

Energy Management in Protected Buildings Owned and Used by the Government of the Republic of Croatia

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ABSTRACT

The Governmental Programme „Bringing your own house in order” was launched and implemented in Croatia over two years ago to improve energy efficiency in government-owned buildings. A significant number of buildings are under the protection of conservers either as individually protected building or as part of an entire protected old city centre. Approximately 2.375 buildings and office spaces are currently under revision. They are located on 2,21 mil square meters in more than 240 municipalities throughout Croatia. The buildings’ annual consumption is estimated at 60 million EUR. Extensive analysis has shown that protected buildings and buildings located within protected old city centres account for approximately 230 million kWh of the total yearly consumption, their emissions amount to 67 thousand tCO₂, and they cost 14 million EUR per year. This paper elaborates on the energy performance of a specific group of buildings, and on their condition regarding the building envelope and the Heating, Ventilation and Air conditioning systems (HVAC). Furthermore, the energy efficiency measures that could be implemented take into account the buildings’ level of preservation. Although protected buildings are excluded from numerous regulations regarding energy efficiency, significant savings could be obtained by implementing specific energy efficiency measures, proper energy management and a change in the occupants’ behaviour.

KEYWORDS

Energy management, energy efficiency in cultural heritage buildings, energy savings, financial savings

1. INTRODUCTION

In the framework of the National Programme of the Republic of Croatia aimed at „Energy Efficiency improvement in Croatia“, the Programme of the Government of the Republic of Croatia entitled "Bringing your own house in order" (HIO) is being implemented as of 2008, with the goal of establishing systematic energy management in facilities¹ owned and used by the Government of the Republic of Croatia. In the process of data collection for the register of public facilities, it turned out that a significant volume of facilities is under conservation protection, which pointed to the necessity of finding some specific solutions in order to increase energy efficiency of these buildings. Interventions on protected buildings need to be kept at a minimum, in

¹ A facility is considered to be a consumer unit; in other words, facilities include: buildings, home building, part of a building, offices, etc.

order to preserve the historical value of buildings; however, certain interventions simply must be performed in order to ensure thermal comfort and undisturbed stay of persons in these facilities, while ensuring appropriate indoor climate for adequate preservation of protected cultural heritage.

Until the end of December 2010, the HIO Programme of the Government of the Republic of Croatia covered 2.375 facilities of the ministries of the Government of the Republic of Croatia, with the total net area of 2,215 million square meters, located at 1.509 locations throughout the Republic of Croatia (over 240 cities and municipalities). Out of these facilities, 57% are owned, and 43% are rented.

Analyzing the sample of 1.524 facilities, based on the database established by the Program, and on the information received from conservation departments, it has been determined that 15,4% of facilities have the status of protected cultural goods, or they include a certain portion of protected cultural goods, while 23,16% of facilities are located within protected historical cores (Figure 2).



Figure 1. Map of territorial distribution

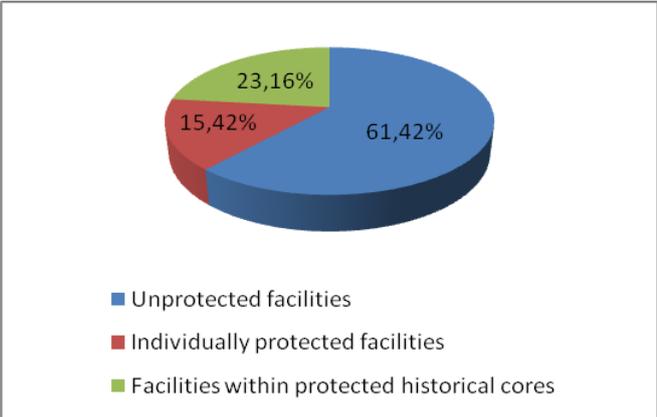


Figure 2. Share of facilities according to the degree of protection under HIO Programme

Of the 15,4% of facilities that have the status of individual protected, or that are using a part of an individual protected cultural good, 28% are located in Istarska County. Of the 23,1% of facilities located within protected historical cores, 44% are located in the City of Zagreb and Zagrebačka County.

Obstacles for the application of energy efficiency measures in the public sector are extraordinarily high. Among the most important obstacles, it is worth pointing out the following: an inherited attitude that energy costs are permanent and unchangeable; lack of employee motivation to ensure energy savings; inability to redirect budgetary funds towards energy efficiency projects without complicated procedures; absence of organizational structure for energy management that would include persons in charge of energy management issues; and lack of a systematic overview of the condition of

facilities, as well as the lack of awareness on the total energy consumption in all state administration facilities.

