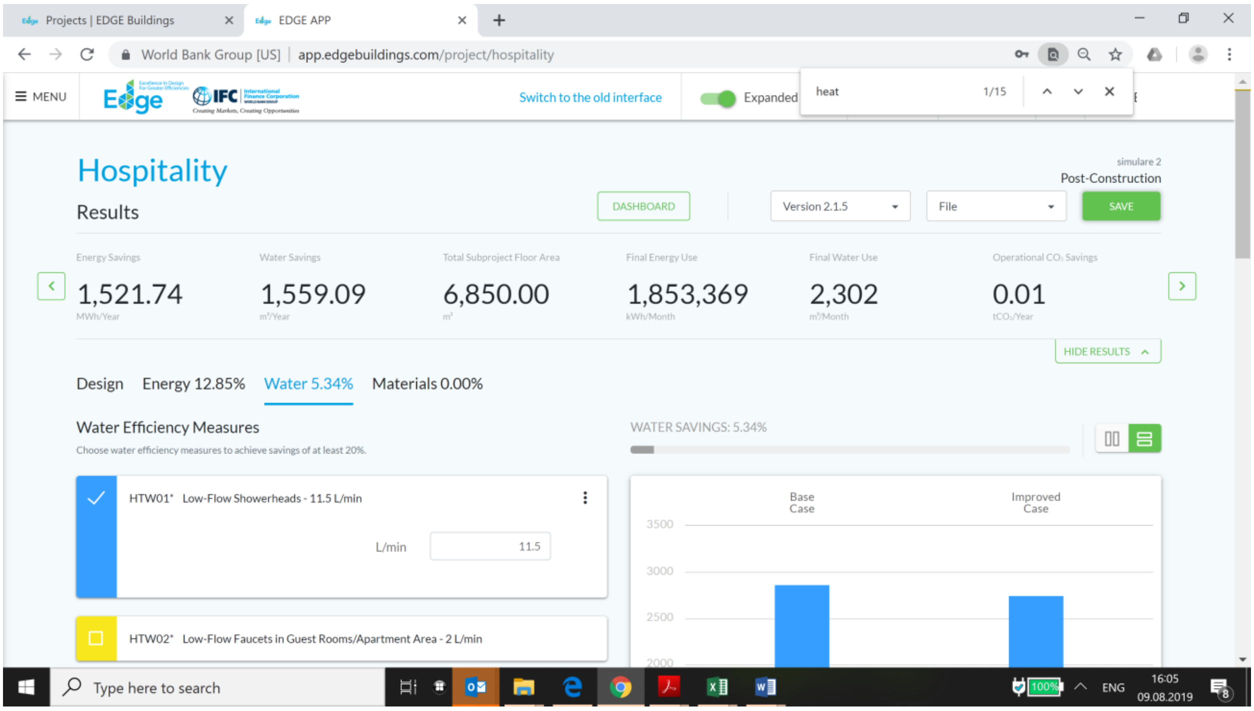
10. Sensible heat recovery from exhaust air



As a result of these simulations, central results can be obtained with each proposed solution, by removing *Insulation external walls* because the investment costs are not justified by renting, and also solutions for *Sensible heat recovery from exhaust air,* because according to the results it adds additional expenses in during use.

In the following picture can be found the results for implementing the following measures:

- Swimming pool cover
- Ground source heat pump
- Electric heat pump for hot water
- Energy saving light bulbs
- Light controls for corridors
- Solar photovoltaics
- Low flow showerheads
- Aerators & auto shut-off faucests



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IMPACT STUDY

Interreg - IPA CBC
Romania - Serbia

EUROPEAN UNION

Cooperation beyond borders.
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