Master methodological approach

Guide for Energy Experts

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List of acronyms

CAPEX – capital expenditure - is the money an organization or corporate entity spends to buy, maintain, or improve its fixed assets, such as buildings, vehicles, equipment, or land.

EEM – energy efficiency measure

IRR – internal rate of return - a metric used in financial analysis to estimate the profitability of potential investments.

NEB – non-energy benefits - are the many and diverse benefits produced by energy efficiency in addition to energy and demand savings.

NEI – non-energy impacts - the benefits and costs of energy efficiency and other distributed energy resources in addition to the energy and demand impacts.

NEE – non-energy efforts – the costs of implementing diverse benefits produced by energy efficiency in addition to energy and demand savings.

NPV – net present value - the difference between the present value of cash inflows and the present value of cash outflows over a period of time.

ROI – return on investment - the benefit (or return) of an investment is divided by the cost of the investment.

TOOL1 – calculation tool that helps energy auditors identify and quantify the non-energy benefits of energy efficiency measures for the company

TOOL2 – calculation tool that support energy auditors in evaluating energy related investments by incorporating the non-energy impacts

VALERI - EN standard 17463:2021 "Valuation of Energy Related Investments"

1. INTRODUCTION

This document is produced within the context of the KNOWnNEBs project, which aims to enhance the adoption of Energy Efficiency Measures (EEM) by companies by capturing the impacts of Non-Energy Benefits (NEBs) and providing a comprehensive assessment of the EEM.

Energy Efficiency Measures (EEMs) are often evaluated primarily based on the energy cost savings they generate. However, various factors within a company may play a more or less significant role in the decision-making process for implementing the selected EEM. In many cases, energy cost savings are not seen as the main driver for EEM implementation. The KNOWnNEBs project aims to address this gap by incorporating non-energy benefits (NEBs) into the economic analysis of EEMs. We believe that by accounting for these additional benefits, the project will improve overall evaluation and, ultimately, increase the adoption rate of energy efficiency measures.

1.1. Scope and objectives

The document 'Master methodological approach' provides guidelines for energy auditors on how to apply the KNOWnNEBs project calculation tools and subsequently present the calculation results to the company's management board. The methodology serves as a supplementary point to the existing energy auditing practices in the project countries.

1.2. Document Structure

The Master methodological approach consists of two main parts: (1) methodology for NEBs inclusion and (2) decision-making approach.

The methodology for NEBs inclusion consists of two calculation tools in MS Excel format:

- TOOL1 for identifying and quantifying the NEBs associated with implementing of energy efficiency measures (EEMs)
- TOOL2 for evaluating the monetary effects of NEBs on EEMs. It is based on the EN standard 17463:2021 "Valuation of Energy Related Investments (VALERI)" with new additions created by the KNOWnNEBs project consortium. The document explains the steps and the inputs required for using both tools.

The decision-making approach provides guidance on how to communicate and demonstrate the numerical values of TOOL2 to the management board of the company in order to facilitate the investments in energy efficiency measures.

2. Identification of Non-Energy Impacts (NEIs)

An energy efficiency project can have various impacts beyond the direct energy savings, which are referred to as Non-Energy Impacts (NEIs) or non-energy effects. In fact, since energy consumption costs for SME companies usually don't exceed 10% of total expenses, factors beyond energy savings play a significant role in the decision to invest or not in the proposed EEM. These impacts can be either positive or negative, depending on the nature and scope of the project. The positive impacts are known as non-energy benefits (NEBs), while the negative impacts are called Non-Energy Efforts (NEEs). In simple terms – an energy efficiency measure will be implemented if the benefits outweigh the efforts as represented in Figure 1 below.

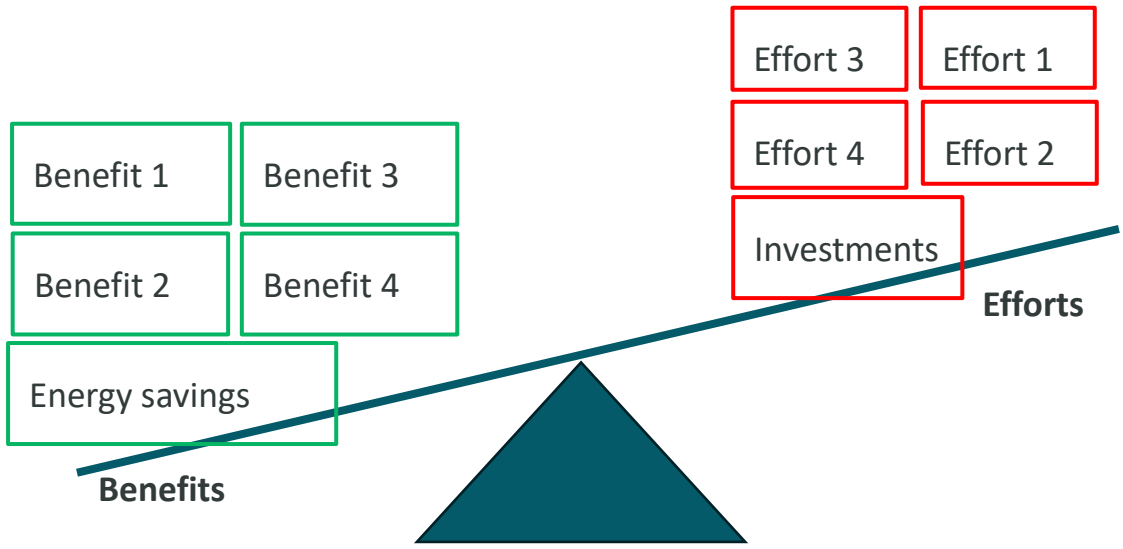


Figure 1: Simplified valuation scale of energy related investments

2.1. Non-energy benefits (NEBs)

Non-Energy Benefits (NEBs) are the various and multiple benefits that energy efficiency measures generate besides saving energy. There are various, such as enhanced air quality, employee's health conditions, comfort level, competitiveness, green reputation of a company, decreased maintenance expenses, etc. Including NEBs enables the complete value of energy efficiency to be recognized. For each EEMs the associated NEBs are different. Even more – the same EEM in different companies will come with different NEBs. This is due the fact that NEBs can be perceived differently in each company.

The non-energy benefits (NEBs) can be classified into two main categories:

- Quantified (monetized) NEB – NEB that has a precise monetary value (e.g. lower maintenance costs, selling of the replaced equipment) associated with it.
- Not quantified (not monetized) NEB – NEB that has a positive impact, but no exact monetary valuation can be assigned (e.g., enhanced indoor air quality; green reputation of the company, employee satisfaction). This category also includes NEBs that have a measurable value, but not in monetary terms (e.g., changing of production line results in noise reduction by 10 dB).

Quantifying NEBs can be complex and challenging, but by asking the company the right key questions, they can become easier to identify:

1. Are there any other monetary savings than energy savings from implementing the EEM?
2. Is there any non-monetary value added from the EEM for the customer or employees? Increased value translates in additional income (e.g. customers want to buy more of the high-quality products).
3. Does the implemented EEM entail a reduction of important risks translating in value proposition increase and cost decrease? (e.g. reduced risk of staff illness or production).

In our experience, when engaging with companies, NEBs related to increased production are typically recognized before energy savings. Energy cost savings are less frequently prioritized unless the company is seeking co-financing or subsidies through state EE support programs. Therefore, it is essential to engage in a thorough, qualitative discussion with company representatives and ask targeted questions (see Chapter 3.1) about potential NEBs and their perceived importance.

When NEBs have been identified, they can be quantified if you can give values to the following parameters.

1. When does the NEB occur:
    - Initial – occurs at the beginning of the EEM implementation (for example, selling old motors, which are replaced with new ones)
    - Yearly – occurs every year after EEM implementation (for example, less maintenance costs)
    - Periodic – occurs at regular intervals or for a specified time period after EEM implementation (e.g., real estate tax reduction for 5 years after building renovation, old gas boiler maintenance costs every 2 years, etc.).
2. What is the unit of measurement[1]?

[1] A definite magnitude of a quantity, defined and adopted by convention or by law, that is used as a standard for measurement of the same kind of quantity.

3. What are the costs of a unit [EUR/unit per year for yearly NEBs; EUR/unit for initial NEBs)? How many units there will be?

The NEB is quantified (monetized) by multiplying the cost of one unit by the number of units. The results may have a broad confidence interval, but they are still useful for companies to make the right decision on implementation of EEMs.

In addition, the NEBs most often occur after the implementation of an energy efficiency project (most often NEBs are yearly). Hence, the management board often overlooks the additional benefits (NEBs) for the company at the decision-making stage, where the non-energy efforts (NEEs) may appear to outweigh the positive aspects of an EEM (NEEs usually are initial – the negative effects of NEEs can be seen in the very beginning of EEM implantation process).

2.2. Non-energy efforts (NEEs)

The non-energy efforts (NEEs) are the negative effects or are the counterparts of NEBs when implementing EEM. NEEs will decrease the value of EEM implementation.

The NEEs can be categorized by the time of occurrence:

- Initial NEEs - occurs at the beginning of the EEM implementation, for example: costs of technical design for EEM (quantified); Loss of productivity during the implementation of EEM (quantified); Additional stress for management board and employees during EEM implementation (not quantified); Noise pollution during the implementation of EEM (not quantified); Training costs of employees (how to operate the new equipment) (quantified); etc.
- Yearly NEEs – occurs every year after EEM implementation, for example: additional software costs for building management system (quantified); Higher maintenance costs (new ventilation system instead of no ventilation, quantified); etc.
- Periodic NEEs - occurs at regular intervals or for a specified time period after EEM implementation: periodic maintenance costs of new equipment and infrastructure (e.g. washing the facade of the building every 10 years after the walls of building are insulated), trainings costs for technical staff, etc.