If we add to this the fact that 43,5% of facilities are leased, rather than owned by the Government of the Republic of Croatia, which means that the users cannot undertake all the potential energy efficiency measures normally available, and also the fact that 43% of facilities are using one part of an existing, free-standing building that is shared with other private sector or public sector users not covered by this paper, we can understand how important it is to have a systematic approach in place for every user of the facilities in question. We should by no means perceive these facts as being aggravating circumstances, or as a justification for the absence of systematic energy management, because "each step we take is counted".

In order to determine the ownership status, using the sample of 1.165 facilities, we have concluded that of the total of 56% of facilities owned by the Government of the Republic of Croatia, 16% are located within the protected historical cores, and 16% have the status of protected cultural goods, or are using one portion of a protected cultural good (Figure 3.).



Figure 3. Buildings owned by the Government of the Republic of Croatia and used by the ministries, according to the category of protection

2. ENERGY AND WATER CONSUMPTION

Annual consumption of energy and water in 2.375 facilities owned and used by the ministries of the Government of the Republic of Croatia, with the total surface of 2.215 million square meters, regardless of the category of protection, is modeled on the basis of an actual sample involving 1.191 facilities, at 680 locations throughout Croatia. The energy and water consumption for the actual sample of 1.191 facilities stands at 40,2 million EUR. Cost distribution of energy and water is shown in Table 1. From the Figure 4. we can see that 35% of total costs are paid for electricity, 24% for water, while the

rest is related to heating or DHW². It was impossible to make any conclusions on the total annual expenditure for all the 2.375 facilities on the basis of simple proportionality, by adding the surface for the remaining facilities; instead, we needed to engage in modeling on the basis of specific functions of individual institutions (office facilities, hospitals, dormitories, ...). The expenditure of these facilities stands at approximately 60 million EUR, 5,4% of which is the expenditure of facilities with the status of individual cultural goods, or those that are located within individual cultural goods, and 18,8% (Figure 5.) of which is the expenditure of facilities within protected historical cores. When it comes to the calculation of energy consumption, the data from the relevant *Methodology* [1] is used for the lower heating value of fuel and for the CO₂ emission factor (the data for liquefied petroleum gas, expressed in cubic meters, was obtained from the provider Proplin d.o.o.).

Table 1. Annual energy and water consumption of the sample of 1.191 facilities, in EUR

Annual energy and water consumption of the sample of 1.191 facilities; €	
Heating oil	6,120,000
Natural gas	4,548,000
Electricity	14,113,000
Heating plants	2,417,000
Liquefied petroleum gas	173,000
Water	9,571,000
Water steam	3,232,000
Heating wood	21,000
Total consumption	40,195,000

