

## BUSINESS CASE ANALYSIS: SUMMARY – administration and library

### Importance of energy supply

Every office or residential building must provide living (or working) conditions of a proper quality. Ensuring a certain level of comfort and meeting other demands (e.g. buildings must be equipped with certain installations, hot water, access to data transfer, etc.) requires utilisation of energy. The energy consumption of a building depends on the building itself, installed equipment, as well as the needs, requirements, and behaviour of the users. Excessive energy consumption is reflected in higher costs and creates a negative impact on the environment. Energy audit of a building serves to collect data on the use of certain types of energy for different purposes, and the costs arising from it. At the same time, the energy consumption indicators reveal where the use of energy is higher than in comparable buildings. Possible measures and investment requirement estimates are discussed below.

### Consumption and costs of energy and water

The table below lists consumptions and costs of energy products (electricity, heating, hot water) for 2013–2015 period. All prices and costs in this document exclude VAT.

**Table 1: Consumption and costs of energy and water**

Year	Electricity [kWh]	Heating [kWh]	Water [m <sup>3</sup> ]	Total (EE + TE)
2013	12,914	190,878	531	203,792 kWh / 531 m <sup>3</sup>
2014	14,157	161,101	502	175,258 kWh / 502 m <sup>3</sup>
2015	14,348	115,710	0	130,058 kWh / 0 m <sup>3</sup>
Average	13,806	155,896	344	169,703 kWh / 344 m <sup>3</sup>
Year	Electricity [€]	Heating [€]	Water [€]	Total, VAT excluded [€]
2013	3,483	15,354	978	19,816 €
2014	3,615	12,634	814	17,063 €
2015	3,628	7,761	213	11,602 €
Average	3,575	11,917	668	16,160 €

**NOTE:** The water is charged at a flat rate by semi-annual or annual calculations of actual hot water consumption. Hence, the value of consumed hot water in 2015 amounts to 0 m<sup>3</sup>, as shown in the following sections.

## Potential savings and required investments

The tables below show values of reduced cost and energy consumption, for each individual measure. The values are not proportional (directly cumulative). To predict the overall reduction of costs and energy consumption, the measures must be considered in a sensible sequence of implementation and interdependence. The total savings are calculated through this method. The sequence of implementing the proposed measures is shown by the tables below which list possible retrofit scenarios. **All displayed costs exclude VAT.**

**NOTE: At the public partner's request, all savings have been calculated according to the average annual consumption in the analysed 2013–2015 period, and the average energy product price during this period. The price of energy product excludes rates that remain unchanged in the event of energy savings due to a measure's implementation (power demand,**

### Measures with the payback period of up to 5 years

**Table 2: Measures with the payback period of up to 5 years**

No.	Description of measure	Potential annual savings						Investment	Payback period
		kWh		m³	€			€	(years)
		HE	EE	W	HE	EE	W		
ORGANISATIONAL MEASURES									
MA	Energy management	8,249	690	26	631	68	26	1,230	1.7
INVESTMENT MEASURES									
U6	Installation of thermostat valves and heads	8,249	/	/	631	/	/	2,243	3.6

### Measures with the payback period of over 5 years

**Table 3: Measures with the payback period of over 5 years**

Table 3: Measures with the payback period of over 5 years									
No.	Description of measure	Potential annual savings						Investment (VAT	Payback period
		kWh		m <sup>3</sup>	€ (VAT excluded)			€	(years)
		HE	EE	W	HE	EE	W		
ORGANISATIONAL MEASURES									
MA	No organisational measures suggested.	/	/	/	/	/	/	/	/
INVESTMENT MEASURES									
U 1	Thermal insulation of building envelope (16 cm)	35,143	/	/	€ 2,686	/	/	€ 36,434	13.6
U 2	Insulation of basement wall beneath the ground level (12 cm)	11,219	/	/	€ 858	/	/	€ 21,025	24.5
U 3	Board insulation against cold attic (20–25 cm)	12,209	/	/	€ 933	/	/	€ 30,791	33.0
U 4	Replacement of windows (0.96 W/m2K) and doors (1.6 W/m2K)	46,279	/	/	€ 3,538	/	/	€ 76,061	21.5
U 5	Central ventilation with heat recovery	/	/	/	/	/	/	€ 30,328	/
U 7	Installation of thermostat heads and valves with remote regulation for all heating systems	15,674	/	/	€ 1,198	/	/	€ 6,623	5.5
U 8	Boiler replacement	19,799	/	/	€ 1,513	/	/	€ 27,254	10.4
U 9	Replacement of existing lighting with T5 and LED technology	/	2,485	/	/	€ 246	/	€ 6,198	25.2
U 10	Replacement of single-stage toilet tanks with two-stage toilet tanks	/	/	47	/	/	€ 47	€ 787	16.6

The tables below list anticipated scenarios of measures for the building, total energy savings, cost savings, investments, payback periods, etc.

