Interreg CENTRAL EUROPE
European Union European Regional Development Fund

BOOSTEE-CE

DELIVERABLE T3.3.1

D.T3.3.1 – Pilot actions preparation **06/2018**

D.T3.3.1: Pilot actions preparation

A.T3.3 Preparation and procurement of pilot actions

Issued by: Partner Nr. 05
Date: Jun 2018

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1. Introduction and aims

This deliverable is a kind of pre-investment report, which contains all information and data about buildings that allow for a description of the condition of the buildings and the pilot action.
Conducting research and analysis of selected buildings as pilot actions is necessary to ensure the identification of energy-related problem areas. Data collected from building owners given in the chapters below determine the current state of the facilities. It also provides the information needed to specify the energy profile of the buildings. In addition, it defines the measures and actions that were taken to implement the pilot action.
The aim of the document is presentation of plan preparatory activities to investment for the PA. This document describes activities as part of the tasks undertaken for each pilot action.

PILOT ACTION - **PA3. Zero-energy public buildings in Zlin Region (CZ) - HOLESOV**

2. Description of the PA building(s)

The description of the building provides basic building and administrative information. It allows to determine the location and the prevailing geographical conditions, the surroundings of the building. In addition, construction data is an example for similar construction solutions.

Type of building: Grammar school
Owner / investor: Zlín region
Year of construction: 1902
Year of use (if different from year of construction): -
Gross building area [m^2]: 4 948,1
Building volume [m^3]: 22 878,3
Building envelope total surface area [m^2]: 7 082,7
Shape factor (A/V ratio) [m^{-1}]: 0,31
The shape factor A/V is the ratio of the total surface area of all external walls (including windows and doors), roofs, floors on the ground or ceilings over the unheated basement, ceilings above the crossings, separating the heated part of the building from outside air to the volume of the heated part of the building, increased by the volume of heated rooms in the utility attic or in the basement and reduced by the volume of separate staircases, elevator shafts, open recesses, loggias and galleries.
It is best if the building shape factor is as low as possible. This means that the building should be as compact as possible, similar in shape to a sphere or cube, that is, solids characterized by the lowest A/V ratio. Considering energy consumption, a building with a high A/V ratio "consumes" more energy.
Typology (number of floors): 4
Number of building users: 408 students + 33 teachers and other staff
Location: Holesov is situated in the north part of the Zlín region cca 20 km far from Zlín.

Available technical documentation: (●) **Yes** ( ) **No**

Energy audit Year: 2017

Technical drawings Year: 2015

Building project for thermo-modernization of the building Year: 2017

Figure 1: Photo of building available for the PA3 – Holesov (source: Energy Agency of the Zlín Region).

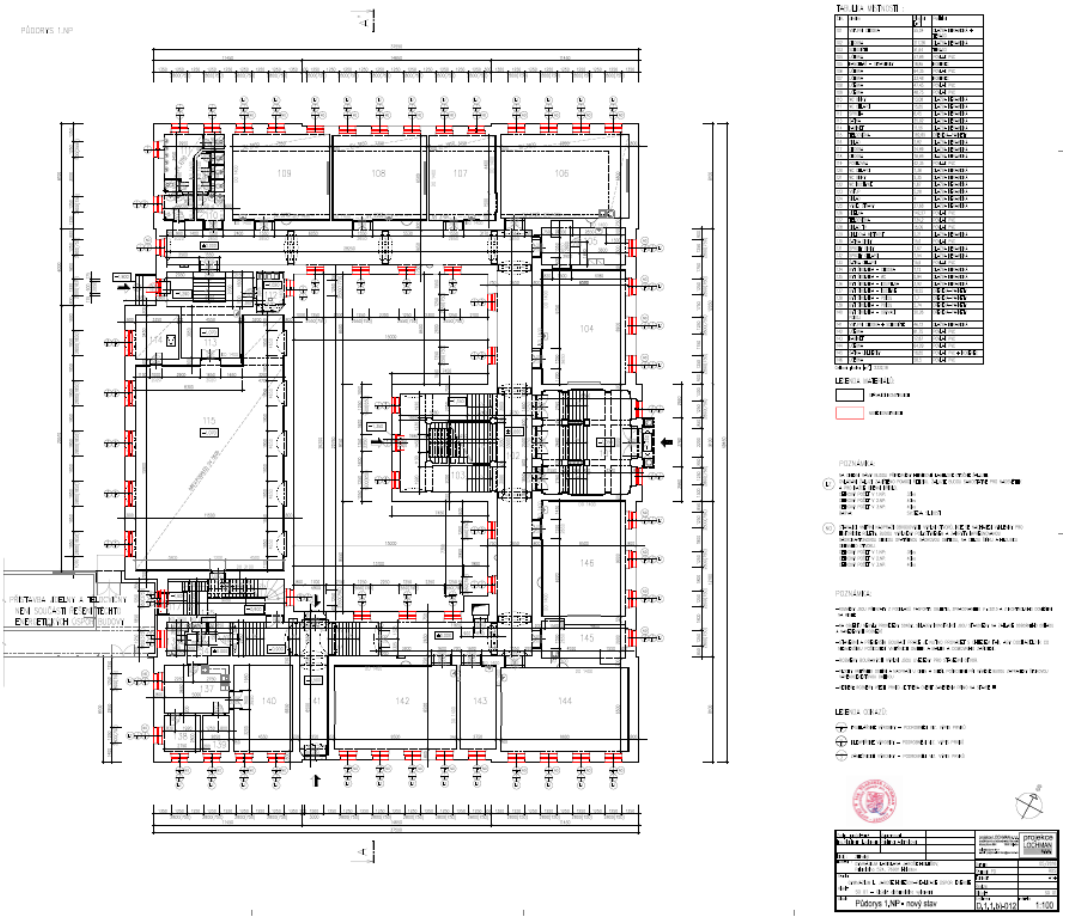


Figure 2: Typology of building available for the PA3 – Holesov (source: Energy Agency of the Zlín Region).

3. Energy PA building(s) profile

Collecting energy data allows to determine the energy profile of the building. It provides information on the insulation of external partitions and the condition of energy systems (heating/cooling, ventilation, electricity, hot water preparation) in buildings.

3.1. External partitions

The technical and construction status of the building envelope influences significantly the heat loss to the environment. The used construction and thermal insulation material is important. In order to improve standards, a norm, regulation is established for each partition in each country. For existing buildings in the case of low insulation, it is recommended to carry out thermo-modernization.

3.1.1. External walls

Walls total surface area [m^2]: 2 863,2

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^2K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^2K][1]
WALL type 1					
1	Lime-cast	0,03	0,88	1,1	0,3 required/0,25 recommended
2	Full brick	0,6	0,78		
3	Lime-cement-cast	0,03	0,66		
WALL type 2					
1	Lime-cast	0,03	0,88	0,94	0,3 required/0,25 recommended
2	Full brick	0,75	0,78		
3	Lime-cement-cast	0,03	0,66		

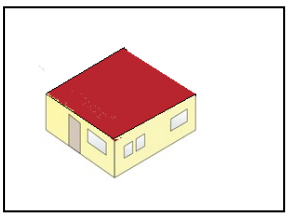
Thermo-modernization of the fasade is not possible because the building is ”listed “(must be preserved).

3.1.2. Roof

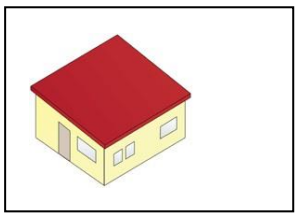
Type of roof:

[1] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

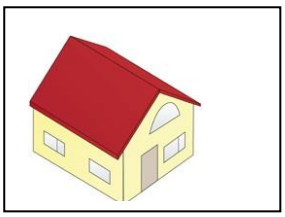
☐ Flat roof



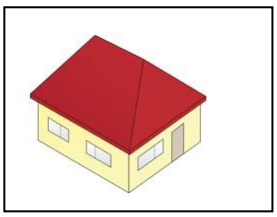
☐ Pent roof



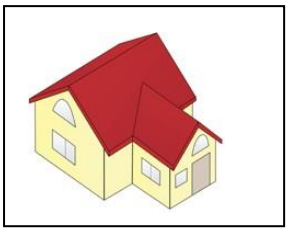
☐ Gable roof



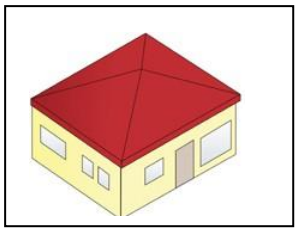
☐ Hip roof



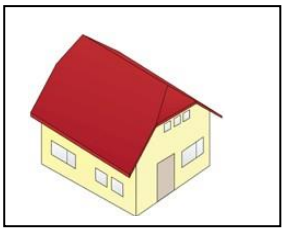
☒ Multi-hip roof



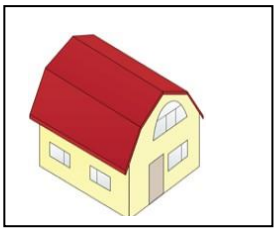
☐ Tented roof



☐ Half-hipped roof



☐ Mansard roof



Roof slope [°]**:** no data **in direction:** no data
Roof total surface area [m^2]: 593 m^2 (STR1) + 672 m^2 insulated (SCH1)

Envelope material (different layers): STR1

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m^{2}K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m^{2}K]
1	Lime-cast	0,01	0,88	0,177 after heat insulation	0,3 required/0,2 recommended
2	Wood	0,025	0,18		
3	Air space	0,22			
4	wood	0,025	0,18		
5	Gravel	0,15	0,58		
6	Full brick	0,065	0,78		

Thermo-modernization (if carried out)
Year: 2018
Applied thermal insulation material: mineral wool
Thickness [cm]: 22
Thermal conductivity [W/mK]: 0,035

Envelope material (different layers): SCH1 – only layers that improve thermal conductivity

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m^{2}K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m^{2}K]
1	Plasterboard	0,0125	0,22	0,141 after heat insulation	0,24 required/ 0,16 recommended
2	Plastic film	0,005	0,35		

Thermo-modernization (if carried out)
Year: 2018
Applied thermal insulation material: mineral wool
Thickness [cm]: 36
Thermal conductivity [W/mK]: 0,035

3.1.3. Ground floor

Floor total surface area [m^2]: -
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1					

3.1.4. Basement ceiling (if the building has a basement)

Total surface area [m^2]: 839,9 m^2 (PDL1) + 703,2 m^2 (PDL2)

Envelope material (different layers): PDL1

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^2K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^2K]
1	Ceramic tile	0,02	1,01	0,362	0,45 required/0,3 recommended
2	Concrete	0,05	1,1		
3	Asphalt strap	0,003	0,21		
4	Concrete	0,15	1,1		
5	Gravel	0,1	0,58		

Envelope material (different layers): PDL2

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^2K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^2K]
1	Ceramic tile	0,02	1,01	1,097	1,05 required/0,7 recommended
2	Concrete	0,05	1,1		
3	Gravel	0,2	0,58		
4	Full brick	0,15	0,73		

Basement
Is the basement heated ? ☐ **Yes** ☒ **No**

Basement walls total surface area [m^2]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^2K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^2K]
1					

3.1.5. Windows

Type:
☐ single window, single glazed
☐ combined window, double glazed
☐ combined window, three panes
☐ single-frame window, double low-emission glass, argon chamber
☐ single-frame window, three glass panes, two (external) glasses are made of ordinary glass, and the inner glass of low-emission glass, the chambers between the glasses are filled with argon
☐ single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
☒ other (what ?) ……combined window, single glazed……..

Shading (sun protection):
☒ curtains
☐ roller shutters
☐ wooden shutters
☐ internal blinds
☐ awnings
☐ other (what ?) ……

Material (PVC, wood, aluminum, wood-aluminum): Wood
Number of windows: all
Windows total surface area [m^2]:
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m^2K]: 2,35
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 1,5 requested/1,2 recommended

Thermo-modernization (if carried out)
Year: 2018
Type of windows: single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
Material: Wood
Number of windows (if all windows are not replaced on the new ones): 264
Windows total surface area [m^2]: 677,91
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m^2K]: 0,9

3.1.6. Doors

Material (wood, aluminum, PVC etc.): Aluminium
Number of doors: 3
Doors total surface area [m^2]: 32,6
Heat transfer coefficient [W/m^2K]: 3,5
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 3,5 requested/2,3 recommended

Thermo-modernization (if carried out)
Year: 2018
Material: Wood
Number of doors (if all doors are not replaced on the new ones): just one door
Doors total surface area [m^2]: 4,3
Heat transfer coefficient [W/m^2K]: 1,08

3.2. Systems energy data

High efficiency of energy systems and the type of energy source determines its consumption. Also important is the issue of installed control and control systems that help ensure optimal thermal conditions. Energy parameters characterizing the building:
Total non renewable primary energy demand [GJ/year or kWh/year]: 1 181 563 kWh/year after investment
Energy consumption (heating) [GJ/year or kWh/year]: 2 400 GJ/year before, 1 807,5 GJ/year after
Efficiency of the heating system [%]: 88
Energy consumption (hot water preparation) [GJ/year or kWh/year]: 579 GJ/year
Efficiency of the hot water preparation system [%]: 88 the same as efficiency of the heating system
Energy consumption (cooling) [GJ/year or kWh/year]: no cooling system
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): natural gas boiler
Regulation and control of systems in the building:
☒ thermostatic valves
☒ heat dividers
☐ motion sensors
☐ electricity meters
☐ water meters
☐ other (what ?)……
Annual fuel consumption [kg or m^3 or kWh or GJ]: 3207 GJ before the investment, 2610,5 GJ after investment
Electricity consumption [kWh/year]: 63 333 kWh
Ordered power [MW]: -
Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps
Power of light bulbs [W]: fluorescent tubes 40-200 W
Number of lighting points: -
Ventilation type (according to the table 1): natural ventilation

Ventilation type	Short description
Natural ventilation	based on natural processes occurring in the environment (using gravity)

Mechanical (forced) ventilation	air exchange is due to the operation of an electric motor driven ventilator. Using the mechanism gives us the ability to control the system
Mechanical ventilation with heat recovery	operates on the principle of mechanical ventilation extended by a recuperator responsible for the recovery of heat from exhaust air from the building
Hybrid ventilation	combination of natural and mechanical ventilation. This system works alternately depending on atmospheric conditions, using natural forces due to the difference in temperature and external air movement (wind) and the mechanics of the fan in the ventilation duct improving the ventilation conditions in case of need
Mixing (blasting) ventilation	based on mixing the contaminated air in the building with clean air and expelling it out. Fresh air flows through the air diffuser system
Displacement ventilation	based on the separation of the two zones (the lower zone to about 1.1 m (sitting position) or the 1.8 m (standing position) and the upper part) in which the different characteristics of the air will be felt

Table 1: Description of type ventilation.