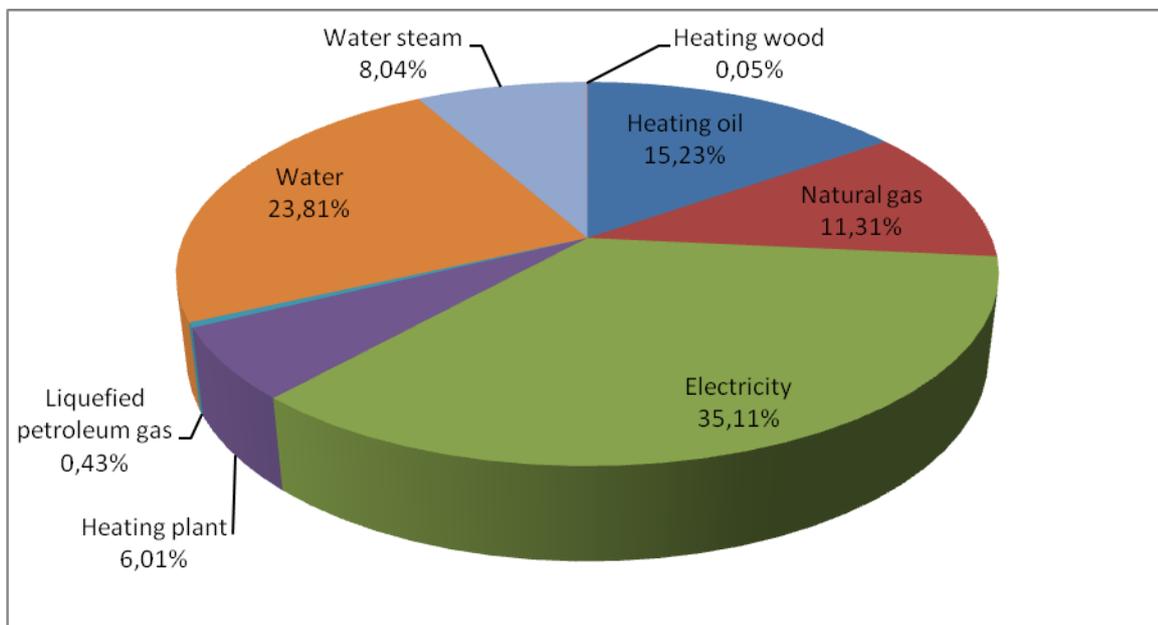


Figure 4. Share of energy sources and water in the cost balance of the total consumption

² Domestic hot water

Protected facilities that are owned and used by the Government of the Republic of Croatia are in one reference year responsible for the consumption of 229 million kWh of energy, emission of 67 thousand tCO₂ , for which the Government of the Republic of Croatia has to spend approximately 14,4 million EURs.

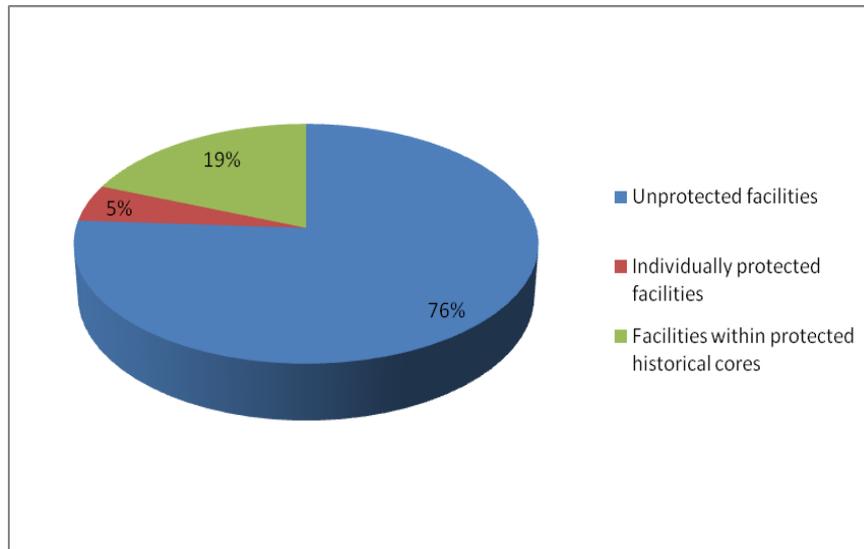


Figure 5. Share of energy sources and water in the cost balance of the total consumption, according to the category of protection

3. CLASSIFICATION OF FACILITIES ACCORDING TO THE PERIOD OF CONSTRUCTION

From the point of view of energy consumption, the period when a building was erected constitutes an extraordinarily important parameter. The division of buildings depending on their age and the type of construction is a factor that does not receive sufficient attention, and also a factor that will need to be taken into account to a higher degree in the future. Due to the characteristics of construction and the absence of regulations on thermal protection in the period of biggest housing construction boom between 1950 and 1980, a wide range of existing housing and non-housing building units nowadays constitute major energy consumers.

The period of construction, as well as the period of possible reconstruction of a building, are pieces of data that can tell a lot about the characteristics and types of construction used in a particular building. This data also tells us a lot on the possible existence of thermal insulation, depending on the legislative circumstances in the sphere of thermal protection that were in place in a given period of construction.

Based on age and construction type, in correlation with the legislative situation, existing buildings in Croatia can be divided into certain characteristic groups:

- buildings constructed prior to 1900;
- buildings constructed in the period 1900 to 1940;
- buildings constructed in the period 1940 to 1970;
- buildings constructed in the period 1970 to 1987;

- buildings constructed in the period 1987 to 2006;
- new constructions that are in compliance, harmonized with the Technical Regulation on Thermal Energy Savings and Thermal Protection in Buildings (Official Gazette 79/05, with the obligatory application as of July 1, 2006), and harmonized with the Technical Regulation on Rational Energy Use and Thermal Protection of Buildings (Official Gazette 110/08; 89/09).

