Interreg
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PRO-ENERGY

PROJECT

PRO-ENERGY - PROMOTING ENERGY EFFICIENCY IN PUBLIC BUILDINGS OF THE BALKAN MEDITERRANEAN TERRITORY

Work Package:	5. Pilot actions & Sustainability
Activity:	5.2. Joint cost-benefit analysis modeller
Activity Leader:	Region of Epirus - Regional Unit of Thesprotia
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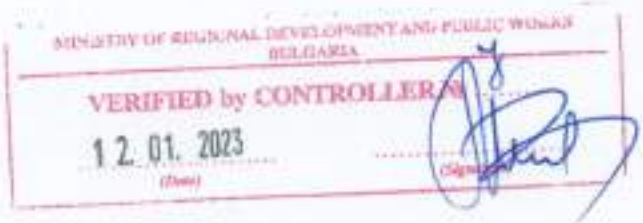
Contribution of the Regional Development Agency with Business Support Centre for Small and Medium-sized Enterprises

Plovdiv

Bulgaria



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IDENTIFICATION SHEET

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1. INTRODUCTION

PRO-ENERGY is a transnational cooperation project, co-financed by the Cooperation Programme "Interreg V-B Balkan Mediterranean 2014-2020", under Priority Axis 2, Specific Objective 2.2 Sustainable Territories. The project aims at promoting Energy Efficiency in public buildings in the Balkan Mediterranean territory and to create a practical framework of modelling and implementing energy investments interventions, through specific ICT monitoring and control systems, as well as through energy performance contracting (EPC). The specific objective of PRO-ENERGY is to reduce by more than 20% the energy spending in public buildings of the participating entities in one year after the implementation of pilot actions.

Based on the above, Work Package 5 (WP 5) "Pilot actions & Sustainability" includes the implementation of pilot actions designed & specified in the Joint Strategy (WP3) & the drafting of a follow-up plan for sustainability of results (pilot actions, trainings) & its consultation with stakeholders. Three types of pilot actions are foreseen:

1) Design & development of an open-source Joint ICT Platform,
2) The design & development of the Joint Cost-Benefit Analysis Modeller (open to all) &
3) The joint preparation of Energy Performance Contracts (open tendering). Pilot actions will valorise results (open to all) of WP3 energy audits on selected buildings.

One public building per area involved will be equipped with smart sensor systems. An integrated cloud-based joint ICT platform will measure & analyse energy consumed at any given period of the day from different sources. Then all data & measurements (available to the wide public) will be integrated & analysed, using specially designed ICT tools, algorithms, data analytics & statistical methods, thus producing the energy consumption profile of each building.

The Activity 5.2 "Joint cost-benefit analysis modeller" aims at supporting decision-making for retrofits, renovations, etc., which lead to increased energy efficiency in public buildings. Retrofits & investments will be planned using the cost-benefit analysis modeller to measure the net present value of energy efficiency interventions. These investments will be implemented outside the PRO-ENERGY project (mostly with the use of energy performance contracting), but their results & impact (energy savings) shall be monitored & measured with the use of the ICT platform.

1.1 Purpose

The present document provides the contribution of the REGIONAL DEVELOPMENT AGENCY WITH BUSINESS SUPPORT CENTRE FOR SMALL AND MEDIUM-SIZED ENTERPRISES - PLOVDIV in the Joint Cost-benefit Analysis tool. The first version of the CBA tool was designed and provided by the Region of Epirus - Regional Unit of Thesprotia to all Project Partners in order to contribute to the final version to be delivered at project level.

The REGIONAL DEVELOPMENT AGENCY WITH BUSINESS SUPPORT CENTRE FOR SMALL AND MEDIUM-SIZED ENTERPRISES - PLOVDIV tested the Cost-benefit tool (version 1) on its pilot building of UARD (UNIVERSITY OF AGROBUSINESS AND RURAL DEVELOPMENT), following the energy audit and the Energy Performance Certificate issued in the previous activities of the PRO-ENERGY.

