TECHNICAL REPORT ON NZEB PILOT ACTIONS

Deliverable D.T3.4.5

Final

12 2020

The eCentral project summary

Addressing poor energy performances of public buildings is at the core of EU's Energy Efficiency Directive and Energy Performance Building Directive but also one of growing financial issues in Central European countries. To address that eCentral project will support key stakeholders to realize benefits of newly implemented building standard – nearly zero energy building (nZEB). eCentral project will prove that nZEB approach, although innovative, is optimal and cost-effective solution for renovation and construction of public buildings. Project aims to capitalise on results of previous and ongoing EU initiatives. Austria has a proven track record with nZEB renovation projects and will be leading other implementing partners (CRO, SLO, HUN) by example. Transnational cooperation will be used to receive maximum international visibility of selected pilot actions. Main outputs of the project are:

- energy performance certificate (EPC) Tool for public authorities
- deployment and promotion of innovative financing schemes
- training programme and project development assistance for nZEB projects
- building renovation strategies for selected regions
- state of the art pilot nZEB public buildings in selected regions
- established cooperation with scientific institutions and other nZEB initiatives

Transnational Assessment and Support Group, formed from project experts and scientific institutions will act as a support team and provide quality checks of each output. EPC Tool will be developed and used by public sector decision makers and project developers beyond eCentral project lifetime. Trained energy efficiency teams within the regional government will serve as a backbone for conducting future nZEB projects. The European Academy of Bolzano (EURAC), one of the leading centres of expertise on energy efficiency in the Central Europe region, will focus on policy analysis and dissemination of eCentral project results.

About this document

This document is part of workpackage T3, named D.T3.4.6 Technical report on nZEB pilot actions. The report provides a recapitulation of technical aspects of pilot actions which were conducted in three pilot counties: Croatia, Slovenia and Hungary. The following partners were responsible for development of this report:

- Croatia – City of Sveta Nedelja, Municipalities of Marija Bistrica and Stupnik (supported by REGEA)
- Slovenia – Municipality of Velenje (supported by KSSENA)
- Hungary – 18th District of Budapest (supported by Energiaklub)

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1. Introduction

eCentral pilot actions serve to test applicability of three innovative financing models: energy performance contracting, public-private partnership and crowdfunding on projects which require (re)construction of public buildings in accordance with the nearly zero energy standard. nZEB standard can be reached with different types of technologies and equipment and leaders of pilot actions were required to find cost optimal solutions for reaching this standard and to demonstrate its long term cost-effectiveness.

Due to the different types and stages/results of pilot actions the report covers technical data retrieved from three phases of their development:

1. Conceptual phase – feasibility study
2. Main project design
3. Monitoring and verification of (re)constructed building

Technical differences between these three project stages were recorded, including reasons for changes of equipment and development approaches. Since not all pilot actions have reached the third (final) stage of development, projections for further expected development was given. In cases where building has not reached an nZEB standard a proposition on additional technical interventions which are needed for it to become one were made.

2. Country overview

2.1. Renovation of Ljudska univerza – Lifelong learning centre in the Municipality of Velenje

2.1.1. Initial condition of the building

The lifelong learning centre is a local institution established to educate adults and it operates only in the interest of the public. The building was built in 1959 and since then, it was always used only for educational purposes. The basic purposes of the rooms and spaces did not change during the years, only certain spaces were trend renovated or modernised. The owner of the building is the City Municipality of Velenje. The building is located at Titov trg 2, 3320 Velenje. The structure consists of a ground floor and two upper floors. A smaller part of the building in which the heating substation is located was originally constructed as a basement. The building houses offices, classrooms, cabinets, toilets and hallways. Learning activities take place throughout the day only inside the building. The exterior walls of the building are built of solid brick and are 45 cm thick. The building has a pigmented façade and part of the facade is lined with brick tiles. Exterior walls were not thermally protected. The roof was flat, covered with roofing felt and was only thermally protected with a thinner layer of older thermal insulation material. Energy-efficient windows with PVC frames, double glazing and external blinds were installed. The entrance door had an aluminium frame and double glazing. Doors leading to the roof were energy inefficient, made with an old wooden frame and just single glazing. The recuperation system was never installed, it was only physically ventilated by opening and closing the windows. The annual average number of visitors revolves around 25,000, and the number of employees averages 20. The ground plan of the building is 24,95 m x 10,91 m. The building has three floors and is 12 metres high. The total surface of the building is 816.60 m^2.