Building energy profile

The energy consumption in construction is distinguished by three types of energy - primary energy (EP), final energy (EK) and utility energy (EU). Primary energy refers to the energy contained in sources, including fuels and carriers, necessary to cover the final energy demand, taking into account the efficiency of the entire chain of acquisition, conversion and transport to the end user. A concept that is important from the point of view of a sustainable development strategy. The ratio of non-renewable primary energy inputs to the generation and delivery of an energy or energy carrier for technical systems is the difference between primary energy and final energy. The final energy is heat and auxiliary energy, which must be delivered to the boundary of the heating system (building) with a given efficiency in order to cover the energy demand for heating and ventilation of rooms. A concept that is important from the point of view of the building's user who incurs costs related to the operation of the building. The efficiency of the system is a conversion of final energy into utility energy. The utility energy concerns energy for heating and ventilation as well as for preparing domestic hot water, regardless of the type and efficiency of the heating device. A concept that is important from the designer's point of view, characterizing thermal insulation and building tightness. The concepts are presented below.

$$EU \xrightarrow{\eta} EK \xrightarrow{w_i} EP$$

Annual demand for non renewable primary energy EP [kWh/m²/year]

Non renewable primary energy demand for heating	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation	Non renewable primary energy demand for preparation of hot water	Non renewable primary energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
177	0	0	23	39	239

Annual final energy demand EK [kWh/m²/year]

Final energy demand for heating	Final energy demand for cooling	Final energy demand for ventilation	Final energy demand for preparation of hot water	Final energy demand for electricity	Sum (1+2+3+4+5)

1	2	3	4	5	6
177	0	0	23	42	242

Annual utility energy demand EU [kWh/m²/year]

Utility energy demand for heating	Utility energy demand for cooling	Utility energy demand for ventilation	Utility energy demand for preparation of hot water	Utility energy demand for electricity	Sum (1+2+3+4+5)
1	2	3	4	5	6
147	0	0	21	13	181

Energy class of the building (according to the table 2): D average energy-intensive building
The EU indicator is a building quality indicator. In general, the smaller the EU, the less energy we lose through the outer baffles of the building. It refers to the energy which is consumed and goes from the building's heating system to the individual rooms, and the heat loss (through penetration and ventilation) to the environment. The EU indicator value in the table below includes only heating/cooling.

Energy class	Energy assessment	EU indicator [kWh/m²/year]
A++	zero-energy building	≤ 10
A+	passive building	up to 15
A	low-energy building	from 15 to 45
B	energy-saving building	from 45 to 80
C	average energy efficient building	from 80 to 100
D	average energy-intensive building	from 100 to 150
E	energy-consuming building	from 150 to 250
F	high-energy consuming building	over 250

Table 2: Building energy class (source: Association for Sustainable Development).

Electricity price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]: 1 528 CZK per month with tax
Variable fee [per kWh]: 4,34 CZK per kWh with tax in high tariff (8 am-4 pm) and 1,98 CZK/kWh low tariff(from 4 pm-8 am)
Subscription [per month]: -

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per GJ]: Overall price is 846 CZK/MWh with tax (235 CZK/GJ). All parts of price depend on the consumption.
Subscription [per month]:

Summary and evaluation of the energy building status
The external walls do not meet the technical requirements in terms of the value of heat transfer coefficient, but the façade is ”listed “(must be preserved). The thermo-modernization in 2018 includes the replacement of window and door joinery and roof insulation. The modernization caused that windows and doors are characterized by low heat transfer coefficient consistent with the legal regulations.
The building's energy system includes the heating system, the hot water preparation system and the power system. The efficiency of the heating system and the preparation of hot water is high (88%). In total, the

building uses annually 890 832 kWh, 75% of which is for heating despite installed thermostatic valves. The energy class classifies it as an average energy intensive building. After completing the investment, the total energy consumption will be 726 249 kWh/year, 69% of which will be for heating.
The building is not equipped with cooling systems and ventilation is done through windows and ventilation ducts.

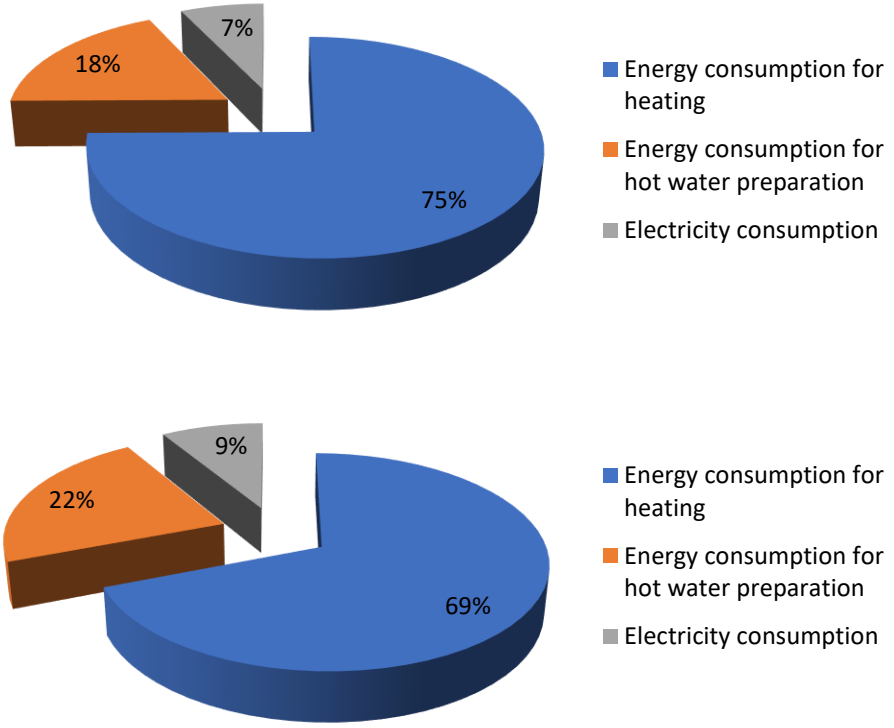


Figure 3: Energy consumption balance of the building for the PA3 – HOLESOV (before and after)

4. Definition of the required resources to run the investment

This chapter describes the measures and activities that were implemented to start the investment in the appropriate order and assign a time schedule and costs. These are only preparatory activities to undertake investment.
The steps that were taken in order to prepare an investment or to carry out other activities are presented in the appropriate order.

PA3 - Holesov						
No.	Preparatory work	Preparatory work description	Time schedule	Cost (EUR)	Market research	Selected external expert
1	Preparation	Based on energy management of the building and possibility of donation Zlín region	2015	-	DONE	EAZK and Zlín region

		decided that Grammar school Holesov will be prepared for the Windows changing and heat insulation of the roof				
2	Project blueprints	Zlín region order the blueprints necessary for the further progress of the project.	9/2015-10/2017	18300	DONE	LOCHMANN
3	Energy audit	EAZK supported Energy expert with all necessary data related to the project	12/2014-12/2016	3500	DONE	TESPORA
4	Donation application	EAZK prepared donation application	8/2016-11/2016	0	DONE	EAZK
5	Public procurement	EAZK prepared blueprints for the public procurement	10/2017-01/2018	3000	DONE	RTS
6	Realization of windows changing and roof insulation	Whole realization will be done during summer holidays	06/2018-09/2018	590000	NOT STARTED	JAVORNIK-CZ-PLUS
7	Evaluation of realization	EAZK continuously collect data to be able to evaluate the project	10/2018	0	NOT STARTED	EAZK
8	Evaluation of the project	EAZK continuously collect data to be able to evaluate the project	10/2019	0	NOT STARTED	EAZK

Table 3: Time schedule and cost estimate of preparatory activities in the PA3 Holesov.

Table 4 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results.

	2018												2019												2020				
Month	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Project month	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
PA3																													

Table 4: PA3 Holesov Activities plan.

start of WPT3 | PA preparations | PA implementation | PA monitoring/evaluation | end of WPT3

Explanation:

PA preparations – A set of activities that are used to initiate the right investment, such as the selection of experts, contractors, collecting data and information, and other administrative work.

PA implementation – A set of activities like installation of equipment, systems, implementation of the OnePlace platform, promotional activities.

PA monitoring/evaluation – Checking whether the expected results are received.

PILOT ACTION - **PA3. Zero-energy public buildings in Zlin Region (CZ) - KROMERIZ basic school**

2. Description of the PA building(s)

The description of the building provides basic building and administrative information. It allows to determine the location and the prevailing geographical conditions, the surroundings of the building. In addition, construction data is an example for similar construction solutions.

Type of building: Primary school
Owner / investor: Zlín region
Year of construction: 1886
Year of use (if different from year of construction): 1887
Gross building area [m^2]: 3 406,2
Building volume [m^3]: 9 055,7
Building envelope total surface area [m^2]: 2 143,19
Shape factor (A/V ratio) [m^{-1}]: 0,38
The shape factor A/V is the ratio of the total surface area of all external walls (including windows and doors), roofs, floors on the ground or ceilings over the unheated basement, ceilings above the crossings, separating the heated part of the building from outside air to the volume of the heated part of the building, increased by the volume of heated rooms in the utility attic or in the basement and reduced by the volume of separate staircases, elevator shafts, open recesses, loggias and galleries.
It is best if the building shape factor is as low as possible. This means that the building should be as compact as possible, similar in shape to a sphere or cube, that is, solids characterized by the lowest A/V ratio. Considering energy consumption, a building with a high A/V ratio "consumes" more energy.
Typology (number of floors): 3
Number of building users: 50 children + 11 teachers
Location: City of Kromeriz is situated in the northwest part of the Zlín region cca 30 km far from Zlín.

Available technical documentation: (•) **Yes** ( ) **No**

Energy audit Year: 2016

Technical drawings Year: 2015

Building project for thermo-modernization of the building Year: 2015

Figure 4: Photo of building available for the PA3 – Practical school Kroměříž (source: Energy Agency of the Zlín Region).

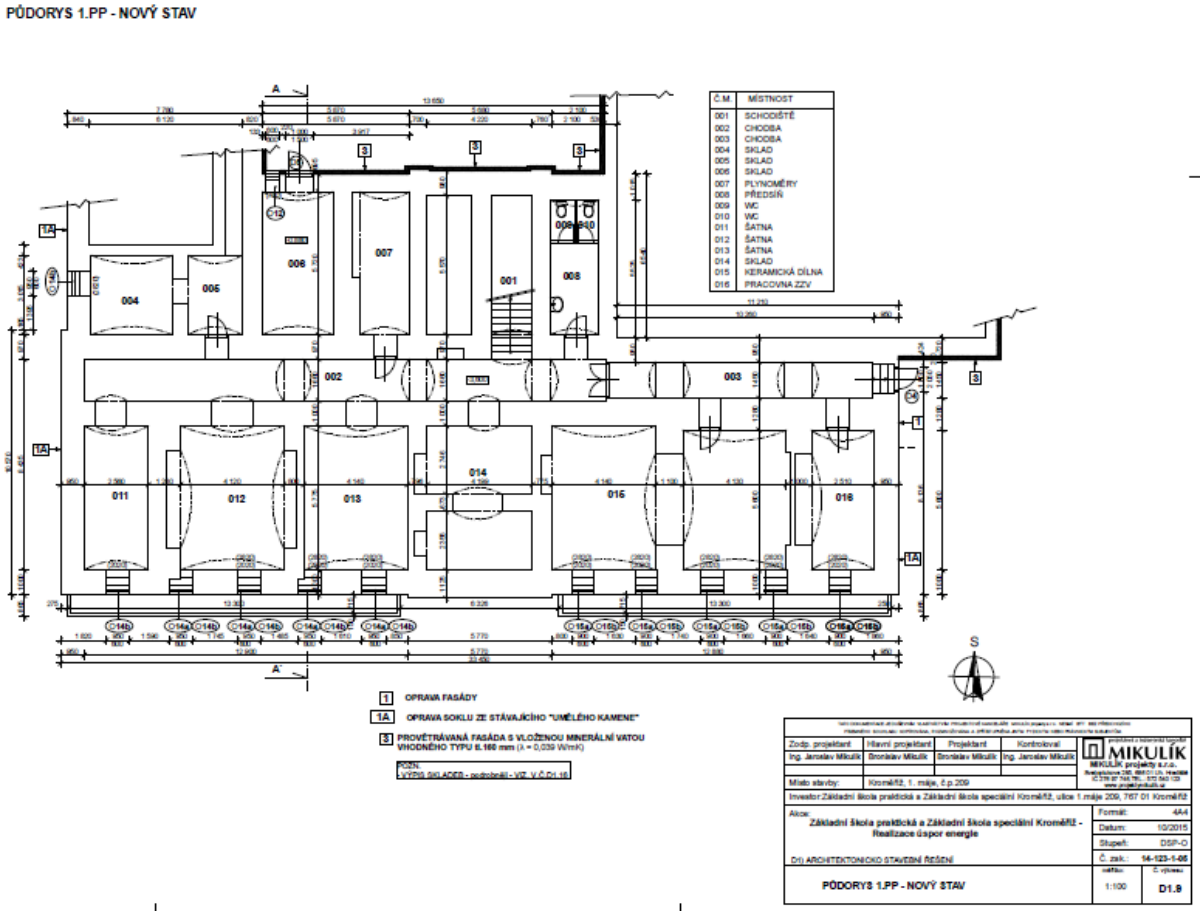


Figure 5: Typology of building available for the PA3 – Practical school Kroměříž (source: Energy Agency of the Zlín Region).

3. Energy PA building(s) profile

Collecting energy data allows to determine the energy profile of the building. It provides information on the insulation of external partitions and the condition of energy systems (heating/cooling, ventilation, electricity, hot water preparation) in buildings.

3.1. External partitions

The technical and construction status of the building envelope influences significantly the heat loss to the environment. The used construction and thermal insulation material is important. In order to improve standards, a norm, regulation is established for each partition in each country. For existing buildings in the case of low insulation, it is recommended to carry out thermo-modernization.

3.1.1. External walls

Walls total surface area [m^2]: 1 762,9

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K][2]
WALL type 1					
1	Lime-cast	0,03	0,88	0,218- insulated	0,3 required/0,25 recommended
2	Full brick	0,6	0,78		
3	Limecement cast	0,03	0,99		
4	EPS/MW	0,16	0,039		
WALL type 2					
1	Lime-cast	0,03	0,88	0,225- insulated	0,3 required/0,25 recommended
2	Full brick	0,45	0,78		
3	Limecement cast	0,03	0,99		
4	EPS/MW	0,16	0,039		
WALL type 3					
1	Lime-cast	0,03	0,88	1,096 – historical part - “must be preserved”	0,3 required/0,25 recommended
2	Full brick	0,75	0,78		
3	Limecement cast	0,03	0,99		
WALL type 4					
1	Lime-cast	0,03	0,88	1,333 – historical part - “must be preserved”	0,3 required/0,25 recommended
2	Full brick	0,6	0,78		
3	Limecement cast	0,03	0,99		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: EPS + mineral wool
Thickness [cm]: 16
Thermal conductivity [W/mK]: 0,039

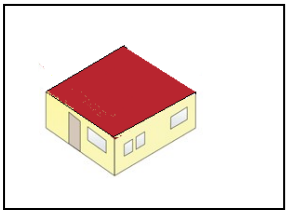
Thermo-modernization of the fasade is not possible because the building is ”listed “(must be preserved).