The NEEs usually occur at the initial stage of an energy efficiency project. A thorough analysis of the NEEs is therefore essential to identify and overcome the barriers that hinder the implementation of EEM. By addressing the NEEs, the management board can gain more confidence and motivation to invest in energy saving projects and achieve the desired outcomes.

As for NEBs, it is essential to engage in a thorough, qualitative discussion with company representatives and ask targeted questions to identify the NEEs and their perceived importance. To identify the NEEs, here are some of the key issues to keep in mind:

1. Rebound Effects (Jevons' Paradox):

- Increased consumption due to cost savings: if energy efficiency upgrades reduce operating costs, the resulting savings might encourage an increase in production or extended use of equipment. This can partially or fully offset the expected energy savings.
- Behavioral changes: consumers or employees might become less vigilant about energy conservation once they see that each unit of energy is "cheaper" due to efficiency, potentially diminishing overall efficiency gains.

2. Upfront costs and investment risks:
   - Capital-intensive improvements: energy-efficient technologies often require significant initial capital expenditures. If projected energy savings do not materialize as expected, or if market conditions change, the return on investment may be lower than anticipated.
   - Financing challenges: securing external funding or reallocating internal funds could strain a company's financial situation, particularly if other, more profitable investments are delayed.
3. Operational and implementation challenges:
   - Complexity and downtime: upgrading equipment or processes for energy efficiency may lead to production interruptions, maintenance complexities, or extended downtimes. The associated costs can erode the net benefits of the efficiency improvements.
   - Training and skill requirements: operating more advanced, energy-efficient systems may require additional employee training. Without proper training or skilled personnel, new systems might be used inefficiently or even damage productivity.
4. Technological and reliability concerns:
   - Technology obsolescence: rapid advancements in energy technologies mean that today's efficient solution might become outdated, locking the firm into less flexible or harder-to-upgrade systems.
   - System compatibility issues: introducing new, more energy-efficient components may require compatibility checks with existing systems. Incompatibilities can cause performance issues, reduce productivity, or create maintenance headaches.
5. Regulatory and market uncertainties:
   - Changing standards and incentives: government policies, subsidies, and standards can shift over time. If regulations change after investments are made, expected payoffs could diminish.
   - Market fluctuations in energy prices: if energy prices unexpectedly drop, the economic rationale for a high-efficiency measure might weaken, resulting in slower payback periods and potential regrets about the initial investment.
6. Environmental and resource trade-offs:
   - Material and resource inputs: some highly efficient technologies rely on specialized materials, rare earth metals, or more complex

manufacturing processes, which could have their own environmental footprints or supply chain vulnerabilities.

- Disposal and decommissioning issues: upgrading to new technologies can render older equipment obsolete, raising questions about disposal, recycling, and the environmental impact of equipment turnover.

3. Methodology for NEBs inclusion into energy audit practice

The methodology consists of two main parts:

- Identification of NEBs
- Analysis and evaluation of the NEBs

For both parts a supporting calculation tool in MS Excel format has been developed.

The TOOL1 is designed to assist energy auditors in identifying the appropriate NEBs for EEMs within energy audits for companies. However, it can also benefit other stakeholders from the implementation of EEMs, such as employees of the companies or energy efficiency policy makers.

TOOL2 is designed to support energy auditors in evaluating energy related investments by incorporating the impact of NEBs and NEEs. It can be applied independently of TOOL1, in case an energy auditor has a clear understanding of the company's NEBs for specific EEMs. Otherwise, we recommend using the TOOL1 first. The tools can be applied separately or in sequential order, where the results of the TOOL1 are used as input data for TOOL2.

We recommend the following steps before using both tools:

- IMPORTANT: Use MS Excel version 2019 or newer[2].
- IMPORTANT: Enable the 'macros' function in Excel to run the tools properly!
- Read the 'Guide for Energy Auditors' and then access the tools.
- Consult the 'user manual' for each tool and follow the instructions!

The tools can be used to their full potential only after a training course[3]. Both tools must be used in conjunction with the energy audit at the company (refer to the recommended sequence in Figure 2).

The TOOL1 can be applied twice during the energy audit process. After the initial contact with the company where company's representative should either provide information about the planned EEM or some indications of the expected EEM. Based on this information, the energy auditor can begin to fill out the TOOL1, STEP1. The energy auditor can identify the potential EEM and list the potential NEBs associated with this EEM.

During the physical inspection, the energy auditor can engage with the company's management board to review the identified potential NEBs for each selected EEM and determine their relevance and significance to the company. Also, the energy auditor together with company representatives can complete the information on NEBs (TOOL1, STEP2) or it can be done after the physical inspection of the company independently by the energy auditor. The identification of NEBs (using

[2] The tools and the visualisation of the results are designed to enhance user experience and clarity; hence the latest version of MS Excel is used.[3] Please contact your national contact point for the possibility to join the training course.

[3] Please contact your national contact point for the possibility to join the training course.

TOOL1) can be repeated as needed once the energy auditor and the company have reached a mutual understanding.

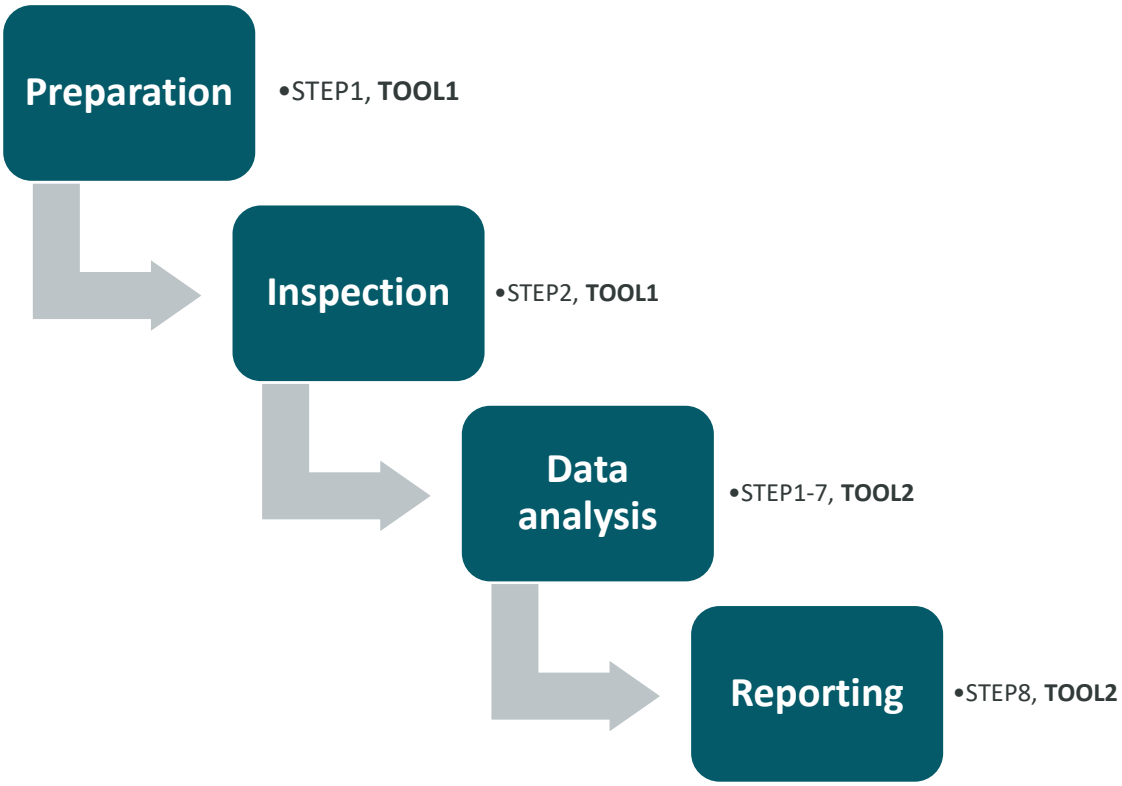


Figure 2: Simplified Energy Auditing Process and Integration of Calculation Tools

The TOOL2 can be applied only after completing the NEB identification process. Since TOOL1 is optional, there are two options for identifying NEBs: either use the results from TOOL1 as input data for TOOL2, or follow the methodology presented in TOOL1 to directly complete TOOL2 STEP1 and STEP2 within TOOL2. However, the identification of NEBs and the assignment of their values must be done during the physical inspection of the company.

After the physical inspection of the company, the energy auditor will perform the calculation and data analysis for the energy audit. During this phase, TOOL2 STEP1 to STEP7 must be completed. This involves using the input data from the energy audit in STEP1 of TOOL2. The energy auditor will then proceed through STEP2 to STEP7 to analyze the NEB effects on each selected EEM. TOOL2 is considered complete once STEP8 is finished. The information from STEP8 of TOOL2 is recommended and can be included in the energy audit report for the company.

3.1. Initial inquiry for companies

Apart from the regular inquiries during the energy audit, the following questions that will contribute to more accurate input data for the TOOL2 should be asked to the company representatives (ideally to the management board):

Question	Purpose in the TOOL2

How does the company decide whether to proceed with investments (not limited to energy efficiency improvements)?	• To understand the key factors influencing the company's investment decisions. • To tailor the presentation of energy audit results in a manner that aligns with the company's priorities.
What criteria must energy efficiency improvement calculations meet to persuade the company to invest in the proposed measures?	• To discern what the company prioritizes when considering investment in suggested measures. • To ensure that the energy audit results clearly demonstrate whether the proposed measures meet the company's minimum expectations for implementation.
How significant are financial aspects, risks, uncertainties, investment amounts, and non-quantified non-energy impacts to the company?	• To accurately weigh different types of indicators in the Benefit Indicator section. • To set parameter variation values for the Sensitivity Analysis. • To determine which parameters to include in developing best and worst-case scenarios in the Scenario Analysis.
What payback period is considered acceptable when evaluating investments?	• To determine the number of years to consider for calculations in the Input Data section. • To define input parameters for the uncertainty indicator in the Benefit Indicator section.
What is the maximum payback time for which the company will invest in various measures?	• To ascertain the number of years to consider for calculations in the Input Data section of the tool • To define input parameters for the uncertainty indicator in the Benefit Indicator section of the tool
Does the company use bank loans or own capital for financing investments?	To determine the proportion of equity capital and debt capital to use in calculations in the Input Data.
What interest rates does the company use for its own capital and for loans in investment calculations?	To identify the interest rates for equity capital and debt to be used in calculations in the Input Data section.
What amounts are considered large and small investments in terms of monetary value?	To appropriately categorize investment amounts in the Benefit Indicator section.