When analyzing energy properties of a building and characteristics of energy consumption, an important indicator is the data on the purpose of the building, and on the specific aspects of energy consumption depending on its purpose. [2]

Using the sample of 1.524 facilities, in cooperation with conservation departments, we have verified the degree of protection for individual facilities and the results of that analysis on the share of various types of facilities in correlation with characteristic construction periods is given in Table 2.

Table 2. Share of facilities in characteristic construction periods

Period of construction	Unprotected facilities	Protected facilities	Facilities within protected cores
Prior to 1900	67	124	93
1900 to 1940	50	32	70
1940 to 1970	221	32	83
1970 to 1987	206	19	55
1987 to 2006	107	7	11
New construction	38	4	10
Unknown period of construction	247	17	31

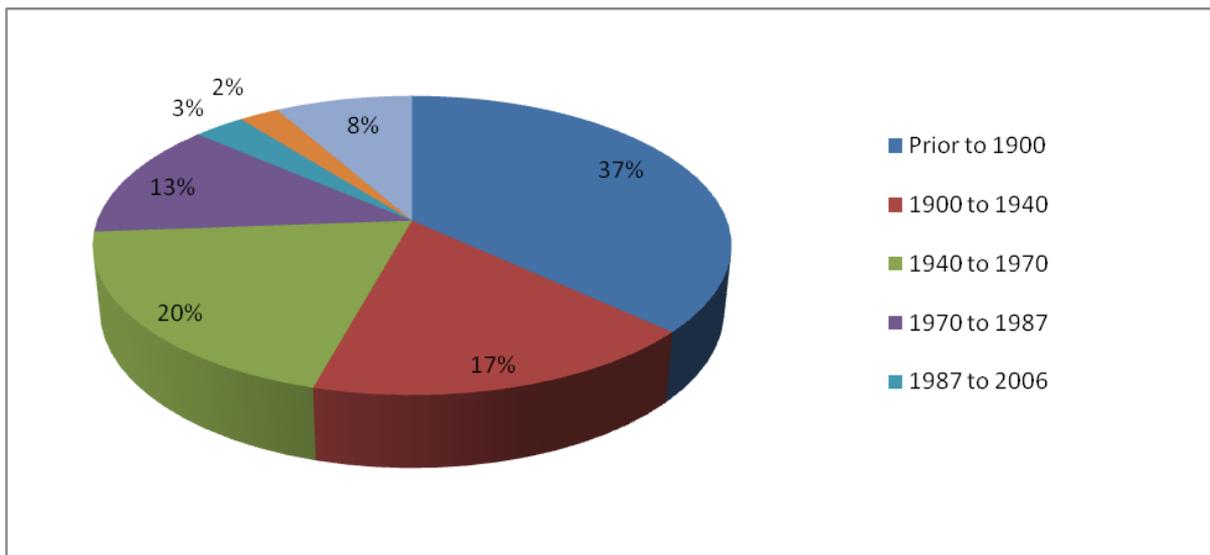


Figure 6. Share of *protected facilities* according to the periods of construction

4. CLASSIFICATION OF FACILITIES ACCORDING TO PURPOSE AND THEIR ENERGY CONSUMPTION FOR HEATING, PREPARATION OF HOT WATER FOR DOMESTIC USE, AND TECHNOLOGICAL NEEDS

The facilities of the Government of the Republic of Croatia are specific both in terms of their purpose, and in terms of the financial expenditure required for energy and water. The facilities are divided into seven categories, taking into account the type of activity performed in them; complexity of the system of heating, cooling and ventilation in facilities; number of staff members and users; as well as the operating regime. The categories include the following types of facilities: clinical hospitals (KB); clinical hospital centers (KBC); specialized hospitals; hospitals; clinics; rehabilitation centers (CZR); various homes; centers for education (CZOO); museums and all other public administration facilities (police stations, customs offices, tax administration offices, social care centers, conservation departments...).

The shares of energy sources used for the heating of facilities, the preparation of hot water for domestic use, and for technological needs are analyzed in more detail as per groups mentioned above, because of a high share of these energy sources in the overall energy balance of all the facilities used by various government ministries.