[2] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

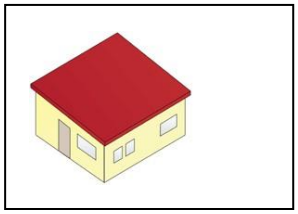
3.1.2. Roof

Type of roof:

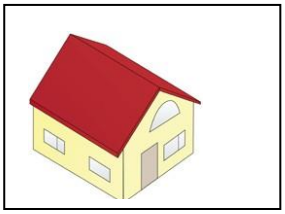
☐ Flat roof



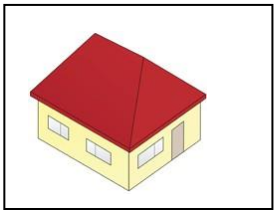
☐ Pent roof



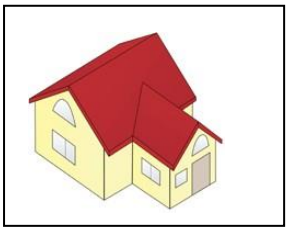
☐ Gable roof



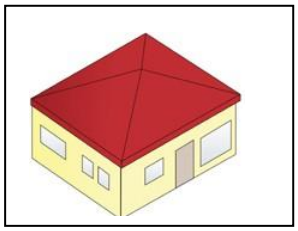
☐ Hip roof



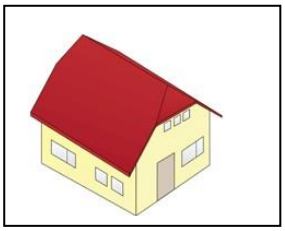
☒ Multi-hip roof



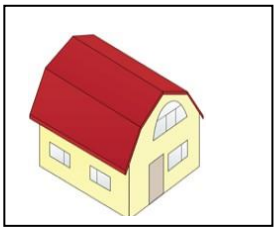
☐ Tented roof



☐ Half-hipped roof



☐ Mansard roof



Roof slope [°]**:** no data **in direction:** no data
Roof total surface area [m^2]: 662,3
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m^2K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m^2K]
1	Lime-cast	0,02	0,88	0,169 after heat insulation	0,3 required/0,2 recommended
2	Wood	0,025	0,18		
3	Air space	0,22			
4	wood	0,025	0,18		
5	Gravel	0,1	0,27		
6	Full brick	0,06	0,78		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 24
Thermal conductivity [W/mK]: 0,039

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m^2K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m^2K]
1	wood	0,025	0,15	0,158	0,24 required/ 0,16 recommended
2	CP spray	0,05	0,043		

3	Pste board	0,5	0,08		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 24
Thermal conductivity [W/mK]: 0,039

3.1.3. Ground floor

Floor total surface area [m^2]: 687,2
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1	Ceramic tile	0,02	1,01	1,489 (0,252 eqvivalent)	0,45 required/ 0,3 recommended
2	Concrete	0,05	1,1		
3	Asphalt strap	0,005	0,21		
4	Concrete	0,1	1,1		
5	Gravel	0,2	0,58		

3.1.4. Basement ceiling (if the building has a basement)

Total surface area [m^2]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1					

Basement
Is the basement heated ? ☐ **Yes** ☒ **No**
Basement walls total surface area [m^2]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^2K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^2K]
1					

3.1.5. Windows

Type:
☐ single window, single glazed
☐ combined window, double glazed
☐ combined window, three panes
☐ single-frame window, double low-emission glass, argon chamber
☐ single-frame window, three glass panes, two (external) glasses are made of ordinary glass, and the inner glass of low-emission glass, the chambers between the glasses are filled with argon
☐ single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
☒ other (what ?) ……..combined window, single glazed……..

Shading (sun protection):
☒ curtains
☐ roller shutters
☐ wooden shutters
☐ internal blinds
☐ awnings
☐ other (what ?) ……..

Material (PVC, wood, aluminum, wood-aluminum): Wood
Number of windows: 116
Windows total surface area [m^2]: 251,2
Diffusers in windows (YES or NO): No
Heat transfer coefficient [W/m^2K]: 2,35
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 1,5 requested/1,2 recommended

Thermo-modernization (if carried out)
Year: 2017
Type of windows: single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
Material: Wood
Number of windows (if all windows are not replaced on the new ones): 114
Windows total surface area [m^2]: 245,2
Diffusers in windows (YES or NO): no
Heat transfer coefficient [W/m^2K]: 0,9

3.1.6. Doors

Material (wood, aluminum, PVC etc.): Wood
Number of doors:5
Doors total surface area [m^2]: 19,3
Heat transfer coefficient [W/m^2K]: 4,5
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 3,5 requested/2,3 recommended

Thermo-modernization (if carried out)
Year: 2017
Material: Wood
Number of doors (if all doors are not replaced on the new ones): 2
Doors total surface area [m^2]: 3,6
Heat transfer coefficient [W/m^2K]: 1,2

3.2. Systems energy data

High efficiency of energy systems and the type of energy source determines its consumption. Also important is the issue of installed control and control systems that help ensure optimal thermal conditions. Energy parameters characterizing the building:
Total non renewable primary energy demand [GJ/year or kWh/year]: 353 348 kWh/year after investment
Energy consumption (heating) [GJ/year or kWh/year]: 833,6 GJ/year before, 516,1 GJ/year after
Efficiency of the heating system [%]: 88
Energy consumption (hot water preparation) [GJ/year or kWh/year]: 64,2 GJ/year
Efficiency of the hot water preparation system [%]: 75
Energy consumption (cooling) [GJ/year or kWh/year]: no cooling system
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): natural gas boiler for heat and natural gas boiler for hot water
Regulation and control of systems in the building:
☒ thermostatic valves
☐ heat dividers
☐ motion sensors
☐ electricity meters
☐ water meters
☐ other (what ?)……
Annual fuel consumption [kg or m^3 or kWh or GJ]: 897,8 GJ/year before the investment, 580,34 GJ/year after investment
Electricity consumption [kWh/year]: 17 100
Ordered power [MW]: -
Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps
Power of light bulbs [W]: fluorescent tubes 40-200 W
Number of lighting points: -
Ventilation type (according to the table 1): natural ventilation

Building energy profile
The energy consumption in construction is distinguished by three types of energy - primary energy (EP), final energy (EK) and utility energy (EU). Primary energy refers to the energy contained in sources, including fuels and carriers, necessary to cover the final energy demand, taking into account the efficiency of the entire chain of acquisition, conversion and transport to the end user. A concept that is important from the point of view of a sustainable development strategy. The ratio of non-renewable primary energy inputs to the generation and delivery of an energy or energy carrier for technical systems is the difference between primary energy and final energy. The final energy is heat and auxiliary energy, which must be delivered to the boundary of the heating system (building) with a given efficiency in order to cover the energy demand for heating and ventilation of rooms. A concept that is important from the point of view of the building's user who incurs costs related to the operation of the building. The efficiency of the system is a conversion of final energy into utility energy. The utility energy concerns energy for heating and ventilation as well as

for preparing domestic hot water, regardless of the type and efficiency of the heating device. A concept that is important from the designer's point of view, characterizing thermal insulation and building tightness. The concepts are presented below.

$$EU \xrightarrow{\eta} EK \xrightarrow{w_i} EP$$

Annual demand for non renewable primary energy EP [kWh/m²/year]

Non renewable primary energy demand for heating	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation	Non renewable primary energy demand for preparation of hot water	Non renewable primary energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
127	0	0	12	24	165

Annual final energy demand EK [kWh/m²/year]

Final energy demand for heating	Final energy demand for cooling	Final energy demand for ventilation	Final energy demand for preparation of hot water	Final energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
129	0	0	12	26	167

Annual utility energy demand EU [kWh/m²/year]

Utility energy demand for heating	Utility energy demand for cooling	Utility energy demand for ventilation	Utility energy demand for preparation of hot water	Utility energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
112	0	0	11	8	131

Energy class of the building (according to the table 2): D average energy-intensive building
The EU indicator is a building quality indicator. In general, the smaller the EU, the less energy we lose through the outer baffles of the building. It refers to the energy which is consumed and goes from the building's heating system to the individual rooms, and the heat loss (through penetration and ventilation) to the environment. The EU indicator value in the table below includes only heating/cooling.

Electricity price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]: 628 CZK per month with tax
Variable fee [per kWh]: 4,73 CZK per kWh
Subscription [per month]: -

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per GJ]: basically all fees are depended on the consumption the price is 429 CZK/MWh for the natural gas
Subscription [per month]:

Summary and evaluation of the energy building status

The external walls partly do not meet the technical requirements in terms of the value of heat transfer coefficient, but the façade is ”listed “(must be preserved). The thermo-modernization in 2017 included the replacement of window and door joinery, roof and walls insulation. The modernization caused that windows and doors are characterized by low heat transfer coefficient consistent with the legal regulations.
The building's energy system includes the heating system, the hot water preparation system and the power system. The efficiency of the heating system and the preparation of hot water is high (88% and 75% respectively). In total, the building uses annually 266 488 kWh, 87% of which is for heating despite installed thermostatic valves. The energy class classifies it as an average energy intensive building. After completing the investment, the total energy consumption will be 178 294 kWh/year, 80% of which will be for heating.
The building is not equipped with cooling systems and ventilation is done through windows and ventilation ducts.

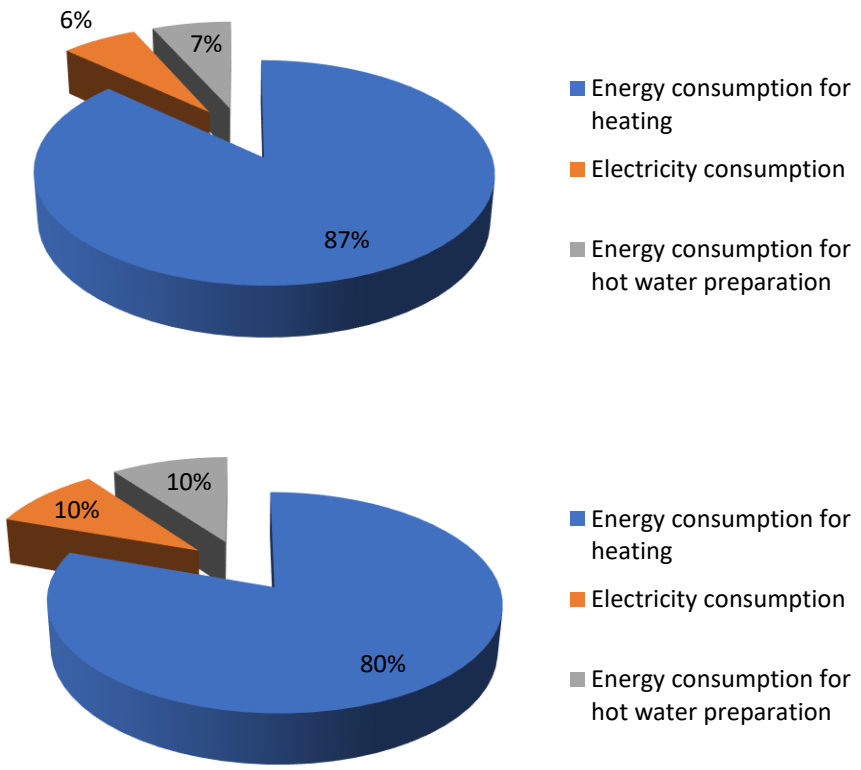


Figure 6: Energy consumption balance of the building for the PA3 – KROMERIZ basic school (before and after)

4. Definition of the required resources to run the investment

This chapter describes the measures and activities that were implemented to start the investment in the appropriate order and assign a time schedule and costs. These are only preparatory activities to undertake investment.
The steps that were taken in order to prepare an investment or to carry out other activities are presented in the appropriate order.

PA3 – Kromeriz						
No.	Preparatory work	Preparatory work description	Time schedule	Cost (EUR)	Market research	Selected external expert
1	Preparation	Based on energy management of the building and possibility of donation Zlín region decided that this school will be prepared for the Windows changing and heat insulation of the roof and heat insulation o the nonhistorical wall	2015	-	DONE	EAZK and Zlín region
2	Project blueprints	Zlín region order the blueprints necessary for the further progress of the project.	09/2015-08/2016	13 300	DONE	Mikulik
3	Energy audit	EAZK supported Energy expert with all necessary data related to the project	02/2016-03/2016	600	DONE	TESPORA
4	Donation application	EAZK prepared donation application	03/2016	-	DONE	EAZK
5	Public procurement	EAZK prepared blueprints for the public procurement	08/2016-10/2016	2900	DONE	RTS
6	Realization of windows changing and roof insulation and nonhistorical wall heat insulation	Whole realization was done during summer holidays	04/2017-08/2017	500 162	DONE	PTACEK-pozemni stavby
7	Evaluation of realization	EAZK continuously collect data to be able to evaluate the project	06/2018	0	NOT STARTED	EAZK
8	Evaluation of the project	EAZK continuously collect data to be able to evaluate the project	10/2019	0	NOT STARTED	EAZK

Table 5: Time schedule and cost estimate of preparatory activities in the PA3 Kromeriz basic school.

Table 6 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results.

	2018												2019												2020				
Month	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Project month	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
PA3																													

Table 6: PA3 Kromeriz basic school - Activities plan.

start of WPT3	PA preparations	PA implementation	PA monitoring/evaluation	end of WPT3

Explanation:

PA preparations – A set of activities that are used to initiate the right investment, such as the selection of experts, contractors, collecting data and information, and other administrative work.

PA implementation – A set of activities like installation of equipment, systems, implementation of the OnePlace platform, promotional activities.

PA monitoring/evaluation – Checking whether the expected results are received.

PILOT ACTION - **PA3. Zero-energy public buildings in Zlin Region (CZ) - KROMERIZ secondary pedagogical and social school**

2. Description of the PA building(s)

The description of the building provides basic building and administrative information. It allows to determine the location and the prevailing geographical conditions, the surroundings of the building. In addition, construction data is an example for similar construction solutions.

Type of building: Secondary school
Owner / investor: Zlín region
Year of construction: 1902
Year of use (if different from year of construction): -
Gross building area [m^2]: 5 232,4
Building volume [m^3]: 25 629,7
Building envelope total surface area [m^2]: 8 298,8
Shape factor (A/V ratio) [m^{-1}]: 0,324

The shape factor A/V is the ratio of the total surface area of all external walls (including windows and doors), roofs, floors on the ground or ceilings over the unheated basement, ceilings above the crossings, separating the heated part of the building from outside air to the volume of the heated part of the building, increased by the volume of heated rooms in the utility attic or in the basement and reduced by the volume of separate staircases, elevator shafts, open recesses, loggias and galleries.
It is best if the building shape factor is as low as possible. This means that the building should be as compact as possible, similar in shape to a sphere or cube, that is, solids characterized by the lowest A/V ratio. Considering energy consumption, a building with a high A/V ratio "consumes" more energy.
Typology (number of floors): 4
Number of building users: 180 students + 35 teachers
Location: City of Kromeriz is situated in the northwest part of the Zlín region cca 30 km far from Zlín.

Available technical documentation: (•) **Yes** ( ) **No**

Energy audit Year: 2015

Technical drawings Year: 2015

Building project for thermo-modernization of the building Year: 2015

Figure 7: Photo of building available for the PA3 – Secondary pedagogical and social school Kroměříž (source: Energy Agency of the Zlín Region).

