

# **Evaluation and development of energy efficiency measures related to existing public building infrastructure through the application of Austrian technologies in the City of Uzice, Zlatibor Region, Serbia**

## **Abstract**

In the EU buildings are the largest consumer of energy and since many of them are over 50 years old there is still a big shortage of energy efficiency, which really makes them inefficient. The renovation of such buildings has a very high potential of energy savings and the reduction of CO<sup>2</sup> emissions. The EU was the first one to set up binding targets for climate change to reduce CO<sup>2</sup> emissions and create a better future. Consequently, each EU state has to set goals for new energy and climate targets for 2030 with the obligation to establish National Energy and Climate Plans – NECPs. These targets require each member state to define a plan to reduce their greenhouse gas emissions, increase the usage of renewable energies and include more energy efficiency measures. Additionally, it should increase the infrastructure across the borders and make individual markets prepared for new and innovative technologies by boosting research and innovation.

Serbia as an EU accession country has taken several efforts to adapt its policy to EU standards and implement secondary legislation. Although, Serbia has started retrofitting efforts, such as the “Renovating Belgrade Initiative”, overall, the practical implementation of energy efficiency measures is still lacking behind. Additionally, Serbia largely relies on the on an intensive usage of coal as fuel, especially for its electricity production and for heating being the second most important after imported natural gas.

The aim of the project was to identify energy efficiency opportunities for the usage of Austrian Technology in the public building stock in Serbia. To reach this goal the project work covered several perspectives of the opportunity. A theoretical research and analysis has been combined with practical work on 3 selected public buildings in the City of Uzice.

A first step was to evaluate the implementation of the EU Energy Directives. In order to implement these, this study contains research on a variety of Directives regarding their prerequisites, measures, legislation and goals for the future and also next steps for the implementation.

An important part of the overall effort is the analysis of energy efficiency measures related to existing building infrastructure through the application of Austrian technologies. Three different public buildings were analyzed: a theatre, a school and a public swimming pool. Focus of the work was the energy system and the building envelope. The interpretation and comparison of results was based on the energy savings potential, energy requirements, the potential of CO<sup>2</sup> emissions reduction and also economic aspects.

Additionally, the aim was to build an excel tool to calculate different aspects of an energy efficiency investment considering investment amounts and economic success per defined energy efficiency measure. By inserting investment inputs, energy inputs (such as energy prices and CO<sup>2</sup> emissions), this tool is able to calculate a variety of financial and energy efficiency related aspects an investor might be interested in, such as Payback Periods, Annuities and CO<sup>2</sup> changes. It is interesting to see that the same measure might have a different outcome on each building and that there is no general solution for increasing energy efficiency.

The study also describes possible financing schemes and financing sources for energy efficiency investments in public buildings. Additionally, it addresses challenges and barriers in energy efficiency investments, such as the creditworthiness of municipalities, the limited borrowing capacities of local governments or low energy tariffs for consumers.

In relation to energy efficiency measures for public buildings several challenges and barriers have been identified:

- Creditworthiness of municipalities
- Borrowing capacity of local governments
- Restrictive budget regulations
- Low energy tariffs for consumers
- Consumption based billing systems for consumers often missing
- High interest rates and refinancing possibilities for local banks
- High transaction cost
- Further opening of local energy markets needed

The technical evaluation and development of energy efficiency measures have been created as show cases to better understand the typical energy efficiency situation of such buildings. The evaluation included dynamic simulations of the buildings and individual energy efficiency measures have been defined. The defined measures for the buildings included the following:

The Theater Building:

- Wall insulation measures
- Heat Recovery measures (HR)
- Combined heat and power solution (CHP)

- Photovoltaic solutions in 2 sizes (PV)

#### The School Building:

- External Wall insulation measures
- Whole envelope insulation measures
- LED lights change
- Heat recovery measures (HR)
- Photovoltaic solutions in 2 sizes (PV)

#### The Swimming Pool:

- Heat Pump solution monovalent and bivalent (HP)
- Photovoltaic solution (PV)
- Solar Thermal solution (ST)

For the Theater Building all identified measures help reduce the consumption of energy, although a significant CO<sup>2</sup> reduction can only be reached with the CHP and PV measures. This is related to the fact that the building is only used part time and the conversion factor for energy is quite high due to the electricity production out of coal. From an economic perspective only the PV installations would make sense. For the PV installation it needs to be considered that most of the produced electricity needs to be sent to the grid as the peak production during the day does not correspond to the peak consumption in the evenings.

For the School building the defined measures lead to an energy reduction opportunity between 9% and 30%. HR leads to significant savings in heat demand, but they are partly offset by the additional electricity demand. CO<sup>2</sup> reduction opportunities arise from the PV installations due to the high conversion factor for electricity and the envelope insulation measures due to a significant reduction in heat demand. In relation to the PV measures school brake during summer needs to be considered as the building is closed during peak production. From an economic perspective the insulation measures are unattractive due to very low heating cost. Very similar economic results are reached for the other defined measure with a payback period between 16,8 and 19,5 years.

For the Swimming Pool the installation of a heat pump (HP) for low temperature heating of the pool water shows considerable potential for energy savings. Reduction of the CO<sup>2</sup> emissions can be achieved with the usage of a heat pump or the usage of solar energy. However, with the usage of heat pumps the CO<sup>2</sup> emissions would even increase due to the higher electricity demand and high conversion factor for electricity. From an economic perspective all defined measure reach financial feasibility during a 20 years project period with the heat pump installations being most attractive with a payback period after 1,7 and 3,5 years.

For the financing of Energy efficiency measures Serbia has access to certain EU funding sources, such as the Instrument for Pre-Accession Assistance (IPA) IPA Funds, the Western Balkans Investment Framework (WBIF) or the Western Balkans Sustainable Energy Financing Facility (WeBSFF). Additionally, Serbia has taken measures to financially support energy efficiency measures, such as a dedicated amount of EUR4,25 Mio in the federal budget, a Fund for Energy Efficiency (BFEE). On the other hand it has also regulatory measures such as the introduction of an ESCO law.

Due to the current COVID pandemic travelling has not been possible. Therefore, to transfer the know-how of this study, several webinars with different stakeholders have been organized and held. One technical workshop was held for building managers in the Zlatibor region. Additionally, for sharing the results of this study and providing a platform for Austrian companies and Serbian representatives two workshops were held for local representatives in Zlatibor and also for interested Austrian companies, investors and official representatives. The event for Austrian companies was organized in cooperation with the WKO Office in Belgrade.

For anyone interested in the project and roll-out of the following energy efficiency study the results, as well as the excel calculation tool and contact information, has been published on the website of SA Consulting at [www.s-a-consulting.com/energy\\_efficiency\\_zlatibor](http://www.s-a-consulting.com/energy_efficiency_zlatibor).

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