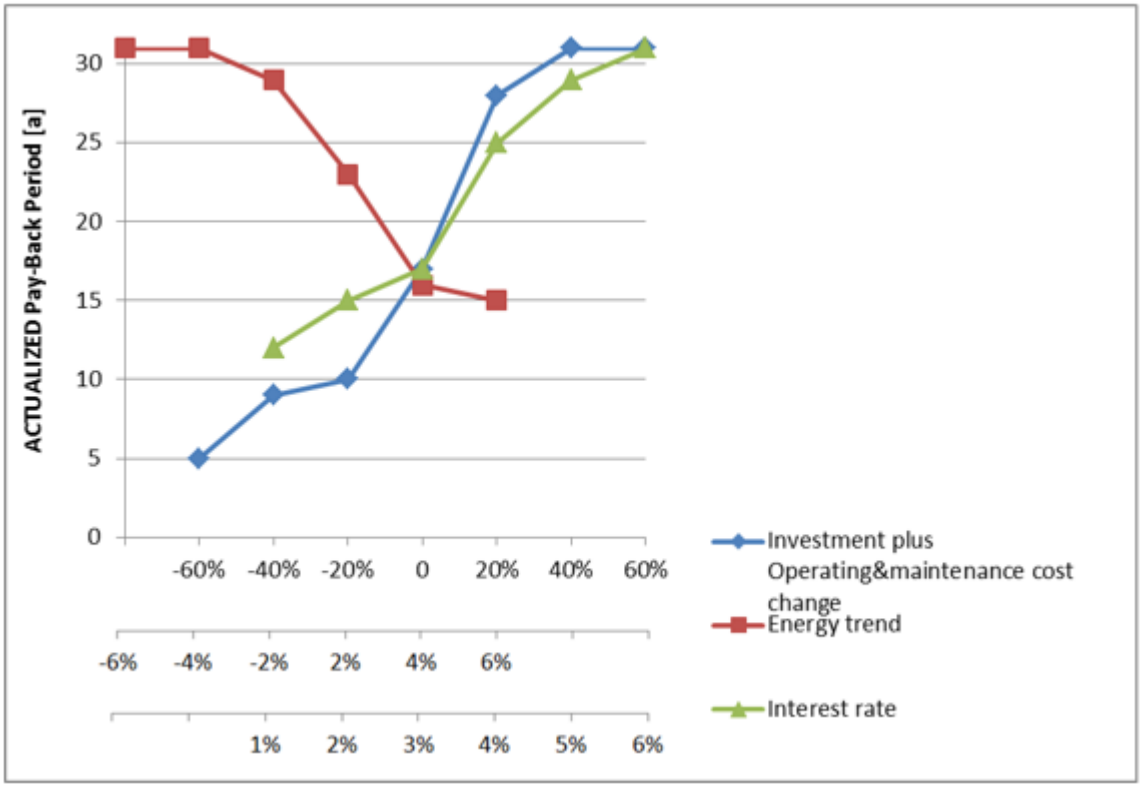
RePublic_ZEB
ZEROING IN ON ENERGY

Co-funded by the Intelligent Energy Europe Programme of the European Union

EXECUTIVE SUMMARY:

SENSITIVITY ANALYSIS



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RePublic_ZEB Project

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Website: www.republiczeb.org

Project consortium

BME	WP3 Leader
BRE	WP6 Leader
BSERC	WP2 Leader
CRES	Partner
CTI	WP1-WP7 Leader Coordination
EIHP	Partner
URBAN-INCERC	Partner
IREC	Partner
LNEG	WP5 Leader
MACEF	Partner
POLITO	WP 4 Leader
ZRMK	Partner

Project overview

The RePublic_ZEB project is focused on the energy and CO_2 emissions associated with existing public buildings and their refurbishment towards nZEB.

The **core objective** of the project is to:

- Define costs-benefit optimized "packages of measures" based on efficient and quality-guaranteed technologies for the refurbishment of the public building stock towards nZEB that are standardized and adopted by builders and building owners.

From this stems three **basic objectives:**

(i) State-of-the-art assessment of the public building stock through a country-specific evaluation of the energy consumption and CO_2 emissions;

(ii) Define reference buildings; and;

(iii) Develop a common framework and a harmonized methodology for the definition of a nZEB concept for public buildings.