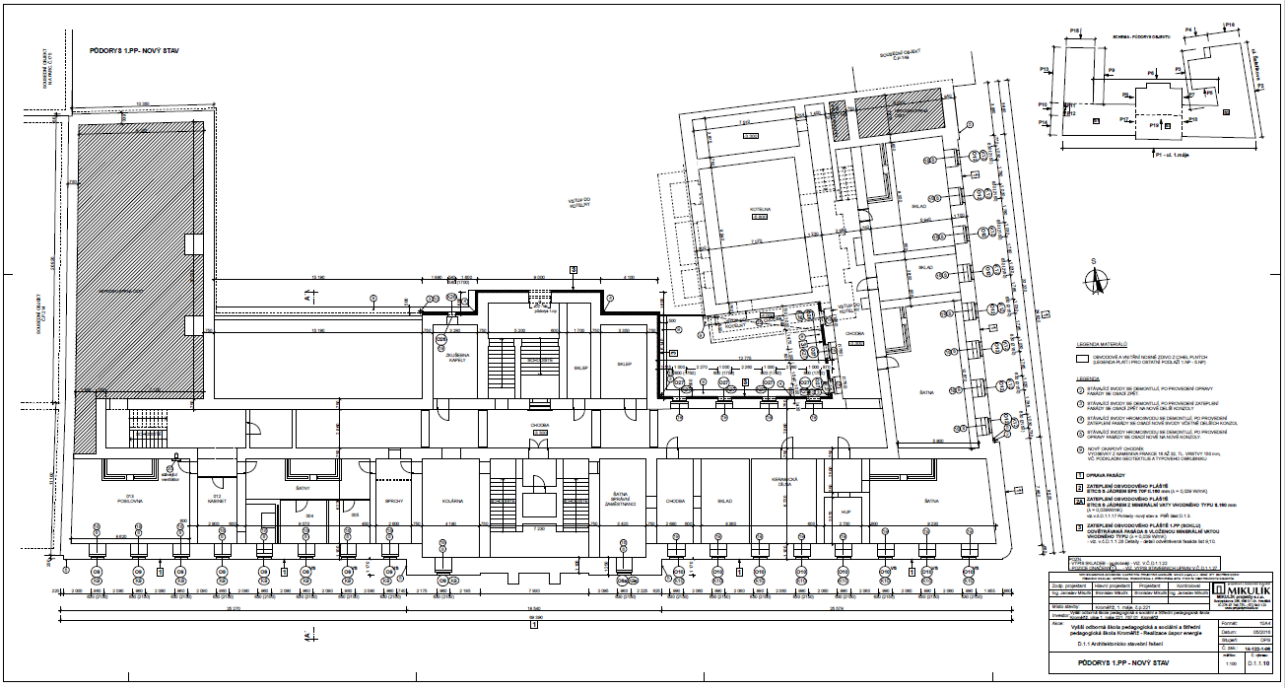


Figure 8: Typology of building available for the PA3 – Secondary pedagogical and social school Kroměříž (source: Energy Agency of the Zlín Region).

3. Energy PA building(s) profile

Collecting energy data allows to determine the energy profile of the building. It provides information on the insulation of external partitions and the condition of energy systems (heating/cooling, ventilation, electricity, hot water preparation) in buildings.

3.1. External partitions

The technical and construction status of the building envelope influences significantly the heat loss to the environment. The used construction and thermal insulation material is important. In order to improve standards, a norm, regulation is established for each partition in each country. For existing buildings in the case of low insulation, it is recommended to carry out thermo-modernization.

3.1.1. External walls

Walls total surface area [m^2]: 2 863,2

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K][3]
WALL type 1					
1	Lime-cast	0,03	0,88	0,219 - insulated	0,3 required/0,25 recommended
2	Full brick	0,45	0,78		
3	Limecement-cast	0,03	0,99		
4	EPS	0,16	0,039		
WALL type 2					
1	Lime-cast	0,03	0,88	0,225 - insulated	0,3 required/0,25 recommended
2	Full brick	0,29	0,78		
3	Limecement-cast	0,03	0,99		
4	EPS	0,16	0,039		
WALL type 3					
1	Lime-cast	0,03	0,7	0,936 – historical part	0,3 required/0,25 recommended
2	Full brick	0,6	0,73		
3	Limecement-cast	0,03	0,7		
WALL type 4					
1	Lime-cast	0,03	0,7	1,096 – historical part	0,3 required/0,25 recommended
2	Full brick	0,45	0,73		
3	Limecement-cast	0,03	0,7		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: EPS + mineral wool
Thickness [cm]: 16
Thermal conductivity [W/mK]: 0,039

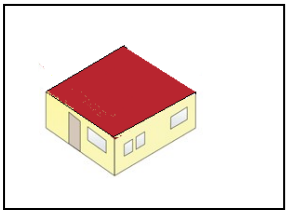
Thermo-modernization of the fasade is not possible because the building is "listed "(must be preserved).

[3] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

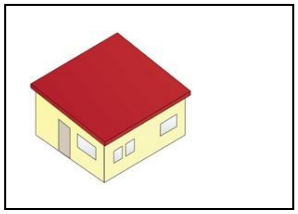
3.1.2. Roof

Type of roof:

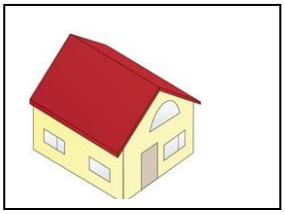
☐ Flat roof



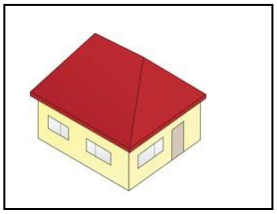
☐ Pent roof



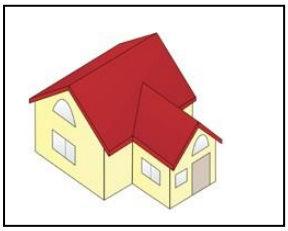
☐ Gable roof



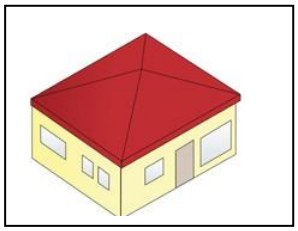
☐ Hip roof



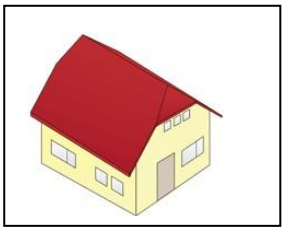
☒ Multi-hip roof



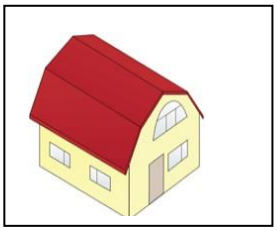
☐ Tented roof



☐ Half-hipped roof



☐ Mansard roof



Roof slope [°]**:** no data **in direction:** no data
Roof total surface area [m^2]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m^2K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m^2K]
1	Lime-cast	0,02	0,88	0,176 after heat insulation	0,3 required/0,2 recommended
2	Wood	0,025	0,18		
3	Air space	0,22			
4	wood	0,025	0,18		
5	Gravel	0,15	0,27		
6	Full brick	0,06	0,78		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 22
Thermal conductivity [W/mK]: 0,039

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m^2K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m^2K]
1	Lime-cast	0,02	0,88	0,138/0,142	0,24 required/ 0,16 recommended
2	Armoured	0,15	1,58		

	concrete				
3	wood	0,5	0,15		
4	Concrete-Gravel	0,1	0,69		
5	Asphalt	0,01	0,21		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 28
Thermal conductivity [W/mK]: 0,037

3.1.3. Ground floor

Floor total surface area [m^2]:391,2
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1	Ceramic tile	0,02	1,01	0,388	0,45 required/ 0,3 recommended
2	Concrete	0,05	1,1		
3	Asphalt strap	0,005	0,21		
4	Concrete	0,1	1,1		
5	Gravel	0,2	0,58		

3.1.4. Basement ceiling (if the building has a basement)

Total surface area [m^2]: 1 206,7
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1	Ceramic tile	0,02	1,01	0,946	1,05 required/ 0,7 recommended
2	Concrete	0,05	1,1		
3	gravel	0,1	0,21		
4	Full brick	0,15	0,73		
5	Lime-cast	0,2	0,7		

Basement
Is the basement heated ? ☐ **Yes** ☒ **No**
Basement walls total surface area [m^2]:

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K]
1					

3.1.5. Windows

Type:
☐ single window, single glazed
☐ combined window, double glazed
☐ combined window, three panes
☐ single-frame window, double low-emission glass, argon chamber
☐ single-frame window, three glass panes, two (external) glasses are made of ordinary glass, and the inner glass of low-emission glass, the chambers between the glasses are filled with argon
☐ single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
☒ other (what ?) ……combined window, single glazed……..

Shading (sun protection):
☒ curtains
☐ roller shutters
☐ wooden shutters
☐ internal blinds
☐ awnings
☐ other (what ?) ……..

Material (PVC, wood, aluminum, wood-aluminum): Wood
Number of windows: all
Windows total surface area [m²]:
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m²K]: 2,35
Defined heat transfer coefficient (according to the norm, national regulations) [W/m²K]: 1,5 requested/1,2 recommended

Thermo-modernization (if carried out)
Year: 2017
Type of windows: single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
Material: Wood
Number of windows (if all windows are not replaced on the new ones): 262
Windows total surface area [m²]: 861,6
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m²K]: 0,9

3.1.6. Doors

Material (wood, aluminum, PVC etc.): Wood
Number of doors:
Doors total surface area [m^2]: 27,6
Heat transfer coefficient [W/m^2K]: 4,5
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 3,5 requested/2,3 recommended

Thermo-modernization (if carried out)
Year: 2017
Material: Wood
Number of doors (if all doors are not replaced on the new ones): 8
Doors total surface area [m^2]: 27,6
Heat transfer coefficient [W/m^2K]: 1,2

3.2. Systems energy data

High efficiency of energy systems and the type of energy source determines its consumption. Also important is the issue of installed control and control systems that help ensure optimal thermal conditions. Energy parameters characterizing the building:
Total non renewable primary energy demand [GJ/year or kWh/year]: 896 099 kWh/year after investment
Energy consumption (heating) [GJ/year or kWh/year]: 2 394,5 GJ/year before, 1 316,8 GJ/year after
Efficiency of the heating system [%]: 89
Energy consumption (hot water preparation) [GJ/year or kWh/year]: 317,1 GJ/year
Efficiency of the hot water preparation system [%]: 89
Energy consumption (cooling) [GJ/year or kWh/year]: no cooling system
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): natural gas boiler
Regulation and control of systems in the building:
☒ thermostatic valves
☐ heat dividers
☐ motion sensors
☐ electricity meters
☐ water meters
☐ other (what ?)……
Annual fuel consumption [kg or m^3 or kWh or GJ]: 2 730,1 GJ before the investment, 1 652,4 GJ after investment
Electricity consumption [kWh/year]: 69 000
Ordered power [MW]: -
Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps
Power of light bulbs [W]: fluorescent tubes 40-200 W
Number of lighting points: -
Ventilation type (according to the table 1): natural ventilation

Building energy profile
The energy consumption in construction is distinguished by three types of energy - primary energy (EP), final energy (EK) and utility energy (EU). Primary energy refers to the energy contained in sources, including

fuels and carriers, necessary to cover the final energy demand, taking into account the efficiency of the entire chain of acquisition, conversion and transport to the end user. A concept that is important from the point of view of a sustainable development strategy. The ratio of non-renewable primary energy inputs to the generation and delivery of an energy or energy carrier for technical systems is the difference between primary energy and final energy. The final energy is heat and auxiliary energy, which must be delivered to the boundary of the heating system (building) with a given efficiency in order to cover the energy demand for heating and ventilation of rooms. A concept that is important from the point of view of the building's user who incurs costs related to the operation of the building. The efficiency of the system is a conversion of final energy into utility energy. The utility energy concerns energy for heating and ventilation as well as for preparing domestic hot water, regardless of the type and efficiency of the heating device. A concept that is important from the designer's point of view, characterizing thermal insulation and building tightness. The concepts are presented below.

$$EU \xrightarrow{\eta} EK \xrightarrow{w_i} EP$$

Annual demand for non renewable primary energy EP [kWh/m²/year]

Non renewable primary energy demand for heating	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation	Non renewable primary energy demand for preparation of hot water	Non renewable primary energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
110	0	0	22	39	171

Annual final energy demand EK [kWh/m²/year]

Final energy demand for heating	Final energy demand for cooling	Final energy demand for ventilation	Final energy demand for preparation of hot water	Final energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
110	0	0	22	42	174

Annual utility energy demand EU [kWh/m²/year]

Utility energy demand for heating	Utility energy demand for cooling	Utility energy demand for ventilation	Utility energy demand for preparation of hot water	Utility energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
100	0	0	16	13	129

Energy class of the building (according to the table 2): C average energy efficient building
The EU indicator is a building quality indicator. In general, the smaller the EU, the less energy we lose through the outer baffles of the building. It refers to the energy which is consumed and goes from the building's heating system to the individual rooms, and the heat loss (through penetration and ventilation) to the environment. The EU indicator value in the table below includes only heating/cooling.

Electricity price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]: 628 CZK per month with tax

Variable fee [per kWh]: 4,73 CZK per kWh
Subscription [per month]: -

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per GJ]: Overall price is 846 CZK/MWh with tax (235 CZK/GJ). All parts of price depend on the consumption.
Subscription [per month]:

Summary and evaluation of the energy building status
The external walls partly do not meet the technical requirements in terms of the value of heat transfer coefficient, but the façade is "listed "(must be preserved). The thermo-modernization in 2017 included the replacement of window and door joinery, roof and walls insulation. The modernization caused that windows and doors are characterized by low heat transfer coefficient consistent with the legal regulations.
The building's energy system includes the heating system, the hot water preparation system and the power system. The efficiency of the heating system and the preparation of hot water is high (89%). In total, the building uses annually 822 221 kWh, 81% of which is for heating despite installed thermostatic valves. The energy class classifies it as an average energy efficient building. After completing the investment, the total energy consumption will be 522 860 kWh/year, 70% of which will be for heating.
The building is not equipped with cooling systems and ventilation is done through windows and ventilation ducts.