Using the sample of 775 facilities with the total net area of 965 thousand square meters, with the aim of determining the share of energy consumption used for heating, preparation of hot water for domestic use, and for technological needs, the analysis concluded that these functions require 41% of the total energy consumption. The overall financial expenditure for all the facilities owned and used by the government ministries is 24,4 million EUR. If we assume that around 25% of that expenditure is created in *protected facilities*, we can conclude that their share in the cost is 6,12 million EUR that the Government of the Republic of Croatia must spend for these energy sources.

Table 3. Specific energy consumption used for the heating of facilities, the preparation of hot water for domestic use and for technological needs of facilities, on the basis of the sample used in the analysis

Distribution of facilities	Specific energy consumption for heating, kWh/m ²	Number of facilities included in the sample	Surface of the sample of facilities, in m ²
KB, KBC and SB	382,00	42	139.507
Clinics, hospitals	347,00	8	33.243
Prisons	269,15	19	44.705
Penitentiaries	252,67	107	76.392
Homes, CZOO and CZR	220,00	84	150.298
Public administration facilities	153,45	427	465.193
Museums	88,35	68	56.107

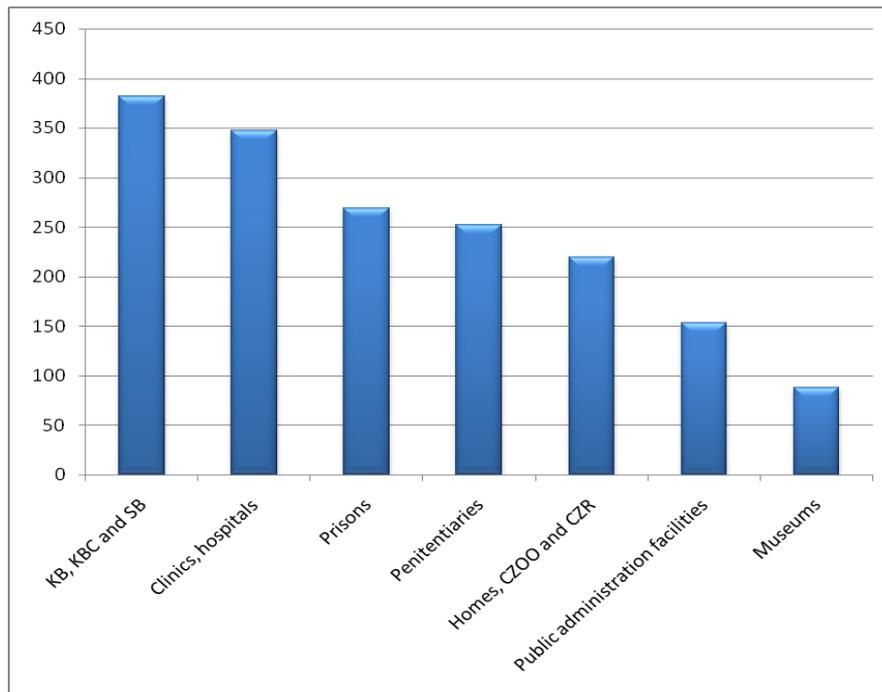


Figure 7. Average specific consumption of facilities according to their category, in kWh/m²

Looking at Table 3, we can conclude that, as expected, the highest specific consumption of energy can be seen in facilities with more complex HVAC systems, while specific consumption is decreasing as the hours of use of facilities decrease. It is also clear that the specific energy consumption is high in relation to existing standards, and that there is significant room for savings.

5. ENERGY EFFICIENCY MEASURES IN CULTURAL HERITAGE BUILDINGS ENCOMPASSED ACCOMPLISHED BY THE "BRINING YOUR OWN HOUSE IN ORDER" PROGRAMME

All the activities within the Programme of the Government of the Republic of Croatia "Brining your own House in Order" (referred to as the Programme) are being implemented in accordance with the obligations of the public sector, which, according to Article 18 of the Law on Efficient Energy Use in Direct Consumption (Official Gazette 152/08), has the duty to engage in management of the direct consumption of energy in public sector buildings. The public sector has the duty to periodically analyze energy consumption; undertake energy audits; develop programmes on energy efficiency for direct energy consumption; undertake energy efficiency measures in direct energy consumption, as determined by the energy efficiency program; maintain, update and develop the energy efficiency information system, in particular for the monitoring of energy consumption; periodically deliver data to the competent ministry, at least once per year. [4]