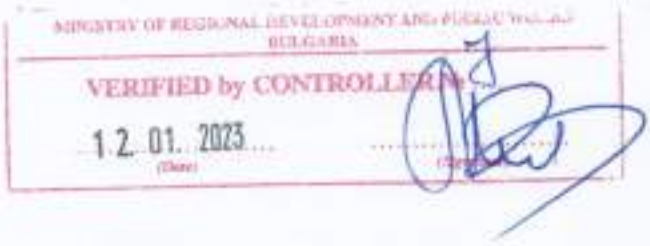
2. JOINT COST-BENEFIT ANALYSIS MODELLER

The tool can be used in two main cases: assessment of the performance of an already existing and operating building and virtual assessment of the energy efficiency of a future building that is currently being designed, built, or renovated. In both cases, the generated data can serve not only as a reference and assessment of the current state of the building, but also as a basis for making decisions about future improvements. Calculations are made based on entered output data for available building systems such as heating, cooling, ventilation, lighting, etc. The assessment begins with the introduction of basic data about the user and the building, as well as a choice of currency in which the potential future investments and their benefits will be measured. The next steps require entering detailed data about the available systems in the building and the levels of automation in them. After entering all the information, the tool can generate a report. The tool has a specialized financial module that allows choosing between different energy sources and entering price information. In this way, if the value of the planned energy efficiency investment and the annual consumption of the building are entered, we will get the time for its repayment and the saved costs in 10 years. This assessment can answer the question: should I invest in a building automation system or what will I lose if I do not.

Of course, this estimate is approximate, especially in financial terms, but it can give a good indicative idea of the potential for increasing energy efficiency.

The cost-benefit analysis modeller (CBA) is composed of the following key features (sheets):

- Cover page
- Operating guide
- Dashboard
- Inputs
- CBA analytics



2.1 Cover page

The cover page acts as the front page of the CBA tool and includes its key information (name of the tool, logos and visual identity, navigation menu, disclaimer, etc.). The cover page provides the key information of the designed tool to the end users.

The cover page also provides the Navigation Menu which will automatically lead the end users to all additional model features (sheets):

1. Operating Guide
2. Dashboard
3. Inputs
4. CBA Analysis

2.2 Operating Guide

The Operating Guide provides a detailed description of the architecture of the cost-benefit analysis modeller. Its acts as the manual prepared containing all operational procedures, instructions and other directives related to the use of the CBA tool. The Operating Guide provides the following information to the end users:

1. **Introduction**

The present sheet includes instructions of how to be used Joint Cost Benefit Analysis Modeller tool, developed within the framework of the PRO-ENERGY project which is co-financed by the Interreg Balkan-Mediterranean Programme.

The CBA Modeller comprises five (5) separate sheets, is coded in Microsoft Excel Windows and is approximately 400 KB in size.

The tool is to be used in order to evaluate energy efficiency projects, both in financial and environmental terms. The project is modelled periodically on a year basis, both for construction and operations periods. All cashflows are assumed to take place at period end dates. An operations period must be inserted at the relevant cell at the "Inputs" sheet in order for the modeller to become operational.

2. Architecture

The CBA Modeller is laid out over five (5) sheets in order to enhance user's convenience and minimize calculations' time.

- Cover: Title page, including disclaimer. It also includes four (4) buttons for navigation to the additional model sheets.
- Operating Guide: The present sheet provides a manual on using the CBA tool.
- Dashboard: A simplified and snapshot presentation of the Key Inputs inserted, the CBA Key results and the Project's Financial Structure. Furthermore, the "Dashboard" sheet presents the main Operating and Investment Flows during both construction and operation periods, concluding to the Free Cash Flow per period examined.
- Inputs: The "Inputs" sheet has mainly to do with data entry. The user must insert its estimations in this sheet.
- CBA analytics: It is a financials output sheet, thus presenting both the occurring financial KPIs of the analysis conducted.

3. Navigation

To aid movement around the model, navigation macros are incorporated in the "Cover" and "Inputs" sheets. Clicking on the options offered, transports the user directly to different locations in the Model.

4. Colour Coding

Data entry cells are yellow. They are located at the "Inputs" sheet and are the only cells which should be altered by a user. Negative amounts are presented in curved brackets (parenthesis) and are highlighted in red coloured text. In case NVP (currency amounts) either/or DSCR (Debt Service Cover Ratio) are negative, the relevant cells are marked in red colour and texting.

2.3 Dashboard

This sheet provides a simplified and snapshot presentation of the Key Inputs inserted, the cost-benefit analysis key results and the project's financial structure. Furthermore, the "Dashboard" sheet presents the main Operating and Investment Flows during both construction and operation periods, concluding to the Free Cash per period examined.