By addressing these questions, more accurate and relevant data can be gathered, enhancing the effectiveness and precision of the energy audit and subsequent analysis using TOOL2.

3.2. TOOL1 – Identification of NEBs

TOOL1 is a tool that helps energy auditors identify and quantify the non-energy benefits (NEBs) of energy efficiency measures (EEMs) for their company. The TOOL1 is based on the experience of KNOWnNEBs project partners, who developed a NEBs matrix with approximately 130 000 data points. The TOOL1 is structured in two main steps.

3.2.1. STEP1: Selection of NEBs for the EEM

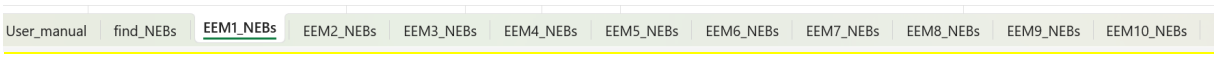
See the Excel sheet 'find NEBs'.

Energy efficiency measure category	Production line	EEM1	EEM3	EEM5	EEM7	EEM9
Energy efficiency measure from categor	Optimization of motor driven systems					
Sort by	Top management	EEM2	EEM4	EEM6	EEM8	EEM10

NEB category	NEB	Top management	Employee	Legislator	Description of the NEB	Examples of quantification
Environment	Emission reduction	7	4	5	Emissions related to any impact categories - climate change, ozone depletion, acidificaton, eutophication, etc. (LCA) or individual metrics for CO, CO2, NOx, SOx and so on.	1. Quantitative - M Number of particles /m2 (example)
Economic	Improvement of compatitiveness	7	0	5	Improved image of a region/ country; can also be a quantified indicator as well. Higher customer satisfaction.	#N/A
Economic	Reduction of (operating) costs	7	3	4	Reduction of cost due to increased efficiency, productivity and right first time. Reduced manual labor costs.	#N/A
Environment	Reduced emissions (dust, CO2, chemical agents etc.)	6	3	3	The harmful emissions of the processes and/or HVAC systems are reduced.	1. Quantitative - M Number of particles /m2 (example)
Economic	Reduction of emission or disposal fees	5	0	6	Reduction of emission or disposal fees.	#N/A
Security & Safety	Energy security	5	0	5	Reduced import dependency, impact on RES integration, supplier diversity, etc.; Herfindahl-Hirschman Index .	1. price forecast
Environment	Reduced use of non-renewable resources	4	1	4	Reducing the non-renewable energy use in processes/building systems	#N/A
Economic	Reduction of (maintenance) costs	4	1	4	Reduction of maintenance costs. Avoided breakdowns due to regular maintenance.	1.Quantitative - Number of breakdowns/defects 2.Quantitative - wages (EUR/hr) * reduced maintenance 3.Quantitative - Longer lifetime of equipment so reduce 4.Quantitative - Technical control cost
Economic	Increased real estate value	4	0	1	Spending money on energy efficiency measures can increase the real estate value of buildings	Quantitative - Assets value
Time	Increased productivity	4	0	5	Higher outputs (nº of finished products) / a certain period of time.	#N/A
Time	Increased equipment lifetime	4	1	4	Increased equipment lifetime due to better operating conditions/ maintenance/ improved fault detection.	Quantitative - Cost of equipment - spending delayed
					Reduced (maximum) noise pollution in dB at the workspace,	Quantitative - Decibels x time of exposure

Choose one EEM category and one specific EEM from the drop-down lists. The tool will display list of all the NEBs in order of likeliness to be associated with the selected EEM. The NEBs can be filtered by the type of beneficiary. Selecting the type of beneficiary rank the NEBs according to the interest of this type of beneficiary. The default option is the top management, but you can also select the employee or the legislator. The value of each NEB may vary depending on the beneficiary. For energy audits, the management board is usually the main beneficiary.

After filling in all three drop-down lists, the energy auditor has the option to save the specific EEM to one of the 10 Excel sheets, by clicking on the corresponding EEM button.



The energy auditor can perform the actions described above multiple times, depending on the needs of the energy audit. However, the maximum number of EEMs that can be selected and saved is limited to 10.

3.2.2. STEP2: Assigning values to selected NEBs

Refer to the Excel sheets for the selected EEMs.

NEB category	NEB	Top management	Employee	Legislator	Description of the NEB	Examples of quantification	Include in calculations
Environment	Emission reduction	7	4	5	Emissions related to any impact categories - climate change, ozone depletion, acidificaton, eutophication, etc. (LCA) or individual metrics for CO, CO2, NOx, SOx and so on.	1. Quantitative - M Number of particles /m2 (example)	Yes
Economic	Improvement of compatitiveness	7	0	5	Improved image of a region/ country; can also be a quantified indicator as well. Higher customer satisfaction.	#N/A	Yes
Economic	Reduction of (operating) costs	7	3	4	Reduction of cost due to increased efficiency, productivity and right first time. Reduced manual labor costs.	#N/A	Yes
Environment	Reduced emissions (dust, CO2, chemical agents etc.)	6	3	3	The harmful emissions of the processes and/or HVAC systems are reduced.	1. Quantitative - M Number of particles /m2 (example)	Yes
Economic	Reduction of emission or disposal fees	5	0	6	Reduction of emission or disposal fees.	#N/A	Yes
Security & Safety	Energy security	5	0	5	Reduced import dependency, impact on RES integration, supplier diversity, etc.; Herfindahl-Hirschman Index .	1. price forecast	Yes
Environment	Reduced use of non-renewable resources	4	1	4	Reducing the non-renewable energy use in processes/building systems	#N/A	No
Economic	Reduction of (maintenance) costs	4	1	4	Reduction of maintenance costs. Avoided breakdowns due to regular maintenance.	1.Quantitative - Number of breakdowns/defects 2.Quantitative - wages (EUR/hr) * reduced maintenance 3.Quantitative - Longer lifetime of equipment so reduce 4.Quantitative - Technical control cost	No
Economic	Increased real estate value	4	0	1	Spending money on energy efficiency measures can increase the real estate value of buildings	Quantitative - Assets value	No
Time	Increased productivity	4	0	5	Higher outputs (n° of finished products) / a certain period of time.	#N/A	No

Each EEM has a table with NEBs categories and associated NEBs, which are ranked from most likely to least likely to occur for the company, based on the selected beneficiary. The management board together with energy auditor must determine which NEBs are relevant for the company and whether they should be included in the subsequent calculations. This can be done using different methods, depending on the specific circumstances (see Figure 2). The selected beneficiary has the discretion to decide what is the optimal solution and how many of the NEBs can be attributed to the company. The number of NEBs for each EEM can vary and can range from none to all indicated NEBs. However, if the company does not specify their own NEBs, the NEBs with scores 5 and above are recommended to be selected for further evaluation. In addition, if a specific NEB is not listed in the NEBs drop-down menu, the energy auditor has the option to add its own NEB.

If a NEB will be quantified the user has to indicate whether this NEB is initial or yearly, what is the unit of measurement of this NEB and also the number of units.

NEB category	NEB	Include in calculations	Quantified/not quantified	Initial/yearly	Unit of measurement	Cost of unit, EUR/unit (for initial) and EUR/unit per year (for yearly)	Amount of units	Importance (1-low; 5-very high)
Environment	Emission reduction	Yes	Quantified	Initial	t CO2	5	100	
Economic	Improvement of compatitiveness	Yes	Not quantified					5
Economic	Reduction of (operating) costs	Yes	Quantified	Initial	employee	2000	3	
Environment	Reduced emissions (dust, CO2, chemical agents etc.)	Yes	Not quantified					2
Economic	Reduction of emission or disposal fees	Yes	Quantified	Yearly	tonns	100	10	
Security & Safety	Energy security	Yes	Not quantified					4
Environment	Reduced use of non-renewable resources	No						
Economic	Reduction of (maintenance) costs	No						

For not quantified NEBs, the energy auditor must collect information from the company's decision makers (top managers) during the energy audit. The company's management board with the help of energy auditor must agree on the importance (a subjective score) of each non-quantified NEB for the company. The following scoring system must be used to indicate the importance of each NEB for the company: 1 – very low importance; 2 – low importance; 3 – average importance; 4 – high importance, 5 – very high importance.

After completing the tasks for one EEM, the energy auditor must repeat them for each EEM measure that is selected for the company in the TOOL1. Once the

information for all EEMs is completed, the energy auditor can proceed to the TOOL2. The data from the TOOL1 will be used to perform the calculations in TOOL2.

3.3. TOOL2 – Analysis and evaluation of NEBs

The TOOL2 is based on the EN standard 17463:2021 "Valuation of Energy Related Investments (VALERI)" with additional new calculation approaches for analysing the monetary effects of NEBs on EEM. The TOOL2 consists of eight main steps.

3.3.1. STEP1: Compilation of input data, NEBs and NEEs

If the TOOL1 is used for the identification of EEM, please enter the same data as in TOOL1. If the TOOL1 is not used, please enter the data from the energy audit report or the results of data analysis (see TOOL1, STEP2). To run the data analysis in TOOL2, ensure that all requested data fields highlighted in yellow are completed. The only exception is the "saved energy type" field. For each EEM, you may specify either a single energy type or up to three energy types with their corresponding values.