**Table 4: Overview of measures with the payback period of up to 5 years**

<b>SCENARIO 1 – Overview of measures with the payback period of up to 5 years</b>			<b>% savings on total annual</b>	
<b>MEASURES</b>	<b>OU→U6</b>			
Annual savings in electrical energy	0.690	MWh	5%	
Annual savings in heating	16.086	MWh	10%	
Annual savings in water	25.9	m <sup>3</sup>	5%	
Total reduction of CO <sub>2</sub> emissions	4,682	kg	10%	
Total annual reduction in costs	1,324	€	% of	9%
Total necessary investment	3,472	€		
Average payback period	2.6	years		

**Table 5: Overview of basic set of anticipated measures**

<b>SCENARIO 2 – Overview of basic set of anticipated measures (calculated in accordance with the declining balance method)</b>			<b>% savings on total annual</b>	
<b>MEASURES</b>	<b>OU→U6→U1→U3→U4→U8</b>			
Annual savings in electrical energy	0.690	MWh	5%	
Annual savings in heating	96.282	MWh	58%	
Annual savings in water	25.9	m <sup>3</sup>	5%	
Total reduction of CO <sub>2</sub> emissions	26,334	kg	54%	
Total annual reduction in costs	8,564	€	% of annual	59%
Total necessary investment	174,011	€		
Average payback period	20.3	years		

**Table 6: Overview of extended set of measures**

<b>SCENARIO 3 – Overview of extended set of anticipated measures (calculated in accordance with the declining balance method)</b>			<b>% savings on total annual</b>	
<b>MEASURES</b>	<b>OU→U7→U1→U2→U3→U4→U8</b>			
Annual savings in electrical energy	0.690	MWh	5%	
Annual savings in heating	103,987	MWh	63%	
Annual savings in water	25.9	m <sup>3</sup>	5%	
Total reduction of CO <sub>2</sub> emissions	28,415	kg	58%	
Total annual reduction in costs	9,153	€	% of	63%
Total necessary investment	199,416	€		
Average payback period	21.8	years		

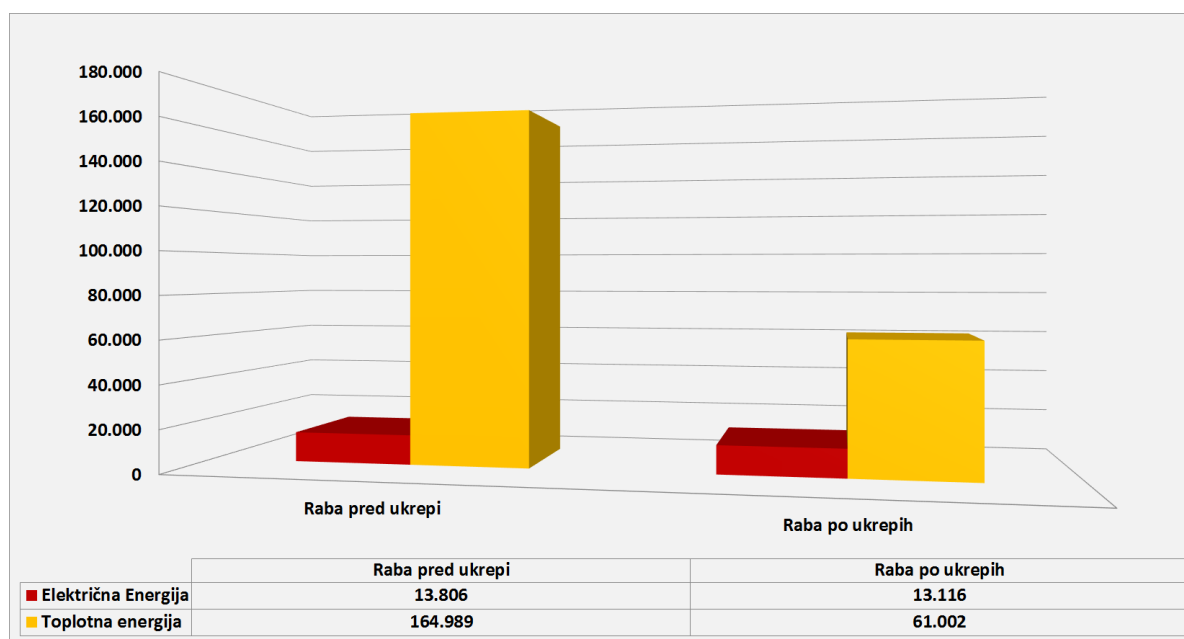
The scenario was selected based on the amount of investment, payback period, and the feasibility of individual investment given the state of the building. The selection can be adapted.