According to the Rule Book on Energy Certification of Buildings (Official Gazette 36/10), which entered into force on April 1, 2010, every new building must have an energy certificate, as well as any existing building being sold, rented, or in leasing, with the exception of buildings that are excluded from the obligation of energy

certification according to the Rule Book on Energy Certification of Buildings. The categories of buildings for which are issued (mutually comparable) energy certificates issued (mutually comparable) are determined based on the predominant purpose of use, and two key categories are: housing buildings and non-housing buildings. According to Article 6 of the Rule Book, energy certificate is not required for buildings that are inscribed in the Register of Cultural Goods of the Republic of Croatia according to the relevant law, nor is it required for buildings that have a special ambiance value, where the fulfilment of energy efficiency requirements would result in an unacceptable change in their character or their external appearance, which is relevant for the protection of such buildings as cultural monuments. [3]

5.1. SYSTEMATIC ENERGY MANAGEMENT AND ENERGY EFFICIENCY MEASURES

In order to apply systematic approach towards energy efficiency measures implementation in public sector it is necessary to apply methodology of systematic energy management. Systematic energy management includes monitoring of energy consumption in a predefined manner, in order for us to be able to respond to the following questions at any point in time:

WHERE are we using energy? – In facilities such as office buildings, hospitals, military barracks, faculties, police stations, courts, border crossing points, etc.

HOW are we using energy? – To power various systems: for heating, cooling, ventilation, lighting, food preparation, etc.

WHICH energy sources are we using? – Electricity, gas, heating oil, wood, thermal energy; water is also an energy source.

HOW MUCH energy are we spending? – How many kWh of electricity and thermal energy are we using; how many litres of heating oil, cubic meters of gas, or other energy sources – and what is the cost of using these energy sources.

WHO is in charge of energy management? – The EE team (energy Efficiency team) at the ministry level; technical staff and janitors at the level of a facility.

HOW do we manage energy? – Through weekly and monthly monitoring of consumption, and also through the analysis of energy consumption on the basis of an energy management information system (ISGE); in addition, we manage energy by planning and implementing energy efficiency measures, and by permanently educating and motivating the EE team and all staff members.

After answering all these questions the aim is to systematically implement energy efficiency measures. We can classify energy efficiency measures into: organizational and educational measures without additional costs, measures involving small costs and a quick return on investment, measures involving higher costs and a longer return on investment. Organizational and educational measures without additional costs include: proper energy management, awareness raising programs and education for target groups, establishment of the energy management system.

The first step in the implementation of energy efficiency measures, and in proper energy management, is to conduct an energy audit as the basis for issuing the Energy Certificate. Energy study (overview) should also provide us with answers to questions

such as which energy efficiency measures should be undertaken in order to decrease energy consumption. certificate. Energy study (overview) should also provide us with answers to questions such as which energy efficiency measures should be undertaken in order to decrease energy consumption.

Within the Program so far, we have witnessed 28 protected facilities. Potential investments following up on the measures proposed by energy audits for these protected facilities in the amount of approximately 2 million EUR, would lead to savings of around 178 thousand EUR per year. Expected payback period would be 12 years.

5.2. PROPOSAL OF MEASURES FOR THE IMPROVEMENT OF ENERGY EFFICIENCY

Some of the measures that can be used to increase energy efficiency are outlined below, especially the measures which do not require interventions on building envelope and which could be easily implemented on majority of cultural heritage buildings.

Measures that could be implemented without mayor intervention on protected building elements

- sealing of windows and external doors;
- verification and repair of window and door reinforcements
- insulation of niches for radiators and window shutter boxes
- installation of thermostat valves on radiators
- insulation of reservoirs and pipes for hot water
- hydraulic balancing of the central heating and cooling system
- installation of automatic regulation, control and monitoring of energy systems
- installation of energy saving bulbs in lighting devices use of energy-saving water equipment for devices that use water ("smart-shower" systems; low-consumption water tanks for toilets; sensor-equipped water pipes and urinals)
- compensation for reactive power by use of compensation batteries
- regulation and control of the lighting system operation (daylight)
- centralization of the heating system and the system for the preparation of hot water for domestic use
- analysis of the heating and cooling system, and, based on need, its replacement by a more energy efficient system (modernization of the existing boiler; installation of a new boiler; change of energy source)
- recuperation of waste heat, waste water, etc.
- replacement or increase of efficiency of the heating system
- replacement or increase of efficiency of the cooling system
- replacement or increase of efficiency of the ventilation and air conditioning system
- replacement or increase of efficiency of the system for preparation of hot water for domestic use
- installation of the central monitoring and management system
- increase of efficiency of the electric installation system and household appliances
- rationalizing the water consumption