Input data

Energy efficiency measure category	Envelope
Energy efficiency measure from category	Improvement to visible building envelope elements
Energy efficiency measure description	Renovation of building by deep renovation standard

Cost of energy efficiency measure (CAPEX)	409200	EUR			
Saved energy type (electricity, heat, e.t.c.)	All types of saved energy combined	Heat			Energy type (up to 3 types)
Annual energy savings	180.338	180.338			MWh/year
Energy price (tariff)	83.07	83.07			EUR/MWh
Energy cost savings	14980.67766	14980.678	0	0	EUR/year
Share of equity capital	0%	%			
Share of debt capital	100%	%			
Interest rate of equity capital	7.20%	%			
Interest rate of debt	3.90%	%			
Discount rate	3.90%	%			

Annual price variation for energy	3%	%
Annual price variation for not energy costs	2%	%

Number of years to be considered	20	years

Quantified non energy benefits

No.	Quantified non energy benefits	Initial / Yearly / Periodic	Unit of measurement	Cost of unit, EUR/unit	Amount of units	Base value, EUR
1	Grant for building renovation	Initial	piece	163680	1	163680
2	Real estate value increase	Initial	m2	30	2192.5	65775
3						0
4						0
5						0
6						0
7						0
8	Real estate tax reduction for 10 years after renovation	Periodic	m2	0.2	2192.5	438.5
9		Periodic				0
10		Periodic				0

Not quantified non energy benefits

No.	Not quantified non energy benefits	Importance (1-low; 5-high)
1	Better visual looks of the building	4
2	Improved indoor air quality	3
3		
4		
5		
6		
7		
8		
9		
10		

Quantified non energy efforts

No.	Not quatified non energy efforts	Initial / Yearly / Periodic	Unit of measurement	Cost of unit, EUR/unit	Amount of units	Base value, EUR
1	Costs of technical design	Initial	pieces	7000	1	7000
2						0
3						0
4						0
5						0
6						0
7						0
8		Periodic				0
9		Periodic				0
10		Periodic				0

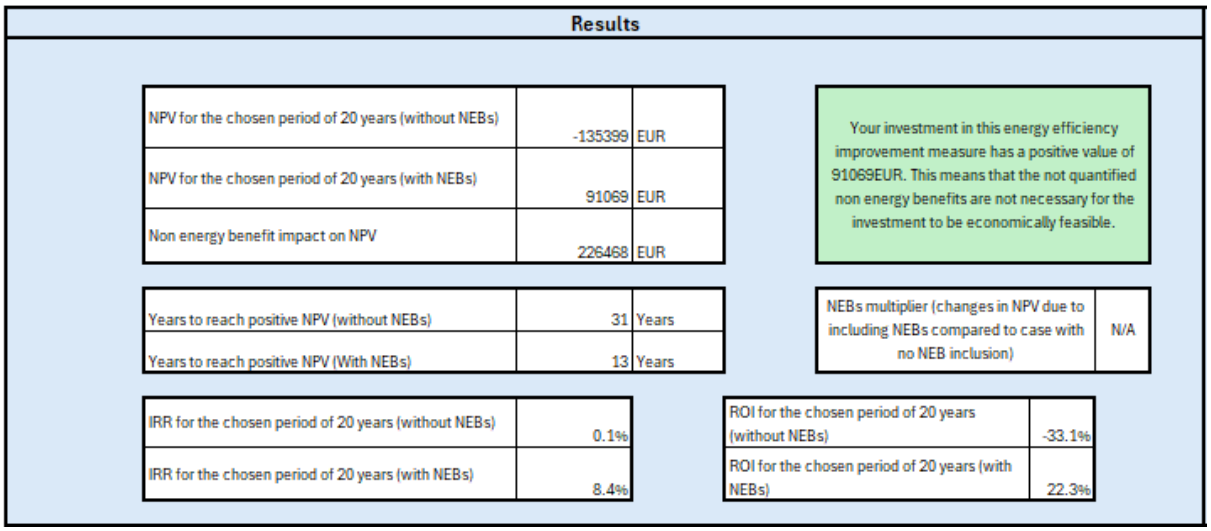
Not quatified non energy efforts

No.	Not quantified non energy efforts	Importance (1-high; 5-very low)
1	Noise during construction	3
2	Issue with low quality construction works	5
3		
4		
5		
6		
7		
8		
9		
10		

3.3.2. STEP2: Analysis of initial results

The TOOL2 calculates the 'Payments in' and 'Payments out' automatically based on the methodology provided in VALERI. For 'Payments in', all indicated quantitative NEBs, and their corresponding values are automatically added to the calculation table. Similarly, for 'Payments out' all indicated quantitative NEEs are presented. In both cases, the values for periodic NEBs and NEEs must be manually entered into the rows highlighted in yellow within their respective tables. The data in the tables are intended for detailed results analysis and for verifying the accuracy of the input data.

The result presenting table and the graphics are the most important part of the analysis.



They show whether the EEM is feasible within the chosen and desired payback time for the company, with or without NEBs included. They also provide other relevant indicators and their values to explain the results more clearly for the company. Based on the calculation results, the text box is coloured:

- Green - the investment in this EEM is feasible and the analysis of not quantified NEBs is not needed but can be considered, which could improve the profitability even more (in this case the analysis of not quantified NEBs will show the amount of allowed negative impacts (expressed in monetary value) in order for this EEM to be feasible).
- Red - the investment in this EEM is not feasible and the analysis of not quantified NEBs should be done to quantify the necessary additional value in order for this EEM to be economically feasible.

The TOOL2 performs the calculations for up to a 30-year period. If the payback time exceeds 30 years, the value 31 will be displayed automatically.

3.3.3. STEP3: Quantification of not quantified NEBs

In this section a monetary value to not quantified NEBs is given. Two types of values are given: (1) for yearly NEBs and (2) for initial NEBs. These values indicate

the necessary additional monetary value of not quantified NEBs in order for the suggested EEM to be feasible.

For instance, if the calculation shows that total value of yearly not quantified NEBs should be 1245 EUR, it means that this EEM will be feasible if all not quantified NEBs give additional 1245 EUR value. The result of this analysis is intended to be presented to company's decision makers (top managers). They can then decide (usually based on their subjective viewpoint) if these not quantified NEBs have the additional necessary value for them. For instance, changing of air handling unit in the company has a not quantified NEB of improved indoor air quality. And based on TOOL2 analysis results this NEB of improved indoor air quality should be at least 1245 EUR in order for the new air handling unit installation to be feasible. The company's decision makers then can evaluate if the indoor air quality improvement due to changing of air handling unit for them has the worth of 1245 EUR.

By giving such a monetary value to not quantified NEBs it is possible to still give a very useful monetary evaluation.

Quantification of not quantified NEBs

No.	Not quantified non energy benefits	Necessary base value of yearly not quantified NEBs in order for the energy efficiency measure to be economically feasible, EUR	Yearly NEBs
1	Better visual looks of the building	0	
2	Improved indoor air quality	0	
3			
4			
5			
6			
7			
8			
9			
10			
Total			

Necessary base value of initial not quantified NEBs in order for the energy efficiency measure be economically feasible	No additional value of NEBs needed for the energy efficiency measure to be economically feasible	EUR
Necessary amount of grant/subsidies/other incentives for the investment to be economically feasible	N/A	%

To ensure EEM implementation is feasible, the quantification of previously unquantified NEBs must include the required initial values. This initial necessary value also is shown as the amount of required subsidies or grants to achieve the desired payback time for the company. The company can then evaluate whether they are willing to invest in an EEM that is not financially viable without not

quantified NEBs or whether they need to seek an EE support program to co-finance the EEM implementation.

3.3.4. STEP4: Sensitivity analysis

Sensitivity analysis examines how variation in the values of an independent variable influences a specific dependent variable under certain assumptions. The calculation methodology for the sensitivity analysis follows the VALERI framework. However, the energy auditor and the company representatives need to indicate the significance and potential changes of each parameter. The results are presented in both tables and graphs. The result in the tables shows how the changes in the parameter could affect the implementation of EEM.

Sensitivity analysis

Parameter variation	25%

Parameter variation	Parameter	Base value	High	Low
30%	Cost of energy efficieny measure (CAPEX), EUR	409200	531960	286440
15%	Energy savings, MWh/year	180.338	207.3887	153.2873
25%	Energy price, EUR/MWh	83.07	103.8375	62.3025
25%	Energy price variation rate, %	3.00%	3.75%	2.25%
25%	Interest rate of equity capital, %	7.20%	9.00%	5.40%
5%	Interest rate of debt, %	3.90%	4.10%	3.71%
25%	NEB quantification	1	1.25	0.75

Sensitivity

	NPV for 20 years (without NEBs)		
Parameter	Base value	High	Low
Cost of energy efficieny measure (CAPEX), EUR	-135399	-258159	-12639
Energy savings, MWh/year	-135399	-94329	-176469
Energy price, EUR/MWh	-135399	-66948	-203849
Energy price variation rate, %	-135399	-114087	-154862
Interest rate of equity capital, %	-135399	-135399	-135399
Interest rate of debt, %	-135399	-140575	-130080
NEB quantification	-135399	-135399	-135399

	NPV for 20 years (with NEBs)		
Parameter	Base value	High	Low
Cost of energy efficieny measure (CAPEX), EUR	91069	17413	164725
Energy savings, MWh/year	91069	132139	49999
Energy price, EUR/MWh	91069	159519	22619
Energy price variation rate, %	91069	112381	71606
Interest rate of equity capital, %	91069	91069	91069
Interest rate of debt, %	91069	85858	96423
NEB quantification	91069	147686	34452

3.3.5. STEP5: Analysis of different scenarios

The TOOL2 generates three scenarios automatically based on the methodology provided in VALERI. The generated scenarios are: Most likely case; Best case; Worst case. Energy auditor must select the relevant parameters to be included in scenario analysis for the calculations, depending on the information about the company. If a parameter is not chosen to be included in scenario analysis then in

all scenarios this parameter will have the base value. The results of the calculations indicate the years to reach positive NPV of the EEM for the company for each of the scenarios.