**Table 7: Scenario selection**

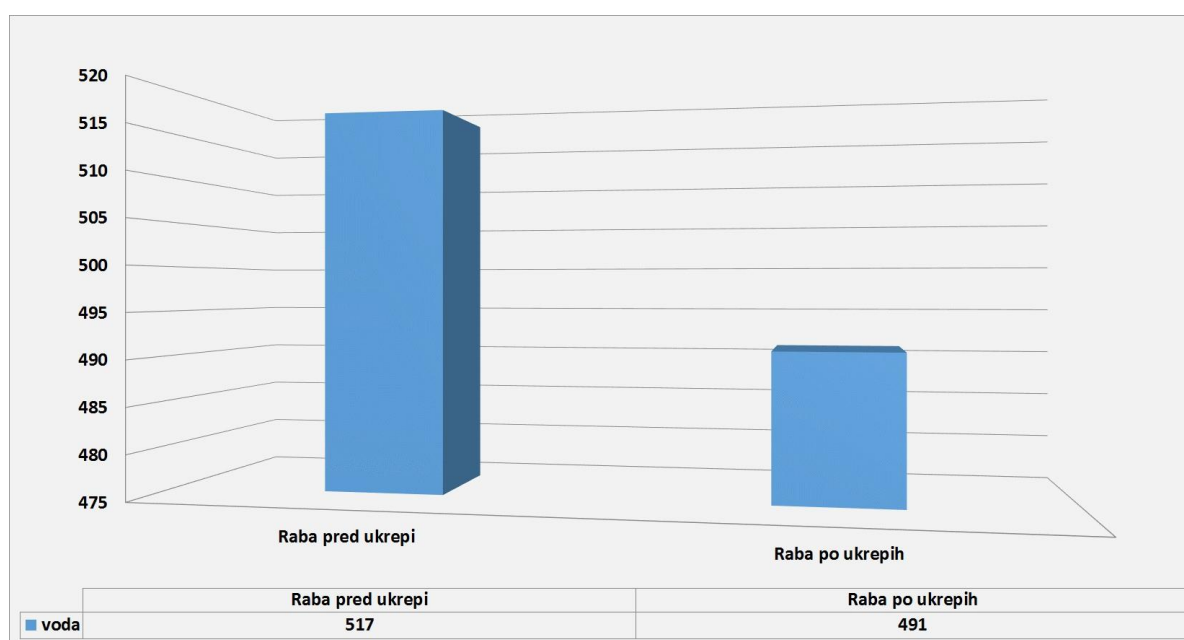
<b>SELECTED SCENARIO</b>	<b>SCENARIO 3</b>
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## Comparison of consumption before and after the implementation of measures – Selected scenario

State	Electricity	Heating	Hot water
Anticipated state (without)	13,806	164,989	517
Anticipated state (after retrofit)	13,116	61,002	491