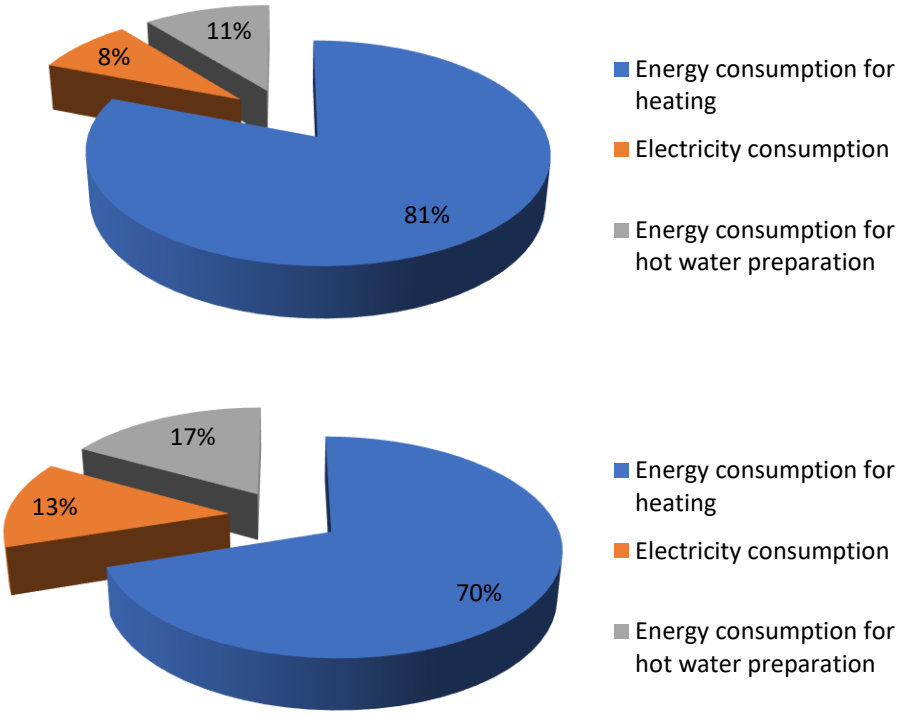


Figure 9: Energy consumption balance of the building for the PA3 – KROMERIZ secondary pedagogical and social school (before and after)

4. Definition of the required resources to run the investment

This chapter describes the measures and activities that were implemented to start the investment in the appropriate order and assign a time schedule and costs. These are only preparatory activities to undertake investment.
The steps that were taken in order to prepare an investment or to carry out other activities are presented in the appropriate order.

PA 3 - Kromeriz						
No.	Preparatory work	Preparatory work description	Time schedule	Cost (EUR)	Market research	Selected external expert
1	Preparation	Based on energy management of the building and possibility of donation Zlín region decided that this school will be prepared for the Windows changing and heat insulation of the roof and heat insulation o the nonhistorical wall	2015	-	DONE	EAZK and Zlín region
2	Project blueprints	Zlín region order the blueprints necessary for the further progress of the project.	09/2015-08/2016	35 000	DONE	Mikulik
3	Energy audit	EAZK supported Energy expert with all necessary data related to the project	02/2016-03/2016	600	DONE	TESPORA
4	Donation application	EAZK prepared donation application	03/2016	-	DONE	EAZK
5	Public procurement	EAZK prepared blueprints for the public procurement	08/2016-10/2016	3 700	DONE	RTS
6	Realization of windows changing and roof insulation and nonhistorical wall heat insulation	Whole realization was during summer holidays	11/2016-09/2017	1 161 890	DONE	PTACEK-pozemni stavby
7	Evaluation of realization	EAZK continuously collect data to be able to evaluate the project	06/2018	0	NOT STARTED	EAZK
8	Evaluation of the project	EAZK continuously collect data to be able to evaluate the project	10/2019	0	NOT STARTED	EAZK

Table 7: Time schedule and cost estimate of preparatory activities in the PA3 Kromeriz Pedagogic school

Table 8 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results.

	2018												2019												2020				
Month	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Project month	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
PA3																													

Table 8: PA3 Kromeriz Pedagogic school - Activities plan.

start of WPT3	PA preparations	PA implementation	PA monitoring/evaluation	end of WPT3

Explanation:

PA preparations – A set of activities that are used to initiate the right investment, such as the selection of experts, contractors, collecting data and information, and other administrative work.

PA implementation – A set of activities like installation of equipment, systems, implementation of the OnePlace platform, promotional activities.

PA monitoring/evaluation – Checking whether the expected results are received.

PILOT ACTION - **PA3. Zero-energy public buildings in Zlin Region (CZ) - NEM UH DORMITORY**

2. Description of the PA building(s)

The description of the building provides basic building and administrative information. It allows to determine the location and the prevailing geographical conditions, the surroundings of the building. In addition, construction data is an example for similar construction solutions.

Type of building: Hospital building - dormitory
Owner / investor: Hospital Uherske Hradiste (Zlín region is 100 % owner of the hospital)/Zlín region
Year of construction: 1972
Year of use (if different from year of construction): -
Gross building area [m^2]: 1 454,5
Building volume [m^3]: 4 653,7
Building envelope total surface area [m^2]: 8 712,23

Shape factor (A/V ratio) [m^{-1}]: 0,25

The shape factor A/V is the ratio of the total surface area of all external walls (including windows and doors), roofs, floors on the ground or ceilings over the unheated basement, ceilings above the crossings, separating the heated part of the building from outside air to the volume of the heated part of the building, increased by the volume of heated rooms in the utility attic or in the basement and reduced by the volume of separate staircases, elevator shafts, open recesses, loggias and galleries.

It is best if the building shape factor is as low as possible. This means that the building should be as compact as possible, similar in shape to a sphere or cube, that is, solids characterized by the lowest A/V ratio. Considering energy consumption, a building with a high A/V ratio "consumes" more energy.

Typology (number of floors): 4

Number of building users: 21 flats

Location: Hospital Uherske Hradiste is situated in the southwest part of the Zlín region cca 30 km from the Zlín.

Available technical documentation: (•) **Yes** ( ) **No**

Energy audit Year: 2016

Technical drawings Year: 2016

Building project for thermo-modernization of the building Year: 2016

Figure 10: Photo of building available for the PA3 – Dormitory (source: Energy Agency of the Zlín Region).

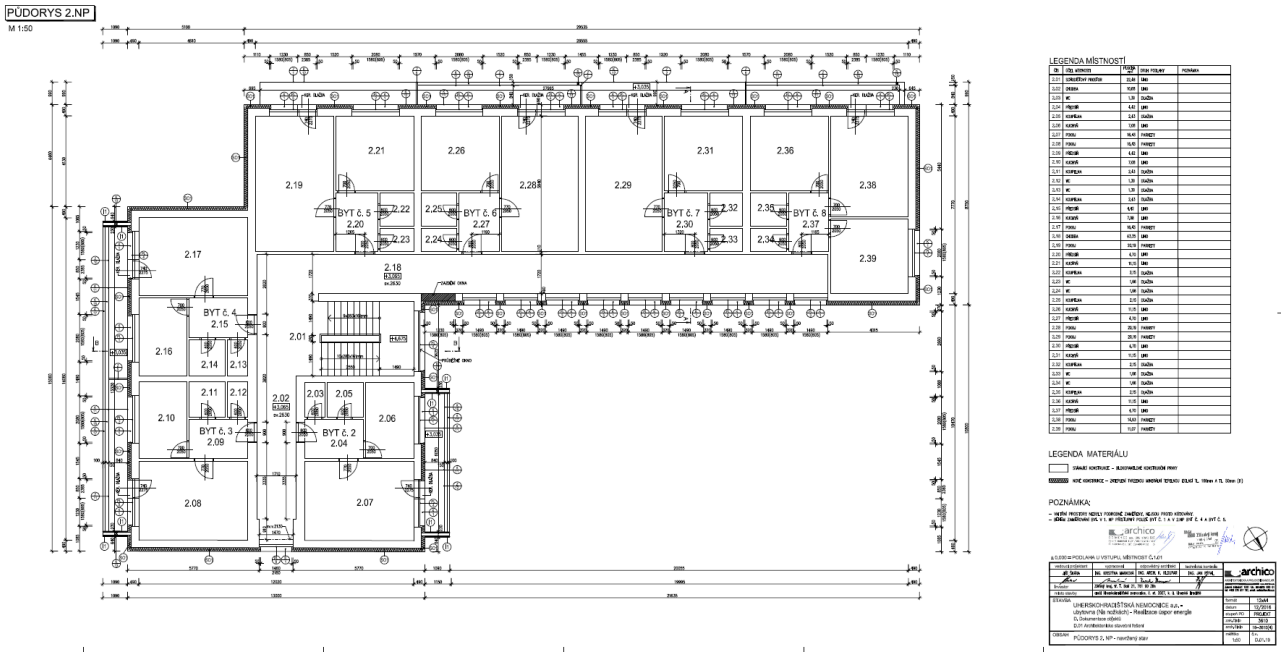


Figure 11: Typology of building available for the PA3 – Dormitory (source: Energy Agency of the Zlín Region).

3. Energy PA building(s) profile

Collecting energy data allows to determine the energy profile of the building. It provides information on the insulation of external partitions and the condition of energy systems (heating/cooling, ventilation, electricity, hot water preparation) in buildings.

3.1. External partitions

The technical and construction status of the building envelope influences significantly the heat loss to the environment. The used construction and thermal insulation material is important. In order to improve standards, a norm, regulation is established for each partition in each country. For existing buildings in the case of low insulation, it is recommended to carry out thermo-modernization.

3.1.1. External walls

Walls total surface area [m^2]: 940,8

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K][4]
1	Lime-cast	0,02	0,88	0,242	0,3 required/0,25 recommended
2	Concrete from slag	0,3	0,55		
3	Limecement cast	0,02	0,99		

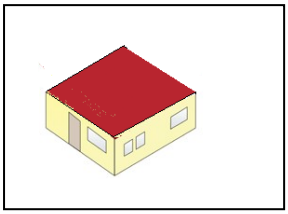
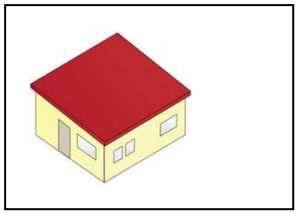
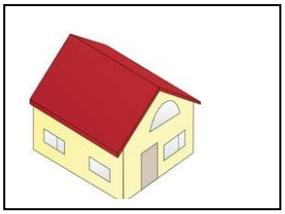
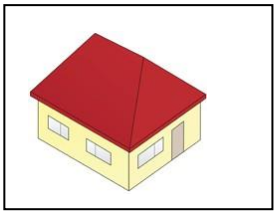
Thermo-modernization (if carried out)
Year: 2018
Applied thermal insulation material: mineral wool
Thickness [cm]: 0,16
Thermal conductivity [W/mK]: 0,039

Thermo-modernization of the fasade is not possible because the building is "listed "(must be preserved).

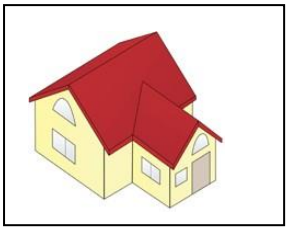
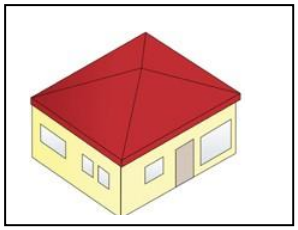
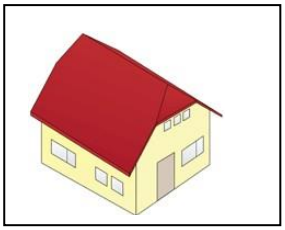
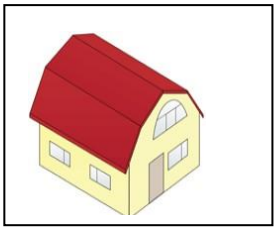
3.1.2. Roof

Type of roof:

☒ Flat roof ☐ Pent roof ☐ Gable roof ☐ Hip roof

☐ Multi-hip roof ☐ Tented roof ☐ Half-hipped roof ☐ Mansard roof

Roof slope [°]**:** 0 **in direction:** N/A
Roof total surface area [m²]: 419,7

[4] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m²K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m²K]
1	Lime-cast	0,015	0,88	0,152 after heat insulation	0,3 required/0,2 recommended
2	Armoured concrete	0,25	1,58		
3	Gravel	0,08	0,58		
4	EPS	0,04	0,051		
5	Chipboard	0,03	0,19		
6	Concrete form slag	0,04	0,55		
7	Asphalt stripes	0,04	0,21		

Thermo-modernization (if carried out)
Year: 2018
Applied thermal insulation material: mineral wool
Thickness [cm]: 24
Thermal conductivity [W/mK]: 0,039

3.1.3. Ground floor

Floor total surface area [m²]: 374,7
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m²K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m²K]
1					

3.1.4. Basement ceiling (if the building has a basement)

Total surface area [m²]: 493,5
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m²K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m²K]
1					

Basement
Is the basement heated ? ☐ **Yes** ☒ **No**
Basement walls total surface area [m²]:

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K]
1					

3.1.5. Windows

Type:
☐ single window, single glazed
☒ combined window, double glazed
☐ combined window, three panes
☐ single-frame window, double low-emission glass, argon chamber
☐ single-frame window, three glass panes, two (external) glasses are made of ordinary glass, and the inner glass of low-emission glass, the chambers between the glasses are filled with argon
☐ single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
☐ other (what ?) ……

Shading (sun protection):
☒ curtains
☐ roller shutters
☐ wooden shutters
☐ internal blinds
☐ awnings
☐ other (what ?) ……

Material (PVC, wood, aluminum, wood-aluminum): PVC
Number of windows: 102
Windows total surface area [m²]: 247
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m²K]: 2,52
Defined heat transfer coefficient (according to the norm, national regulations) [W/m²K]: 1,5 requested/1,2 recommended

Thermo-modernization (if carried out)
Year: 2018
Type of windows: single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
Material: wood
Number of windows (if all windows are not replaced on the new ones): 102
Windows total surface area [m²]: 247
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m²K]: 0,9

3.1.6. Doors

Material (wood, aluminum, PVC etc.): Wood
Number of doors: 4
Doors total surface area [m^2]: 41,4
Heat transfer coefficient [W/m^2K]: 5,65
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 3,5 requested/2,3 recommended

Thermo-modernization (if carried out)
Year: 2018
Material: wood
Number of doors (if all doors are not replaced on the new ones): 4
Doors total surface area [m^2]: 41,4
Heat transfer coefficient [W/m^2K]: 1,1

3.2. Systems energy data

High efficiency of energy systems and the type of energy source determines its consumption. Also important is the issue of installed control and control systems that help ensure optimal thermal conditions. Energy parameters characterizing the building:
Total non renewable primary energy demand [GJ/year or kWh/year]: 122 287 kWh/year after investment
Energy consumption (heating) [GJ/year or kWh/year]: 743 GJ/year before the investment, 460,6 GJ/year after investment
Efficiency of the heating system [%]: 99
Energy consumption (hot water preparation) [GJ/year or kWh/year]: 172,8 GJ/year
Efficiency of the hot water preparation system [%]: 99
Energy consumption (cooling) [GJ/year or kWh/year]: no cooling system
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): District heating system. Central boiler room for hospital is power by natural gas.
Regulation and control of systems in the building:
☒ thermostatic valves
☐ heat dividers
☐ motion sensors
☐ electricity meters
☐ water meters
☐ other (what ?)……
Annual fuel consumption [kg or m^3 or kWh or GJ]: 915,8 GJ before the investment, 460,6 GJ after investment
Electricity consumption [kWh/year]: 5 156
Ordered power [MW]: -
Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps
Power of light bulbs [W]: fluorescent tubes 40-200 W
Number of lighting points: -
Ventilation type (according to the table 1): natural ventilation

Building energy profile

The energy consumption in construction is distinguished by three types of energy - primary energy (EP), final energy (EK) and utility energy (EU). Primary energy refers to the energy contained in sources, including fuels and carriers, necessary to cover the final energy demand, taking into account the efficiency of the entire chain of acquisition, conversion and transport to the end user. A concept that is important from the point of view of a sustainable development strategy. The ratio of non-renewable primary energy inputs to the generation and delivery of an energy or energy carrier for technical systems is the difference between primary energy and final energy. The final energy is heat and auxiliary energy, which must be delivered to the boundary of the heating system (building) with a given efficiency in order to cover the energy demand for heating and ventilation of rooms. A concept that is important from the point of view of the building's user who incurs costs related to the operation of the building. The efficiency of the system is a conversion of final energy into utility energy. The utility energy concerns energy for heating and ventilation as well as for preparing domestic hot water, regardless of the type and efficiency of the heating device. A concept that is important from the designer's point of view, characterizing thermal insulation and building tightness. The concepts are presented below.

$$EU \xrightarrow{\eta} EK \xrightarrow{w_i} EP$$

Annual demand for non renewable primary energy EP [kWh/m²/year]

Non renewable primary energy demand for heating	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation	Non renewable primary energy demand for preparation of hot water	Non renewable primary energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
57	0	0	3	15	75

Annual final energy demand EK [kWh/m²/year]

Final energy demand for heating	Final energy demand for cooling	Final energy demand for ventilation	Final energy demand for preparation of hot water	Final energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
57	0	0	3	16	76

Annual utility energy demand EU [kWh/m²/year]

Utility energy demand for heating	Utility energy demand for cooling	Utility energy demand for ventilation	Utility energy demand for preparation of hot water	Utility energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
52	0	0	3	4	71

Energy class of the building (according to the table 2): B energy-saving building

The EU indicator is a building quality indicator. In general, the smaller the EU, the less energy we lose through the outer baffles of the building. It refers to the energy which is consumed and goes from the building's heating system to the individual rooms, and the heat loss (through penetration and ventilation) to the environment. The EU indicator value in the table below includes only heating/cooling.