2.4 Inputs

As described before, the present section of the modeller involves the input of data to be analyzed in the next sections. The user must insert its estimations regarding:

- Annual Energy Cost Savings: The estimated annual energy savings to be triggered by the project's accomplishment, in currency terms.
- Total Capital Expenditure: The amount of the total capital expenditures for project's construction, in currency terms
- Subsidy/Grant Amount: The grant to be received for financing the project's construction.
- Debt: The debt % to be used to cover own financing.
- Loan inputs: Interest rate (the loan's interest rate), Maturity years (the loan's maturity period), Loan type, Grace period (if applicable), Total Operating Expenses (automatically calculated the sum of total operating expenses).
- Financial and Fiscal inputs: Inflation rate (according to the national CPI index), Energy inflation rate, Tax rate, Discount factor.
- Environmental Inputs: Reduction in Electricity Consumption (kWh/y), Reduction in Diesel Consumption (kWh/y), Operations Period (the project's estimated operational period in years).

Besides the aforementioned data entry cells, the "Inputs" sheet also incorporates:

1. A presentation of the project's overall financial structure, taking into consideration the information provided by the user regarding the subsidy to be received and the amount of debt to be used to cover own financing. Within this framework, equity is automatically calculated.
2. The loan balance at the end of the grace period as well as the occurring interest, in case such a period is projected, according to the financing institution's term sheet. The aforementioned amounts are automatically calculated. Please note that in case the option of "No" grace period is selected, the amount of the loan balance equals to the total debt amount, while no relevant interest is accruing.
3. A snapshot presentation of the CBA Results regarding financial KPIs, reductions in total energy consumption and reduction of CO2 emissions.
4. Three macros for navigating to the CBA Results' Analytics, Dashboard and Operating Guide sheets.
5. Instructions for data entry in two ways: First, each data entry cell has an advice on filling-in, in excel comment format. Second, a color code is provided for user's convenience.

2.5 CBA analysis

The present section provides a financial output sheet, thus presenting both the occurring financial KPIs of the analysis conducted, as well as Investor's Profit & Loss statement, Investor's Cash Flow statement, Payback Analysis and Debt Service Cover Ratio Analysis. The very analysis takes place under the Discounted Cash Flows investment valuation framework.

3. THE BULGARIAN CASE

3.1 Introduction

Energy efficiency is the goal of every investor, owner or user of buildings amid the trend of increasing energy prices worldwide. Often this understandable drive goes hand in hand with quite unrealistic expectations.

Before we take the first important step towards energy efficiency, we need to know a few things: where are we on the energy efficiency scale, can we improve it and by what means? How much will it cost and how long will the investment pay for itself?

What does energy efficiency depend on?

Let's not forget that the energy efficiency of buildings is a relative concept. The expression itself shows a ratio between consumed energy, the costs incurred for it and the benefits received in return. The latter are individual to each business and building and are the most difficult thing to measure. But the ratio between the first two, other things being equal, can give some idea of where our existing or planned building is on the scale of energy efficiency.

In terms of technology, here are the categories that contribute most significantly to energy consumption and relate to the energy efficiency of the building.

It is evident that the largest and most expensive of these also have the greatest potential for cost savings. However, they are also the ones that are the most static and, accordingly, the most difficult subject to significant renovation and modernization in the direction of energy efficiency. Therefore, with a building already designed or built, the only system that can be integrated and change the energy picture remains the building automation system. If the existing building technical installations allow connection to a building automation system, this can seriously change the game in a positive direction in terms of efficiency.

The present section of the report will provide a use case of the tool by the Bulgarian Partner. The REGIONAL DEVELOPMENT AGENCY WITH BUSINESS SUPPORT CENTRE FOR SMALL AND MEDIUM-SIZED ENTERPRISES will test the CBA tool by creating inputs and will report the final analytics extracted by the tool.

The Bulgarian Partner will use the report from their pilot buildings' energy audits of the UARD (UNIVERSITY OF AGROBUSINESS AND RURAL DEVELOPMENT) building, conducted within the WP3 of the project in order to create their inputs inside the CBA tool.

The monolithic building is with wooden roof structure, vertically supporting structure - framed with brick washers and internal staircase. The building was built in 1948-1949 and it was a nursery and kindergarten and renovated in 2001 with new frame diaphragms. Between the floors, the

slab is concrete. It is in the city of Plovdiv, 4003 Plovdiv, 78, Dunav Blvd. Built-up area: 851 sq./m; Total built-up area: 1421 sq./m

The premises have local air conditioning, which ensures year-round maintenance of the microclimate parameters. Air conditioning heat pump systems, type SPLIT, were installed.