**Graph 1: Comparison of energy consumption before and after the implementation of measures**

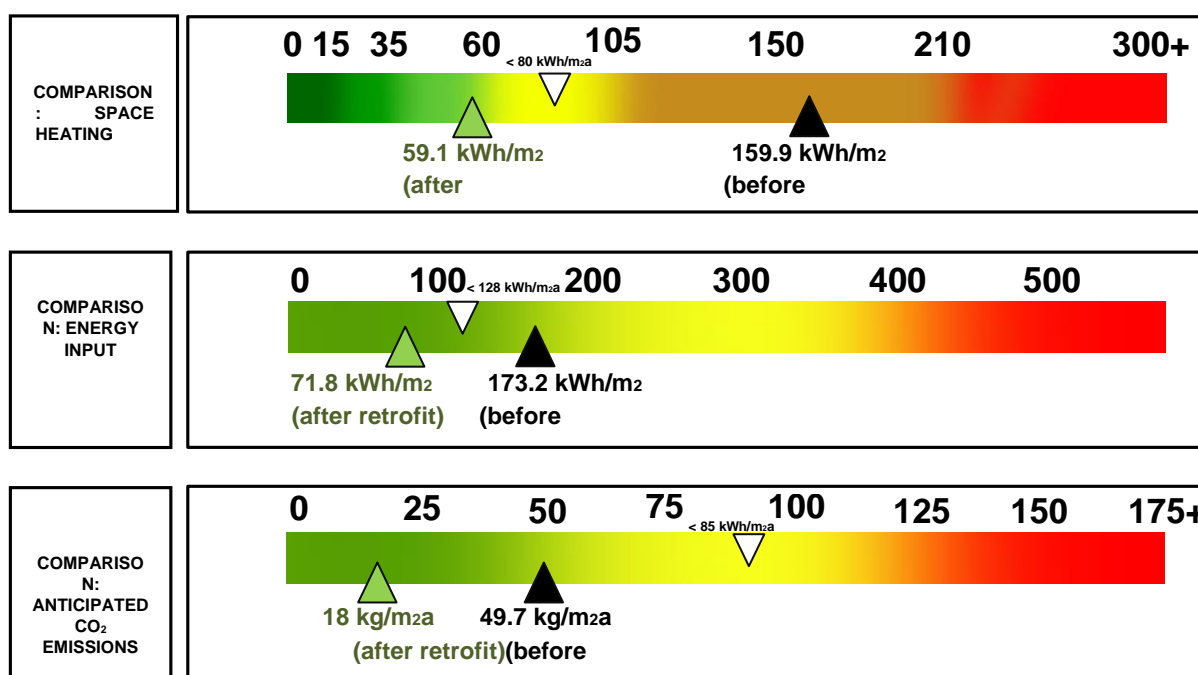


**Graph 2: Graph 1: Comparison of water consumption before and after the implementation of measures**

## Energy indicators before and after the implementation of measures

The graph below shows the comparison of energy consumption indicators before and after the implementation of retrofit through selected measures (presented in the tables). The black arrow indicates the planned state of the building after the measures have been implemented. The white arrow denotes recommended values for public buildings.

**NOTE:** The indicators for the current state of building are based on the anticipated energy consumption and temperature deficit.



Graph 3: Energy indicators before and after retrofit

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## **Guidelines for implementation of measures and possible sources of financing**

The implementation of measures defined by an energy audit is largely dependent upon the organisation's/institution's management; it also requires a qualified person (energy manager). If an organisation/institution does not have such a person at its disposal, it can employ an external contractor who is responsible for achieving energy efficiency goals. The collaboration between the organisation's/institution's management and the energy manager is crucial.

### **Organisational measures**

Organisational measures can save a considerable amount of energy through relatively low costs. Implementation of organisational (soft) measures is the first step towards energy efficiency and represents the basis for all further investment measures. Each building needs a person or an organisation that will be responsible for the building's energy efficiency. To secure quality and positive effects of organisational measures, it is important to follow the process below.

#### **Energy and financial data collection**

**Analysis → Continuous analysis based on various indicators**

**Deviations**

**Planning of measures**

**Planning of consumption**

**Organisational measures**

**Investment measures → Energy audit (update)**

**Implementation of measures**

**Monitoring indicators**

### **Graph 4: Organisational measures: Implementation process**

In the event that the public institution does not have adequate staff to implement certain measures, it must find competent persons and/or organisations that will aid in their implementation.

### **Investment measures**

Extended energy audit is a document that allows for a comprehensive energy overview of a building, and lists measures that can be implemented to improve current state. Proposed measures are

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implemented based on:

- inspection of the buildings,
- measurements,
- building physics calculations,
- project and technical documentation overview,
- etc.

According to the implementation process proposed by an energy auditor, the investment measures can be divided into three groups.

- **Group A:** Measures relating to simple maintenance works performed by the manager in the context of regular or routine maintenance (e.g. replacement of a thermostatic valve, replacement of toilet tank, etc.);
- **Group B:** Measures that do not require additional documentation (except energy audit). Contracts may be awarded based on the list of works identified by an energy audit (in accordance to instructions below).
- **Group C:** Measures that require preparation of project documentation that guides their implementation. Based on an energy audit, the terms of reference is prepared, which serves as the project basis.