Electricity price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per kWh]: 1860 CZK per kWh
Subscription [per month]: -

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per GJ]: Overall price is 823 CZK/MWh with tax. All parts of price depend on the consumption.
Subscription [per month]:

Summary and evaluation of the energy building status
The external walls meet the technical requirements in terms of the value of heat transfer coefficient. The thermo-modernization in 2018 includes the replacement of window and door joinery, roof and walls insulation. The modernization caused that windows and doors are characterized by low heat transfer coefficient consistent with the legal regulations.
The building's energy system includes the heating system, the hot water preparation system and the power system. The efficiency of the heating system and the preparation of hot water is very high (99%). In total, the building uses annually 259 544 kWh, 80% of which is for heating despite installed thermostatic valves. The energy class classifies it as an energy saving building. After completing the investment, the total energy consumption will be 181 100 kWh/year, 71% of which will be for heating.
The building is not equipped with cooling systems and ventilation is done through windows and ventilation ducts.

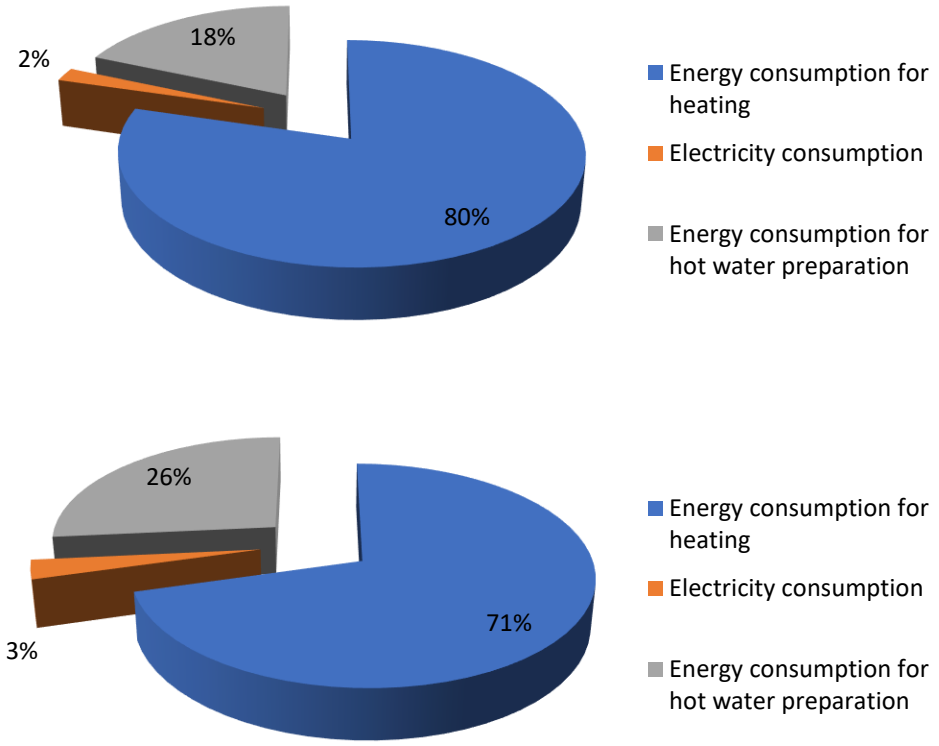


Figure 12: Energy consumption balance of the building for the PA3 – Dormitory UH hospital (before and after)

4. Definition of the required resources to run the investment

This chapter describes the measures and activities that were implemented to start the investment in the appropriate order and assign a time schedule and costs. These are only preparatory activities to undertake investment.
The steps that were taken in order to prepare an investment or to carry out other activities are presented in the appropriate order.

PA 3 – Dormitory Uherske Hradiste hospital						
No.	Preparatory work	Preparatory work description	Time schedule	Cost (EUR)	Market research	Selected external expert
1	Preparation	Based on energy management of the building and possibility of donation Zlín region decided that this sbuilding will be prepared for the heat insulation of the roof and heat insulation of the walls	2016	-	DONE	EAZK and Zlín region
2	Project blueprints	Zlín region order the blueprints necessary for the further progress of the project.	05/2016-12/2016	16000	DONE	G G Archico
3	Energy audit	EAZK supported Energy expert with all necessary data related to the project	10/2016-12/2016	1700	DONE	TESPORA
4	Donation application	EAZK prepared donation application	12/2016	-	DONE	EAZK
5	Public procurement	EAZK prepared blueprints for the public procurement	08/2017-12/2017		DONE	RTS
6	Realization of the heat insulation	Whole realization was done during summer holidays	03/2018-07/2018	79 164	DONE	Stavby Vanto
7	Evaluation of realization	EAZK continuously collect data to be able to evaluate the project	05/2019	0	NOT STARTED	EAZK
8	Evaluation of the project	EAZK continuously collect data to be able to evaluate the project	10/2019	0	NOT STARTED	EAZK

Table 9: Time schedule and cost estimate of preparatory activities in the PA3 – Dormitory UH hospital.

Table 10 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results.

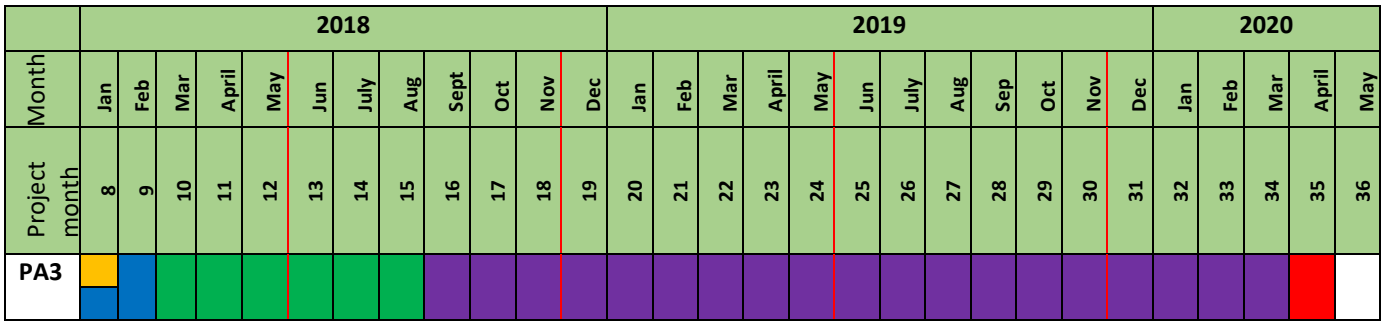


Table 10: PA3 – Dormitory UH hospital - Activities plan.

start of WPT3	PA preparations	PA implementation	PA monitoring/evaluation	end of PA	end of WPT3

Explanation:

PA preparations – A set of activities that are used to initiate the right investment, such as the selection of experts, contractors, collecting data and information, and other administrative work.

PA implementation – A set of activities like installation of equipment, systems, implementation of the OnePlace platform, promotional activities.

PA monitoring/evaluation – Checking whether the expected results are received.

PILOT ACTION - **PA3. Zero-energy public buildings in Zlin Region (CZ) - NEM UH Intern medicine**

2. Description of the PA building(s)

The description of the building provides basic building and administrative information. It allows to determine the location and the prevailing geographical conditions, the surroundings of the building. In addition, construction data is an example for similar construction solutions.

Type of building: Hospital building – intern medicine
Owner / investor: Hospital Uherske Hradiste (Zlín region is 100 % owner of the hospital)/Zlín region
Year of construction: 2017-2018
Year of use (if different from year of construction): 2018
Gross building area [m^2]: 10 171,46
Building volume [m^3]: 38 261,2
Building envelope total surface area [m^2]: 8 664,68
Shape factor (A/V ratio) [m^{-1}]: 0,23
The shape factor A/V is the ratio of the total surface area of all external walls (including windows and doors), roofs, floors on the ground or ceilings over the unheated basement, ceilings above the crossings, separating the heated part of the building from outside air to the volume of the heated part of the building,

increased by the volume of heated rooms in the utility attic or in the basement and reduced by the volume of separate staircases, elevator shafts, open recesses, loggias and galleries.
It is best if the building shape factor is as low as possible. This means that the building should be as compact as possible, similar in shape to a sphere or cube, that is, solids characterized by the lowest A/V ratio. Considering energy consumption, a building with a high A/V ratio "consumes" more energy.
Typology (number of floors): 6
Number of building users: -
Location: Hospital Uherske Hradiste is situated in the southwest part of the Zlín region cca 30 km from the Zlín.

Available technical documentation:	(•) **Yes**	( ) **No**
Energy audit	Year:	2016
Technical drawings	Year:	2016
Building project for thermo-modernization of the building	Year:	2016

Figure 13: Photo of building available for the PA3 – new intern medicine (source: Energy Agency of the Zlín Region).

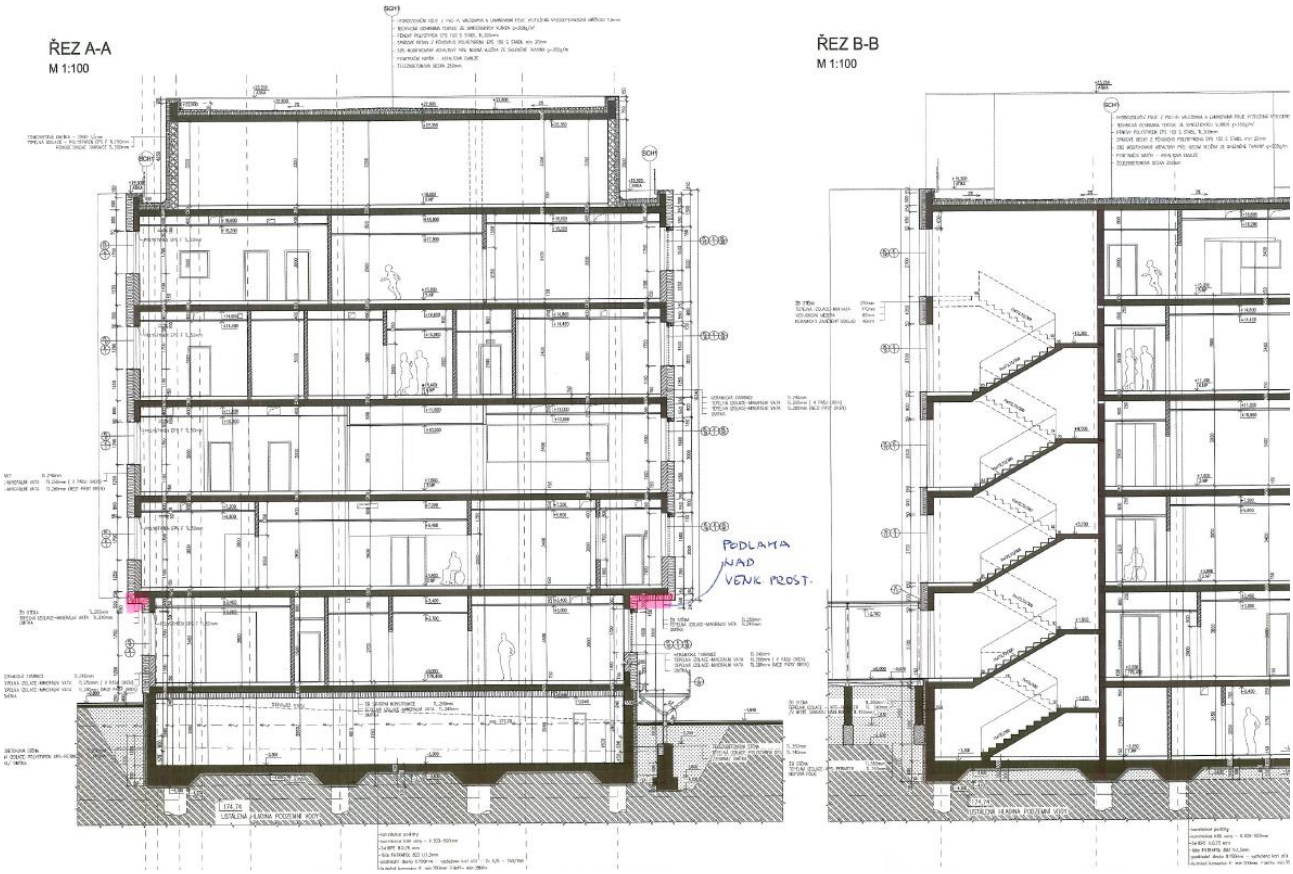


Figure 14: Typology of building available for the PA3 – new intern medicine (source: Energy Agency of the Zlín Region).

3. Energy PA building(s) profile

Collecting energy data allows to determine the energy profile of the building. It provides information on the insulation of external partitions and the condition of energy systems (heating/cooling, ventilation, electricity, hot water preparation) in buildings.

3.1. External partitions

The technical and construction status of the building envelope influences significantly the heat loss to the environment. The used construction and thermal insulation material is important. In order to improve standards, a norm, regulation is established for each partition in each country. For existing buildings in the case of low insulation, it is recommended to carry out thermo-modernization.

3.1.1. External walls

Walls total surface area [m^2]: 4 947,4

Envelope material (different layers):

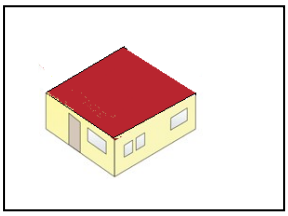
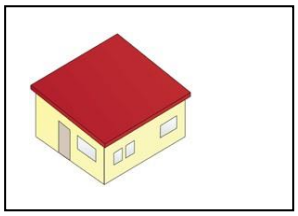
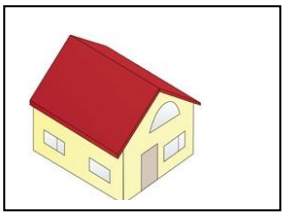
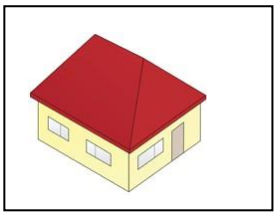
No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K][5]
1	Lime cast	0,01	0,99	0,22	0,3 required/0,25 recommended
2	Brick with air spaces	0,24	0,38		
3	Mineral wool	0,18	0,035		

Thermo-modernization of the fasade is not possible because the building is "listed "(must be preserved).