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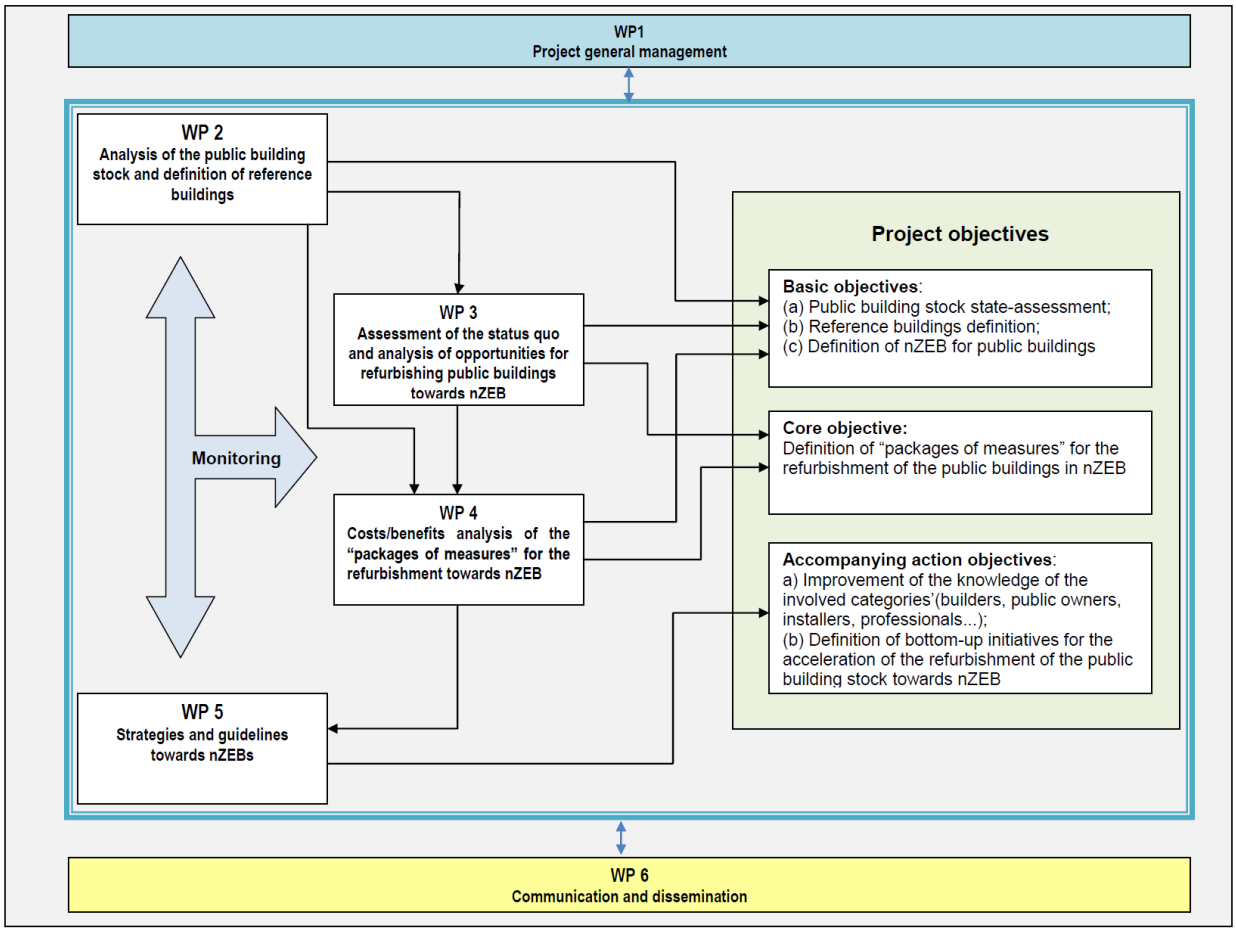
Legal Notice

Executive Summary

This document is one of a series of executive summary of the core deliverables of the RePublic_ZEB project. This is a summary of the fourth deliverable in Work Package (WP) 4. The flow chart below shows its context in the overall project.



1. Objective

The objectives of this report are to:

- undertake a sensitivity analysis on the nZEB packages of measures identified for each reference building
- identify the impact of the key parameters on the drive to refurbish the public building stock towards nZEB.