- increase of efficiency of the regulation and management system
- establishment of the energy management system

Measures that could be implemented in special cases with intervention on building envelope

- improving thermal characteristics of the external envelope of the building
- insulation of the existing pitched roof, or ceiling below unheated attic, using a thicker insulation layer
- replacement of windows and external doors (recommended U value for windows: 1.1 to 1.8 W/m²K)
- installation of micro switches on windows, which shut down heating or cooling when opening windows
- thermal insulation of facilities, or an upgrade of insulation (walls, floors and roof, as well as surfaces adjoining unheated areas); construction of a windshield at house entrance
- repair and reconstruction of chimneys
- use of renewable energy sources (solar energy, biomass, geothermal energy), for the purpose of heating hot water for domestic use by use of sun collectors, or the production of electricity by photovoltaic cells [2][3]

5.3. EDUCATION ACTIVITIES

One of the fundamental barriers to the implementation of energy efficiency measures is the lack of information and knowledge, and insufficient awareness on the need to protect the environment in which we live. Raising the level of knowledge is therefore one of the most important issues when it comes to the implementation of energy efficiency measures. In the scope of the Programme so far, 4.336 persons from all government ministries participated in various workshops and courses (the Green Office motivation and awareness workshop; course for energy advisors; course for energy management in buildings; workshop for responsible persons; workshop for technical staff). Raising awareness on the need to manage energy through these training endeavours, annual savings for energy and water are expected to be in the range of approximately 68.500 EUR. According to a conservative estimate on the savings that would result from the raised awareness on the need to manage energy, achieved through these training endeavours, annual savings for energy and water are expected to be in the range of approximately 70 thousand EUR. Activities within the Programme envisaged for the forthcoming period foresee education for further 5.000 public sector employees.

5.4. COST-FREE ENERGY EFFICIENCY MEASURES

Cost-free energy efficiency measures are measures that do not require investment costs and they include: changes in employee behaviour, better energy system management, and, for example, the possibility of contracting more favourable tariff models.. Up to now, such measures within the Programme have covered a total of 14 protected facilities, which lead to savings of 74.658 EUR per year. On top of that,

possibility of further savings has been noted in 54 protected facilities, in the range of 119.200 EUR per year.

5.5. MEASURES WITH ADDITIONAL INVESTMENT

Measures that required additional financial investments have also been undertaken within the Programme, such as: energy savings indoor and outdoor lighting and repairmen of water pipelines. For example, the savings achieved by April 2011 on 17 protected facilities with expected savings in the range of 219.200 EUR per year with payback time of 4,7 years. In addition to that, possibility of further savings has been noted in 21 facilities, in the range of 22.000 EUR per year.

5.6. SMART METERING SYSTEM

With the aim to collect data about hourly and daily energy and water consumption in order to be able to analyze and monitor energy performance of buildings, the implementation of smart metering system of energy and water consumption was implemented within the HIO Program. There are 140 facilities covered by this smart metering system, at 20 locations throughout the Republic of Croatia, with the annual expenditure on energy and water in the range of 8.13 million EUR. The investment for the implementation of these measures was 247.000 EUR. Expected annual savings on the basis of the establishment of remote reading of energy consumption are estimated at 10% of the total annual consumption, or 808.220 EUR per year. In the first months of system operation it was observed extreme water consumption in complex of buildings (including some protected buildings). It is expected that after water pipes repairmen financial saving will be 90.000 EUR per year while payback time of this investment will be less than four months.

6. IMPORTANCE OF ENERGY EFFICIENCY MEASURES IN PROTECTED FACILITIES AND OBSERVED ENERGY SAVINGS POTENTIAL

When implementing energy efficiency measures, it is very important to adhere to an appropriate timeline of measures and their application. The installations of thermal insulation in the facility, and the replacement of doors and windows, are measures that provide best results in terms of thermal energy savings, while at the same time increasing the comfort of users. All subsequent measures that can be planned in facilities provide much better results when the external envelope of the building is upgraded. However, in most protected facilities, the insulation of the external envelope from the external side is not possible due to the danger of visual impairment of the building. An alternative would be to install insulation internally, although that approach is less favorable from the physical and construction point of view, because of the need to resolve additional problems, such as the diffusion of water vapor, loss of usable space, the appearance of thermal bridges, etc. In the text that follows, we provide the overview of the situation with protected facilities, together with the overview of perceived opportunities for the application of energy efficiency measures.