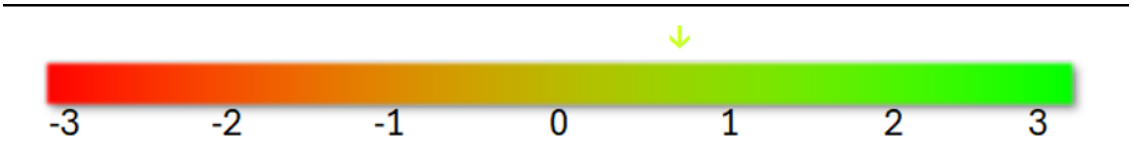
Include in scenario analysis (1 - yes; 0 - no)	Parameter	Most likely case (base value)	Best case	Worst case
1	Cost of energy efficieny measure (CAPEX), EUR	409200	286440	531960
1	Energy savings, MWh/year	180.338	207.3887	153.2873
1	Energy price, EUR/MWh	83.07	103.8375	62.3025
0	Energy price variation rate, %	3.00%	3.00%	3.00%
0	Interest rate of equity capital, %	7.20%	7.20%	7.20%
0	Interest rate of debt, %	3.90%	3.90%	3.90%
1	NEB quantification	1	1.25	0.75

3.3.6. STEP6: CAPEX analysis

The capital expenditures (CAPEX) are the funds invested by a company in acquiring, maintaining, or improving fixed assets such as property, buildings, factories, equipment, and technology. This section of the TOOL2 calculates the permissible CAPEX with or without NEBs for all years (from 1 to 30), regardless of the selected calculation period. The CAPEX analysis results outline the allowable investments—both with and without the monetary effects of NEBs—for each calculation period (ranging from 1 to 30 years) needed to ensure EEM feasibility. This information can be used in case to compare actual costs of implementing EEM with permissible costs. Also, in case if actual costs of EEM implementation are not know the CAPEX analysis can be used to understand what EEM implementation costs are permissible.

3.3.7. STEP7: Analysis of benefit indicator

This step is the final step for the calculations of selected EEM and is the most complex and has been fully developed during KNOWnNEBs project. The benefit indicator was essential to create as it demonstrates in a clear and comprehensible way for the company whether the EEM is advantageous or not for the company to implement.



The benefit indicator is created by considering the financial, risk, uncertainty, investment, and non-energy impacts indicators, and the table below explains the reasons for using each of them.

Category	Name of the indicator	Reasons for using in the methodology
Financial	Return of investment (ROI, %)	Return of investment is widely used as a financial indicator to quantify whether the investment will be profitable
Financial	IRR/discount rate	This ratio indicates if the investment is profitable. If this ratio is above 1 it means that the investment is feasible. If this ratio is less than 1, it means that the investment is not feasible.
Risk	Worst case time to reach positive NPV minus most likely case to reach positive NPV, years	Investment feasibility calculations contain a lot of assumptions. During scenario analysis it can be see what investment horizon would be needed to reach positive NPV for worst case scenario. Time to reach positive NPV for worst case scenario can be considerably longer than in the most likely case scenario. The longer the time to reach positive NPV in worst case scenario is the riskierimplementing the suggested EEM measure is.
Risk	Most likely case to reach positive NPV minus best case to reach positive NPV, years	Investment feasibility calculations contain a lot of assumptions. During scenario analysis we can see what investment horizon would be needed to reach positive NPV for best case scenario. Time to reach positive NPV for best case scenario can be considerably shorter than in the most likely case scenario. The shorter the time to reach positive NPV in best case scenario is the less risky implementing the suggested EEM measure is.
Uncertainty	Number of years to be considered	The longer time to be considered in calculations the more uncertainty and possible negative effects it brings to the table. If the calculation period is short, then it is unlikely to something unforeseen to happen. Therefore, the longer the calculation period the higher possible negative effects can be for the company implementing an EEM.
Uncertainty	Time to reach positive NPV/number of years to be considered	Achieving a positive NPV sooner reduces the risk that uncertainty will negatively impact EEM outcomes. This indicator compares the time taken to reach a positive NPV against the overall calculation time horizon.
Amount of investment	CAPEX (indicate values for small and extremely large investments for the energy audited company)	Usually, companies are less willing to make large investments because it can be a burden to companies' cash flow.

Not quantified non energy impacts (NEIs)	Sum of not quantified non energy benefits (NEBs) minus sum of not quantified non energy efforts (NEEs)	Since there are not quantified non energy benefits and efforts that occur during with implementation of EEMs, it is important to also evaluate (take into consideration) these effects. Sometimes these not quantified impacts can be the real motivation to implement or not to implement the suggested EEMs.

Valuation of each of the 8 indicators is done in a scale from -3 to +3. For each of the 8 indicators the tool indicates the border values at which the indicator is valued at "-3" and "+3". If the actual value of an indicator is smaller than the indicated border value for score "-3", then for this indicator a valuation of "-3" is assigned. If the actual value of an indicator is larger than the indicated border value for score "+3", then for this indicator a valuation of "+3" is assigned. If the actual value of an indicator is between the border values, then a linear scoring is used. In the tool each of the 8 indicator scores can be seen in a chart where you can see the actual value of the indicator as well as the border values of each of the indicator. The tool allows the users to change the border values of the indicators if more accurate information is available.

No.	Type of indicator	Indicator	Value	Value at which score is "3"	Value at which score is "-3"	Value at which score is "0"	Score
1	Financial	Return of investment (ROI, %)	22.3%	30.0%	-30.0%	0	2.23
2	Financial	IRR/discount rate	2.15	2	0	1	3.00
3	Risk	Worst case time to reach positive - most likely case to reach positive NPV, years	18	0	10	5	-3.00
4	Risk	Most likely case to reach positive NPV - best case to reach positive NPV, years	9	6	0	3	3.00
5	Uncertainty	Number of years to be considered	20	1	19	10	-3.00
6	Uncertainty	Time to reach positive NPV/number of years to be considered	0.65	0.5	1.5	1	2.10
7	Amount of investment	CAPEX (indicate values for small and extremely large investments for the energy audited company)	409200	0	500000	250000	-1.91
8	Not quantified non energy impacts (NEIs)	Sum of not quantified non energy benefits (NEBs) minus sum of not quantified non energy efforts (NEEs)	-1	25	-25	0	-0.12

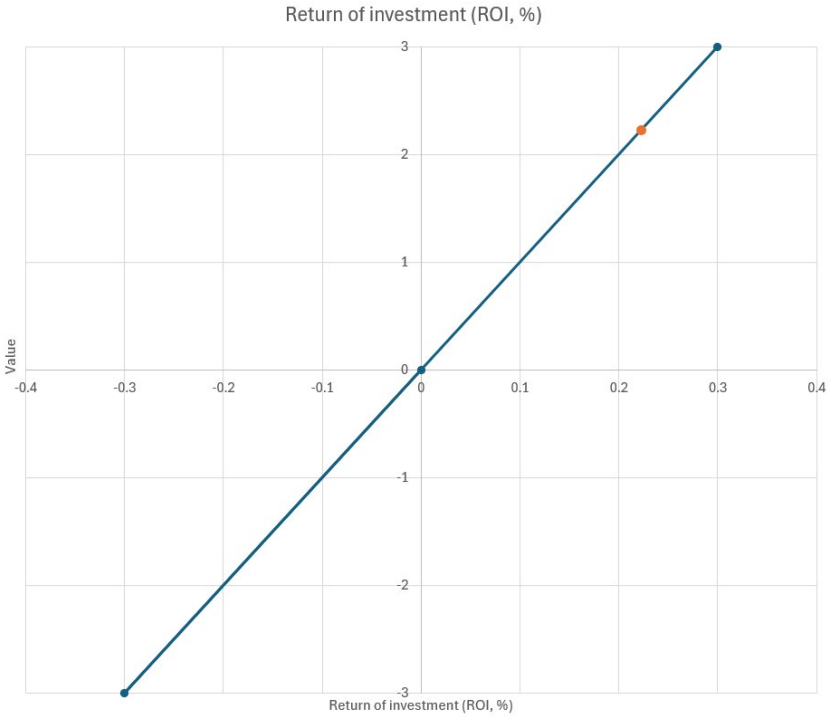
Energy auditor in collaboration with the company's management board can assign a value from 0 to 5 on the significance of each of the 5 categories of indicators for implementing the EEM. Where 0 - irrelevant and 5 – very significant. If these values are not assigned, the default values are used.

Based on these inputs, a benefit indicator is provided as a numerical value. A positive value of the benefit indicator signifies that the measure is beneficial for the company and should be implemented, whereas a negative value signifies the contrary. The indicator is scored on a scale from -3 to +3, which is presented in a chart by the TOOL2.

Type of indicator	Importance	Weight	Score without weighting
Financial	5	41.7%	2.61
Risk	2	16.7%	0.00
Uncertainty	1	8.3%	-0.45
Amount of investments	2	16.7%	-1.91
Not quantified NEIs	2	16.7%	-0.12
Total	12	100%	0.03

The scoring thresholds (when an indicator reaches -3 or +3) can be modified. The indicator receives a linear score based on its value within the threshold range:

- +3 – it is imperative to implement the measure as soon as possible
- + 2 – the measure is highly recommended
- +1 – implement the measure with caution
- 0 – the measure has no significant impact
- -1 – the measure is not feasible under the current conditions
- -2 – the measure is detrimental and should be avoided
- -3 – the measure is disastrous and must be rejected



3.3.8. STEP8: Summary of the results

To complete STEP8, follow steps 1 to 7 for each EEM you have chosen. Then, go to the 'Summary' sheet in MS Excel to finish the work with TOOL2.

The summary table shows the main parameters of the selected EEMs. The energy auditor should select the EEMs based on the company's information and include them in the summary. The summary table can serve as an annex to the energy audit report.