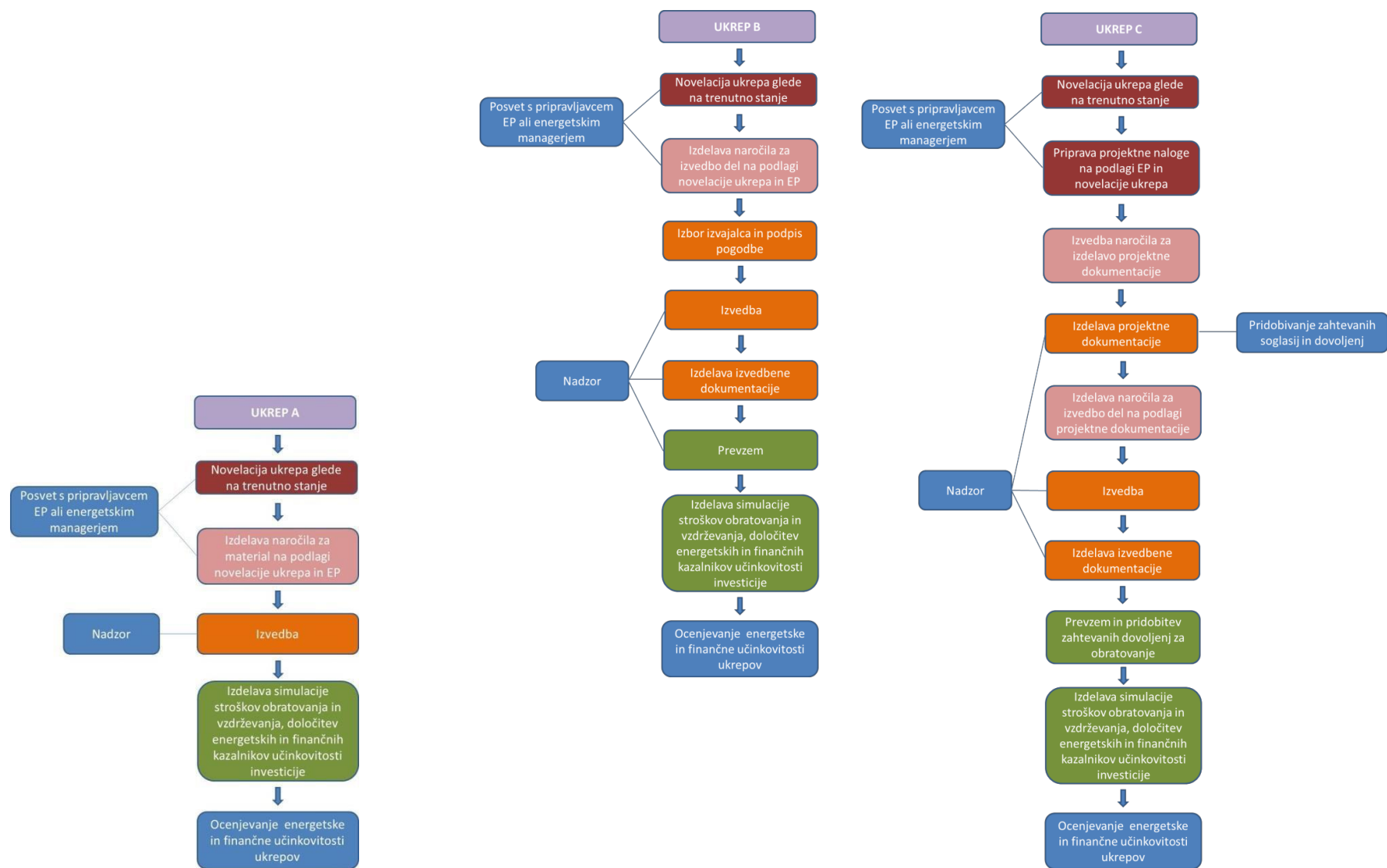
The building management can decide to follow its own implementation process, regardless of the group of measures proposed by the energy auditor.

Possible interactions of measures must be taken into account, especially those that are mutually exclusive.

For a better understanding of how to approach the implementation of a specific group of measures, the figure below shows the principal steps of implementing a group of measures.



Graph 5: Process of implementing individual measures



#### MEASURE A

Adaptation of measure to the current situation

Consulting energy auditor or energy manager

Preparation of contract for material based on the measure adaptation and EA

Supervision

Implementation

Simulation of operational and maintenance costs, identification of financial performance indicators for investment

Assessing measures' energy efficiency and financial efficiency

#### MEASURE B

Adaptation of measure to the current situation

Consulting energy auditor or energy manager

Preparation of order for material based on the measure adaptation and EA

Selection of contractor and conclusion of contract

Implementation

Supervision

Implementation documentation

Takeover

Simulation of operational and maintenance costs, identification of financial performance indicators for investment

Assessing measures' energy efficiency and financial efficiency

#### MEASURE C

Adaptation of measure to the current situation

Consulting energy auditor or energy manager

Preparation of order for material based on the measure adaptation and EA

Awarding contract for project documentation

Creating project documentation

Obtaining necessary consents and permits

Preparation of contract for works based on project documentation

Supervision

Implementation documentation

Takeover and obtaining necessary operational permits

Simulation of operational and maintenance costs, identification of financial performance indicators for investment

Assessing measures' energy efficiency and financial efficiency