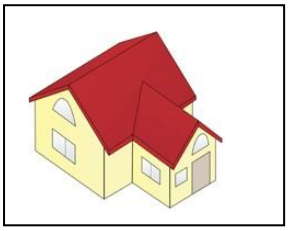
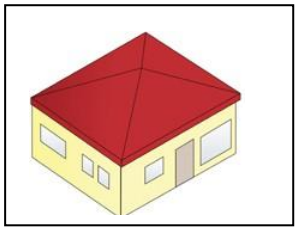
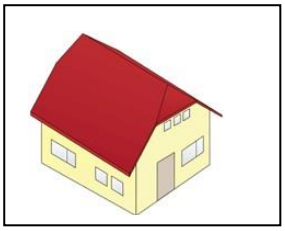
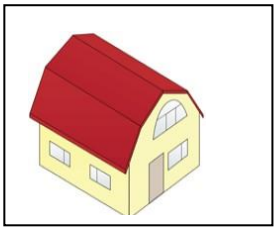
3.1.2. Roof

Type of roof:

☒ Flat roof ☐ Pent roof ☐ Gable roof ☐ Hip roof

☐ Multi-hip roof ☐ Tented roof ☐ Half-hipped roof ☐ Mansard roof

Roof slope [°]**:** 0 **in direction:** N/A
Roof total surface area [m²]: 1 391,9
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m²K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m²K]
1	Armoured concrete	0,25	1,74	0,16	0,3 required/0,2 recommended
2	Charbit	0,002	-		
3	EPS 150S	0,23	0,035		
4	Hydroisolation	0,002	0,16		

[5] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

	foil				

3.1.3. Ground floor

Floor total surface area [m^2]: 1 515,5
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1	Concrete	0,07	1,16	0,409	0,45 required/ 0,3 recommended
2	EPS 70 Z	0,08	0,039		
3	Armoured concrete	0,3	1,48		

3.1.4. Basement ceiling (if the building has a basement)

Total surface area [m^2]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1					

Basement
Is the basement heated ? ☐ **Yes** ☐ **No**
Basement walls total surface area [m^2]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^2K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^2K]
1					

3.1.5. Windows

Type:
☐ single window, single glazed
☐ combined window, double glazed
☐ combined window, three panes
☐ single-frame window, double low-emission glass, argon chamber
☐ single-frame window, three glass panes, two (external) glasses are made of ordinary glass, and the inner glass of low-emission glass, the chambers between the glasses are filled with argon
☐ single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
☐ other (what ?) .....

Shading (sun protection):
☒ curtains
☐ roller shutters
☐ wooden shutters
☐ internal blinds
☐ awnings
☐ other (what ?) ……..

Material (PVC, wood, aluminum, wood-aluminum): PVC
Number of windows: 262
Windows total surface area [m^2]: 723,6
Diffusers in windows (YES or NO): No
Heat transfer coefficient [W/m^2K]: 0,9
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 1,5 requested/1,2 recommended

3.1.6. Doors

Material (wood, aluminum, PVC etc.): PVC
Number of doors: 6
Doors total surface area [m^2]: 33,6
Heat transfer coefficient [W/m^2K]: 1,2
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 3,5 requested/2,3 recommended

3.2. Systems energy data

High efficiency of energy systems and the type of energy source determines its consumption. Also important is the issue of installed control and control systems that help ensure optimal thermal conditions. Energy parameters characterizing the building:
Total non renewable primary energy demand [GJ/year or kWh/year]: 8 416 884 kWh/year
Energy consumption (heating) [GJ/year or kWh/year]: 2 447 251 kWh/year
Efficiency of the heating system [%]: 93
Energy consumption (hot water preparation) [GJ/year or kWh/year]: 255 816 kWh/year
Efficiency of the hot water preparation system [%]: 94
Energy consumption (cooling) [GJ/year or kWh/year]: 5 889 kWh/year + 150 909 kWh/year for ventilation + 940 970 kWh/year for air adjustment
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): District heating system. Central boiler room for hospital is power by natural gas.
Regulation and control of systems in the building:
☒ thermostatic valves
☐ heat dividers
☒ motion sensors
☐ electricity meters
☐ water meters
☐ other (what ?)……
Annual fuel consumption [kg or m^3 or kWh or GJ]: 4 516 000 kWh
Electricity consumption [kWh/year]: 1 815 406

Ordered power [MW]: -
Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps
Power of light bulbs [W]: fluorescent tubes 40-200 W
Number of lighting points: -
Ventilation type (according to the table 1): hybrid ventilation

Building energy profile

The energy consumption in construction is distinguished by three types of energy - primary energy (EP), final energy (EK) and utility energy (EU). Primary energy refers to the energy contained in sources, including fuels and carriers, necessary to cover the final energy demand, taking into account the efficiency of the entire chain of acquisition, conversion and transport to the end user. A concept that is important from the point of view of a sustainable development strategy. The ratio of non-renewable primary energy inputs to the generation and delivery of an energy or energy carrier for technical systems is the difference between primary energy and final energy. The final energy is heat and auxiliary energy, which must be delivered to the boundary of the heating system (building) with a given efficiency in order to cover the energy demand for heating and ventilation of rooms. A concept that is important from the point of view of the building's user who incurs costs related to the operation of the building. The efficiency of the system is a conversion of final energy into utility energy. The utility energy concerns energy for heating and ventilation as well as for preparing domestic hot water, regardless of the type and efficiency of the heating device. A concept that is important from the designer's point of view, characterizing thermal insulation and building tightness. The concepts are presented below.

$$EU \xrightarrow{\eta} EK \xrightarrow{w_i} EP$$

Annual demand for non renewable primary energy EP [kWh/m²/year]

Non renewable primary energy demand for heating	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation + air adjustment	Non renewable primary energy demand for preparation of hot water	Non renewable primary energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
264	3	321	28	210	826

Annual final energy demand EK [kWh/m²/year]

Final energy demand for heating	Final energy demand for cooling	Final energy demand for ventilation + air adjustment	Final energy demand for preparation of hot water	Final energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
264	3	342	28	224	861

Annual utility energy demand EU [kWh/m²/year]

Utility energy demand for heating	Utility energy demand for cooling	Utility energy demand for ventilation + air adjustment	Utility energy demand for preparation of hot water	Utility energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
240	1	107	25	70	443

Energy class of the building (according to the table 2): A low-energy building
The EU indicator is a building quality indicator. In general, the smaller the EU, the less energy we lose through the outer baffles of the building. It refers to the energy which is consumed and goes from the building's heating system to the individual rooms, and the heat loss (through penetration and ventilation) to the environment. The EU indicator value in the table below includes only heating/cooling.
This building is used as a hospital, which means that Energy class has another indicators in kWh/(m² year)

Electricity price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per kWh]: 1 860 CZK per kWh
Subscription [per month]: -

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per GJ]: Overall price is 823 CZK/MWh with tax. All parts of price depend on the consumption.
Subscription [per month]:

Summary and evaluation of the energy building status
The external partitions meet the technical requirements in terms of the value of heat transfer coefficient. This is the new building built in 2018.
The building's energy system includes the heating system, the hot water preparation system, cooling system and the power system. The efficiency of the heating system and the preparation of hot water is very high (93% and 94% respectively). In total, the building will be use annually 5 616 241 kWh, 44% of which is for heating. The energy class classifies it as an low-energy building.
The ventilation is hybrid, so is the mix of natural and mechanical ventilation.

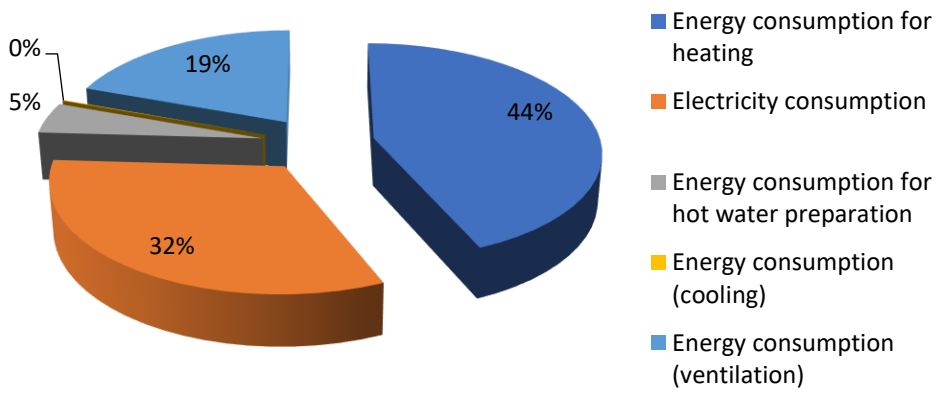


Figure 15: Energy consumption balance of the building for the PA3 – new intern medicine.

4. Definition of the required resources to run the investment

This chapter describes the measures and activities that were implemented to start the investment in the appropriate order and assign a time schedule and costs. These are only preparatory activities to undertake investment.
The steps that were taken in order to prepare an investment or to carry out other activities are presented in the appropriate order.

PA 3 –Uherske Hradiste hospital new intern medicine building						
No.	Preparatory work	Preparatory work description	Time schedule	Cost (EUR)	Market research	Selected external expert
1	Preparation	Based on hospital development strategy is going to be build new building.	2015	-	DONE	EAZK and Zlín region
2	Project blueprints	Zlín region order the blueprints necessary for the further progress of the project.	2015-2016	-	DONE	G G Archico
3	Certificate of energy class	Necessary document for the allowances	2016	-	DONE	Ing. Lepcio
4	Realization of the building	Whole realization	04/2017-09/2018	14 325 918	DONE	GEOSAN GROUP a.s. a Zlínstav a.s.
5	Evaluation of realization	EAZK continuously collect data to be able to evaluate the project	05/2019	0	NOT STARTED	EAZK
6	Evaluation of the project	EAZK continuously collect data to be able to evaluate the project	10/2019	0	NOT STARTED	EAZK

Table 11: Time schedule and cost estimate of preparatory activities in the PA3 – new intern medicine.

Table 12 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results.

	2018												2019												2020				
Month	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Project month	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
PA3																													

Table 12: PA3 – new intern medicine Activities plan.

start of WPT3	PA preparations	PA implementation	PA monitoring/evaluation	end of PA	end of WPT3

Explanation:

PA preparations – A set of activities that are used to initiate the right investment, such as the selection of experts, contractors, collecting data and information, and other administrative work.

PA implementation – A set of activities like installation of equipment, systems, implementation of the OnePlace platform, promotional activities.

PA monitoring/evaluation – Checking whether the expected results are received.

PILOT ACTION - **PA3. Zero-energy public buildings in Zlin Region (CZ) - NEM UH PATHOLOGY**

2. Description of the PA building(s)

The description of the building provides basic building and administrative information. It allows to determine the location and the prevailing geographical conditions, the surroundings of the building. In addition, construction data is an example for similar construction solutions.

Type of building: Hospital building - pathology
Owner / investor: Hospital Uherske Hradiste (Zlín region is 100 % owner of the hospital)/Zlín region
Year of construction: 1917
Year of use (if different from year of construction): -
Gross building area [m^2]: 749,4
Building volume [m^3]: 2 787,9
Building envelope total surface area [m^2]: 1 362,35
Shape factor (A/V ratio) [m^{-1}]: 0,49
The shape factor A/V is the ratio of the total surface area of all external walls (including windows and doors), roofs, floors on the ground or ceilings over the unheated basement, ceilings above the crossings, separating the heated part of the building from outside air to the volume of the heated part of the building,

increased by the volume of heated rooms in the utility attic or in the basement and reduced by the volume of separate staircases, elevator shafts, open recesses, loggias and galleries.
It is best if the building shape factor is as low as possible. This means that the building should be as compact as possible, similar in shape to a sphere or cube, that is, solids characterized by the lowest A/V ratio. Considering energy consumption, a building with a high A/V ratio "consumes" more energy.
Typology (number of floors): 2
Number of building users: 3 doctors, 8 laboratory technicians, 2 other staff, 1 administrative worker and 1 sanitary worker
Location: Hospital Uherske Hradiste is situated in the southwest part of the Zlín region cca 30 km from the Zlín.

Available technical documentation:	(•) **Yes**	( ) **No**
Energy audit	Year:	2016
Technical drawings	Year:	2016
Building project for thermo-modernization of the building	Year:	2016

Figure 16: Photo of building available for the PA3 – Pathology (source: Energy Agency of the Zlín Region).

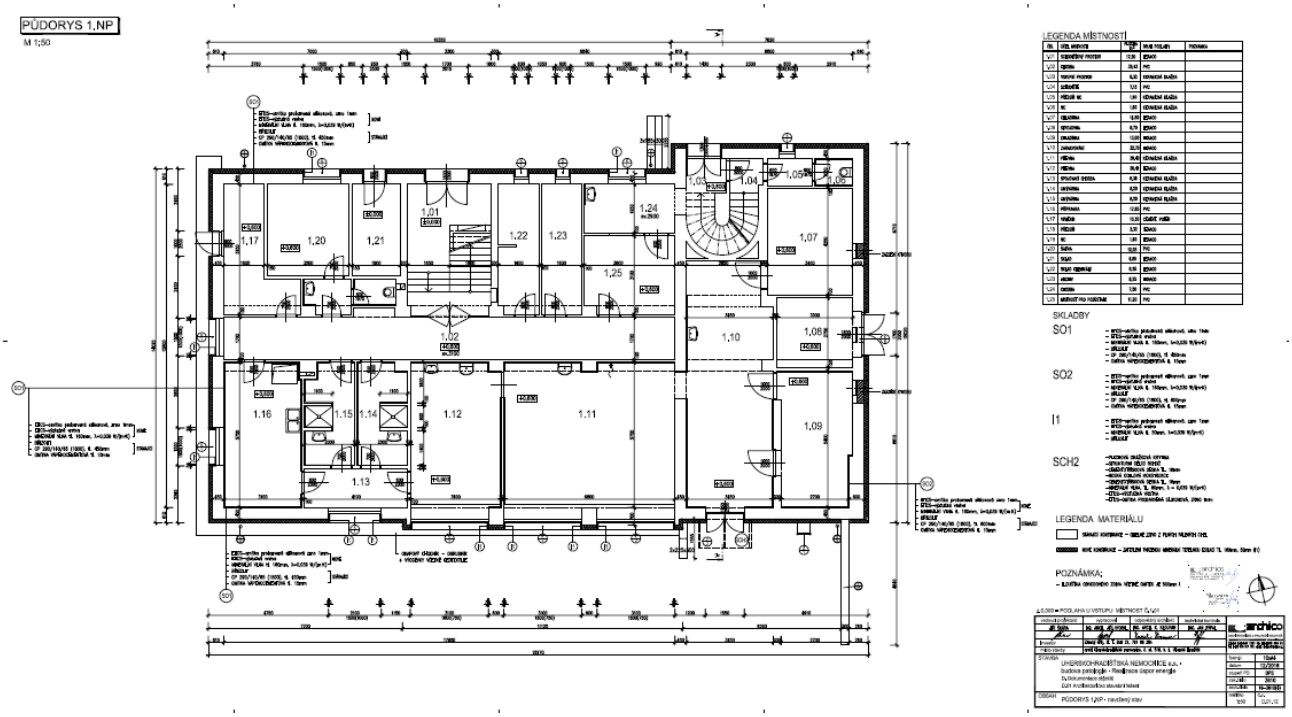


Figure 17: Typology of building available for the PA3 – Pathology (source: Energy Agency of the Zlín Region).