4. Decision-making approach

Communicating the energy audit findings, potential cost savings, and recommended actions effectively is essential to secure the company's management team support for implementing energy efficiency measures.

Hence, the decision-making approach comprises three main steps with guidelines on how to convey the outcomes of energy audit and the KNOWnNEBs calculation methodology to the management team of a company.

4.1. STEP1: Preparation activities

Before meeting with the management team to present the energy audit outcomes, it is imperative to conduct some preparation activities. The following are some suggestions what to consider in the preparation process:

- Adapt the message: consider the board's interests – see 3.1. – and their level of technical expertise. Use clear, concise language with visuals and avoid excessive technical jargon.
- Highlight key findings: summarize the audit's overall impact on energy consumption and potential cost savings.
- Prioritize recommendations: present the most impactful and cost-effective recommendations first, with clear implementation timelines and payback periods.
- Quantify the benefits: translate energy savings into financial savings, environmental impact (reduced carbon footprint), and potential return on investment (ROI).
- Be realistic: acknowledge any limitations or challenges associated with implementing recommendations.
- Prepare for questions: anticipate potential questions about costs, disruption to operations, and long-term benefits.

These tips provide you with the best practices for conveying the energy audit outcomes, obtaining the approval of the management team, and initiating a plan for a more efficient and environmentally friendly future for the company.

4.2. STEP2: Communication strategy

Decision makers most likely have no domain knowledge. Therefore, you are the experts, not the management. The outcome of an energy audit depends largely on how well the recommendations and possible results are communicated. Energy audits can be technical and data-based, but it is essential to turn those insights into simple, practical steps without leaving any gaps. There are some suggestions on providing the desired outcomes:

- The decision-makers may lack the technical background. Using simple language prevents confusion and ensures everyone comprehends the

proposed solutions. For example, use monetary benefit over kWh, or present price of kWh to give context.

- Uncertainty impedes action. Decision-makers have multiple responsibilities, if they cannot easily grasp the potential benefits, they may be reluctant to proceed with the energy saving opportunity. A clear presentation with quantified outcomes and steps required helps overcome this reluctance.
- By presenting the audit findings in a clear and concise way, you can enable decision-makers to take action and achieve significant energy savings. For instance, think of it like explaining it to a colleague who has little knowledge of how any of this works.
- Highlighting potential risks builds trust. A prompt "no" to a bad project is better than a delayed "yes" that wastes money. The non-energy efforts (NEEs) are perceived as the risks for implementation of the EEM and can be used for communication.
- Addressing uncertainty. This is done by the sensitivity analysis in TOOL2, STEP4 and can be used for result presenting. In addition, for better understanding of the situation, it is possible to show:
    - historic price data if available to demonstrate electricity cost trends.
    - future price predictions if possible.
    - long-term contracts or hedging strategies that can reduce price risks.
- Look for examples of successful energy-saving projects in similar businesses. Compare your energy consumption anonymously with competitors or industry averages.

These tips will help you convey the benefits of energy efficiency investments to the management team.

4.3. STEP3: Presentation of the results

4.3.1. Introduction and context

A top-down Analysis Approach is preferable. To start with the overall view, then focus on the key areas. The presentation should follow a top-to-bottom order to make the argument. This also educates the reader about the general situation and sets up the context.

Some possible ideas for initial 'overview' slides are:

- How much energy the company consume? How much energy can be saved? Show the percentage of total and in monetary units. Pie charts, Sankey diagrams or tables of energy consumption categories to give insight into which areas are more important than others (like, heating vs lighting, etc.).
- What proportion of the cost goes to meet the energy demand? How does it compare to other cost categories? This will give a good context of the monetary value and how it compares to other cost areas. Pie charts, Sankey diagrams or tables of cost categories to give insight into energy costs vs other costs for the company.

- How the energy audit was conducted at the company, key areas of assessment, findings, present conditions, opportunities for enhancements, etc.

This will set the stage and allow the involved stakeholders to understand the situation. For the 'big picture' slide of findings (see Figure 3), it is suggested to use:

- A slide that shows how much of the costs could be saved
- A table of actions that could be taken that would yield X, Y, Z.
- A bar chart showing the present situation vs what could happen with improvements.

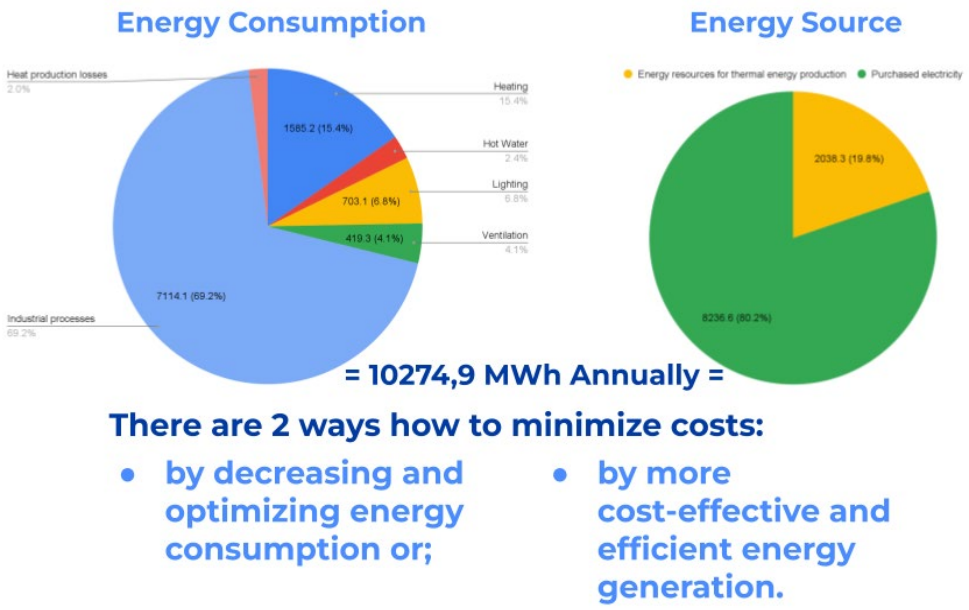


Figure 3: Example of the slide 'big picture' and '80-20 rule'

Before presenting more details, summarize the main findings for the participants. The '80-20 rule' (aka Pareto Principle) means that 20% of causes produce 80% of outcomes. Sometimes one category has the most impact. If so, emphasize the largest slice because it could lead to the biggest saving, result, and outcome. Additionally, energy auditors can use Sankey diagrams to illustrate the energy distribution of an organization.

Also, include brief information on the company's role in climate change mitigation activities. The company's commitment to climate change mitigation is clearly demonstrated through its implementation of EEM. By reducing energy consumption, the company not only realizes significant cost savings but also lowers its CO_2 emissions. This dual benefit highlights that energy efficiency transcends mere financial gains—it plays a crucial role in diminishing the company's overall environmental impact. Through these initiatives, the company actively contributes to broader climate change mitigation efforts, reinforcing its commitment to sustainability and environmental stewardship.

4.3.2. Review and presentation of investment project

Make sure to describe the methodology and how the results were done. Everyone should be on the same page rather than puzzled. Both IRR and NPV are helpful economic indicators to decide what projects to take and what profitability a company can anticipate:

- Net Present Value (NPV): Use NPV for precise euros value comparisons, especially when prioritizing maximizing the total value added by projects.
- Internal Rate of Return (IRR): Use IRR when you need to evaluate the relative profitability of projects quickly and when comparing projects with different investment sizes or durations.

To conclude, NPV measures the total value created, while IRR measures the relative profitability of an investment. Both are useful methods, but they have different roles in project assessment.

The following information is essential for a comprehensive understanding of the project and the calculation of IRR or NPV:

- Required Investment: The initial cost of the upgrades.
- Project Lifespan: The duration of the upgrades' benefits.
- Expected Savings: The annual amount of money that the upgrades will reduce the energy bills by.

If potential projects and opportunities are many, focus on the ones that have the biggest savings or monetary value. Give the project context:

- How much is being spent on this currently?
- How does it relate to total company costs or the total energy costs?
- How does it fit in the company’s strategy?

Explain what needs to be done simply:

- During audit, we identified X
- We recommend doing Y because of Z

Show both tables and graphs. List the project's costs and benefits. Use the key variables from the previous block. For projects that are more complicated or risky, state the assumptions, risks, and possible results for different scenarios.

4.3.3. Presentation of energy audit results

The following information can be provided for the company management team in one slide for each of the EEM analysed in the TOOL2:

- Main project inputs: CAPEX (EUR), Annual money savings (EUR/year)/Energy Savings (MWh/year), List of Quantified Non-Energy Benefits, List of Quantified Non-Energy Efforts, Project Lifetime (years).
- Project financial metrics in a comprehensive table: project NPV, IRR, Years to positive NPV, Best case NPV, Worst case NPV (results from TOOL2)
- Add the benefit indicator scale and value of the indicator for the EEM.

- Brief conclusions: Based on the current assumptions the EEM *makes/does not* makes financial sense. The recommendation is to complete this project *as soon as possible/invest after review/pass*.

4.3.4. Conclusions

Based on our experience communicating with companies regarding energy audit outcomes, we recommend presenting the consultation section—focusing on EEMs—before diving into the detailed energy audit results. This reordering aligns with how companies typically engage with audit findings.

- Prioritizing EEMs: companies are more interested in the actionable aspects of energy audits—specifically, the EEMs they can implement—than in the detailed technical information behind each measure.
- Enhanced engagement with management: By dealing with consultation details that outline the recommended EEMs and associated costs, the report can capture the management board's attention more effectively. Management tends to favor clear, high-level results that emphasize practical outcomes over in-depth technical indicators.
- Simplifying complex data: since management boards often lack the technical expertise to fully appreciate detailed audit data, front-loading the report with the main results and cost implications of the suggested EEMs can facilitate quicker, more focused decision-making.

