REVERTER

Brezovo, Bulgaria

Roadmap III (2024)

Social Buildings in Brezovo

Co-funded by the European Union

Area characteristics

The municipality of Brezovo is located in the transitional-continental climate zone - warm summers and mild winters are present. Average January temperatures are positive, while average July temperatures vary between 22-24 °C. Precipitation has a pronounced autumn-winter maximum. The annual amount is about 500 mm/m^2. The prevailing winds are westerly with an average annual speed of 1.1 m/s.

Characteristic for the western parts of the climatic region of Eastern Central Bulgaria, where Brezovo is located, are the mild winter with frequent warming under the influence of Mediterranean cyclones and the protective effect of Stara Planina in relation to the invasions of cold continental air, as well as hot summer with a small temperature amplitude and relatively low relative air humidity.

Seasonal precipitation amounts in the area almost equalize, with the maximum often occurring in spring and autumn, which indicates a transition to a Mediterranean-continental climate regime, more pronounced in the southern parts of the municipality. Under the influence of warm air masses the winter is warm and mild. As a result of the rapid rise in temperatures at the end of winter, spring starts early. The average temperature in October is 2-3 °C higher than in April. The average annual temperature is 12.5 °C, and the average January temperature is 0.2 °C. The average daily temperature at the beginning of March exceeds 5 °C, and at the beginning of April it is 10 °C.

- The average annual air temperature is 11.4 °C.
- The average annual maximum air temperature is 16.9 °C, and the minimum is 5.7 °C.
- The average monthly air temperature is 11.2 °C.
- Average monthly relative air humidity is 74%.

Precipitation depends on the characteristics of atmospheric circulation, altitude and landforms.

Population characteristics

According to data from Census 2021, Brezovo Municipality has 16 settlements with a total population of 6170 inhabitants. Of these, 1,604 people live in the city of Brezovo, and the remaining 4,696 live in the surrounding villages. The predominant ethnic group is Bulgarians. There is a total of 3,241 people of working age, of which 1,839 are men and 1,402 are women. The reduction of the population in the last 10 years is clearly outlined. In numbers, it has decreased in 2021 from the previous national census in 2011 by 1128 people or 15.4%.

The conclusion of the analysis of the population census by age is that the population is ageing. The highest number of the population is occupied by people over 70 years.

The conclusion of the analysis of the population census by age is that the population is ageing. The trend in population dynamics is characterized by a decrease in the population and, respectively, the number of households.

According to the Municipal action plan for the period 2021-2023, the Municipality of Brezovo has an unfavorable socio-demographic structure. The plan states that unemployment among the able-bodied population in the municipality is 20%. This is an important economic and social problem, which probably affects many spheres of life of the people in the municipality. According to the plan, only three people found work through the Regional Employment Program. This fact may indicate limited opportunities for employment and economic development in the region, which may be a challenge to increase employment. Based on Eurostat indicators, about 30% of the population in the municipality are below the poverty line.

Housing characteristics

The first building - a family-type accommodation center - is a residential-type social service that provides a living environment for the full growth and development of children deprived of parental care, for whom, at the time of placement, the possibilities of returning to the biological family, placement with relatives have been exhausted and relatives or foster family.

The second building is a family-type accommodation center in Zelenikovo which offers also individual daily care, medical supervision and psychological support for children deprived of parental care.

The two buildings accommodate a total of about 25 residents.

The energy demand of the two Social buildings, which are analysed in the present Roadmap, is presented in Table 3.

Table 3. Calculation of final and primary energy consumption and CO2 emissions in Social buildings.

	Heating source	Heating energy	Electricity	Total final energy consumption	Primary energy consumption	Heated area	Specific consumption	CO2 emissions generated	Specific emissions
		MWh	**MWh**	**MWh**	**MWh**	**m^2**	**kWh/m^2**	**t/y**	**kg/m^2**
Orphanage for vulnerable people in Brezovo	Electricity	0,0	34,0	34,0	85	240	141,7	27,8	116,0
Social house for children in Zelenikovo	Gas oil	61,9	28,1	90,0	138,34	406	221,7	39,5	97,4
Total		61,9	62,1	124,0	223,34		181,7	67,4	

Energy poverty status

As shown in **Error! Reference source not found.**2, the share of population living in a dwelling with leaks, damp or rot in the area of the Bulgarian pilot is higher than the national share (almost by 1-2%). The same is true for the share of population not able to keep home adequately warm. However, the difference decreases over the years (i.e., from 8.9% in 2017 to 1.5% in 2021). In contrast, the share of population having arrears on utility bills is lower in the pilot area compared to the national indicator. Again, the difference decreases over the years (i.e., from 10.3% in 2019 to 3.1% in 2021). In general, it appears that the consensual EP indicators in the pilot area are approaching the corresponding national indicators over time and, as is the case nationally, are improving.