2.1.2. Conceptual phase

The exterior walls were constructed with standard (full) brick with 45 cm of width. The majority of the exterior wall surfaces was covered with pigmented façade render, while a part is covered by brick tiles. There was no thermal insulation present. It was estimated that by applying thermal insulation (recommended EPS for the walls and mineral wool for the roof) the energy use could have been decreased by 25% and 20% respectively (a total of 40% from considering absolute required energy). Concerning past prices and materials as well as a rough estimation of required insulation, and not considering any unforeseen expenses, the EE measures would have been required at least EUR 70.000,00 to be implemented. The measure would decrease the required heat supply by about 40.800 kWh annually (from 102 MWh to about 61 MWh per year). In terms of primary energy, this would decrease the required amount by about 49 MWh. After the renovation measure, the building would have an estimated energy number of 75 kWh/m^2a for heat or a combined energy number of 105 kWh/m^2a. This would represent the starting scenario on which additional measures could be developed. The majority of building fixtures installed on the building meet the current requirements on energy efficiency. The windows have energy efficient PCV frames with double-glazing and integrated exterior shading element to reduce solar heat gains. The main entrance door is made of an aluminium frame with double glazed panes of glass. Some components would need to be refurbished, like the doors leading to the roof are energy inefficient with a wooden frame and single glazing. The effect on the overall investment is unknown, while the impact on the reduction of energy is estimated to be negligible. The building was provided with heat from a heating substation of the local district heating system. The system had a single heating circuit with heating elements (about 50% are rib-line traditional radiators and 50% newer more efficient panel radiators) located under windows. No thermostatic valves were installed. The heating system was insufficiently insulated in non-conditioned quarters. The proposed measures would include hydraulic balancing of the heating system, insulation of distribution pipes and installation of thermostatic valves. Advanced regulation of the heating system (an adaptation of the heating requirements concerning the profile of usage) would be considered. The building's interior was cooled by individual air conditioning systems with no regulation or central oversight. The cooling requirement should have been considered alongside ventilation and recuperation. There was no ventilation system in place. Due to increased airtightness caused by the additional thermal insulation, a centrally managed recuperation (waste heat recovery) system would be considered. The lighting system was mostly comprised of energy inefficient fluorescent lamps with traditional ballast and reflective raster. Energy-efficient lamps, mostly CFLs, represent about 5 % of lighting. The proposed measures would include the substitution of inefficient ballasts with electronic ones or changing the technology to LED entirely (depends on the economic feasibility). Furthermore, the regulation of the lighting system with motion sensors (particularly in hallways) and automatic shut-off switches when the building is not in use will be considered. Sanitary hot water was prepared centrally from the energy of the district heating system. Regulation (matching preparation of hot water with actual requirements) was not up to date. Optimizing the heating profile would be considered. The renovation of the boiler room was not economically feasible (for example instalment of micro co-generation units). Therefore, to increase the share of renewable energy and offset additional demand (foreseen) for electrical energy due to the instalment of the recuperation system the development of a PV power plant would be considered. The estimated installed power would reach 11 kWp, which would produce about 12 MWh yearly (projected 1200 working hours at 100% nominal capacity) and would be contacted to the grid (net metering). The production from the PV power plant would offset more than 55% of the current electrical energy demand.

2.1.3. Main project design

The roof has been completely renovated. A vapour barrier in the form of a geotextile with a weight of 300 g / m^2 was placed on the plate. It is followed by two layers of insulation, 16 cm EPS with thermal conductivity of 0,034 W/mK and 6 cm XPS with the same thermal conductivity. On top of both layers, a multi-layer PVC synthetic sealing foil was laid, which ensures the waterproofing of the roof. A solar power plant was installed above the foil on aluminium construction. The building now has energy-efficient windows with PVC frames, double glazed and external blinds (patches). The entrance door has an aluminium frame, double glazed and an updated interrupted thermal bridge. Doors leading to the roof are energy efficient, made with PVC frame and double glazing. All inefficient joinery was replaced or repaired. A small photovoltaic power plant is installed on the roof. The installation is now carried out with the help of an aluminium load-bearing structure. A small photovoltaic power plant is made of photovoltaic modules made of multi-crystalline silicon. The total number of modules installed on the roof is 54. The modules represent a photovoltaic generator with a total power of 16.74 kWp. The electrical voltage converted by the module is direct current. A module consists of several cells that are connected in series. As mentioned for the photovoltaic power plant, BISOL BMO-310 photovoltaic modules are used, which operate at a maximum power of 310 Wp. One module consists of 60 cells tied in the series. The installation of the modules on the roof was carried out with the help of standard brackets adapted for photovoltaic modules, which, given that the roof is flat, have the option of mounting by correcting the installation angle. Thermostatic valves with a thermostatic head are now installed on all radiators. Organizational measures were taken. Employees were taught about energy efficiency and parallel behaviour. The lighting in the building was made with lamps of different powers and designs. Lighting is now energy efficient. 99 lamps are now lit by LEDs. 54 installed LED bulbs shine with a power of 33 W, 15 installed LED bulbs shine with a power of 12 W and 30 installed LED bulbs shine with a power of 17 W.

2.1.4. Monitoring and verification of reconstructed building

As part of the inspection, independent experts made several physical visits to the building. The measures were very well implemented, in addition to energy measures, other renovation measures were carried out to beautify the interior appearance of the building and ensure the good appearance and well-being of employees. Due to its educated staff, KSSENA can carry out energy accounting, monitor and further measures. All data obtained in the field and through the accounting of the Lifelong Learning Centre building are collected in the E2-MANAGER portal, which is specially adapted to satisfy the needs of energy accounting and data collection, with which we can also express and extract various energy indicators. KSSENA is also, as a local energy agency, in constant contact with the owners and management of the building. Several annual organisational measures are being implemented to continue teaching employees about energy efficiency, including the installation of physical graphic images of energy behaviour placed throughout the premises.

2.1.5. Conclusions and next steps

The building was renovated according to the nZEB standards. Both organizational and investment measures were proposed by energy experts. Due to the lack of funds and additional requirements of the renovation of the Institute for Cultural Heritage of Slovenia, the facade was neither insulated nor innovated. The Lifelong learning centre falls under the protection of monuments, so all different looks of the exterior, ought to be approved by the Institute for Cultural Heritage of Slovenia. Talks with the Institute are already underway, and the facade will be arranged according to its instructions so that the building will remain under monument protection. Due to a lack of funds and the long payback period, the recuperation system is still not installed. Funds for the recuperation system and the facade are already being raised. The building is otherwise very energy efficient. However, when the last two measures proposed (facade renovation and installation of a recuperation system) are implemented, the building will meet the zero energy conditions of the building. Even now, the building, thanks to a perfectly functioning solar power plant, provides its own electricity, which already saves a lot of money.