This approach not only helps in engaging key decision-makers but also enhances the overall effectiveness of the energy audit report by aligning it with the audience's priorities. Presenting consultation insights first ensures that the actionable recommendations are immediately visible, leading to more strategic and informed discussions at the management level.

For presenting the conclusions write a summary of the project and the main lessons learned by:

- Reiterate the benefits: briefly remind the board of the potential cost savings and positive environmental impact of implementing the energy audit recommendations.
- Highlight prioritized actions: emphasize the most impactful and cost-effective recommendations, potentially mentioning a specific number.
- Propose next steps: recommend scheduling a follow-up meeting to discuss the prioritized actions in detail and answer any questions.
- Analyse EEM project's feasibility for the company:
  - Invest (+1-+3) - Based on scenario analysis, all the scenarios result in a positive NPV for the project's lifetime. This category is assigned to cases where there is negligible risk of failure.
  - Invest After Review (-1-+1) - These are cases where the outcome is uncertain and depends on various factors. The decision depends on the company's risk appetite and preferences. If the company is interested in this investment opportunity, this case should be

presented with more details and explanations of the potential outcomes and assumptions, so that the company's management can make an informed judgment.

- Pass (-3--1) - Scenario analysis indicates that, with the current assumptions, it is very likely that the project will yield a negative NPV or have no chance of a positive NPV. However, the company can still consider if there are any non-quantifiable benefits or ways to reduce the capital expenditure or operating costs.

In conclusion, express enthusiasm and commitment, as well as show your confidence in the positive outcomes and your dedication to achieving them collaboratively.

ANNEX1: TOOL1 - Identification of NEBs (MS Excel)

The TOOL1 is available here for download: https://www.e-sieben.at/en/projects/22003_knownnebs.php

ANNEX2: TOOL2 - Analyzation of NEBs (MS Excel)

The TOOL2 is available here for download: https://www.e-sieben.at/en/projects/22003_knownnebs.php

ANNEX 3: Template for presenting the energy audit results (MS PowerPoint)

The template for presenting the energy audit results is available here for download: https://www.e-sieben.at/en/projects/22003_knownnebs.php

ANNEX 4: Example

Communication with the company

The company was initially contacted by phone to arrange a physical inspection of the facilities. During this call, the company representative was informed that, in addition to the regular energy audit, non-energy impacts, benefits, and efforts would also be evaluated. To facilitate understanding, a brief explanation of non-energy impacts was provided to the company.

Additionally, the energy auditor requested to meet with representatives who could discuss the questions outlined in Chapter 3.1 of this document. The auditor also inquired whether the company had already identified any specific energy efficiency measures of interest. The company is interested in replacing the cheese production line.

After the phone call, the energy auditor sent the company a request for energy consumption data along with the questions outlined in Chapter 3.1 of this document.

Information gathered for data analysis during physical inspection

The company's technical director accompanied the energy auditor during the physical inspection of the facilities.

During the physical inspection of the company the following actions and measurements were performed: building envelope evaluation, insulation inspection, lighting inspection, electrical measurements of the cheese production line.

The energy auditor gained insight into the company's decision-making process for energy efficiency measures through a meeting with a management board representative. The maximum investment limit for such measures is 500,000 EUR. For smaller investments up to 10,000 EUR, the company fully funds them using its own capital. However, for investments exceeding 10,000 EUR, only 20% is covered by the company's own capital. The interest rate for equity capital is 7.2%, while the interest rate for debt is 4.0%. The evaluation period for energy efficiency measures is seven years. In assessing these measures, financial indicators such as ROI and IRR are prioritized. Uncertainty regarding payback time is considered unimportant, while risks, investment amounts, and non-quantified NEIs (Non-Energy Impacts) are given lower priority.

In addition, to the basic information and data that is gathered for regular energy audit report for companies, following additional information was collected in order to use the calculation TOOL1 and TOOL2. All the information on NEBs and NEEs was discussed with the technical director of the site.

For the energy efficiency measure the company expressed interest in during the phone call with the energy auditor, the auditor prepared a list of key NEBs (with a scoring of 5 to 7 from TOOL1). This was done to determine whether these benefits could be quantified and to understand how the company perceives and values different NEBs.

1) Replacement of the cheese production line. NEBs: increased income due to better productivity, no need for a large maintenance each 3 years, reduction of (operating) costs – quite important, employee satisfaction – low priority. NEEs - downtime during construction.

For other two EEM, the energy auditor identified and discussed the possible NEBs and NEEs during the physical inspection of the company.

2) Energy efficiency lights (LEDs). NEBs: increased real estate value, reduction of operation costs, reduction of emissions and disposal fees. Improved lighting is very important, employees' satisfaction – lower priority, work performance – low priority.

NEEs: noise during construction lower priority, downtime during construction – low priority.

3) Improvements to non-visible building envelope elements. NEBs – cofinancing for renovation (40%of CAPEX), employees' satisfaction – lower priority, reduced noise – low priority.

Performing the TOOL1 and TOOL2

After completing the physical inspection of the company, the energy auditor conducts the necessary data analysis for the energy audit report in accordance with national legislation. The next step involves using TOOL1 to identify non-energy benefits (NEBs) for each recommended energy efficiency measure in the energy audit report.

Based on discussions with the technical director and the management board, the energy auditor selects the most valuable NEBs for the company for each of the recommended EEM. Once the selection process is complete, TOOL2 is used to determine whether each NEB can be quantified. For quantifiable NEBs, a value is assigned. For not quantifiable NEBs a value from perception scale is selected. Additionally, TOOL2 is used to identify and quantify non-energy efforts (NEEs), too.

After completing the identification and selection process for NEBs and NEEs related to each energy efficiency measure, the energy auditor holds an online meeting with the technical director to present the results. During the meeting, the auditor and the company agree on the selected non-energy impacts (NEBs, NEEs), their quantifiable values, and the company's perception of them.

Following this agreement, the energy auditor proceeds with data analysis for each recommended energy efficiency measure using TOOL2.

Energy Efficiency measure 1: Replacing of cheese production line

Short description of the energy related investments

In order to increase the productivity of the production line, it has been decided to replace the existing machinery for the production line to a new one. The total investment for this measure is 300,000 EUR. The total planned energy savings is 77.4 MWh/year where electricity is 18.0 MWh/year and heat is 59.4 MWh/year.

Suggestions for decision

The calculated benefit indicator is -0.132, indicating that, based on the current assumptions, the EEM has low financial viability. It is recommended to reconsider the investment after a thorough review. The final decision should be based on the company's risk appetite and strategic preferences.

The planned total energy cost savings amount to 7,813.48 EUR per year. However, the NPV remains negative for the chosen payback period, both with and without quantifiable NEBs. As a result, an additional evaluation of non-quantifiable NEBs was conducted.

Summary of results

The following quantifiable and not quantifiable NEBs have been identified:

- Increased income due to better productivity – yearly, 40,000 EUR
- No need for large maintenance each 3 years – periodic, 1000 EUR
- Reduction of (operating) costs – importance "3"
- Employee satisfaction – importance "1"

The following quantifiable and not quantifiable NEEs have been identified:

- Downtime during construction – initial, 12,500 EUR

The results of NPV analysis for 7-year payback period are as follow:

- NPV without NEBs is –248,629 EUR (IRR -28.3%)
- NPV with NEBs is -6370 EUR (IRR 4.1%)

The sensitivity analysis reveals that the NPV without NEBs is highly dependent on capital expenditures (CAPEX), while the NPV with NEBs is influenced by both CAPEX and the quantification of NEBs.

The scenario analysis presents different projections for achieving a positive NPV. In the best-case scenario, this is expected to happen within 5 years, whereas the most likely scenario suggests an 8-year period. In the worst-case scenario, achieving a positive NPV could take up to 13 years.

Parameters for the calculations:

Discount rate: 4.64%

Annual price variations for energy 3%, for others – 2%.

Lifetime: 7 years

Energy price: Electricity – 165 EUR/MWh; Heat – 81.54 EUR/MWh

Energy Efficiency measure 2: Energy efficient lights (e.g LED)

Short description of the energy related investments

In order to increase the energy efficiency, it has been decided to install 100 new LED light bulbs in a building (200W halogen replaced with 50 W LED). The total investment for this measure is 5000 EUR. The planned energy savings of electricity is 9.75 MWh/year.

Suggestions for decision

The calculated benefit indicator is 2.105, indicating that, based on the current assumptions, the EEM has financial viability. It is recommended to invest in energy efficiency measure.

The planned total energy cost savings amount to 1608.75 EUR per year. The NPV is positive for both cases without and with quantifiable NEBs. As a result, no additional evaluation of non-quantifiable NEBs is needed.

Summary of results

The following quantifiable and not quantifiable NEBs have been identified:

- Increased real estate value – initial, 150 EUR
- Reduction of (operating) costs – yearly, 20 EUR
- Reduction of emission or disposal fees – yearly, 100 EUR
- Improved lighting – importance "5"
- Employee satisfaction – importance "2"
- Work performance – importance "1"

The following quantifiable and not quantifiable NEEs have been identified:

- Noise during construction – importance "2"
- Downtime during construction – importance "1"

The results of NPV analysis for 7-year payback period are as follow:

- NPV without NEBs is 4628 EUR (IRR 29.4%)
- NPV with NEBs is 5470 EUR (IRR 33.8%)

The sensitivity analysis reveals that the NPV without NEBs and with NEBs is highly dependent on the energy price and related energy savings.

The scenario analysis presents different projections for achieving a positive NPV. In the best-case scenario, this is expected to happen within 2 years, whereas the most likely scenario suggests a 4-year period. In the worst-case scenario, achieving a positive NPV could take up to 5 years.

Parameters for the calculations:

Discount rate: 7.20%

Annual price variations for energy 3%, for others – 2%.