Figure 1: Façade of the building

We will make a comparison between the computer modelling used to estimate the annual energy consumption and an accurate estimate of the energy savings made during the inspection and certification of the building, and the cost-benefit analysis modeller (CBA).

For estimation of the annual energy consumption and accurate estimation for the energy saving during the inspection of the building, related to its certification, computer modelling and simulation of the site is applied, through the software product "EAB software". The program considers the building as an integrated system with one thermal zone consisting of:

- Building structural elements;
- Energy systems;
- Residents and living regime of the building;
- Local climate.

A standard of the building is created, corresponding to the normative requirements, effective for the year of putting the building into operation and the current normative requirements. The

input data of the building are entered, which include climatic data (geographical area), the type of the building, mode of use, characteristics of all enclosing elements with their thermophysical characteristics - heat transfer coefficients.

All geometric data on the facades are entered and generalized information about the building is obtained - the heated area, the area of the enclosing elements, as well as the living regime and the heating regime. The building operates for 8 hours and is used by 147 people, incl. teachers, students and staff.

The technical and economic analysis of the effect of the introduction of the planned energy saving measures was performed with the help of economic software "Financial Calculations" of ENSI at an accepted interest rate of 0.3% and annual inflation of 0.5%.

3.2 Inputs

The data entered in the CBA tool were based on the energy upgrade scenarios suggested in the energy audit. According to the Energy Performance Certificate of the pilot building the inputs for the Cost-benefit tool are being described in the following table:

CBA Inputs	UARD Building
Annual Energy Cost Savings (euro)	626
Total Capital Expenditure (euro)	5113
Subsidy/Grant Amount (euro)	-
Debt (%)	-
Interest Rate (%)	0.3%
Maturity (years)	-
Grace Period (years)	-
Maintenance Costs (euro)	0
Staff Costs (euro)	0
Managerial Costs (euro)	0
Insurance Costs (euro)	0
Other Expenses (euro)	-
Inflation Rate (%)	0.5%
Energy Inflation Rate (%)	-
Tax Rate (%)	-
Discount Factor (%)	0
Operations Period (years)	19

Table 1: Inputs on the CBA tool

3.3 CBA Analytics

Proposals	UARD Building
NPV (€)	6781
IRR (%)	10.36
Payback Period (years)	9
DSCR (average)	N/A

Table 2: Results on the CBA tool

All the above data were extracted from the CBA tool provided (Annex 1 & Annex 2).

UARD Building Analytics

Investor's P&L																	
Revenues																	
Energy Cost Savings	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626
Operating Expenses (OpEx)																	
Maintenance Costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staff Costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Managerial Fees	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insurance Costs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Expenses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total OpEx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EBITDA	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626
Total Depreciation	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
EBIT	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357
Total Interest	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EBT	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357
Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Income	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357

Table 3: Investor's Profit and Loss - UARD

Investor's Cash Flow																	
Net Income		357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357
Total Depreciation (+)		269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
Loan Repayment (-)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capital Expenditure	(1,313)																
Subsidy/Grant Injection	-																
Loan Injection	-																
Free Cash Flow (FCF)	(1,313)	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626
Cumulative FCF	(1,313)	(686)	(1,312)	(1,938)	(2,564)	(3,190)	(3,816)	(4,442)	(5,068)	521	1,147	1,773	2,399	3,025	3,651	4,277	4,903
Discount Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Discounted Cash Flow (DCF)	(1,313)	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626	626
Cumulative DCF	(1,313)	(687)	(1,313)	(1,939)	(2,565)	(3,191)	(3,817)	(4,443)	(5,069)	521	1,147	1,773	2,399	3,025	3,651	4,277	4,903

Table 4: Investor's Cash Flow - UARD

Payback Analysis																	
Cumulative FCF (CFCF)	(1,313)	(687)	(1,313)	(1,939)	(2,565)	(3,191)	(3,817)	(4,443)	(5,069)	521	1,147	1,773	2,399	3,025	3,651	4,277	4,903
Positive CFCF years	-	-	-	-	-	-	-	-	-	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Debt Service																	
Debt Service Cover Ratio (DSCR)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 5: Payback Analysis - UARD

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3.4 Conclusions and recommendations

During the survey and analysis of the Energy agency of the pilot building in Bulgaria, two modelers were used - economic and technical. The modeler developed within the project is one and combines economic and technical indicators in one. After the comparison, we found that the results are similar. We have a recommendation to make the interface of the modeler more attractive for end users, as well as to enable graphical representations of the analyzes and the possibility of automatic generation of report forms.