- After an increase in 2018, all EP expenditure indicators decline steadily. The same pattern is observed in the consensual-based EU SILC indicators.
- According to the Low Expense, High Expense and "25% threshold" indicators, the share of population facing EP problems is around 15%, on average. The "10% rule" seems to overestimate the EP problem (more than half of the population is characterised as EP).
- The EP levels in the area of interest, i.e., the Brezovo pilot, are higher than the national averages for all four indicators by around 11% (for the "10% rule" indicator) to more than 75% (for the Low Expense indicator).
- The gap between the pilot area and the national average is gradually narrowing for three indicators, i.e., "10% rule", High Expense and "25% threshold". Nevertheless, the gap increases for the Low Expense indicator, i.e., from 55.6% in 2019 to 76.2% in 2021.

Willingness to participate in energy retrofit actions

The vision of the Brezovo building renovation roadmap is based on renewed and decarbonized building stock by 2050, which provides a high quality of life in a healthy, safe, energy-efficient, modernized and high-tech living environment, based on a complex of linked factors, such as active participation of users for the efficient use of energy, management of energy production and consumption in the building and professional management of the building stock. The roadmaps should ensure a modern, up-to-date and cost-effective regulatory framework by introducing the "Energy Efficiency First" principle.

In order to achieve a high degree of energy efficiency and decarbonization of the existing housing stock, it is necessary: (1) to limit energy needs, by improving the energy characteristics of the external building elements and the systems for ensuring the microclimate; (2) more of the required energy to be produced from sources with low CO2 emissions (renewable energy).

Three different combinations of energy-efficiency and RES interventions were examined for the three types of buildings. More specifically, the following renovation options were modelled and analysed (Table 4).

Table 4. Examined combinations of energy efficient and RES interventions for Social building.

	O1	O2	O3
Walls	Walls are insulated with a 50mm thick layer of mineral wool insulation with a heat conductivity rating of $\lambda \leq 0.039$ W/mK.	Walls are insulated with a 120mm thick layer of mineral wool insulation with a heat conductivity rating of $\lambda \leq 0.039$ W/mK.	Walls are insulated with a 150mm thick layer of mineral wool insulation with a heat conductivity rating of $\lambda \leq 0.039$ W/mK.
Roof	Roof is insulated with a 100mm thick layer of rigid mineral wool insulation boards with a heat conductivity rating of $\lambda \leq 0.039$ W/mK.	Roof is insulated with a 150mm thick layer of rigid mineral wool insulation boards with a heat conductivity rating of $\lambda \leq 0.039$ W/mK.	Roof is insulated with a 200mm thick layer of rigid mineral wool insulation boards with a heat conductivity rating of $\lambda \leq 0.039$ W/mK.
Basement	The building plinth is additionally insulated with a 50mm thick layer of XPS with a heat conductivity rating of $\lambda \leq 0.036$ W/mK, at least 500m below grade level to ensure insulation layer extension below ground freezing layer.	The building plinth is additionally insulated with a 100mm thick layer of XPS with a heat conductivity rating of $\lambda \leq 0.036$ W/mK, at least 100mm below grade level to ensure insulation layer extension below ground freezing layer.	Unheated basement ceiling is insulated with a 100mm thick layer of mineral wool insulation with a heat conductivity rating of $\lambda \leq 0.046$ W/mK. The building plinth is additionally insulated with a 100mm thick layer of XPS with a heat conductivity rating of $\lambda \leq 0.039$ W/mK, at least 100mm below grade level to ensure insulation layer extension below ground freezing layer.
Doors	All old wooden staircase entrance doors are changed with insulated metal doors with a U value of 1.40 W/m^{2}K	All old wooden staircase entrance doors are changed with insulated metal doors with a U value of 1.40 W/m^{2}K	All old wooden staircase entrance doors are changed with insulated metal doors with a U value of 1.40 W/m^{2}K
Windows	All old wooden windows are changed with triple glazing windows in PVC frame with a combined U value of 1.1 W/m^{2}K	All old wooden windows are changed with triple glazing windows in PVC frame with a combined U value of 1.1 W/m^{2}K	All old wooden windows are changed with triple glazing windows in PVC frame with a combined U value of 1.1 W/m^{2}K
Technical systems	-	-	New A2A heatpump is installed; SCOP > 3.35 W/W