Lifetime: 7 years

Energy price: Electricity – 165 EUR/MWh

Energy Efficiency measure 3: Improvements to non-visible building envelope elements

Short description of the energy related investments

In order to increase the energy efficiency, it has been decided to insulating attic with 300 mm rock wool (1973 m2). The total investment for this measure is 75,000 EUR. The total planned energy savings is 116.13 MWh/year where electricity for cooling is 12.45 MWh/year and heat is 103.68 MWh/year.

Suggestions for decision

The calculated benefit indicator is 1.523, indicating that, based on the current assumptions, the EEM has financial viability. It is recommended to invest in energy efficiency measures.

The planned total energy cost savings amount to 10,508.32 EUR per year. The NPV without NEB is negative, but with NEBs it is positive for the chosen payback period.

Summary of results

The following quantifiable and not quantifiable NEBs have been identified:

- Cofinancing for renovation – initial, 30,000 EUR
- Employee satisfaction – importance "2"
- Reduced noise – importance "1"

The results of NPV analysis for 7-year payback period are as follow:

- NPV without NEBs is -5703 EUR (IRR 2.5%)
- NPV with NEBs is 24,297 EUR (IRR 17.5%)

The sensitivity analysis reveals that the NPV without NEBs and with NEBs is highly dependent on the energy price and CAPEX.

The scenario analysis presents different projections for achieving a positive NPV. In the best-case scenario, this is expected to happen within 2 years, whereas the most likely scenario suggests a 5-year period. In the worst-case scenario, achieving a positive NPV could take up to 16 years.

Parameters for the calculations:

Discount rate: 4.56%

Annual price variations for energy 3%, for others – 2%.

Lifetime: 7 years

Energy price: Electricity – 165 EUR/MWh; Heat – 81.54 EUR/MWh

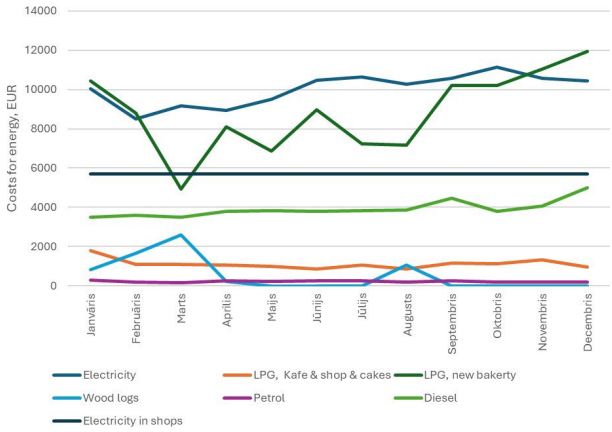
Presentation to the management board

After completing the data analysis, the energy auditor prepares a presentation on the results using the template provided by the KNOWnNEBs project. The auditor then schedules an online meeting with the company's management board to present and discuss the findings.

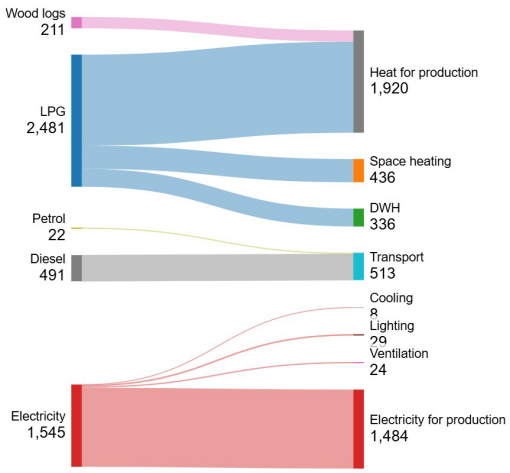
The presentation begins with an overview of the company's energy consumption, costs, and environmental impact. The most important part of the discussion is the conclusions, where the energy auditor provides an overview of all recommended energy efficiency measures and assesses whether they are worth implementing. For the measures that interest the company the most, the auditor presents more detailed information.

As a result, the company will receive a table outlining the recommended energy efficiency measures from the audit, which will help with planning their implementation.

How much does energy cost?



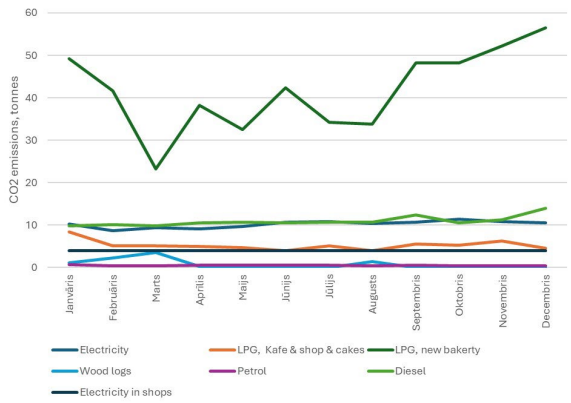
How much energy can be saved?

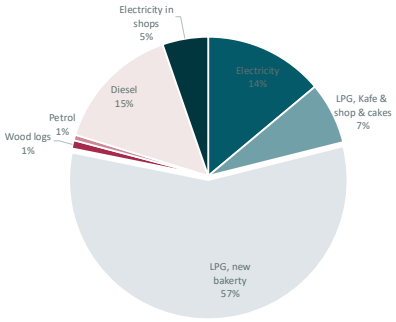


Expected energy savings: 125.88 MWh/year

Expected savings: 12,117 EUR/year

Your role in climate change





known NEBs

known NEBs

KNOWnNEBs has received funding from the European Union's LIFE21-CET-AUDITS programme under grant agreement no. 101076494.

Conclusions

Energy Efficiency Measure Summary

Name of EEM	CAPEX, EUR	Annual savings, EUR/year	Project lifetime, years	NPV with NEBs, EUR	IRR with NEBs, %	Benefit indicator	Worst case NPV, years	Best case NPV, years	Decision
Replacing of cheese production line	300,000	7,813.48	7	-6370	4.1	-0.132	13	5	Invest after review
Energy efficient lights (e.g LED)	5000	1608.75	7	5470	33.8	2.105	5	2	INVEST
Improvements to non-visible building envelope elements	75,000	10,508.32	7	24297	17.5	1.523	16	2	INVEST

known NEBs

Total for Projects worth pursuing

CAPEX, EUR	Annual savings, EUR	Annual energy savings, MWh	NPV with NEBs, EUR	Simple payback time, years
80,000	12,117	125.88	29767	6.6

known NEBs

KNOWnNEBs has received funding from the European Union's LIFE21-CET-AUDITS programme under grant agreement no. 101076494.

Energy Efficiency Measure Walk through

Conduction of energy audit

- During the physical inspection of the company the following actions and measurements were performed: building envelope evaluation, insulation inspection, lighting inspection, electrical measurements of the cheese production line.
- The energy auditor gained insight into the company's decision-making process for energy efficiency measures through a meeting with a management board representative.
- The basic information and data that is gathered for regular energy audit report for companies, following additional information was collected in order to use the calculation TOOL1 and TOOL2 from the technical director of the company.

EEM1:

Replacing of cheese production line

Main Project Inputs	
CAPEX	300,000 EUR
Annual money saving	7,813.48 EUR/year
Annual energy savings	77.4 MWh/year
List of quantified NEBs	Increased income due to better productivity– yearly, 40,000 EUR. No need for large maintenance each 3 years – periodic, 1000 EUR
Not quantified NEBs	Reduction of (operating) costs– importance "3". Employee satisfaction – importance "1"
List of quantified NEEs	Downtime during construction– initial, 12,500 EUR
Project lifetime	7 years

Project Financial Metrics	
Project NPV	without NEBs -248,629 EUR with NEBs -6370 EUR
IRR, %	without NEBs -28.3% with NEBs 4.1%
Years to positive NPV	8 years
Best case, NPV	5 years
Worst case, NPV	13 years
Benefit indicator	-0.132

- **Recommendation :** Based on the current assumptions, the EEM has low financial viability. It is recommended to reconsider the investment after a thorough review. The final decision should be based on the company's risk appetite and strategic preferences.

EEM2:

Install 100 new LED light bulbs in a building (200W halogen replaced with 50 W LED)

Main Project Inputs	
CAPEX	5000 EUR
Annual money saving	1608.75 EUR/year
Annual energy savings	9.75 MWh/year
List of quantified NEBs	Increased real estate value– initial, 150 EUR. Reduction of (operating) costs – yearly, 20 EUR. Reduction of emission or disposal fees – yearly, 100 EUR
Not quantified NEBs	Improved lighting – importance "5". Employee satisfaction – importance "2". Work performance – importance "1"
List of quantified NEEs	Noise during construction – importance "2". Downtime during construction – importance "1"
Project lifetime	7 years

Project Financial Metrics	
Project NPV	without NEBs 4628 EUR with NEBs 5470 EUR
IRR, %	without NEBs 29.4% with NEBs 33.8%
Years to positive NPV	4 years
Best case, NPV	2 years
Worst case, NPV	5 years
Benefit indicator	2.105

- **Recommendation:** The calculated benefit indicator is 2.105, indicating that, based on the current assumptions, the EEM has financial viability. It is recommended to invest in energy efficiency measure.

EEM3: Insulating attic with 300 mm rock wool (1973 m2)

Main Project Inputs	
CAPEX	75,000 EUR
Annual money saving	1,508.32 EUR/year
Annual energy savings	116.13 MWh/year
List of quantified NEBs	Cofinancing for renovation– initial, 30,000 EUR
Not quantified NEBs	Employee satisfaction – importance "2" Reduced noise – importance "1"
Project lifetime	7 years

Project Financial Metrics	
Project NPV	without NEBs -5703 EUR with NEBs 24,297 EUR
IRR, %	without NEBs 2.5% with NEBs 17.5%
Years to positive NPV	5 years
Best case, NPV	2 years
Worst case, NPV	16 years
Benefit indicator	1.523

- **Recommendation:** The calculated benefit indicator is 1.523, indicating that, based on the current assumptions, the EEM has financial viability. It is recommended to invest in energy efficiency measures.

known NEBs