2. Approach

The previous report identified, for each reference building, the most suitable packages of energy efficiency measures in order to achieve the nZEB goal. These were defined in terms of:

- energy performance;
- Renewable Energy Ratio, RER;
- global cost (GC), broken down in terms of investment, operating and maintenance, energy;
- actualized pay-back period;
- CO_2 emission.

The project partners identified that the main parameters affecting the choice of a package of measures were economic. Although technological parameters (e.g. thermal conductivity of insulating materials, g-value of glass, efficiency of heating/cooling generators, etc.) can affect the choice of a package of measures, their final impact is a cost reduction in terms of investment and energy costs. The sensitivity analysis therefore focussed on:

Parameter	**Initial conditions**	**Sensitivity analysis**
Investment plus operating and maintenance costs	0% change	Change in values from -60% to +60%
Energy cost	4% energy trend applied to all energy sources in the period 2015 to 2023	-6% to +6% energy trend applied to all energy sources in the period 2015 to 2023
Real interest rate	3% real interest rate	Change in value from 1% to 6%

The results were presented as graphs in terms of the change in global cost (ΔGC) and actualised pay-back period (PBP_{act}) for each nZEB package. Three abscissa axes are shown, one for each economic parameter with the trends intersecting at the initial conditions.

The aim was to determine the range of conditions that makes a package of measures cost-effective (i.e. $\Delta GC<0$) and sustainable in terms of return of the investments (i.e. PBP_{act} around 5-10 years). The analysis aims at identifying the economic boundary conditions that can drive refurbishments towards the nZEB target.

The main report contains an extensive range of graphs and supporting observations for each reference building in each partner country which are helpful at a national level. Figures 1a and 1b overleaf show the example of a Croatian office in a continental climate.

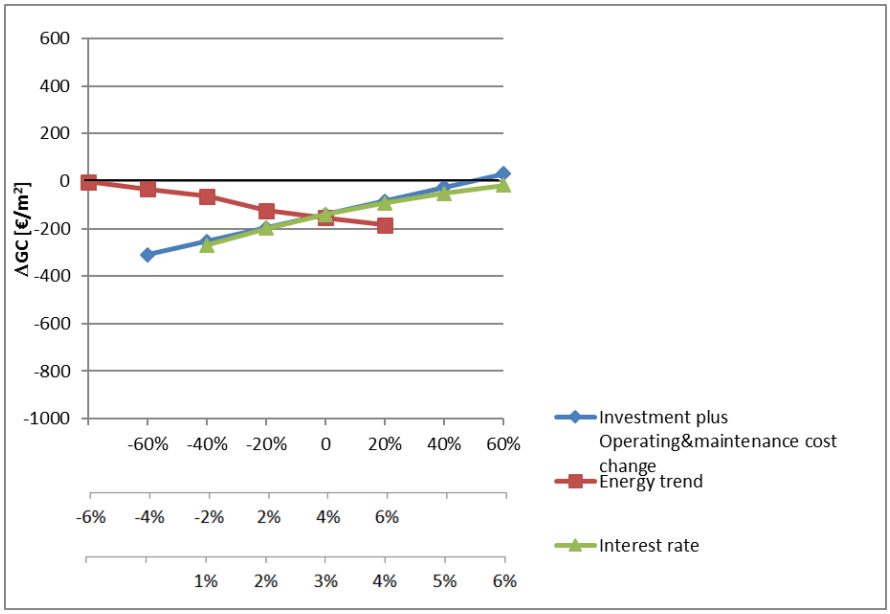


Figure 1a. Sensitivity of Global Cost to changes in economic parameters for an nZEB package for a Croatian office (Continental climate)