The analysis led to the following results as presented in Table 5 in regards the calculation of two different indicators for their comparative analysis.

Table 5. Results of the examined energy efficiency and RES interventions.

Cost effectiveness based on the final energy savings (€/kWh)	Social buildings
O1	1.10
O2	1.13
O3	1.81
Cost effectiveness based on the CO_2 emission reduction (€/kg CO_2)	**Social buildings**
O1	4.34
O2	4.47
O3	6.18

On-site visit and expert assessment of the two social housing buildings in Municipality of Brezovo, established the need and possibility for deep renovation of the buildings. An analysis was made of the enclosing structures and the available joinery, the condition of the heating installation and the existing heat source.

Based on the inspections, an analysis was made of the possibilities for:

- energy saving by building envelope renovation
- transition from liquid or solid fuel (raw biomass) to modern and effective heat pump heating;
- introduction of RES source – roof PV installation and solar collectors for DHW.

The assessment of the impact of the measures is presented in Table 6.

Table 6. Assessment of measures for Social buildings.

Measure	Final energy savings (MWh)	CO_2 emission savings tCO_2/MWh	Total investment per building (€)
Energy saved from heating optimization - from deep renovation (60% savings)	74.4	20.69	412867.1
Energy saved from the introduction of RES in buildings - photovoltaics and solar-thermal installations - 70% of the annual consumption is from PV	43.47	21.13	
Total	**117.87**	**41.81**	
Final energy savings per building	58.94		
Primary energy savings per building	155.74		

Renovations triggered by REVERTER

REVERTER is expected to contribute to the renovation of the two social buildings in the Municipality of Brezovo in the period of five years after the completion of the project (2026-2030) through the establishment and operation of the physical and digital one-stop shops, visits to homes of energy-poor households by REVERTER Ambassadors who will inform them about energy renovation issues and the awareness-raising and training activities to reinforce the existing level of knowledge of the energy poor households. The social events, organised by the project, are attended not only by citizens and residents of the buildings but also by representatives of the local government, who receive new knowledge related to energy efficiency, RES and energy management. Also, useful information for decision-makers is regularly updated on the digital One Stop Shop.

The contribution of REVERTER project, including post-project period, is summarised in Table 7.

Table 7. Contribution of REVERTER project to the implementation of the specific roadmap for the renovation of the two social buildings in the period 2025-2030.

Impacts	Energy poor households
Number of renovated buildings	**2**
Resulted cumulative final energy savings (GWh)	0.118
Resulted cumulative primary energy savings (GWh)	0.311
Resulted cumulative CO_2 reduction (ktn CO_2)	0.042
Resulted employment impacts (person-years)	12.8
Resulted cumulative multiple benefits (million €)	0.0025
Required new investments (million €)	0.826

The REVERTER project

The REVERTER stands for Deep REnovation roadmaps to decrease households VulnERability to Energy poveRty. The REVERTER project is funded under the LIFE Programme with under the Grant Agreement No 101076277.

9 Roadmaps

The roadmaps are tailor-made to the characteristics of the building stock, the characteristics of the vulnerable households and the climate conditions, to cover a sufficiently cohesive group of cases that will allow for a larger-scale rollout and replication of the proposed actions for the effective analysis and tackling of the problem. The roadmaps will target the worst-performing homes first ("worst first" principle), will cope with split-incentive dilemmas and will address market, information and behavioural failures through the creation of "one-stop shops" (OSS) in 4 countries as defaults for the enrolment of vulnerable households in subsidised energy efficiency improvement programmes for buildings.