6.1. REPLACEMENT OF FUEL OIL AS ENERGY SOURCE

One of the most favorable energy efficiency measures that can provide significant energy and environmental savings is heating fuel oil retrofit. 420 facilities use heating oil as energy source for the heating of 534 thousand square meters of area, and for the preparation of hot water (using approximately 11 million liters of fuel oil per year), and government ministries are spending around 6,2 million EUR for that purpose. The share of protected facilities that are using fuel oil among the aforementioned total of 420 facilities stands at significant 35% using approximately 4,4 million liters of fuel oil while spending 2,4 million EUR.

In the sample of 91 protected facilities that are using fuel oil as energy source for heating, 55% of facilities have boilers older than 15 years. There is potential for savings in these facilities by replacing old boilers (even if not changing the fuel), because boilers using older technology are less efficient, and their efficiency is further diminished over the years of exploitation. In any case, when replacing boilers it is desirable to change a less appropriate energy source with one that is environmentally more acceptable, such as natural gas, if there is possibility to do so.

6.2. ENERGY-SAVING WATER EQUIPMENT

The total annual expenditure for water is 14,2 million EUR for all the 2.375 facilities registered in the register of public buildings. Having in mind the average price of water in the Republic of Croatia, the consumption level is estimated at approximately 6 million m³ per year. For 504 protected facilities for which we had comprehensive data, it turns out that only 11% (or 53 facilities) have some kind of water saving equipment. A mere installation of perlator (aerator) on the existing mixer tap (battery) makes it possible to achieve savings in the range of 40%. The installation is relatively straightforward, and the return on investment period is quite brief – merely a couple of months. Likewise, the installation of water-saving water tanks in toilets can result in halving the consumption of water for that purpose.

6.3. ENERGY-SAVING LIGHTING

The total annual expenditure on electricity for all the 2.375 facilities covered by the register of public buildings stands at 20,8 million EUR, or 175 million kWh_e of annual consumption. The share of electricity needed for lighting stands at around 15%. Among the 403 analyzed protected facilities, in 23% of facilities most of the installed light bulbs are of the classic incandescent variety. A recommended energy efficiency measure for such facilities would certainly be to install energy-saving lighting equipment; however, we need to emphasize that an upgrade of the lighting system would also be needed in most cases, in order to achieve the conditions prescribed by the current norms on lighting quality. Given the fact that the existing systems typically do not fulfill the requirements prescribed by the norms on the quality of lighting, the implementation of this measure would not result in savings of energy and money, but it would nevertheless ensure more appropriate working conditions for users.

6.4. THERMAL INSULATION OF THE ROOF

The analysis of 319 protected facilities has shown that 82% of them do not possess thermal insulation of the roof, or ceiling below the unheated area. When renovating roofs on culture monuments, there is certainly a need to consider the installation of thermal insulation, given the fact that thermal insulation of the roof is a rather simple procedure with major economic benefits. The recommended thermal insulation is a 20-cm thick layer of rock wool, while the payback period is not longer than 5 years.

CONCLUSION

Even though cultural heritage buildings are not under the obligation to obtain energy certificates according to the laws of the Republic of Croatia, nor are they under the obligation to undertake energy efficiency measures, this paper, on the basis of a wide range of collected data and analyses, points to the possibility, and in fact the necessity, of including protected buildings among the buildings that are obliged to engage in energy management, in order to decrease the expenditures on energy and water and CO₂ emissions. Neglect of buildings classified as protected monuments of cultural heritage would have a long-term detrimental impact upon their condition, as well as upon the energy expenditure itself.

Individually protected facilities and facilities within protected cores that are owned and used by the Government of the Republic of Croatia are responsible for the consumption of 229 million kWh of thermal energy and electricity, and for 67,5 thousand tons of CO₂ emissions per year. The Government of the Republic of Croatia is spending approximately 14,4 million EUR per year in order to cover energy and water needs for these facilities.

The establishment of systematic energy management in individually protected facilities and in facilities within protected cores, owned and used by the Government of the Republic of Croatia, would result in an expected decrease of energy and water consumption in the range of minimum 10%, up to 30%. Annually, this would result in a decrease in expenditures in the range of 1,5 to 4,3 million EUR. Consequently, it would be possible to decrease the emissions by 6,7 to 20,1 thousand tCO₂/year.

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