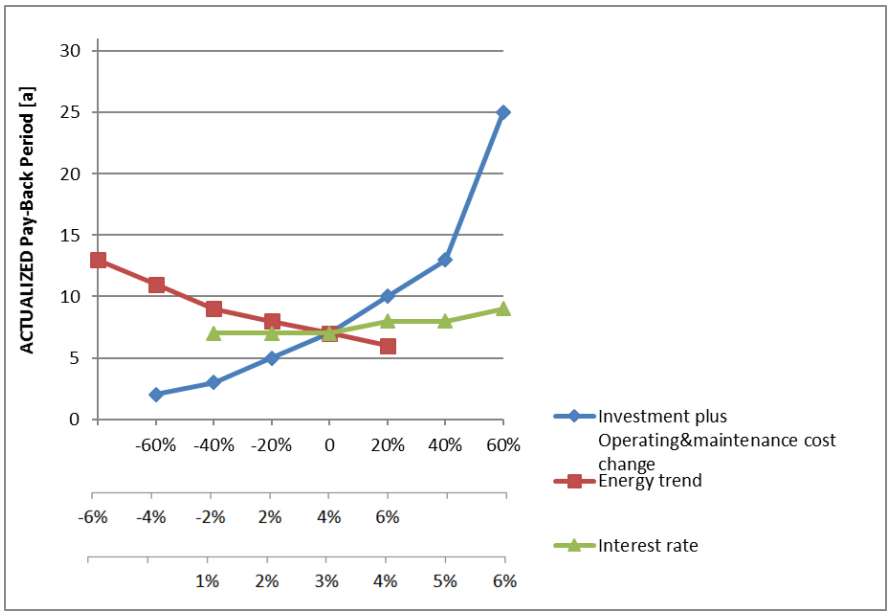


Figure 1b. Sensitivity of Payback to changes in economic parameters for an nZEB package for a Croatian office (Continental climate)

3. Findings

Table 1 summarizes the results of the sensitivity analysis for each country. Each parameter is categorized as:

- ++ **very effective**, when a change in it produces a very significant variation in the actualized pay-back period and/or global cost;
- \+ **effective**, when a change in it produces a significant variation in the actualized pay-back period and/or global cost;
- – **ineffective**, when a change in it produces little variation in the results.

	Reference building	ΔGC			PBP_{act}		
	Use	Investment operating maintenance costs	Energy trend	Interest rate	Investment operating maintenance costs	Energy trend	Interest rate
BULGARIA	Student hostel	+	++	+	++	++	++
	School	+	++	+	++	++	++
	Office	+	++	+	++	++	++
	Hospital	+	++	+	++	++	++
CROATIA	Office continent	+	+	+	++	–	–
	Office coast	+	+	+	++	–	–
	Educational continent	++	+	++	++	–	–
	Educational coast	++	+	++	++	+	+
FORMER YUGOSLAV REPUBLIC OF MACEDONIA	Office						
	School						
GREECE	School	++	++	++	++	++	+
	Office	++	+	++	++	++	++
HUNGARY	Office	–	–	–	++	+	++
	Kindergarten	+	+	+	++	+	+
	Student hostel	+	+	+	++	–	–
ITALY	Social housing	–	–	–	–	–	–
	School	++	–	–	+	–	–
	Office	+	+	+	++	++	++
PORTUGAL	Social housing	–	–	–	+ +	–	+
	Office	+	–	–	+ +	+	+ +
ROMANIA	Office	+	–	–	+ +	+	–
	School	+	–	–	+ +	+	–

	Reference building	ΔGC			PBP_{act}		
	Use	Investment operating maintenance costs	Energy trend	Interest rate	Investment operating maintenance costs	Energy trend	Interest rate
SLOVENIA	Office	–	–	+	–	+	–
	Kindergarten	–	–	+	–	+	–
	School	–	–	+	–	+	–
	Health-care facility	–	–	+	–	+	–
	Home for elderly people	–	–	+	–	+	–
SPAIN	Office	+	–	–	+	–	–
	Hospital	++	+	+	++	+	+
UK	Victorian Office	++	++	+	++	++	+

Table 1. Summary of sensitivity analysis for each reference building

The cross-country comparison shows that the economic variables that have the greatest impact on the variation in the global cost are the investment and the operating/maintenance cost. These are the costs for the use, application and management of the technologies needed to transform the building into a nearly zero-energy one.

Generally speaking, a decrease in the energy cost reduces the differential global cost; in many cases this reduction allows a retrofit solution to become cost-effective.

In addition, a decrease in the interest rate generally yields a reduction in the differential global cost. The exception to this is when the retrofit running costs for the building are higher than those for the building in its current state: in this instance the differential global cost decreases when the interest rate increases. This situation is almost unique amongst the cases analysed.

In conclusion, in order to effectively promote the refurbishment of the building stock into very energy efficient buildings, it is extremely important to have financial support from municipalities in conjunction with central governments to provide grants, low interest loans, tax breaks and other subsidies. Moreover, smart management contracts for nZEBs are recommended to reduce the impact of the operating and maintenance costs on the global cost.