3. Energy PA building(s) profile

Collecting energy data allows to determine the energy profile of the building. It provides information on the insulation of external partitions and the condition of energy systems (heating/cooling, ventilation, electricity, hot water preparation) in buildings.

3.1. External partitions

The technical and construction status of the building envelope influences significantly the heat loss to the environment. The used construction and thermal insulation material is important. In order to improve standards, a norm, regulation is established for each partition in each country. For existing buildings in the case of low insulation, it is recommended to carry out thermo-modernization.

3.1.1. External walls

Walls total surface area [m^2]: 511

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K][6]
WALL type 1					
1	Lime-cast	0,02	0,88	0,24	0,3 required/0,25 recommended
2	Brick with air spaces	0,45	0,78		
3	Limecement cast	0,03	0,99		
WALL type 2					
1	Lime-cast	0,02	0,88	0,231	0,3 required/0,25 recommended
2	Brick with air spaces	0,6	0,78		
3	Limecement cast	0,03	0,99		

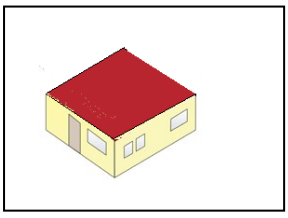
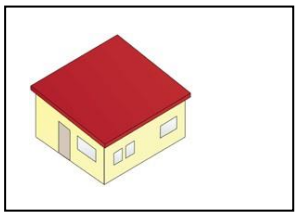
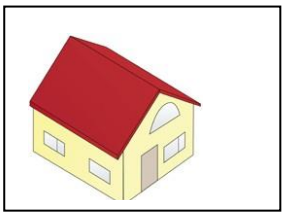
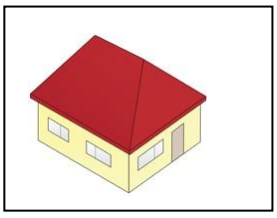
Thermo-modernization (if carried out)
Year: 2018
Applied thermal insulation material: mineral wool
Thickness [cm]: 0,16
Thermal conductivity [W/mK]: 0,039

Thermo-modernization of the fasade is not possible because the building is "listed "(must be preserved).

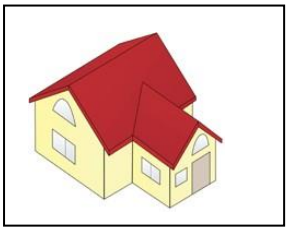
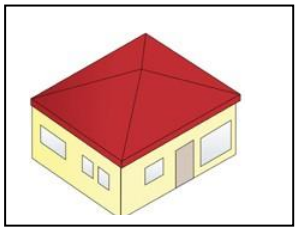
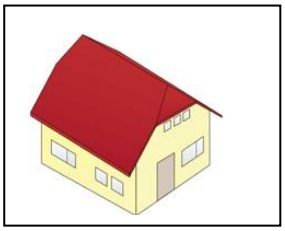
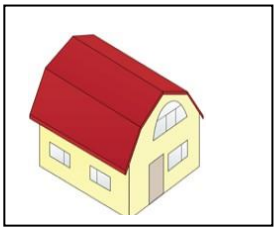
3.1.2. Roof

Type of roof:

☒ Flat roof ☐ Pent roof ☐ Gable roof ☐ Hip roof

☐ Multi-hip roof ☐ Tented roof ☐ Half-hipped roof ☐ Mansard roof

[6] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

Roof slope [°]**:** 0 **in direction:** N/A
Roof total surface area [m^2]: 374,7
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m^2K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m^2K]
1	Lime-cast	0,02	0,88	0,169 after heat insulation	0,3 required/0,2 recommended
2	Armoured concrete	0,25	1,58		
3	Asphalt stripes	0,001	0,21		
4	Dross	0,15	0,27		
5	Concrete	0,05	1,23		
6	Asphalt stripes	0,002	0,21		
7	Concrete	0,03	1,23		
8	Asphalt stripes	0,005	0,21		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: EPS 100 S
Thickness [cm]: 24
Thermal conductivity [W/mK]: 0,037

3.1.3. Ground floor

Floor total surface area [m^2]: 374,7
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1	Ceramic tiles	0,02	1,01	1,73 (0,375 equivalent)	0,45 required/ 0,3 recommended
2	Concrete	0,08	1,1		
3	Asphalt straps	0,005	0,21		
4	Concrete	0,15	1,1		
5	Gravel	0,1	0,58		

3.1.4. Basement ceiling (if the building has a basement)

Total surface area [m^2]: 493,5

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m²K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m²K]
1					

Basement
Is the basement heated ? ☐ **Yes** ☒ **No**
Basement walls total surface area [m²]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K]
1					

3.1.5. Windows

Type:
☐ single window, single glazed
☐ combined window, double glazed
☐ combined window, three panes
☒ single-frame window, double low-emission glass, argon chamber
☐ single-frame window, three glass panes, two (external) glasses are made of ordinary glass, and the inner glass of low-emission glass, the chambers between the glasses are filled with argon
☐ single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
☐ other (what ?) ……

Shading (sun protection):
☒ curtains
☐ roller shutters
☐ wooden shutters
☐ internal blinds
☐ awnings
☐ other (what ?) ……

Material (PVC, wood, aluminum, wood-aluminum): PVC
Number of windows:
Windows total surface area [m²]: 82,7
Diffusers in windows (YES or NO): No
Heat transfer coefficient [W/m²K]: 1,2
Defined heat transfer coefficient (according to the norm, national regulations) [W/m²K]: 1,5 requested/1,2 recommended

3.1.6. Doors

Material (wood, aluminum, PVC etc.): Wood
Number of doors: 5
Doors total surface area [m^2]: 19,2
Heat transfer coefficient [W/m^2K]: 1,2
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 3,5 requested/2,3 recommended

3.2. Systems energy data

High efficiency of energy systems and the type of energy source determines its consumption. Also important is the issue of installed control and control systems that help ensure optimal thermal conditions. Energy parameters characterizing the building:
Total non renewable primary energy demand [GJ/year or kWh/year]: 73 620 kWh/year after investment
Energy consumption (heating) [GJ/year or kWh/year]: 387,9 GJ/year before the investment, 249,5 GJ/year after investment
Efficiency of the heating system [%]: 99
Energy consumption (hot water preparation) [GJ/year or kWh/year]: 6,1 GJ/year
Efficiency of the hot water preparation system [%]: 99
Energy consumption (cooling) [GJ/year or kWh/year]: no cooling system
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): District heating system. Central boiler room for hospital is power by natural gas.
Regulation and control of systems in the building:
☒ thermostatic valves
☐ heat dividers
☐ motion sensors
☐ electricity meters
☐ water meters
☐ other (what ?)……
Annual fuel consumption [kg or m^3 or kWh or GJ]: 394 GJ before the investment, 255,6 GJ after investment
Electricity consumption [kWh/year]: 9 800
Ordered power [MW]: -
Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps
Power of light bulbs [W]: fluorescent tubes 40-200 W
Number of lighting points: -
Ventilation type (according to the table 1): natural ventilation

Building energy profile
The energy consumption in construction is distinguished by three types of energy - primary energy (EP), final energy (EK) and utility energy (EU). Primary energy refers to the energy contained in sources, including fuels and carriers, necessary to cover the final energy demand, taking into account the efficiency of the entire chain of acquisition, conversion and transport to the end user. A concept that is important from the point of view of a sustainable development strategy. The ratio of non-renewable primary energy inputs to the generation and delivery of an energy or energy carrier for technical systems is the difference between primary energy and final energy. The final energy is heat and auxiliary energy, which must be delivered to the boundary of the heating system (building) with a given efficiency in order to cover the energy demand for heating and ventilation of rooms. A concept that is important from the point of view of the building's

user who incurs costs related to the operation of the building. The efficiency of the system is a conversion of final energy into utility energy. The utility energy concerns energy for heating and ventilation as well as for preparing domestic hot water, regardless of the type and efficiency of the heating device. A concept that is important from the designer's point of view, characterizing thermal insulation and building tightness. The concepts are presented below.

$$EU \xrightarrow{\eta} EK \xrightarrow{w_i} EP$$

Annual demand for non renewable primary energy EP [kWh/m²/year]

Non renewable primary energy demand for heating	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation	Non renewable primary energy demand for preparation of hot water	Non renewable primary energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
40	10	0	32	42	124

Annual final energy demand EK [kWh/m²/year]

Final energy demand for heating	Final energy demand for cooling	Final energy demand for ventilation	Final energy demand for preparation of hot water	Final energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
40	9	0	30	39	118

Annual utility energy demand EU [kWh/m²/year]

Utility energy demand for heating	Utility energy demand for cooling	Utility energy demand for ventilation	Utility energy demand for preparation of hot water	Utility energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
36	3	0	10	13	62

Energy class of the building (according to the table 2): C average energy efficient building
The EU indicator is a building quality indicator. In general, the smaller the EU, the less energy we lose through the outer baffles of the building. It refers to the energy which is consumed and goes from the building's heating system to the individual rooms, and the heat loss (through penetration and ventilation) to the environment. The EU indicator value in the table below includes only heating/cooling.

Electricity price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per kWh]: 1860 CZK per kWh
Subscription [per month]: -

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per GJ]: Overall price is 823 CZK/MWh with tax. All parts of price depend on the consumption.
Subscription [per month]:

Summary and evaluation of the energy building status

The external partitions meet the technical requirements in terms of the value of heat transfer coefficient. The thermo-modernization in 2017 and 2018 includes the roof and walls insulation.

The building's energy system includes the heating system, the hot water preparation system and the power system. The efficiency of the heating system and the preparation of hot water is very high (99%). In total, the building uses annually 119 244 kWh, 90% of which is for heating despite installed thermostatic valves. The energy class classifies it as an average energy efficient building. After completing the investment, the total energy consumption will be 80 799 kWh/year, 86% of which will be for heating.

The building is not equipped with cooling systems and ventilation is done through windows and ventilation ducts.

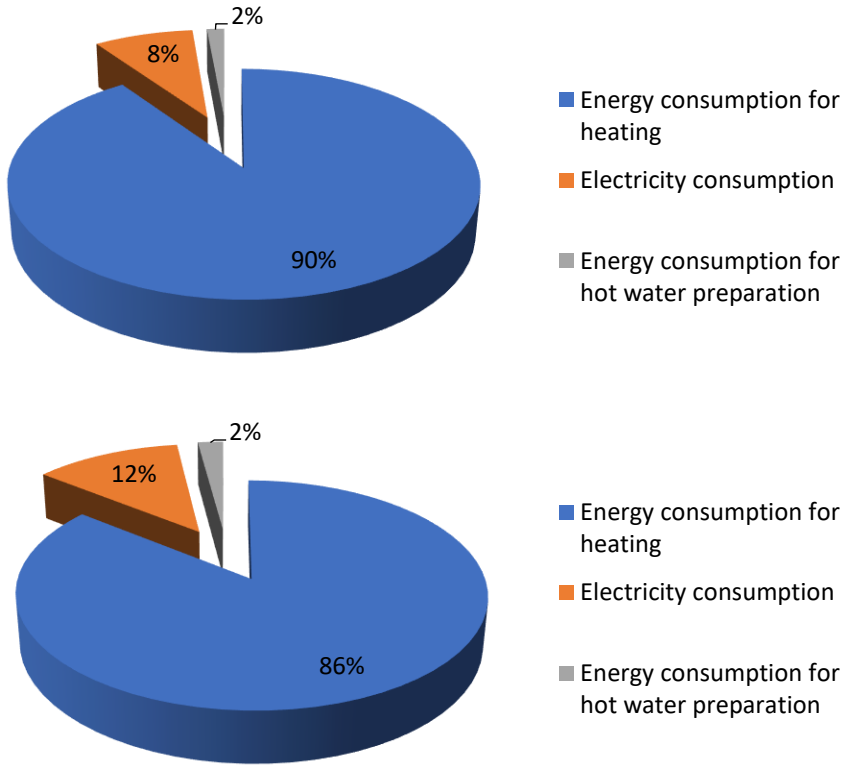


Figure 18: Energy consumption balance of the building for the PA3 – Pathology UH hospital (before and after)

4. Definition of the required resources to run the investment

This chapter describes the measures and activities that were implemented to start the investment in the appropriate order and assign a time schedule and costs. These are only preparatory activities to undertake investment.

The steps that were taken in order to prepare an investment or to carry out other activities are presented in the appropriate order.

PA 3 – Pathology Uherske Hradiste hospital						
No.	Preparatory work	Preparatory work description	Time schedule	Cost (EUR)	Market research	Selected external expert
1	Preparation	Based on energy management of the building and possibility of donation Zlín region decided that this sbuilding will be prepared for the heat insulation of the roof and heat insulation of the walls	2016	-	DONE	EAZK and Zlín region
2	Project blueprints	Zlín region order the blueprints necessary for the further progress of the project.	05/2016-12/2016	16000	DONE	G G Archico
3	Energy audit	EAZK supported Energy expert with all necessary data related to the project	10/2016-12/2016	1700	DONE	TESPORA
4	Donation application	EAZK prepared donation application	12/2016	-	DONE	EAZK
5	Public procurement	EAZK prepared blueprints for the public procurement	08/2017-12/2017		DONE	RTS
6	Realization of the heat insulation	Whole realization was done during summer holidays	03/2018-07/2018	79 164	DONE	Stavby Vanto
7	Evaluation of realization	EAZK continuously collect data to be able to evaluate the project	05/2019	0	NOT STARTED	EAZK
8	Evaluation of the project	EAZK continuously collect data to be able to evaluate the project	10/2019	0	NOT STARTED	EAZK

Table 13: Time schedule and cost estimate of preparatory activities in the PA3 - Pathology.

Table 14 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results.

	2018												2019												2020				
Month	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Project month	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
PA3																													

Table 14: PA3 - Pathology Activities plan.

start of WPT3	PA preparations	PA implementation	PA monitoring/evaluation	end of PA	end of WPT3

Explanation:

PA preparations – A set of activities that are used to initiate the right investment, such as the selection of experts, contractors, collecting data and information, and other administrative work.

PA implementation – A set of activities like installation of equipment, systems, implementation of the OnePlace platform, promotional activities.

PA monitoring/evaluation – Checking whether the expected results are received.

PILOT ACTION - **PA3. Zero-energy public buildings in Zlin Region (CZ) - Valasske Klobouky grammar school**

2. Description of the PA building(s)

The description of the building provides basic building and administrative information. It allows to determine the location and the prevailing geographical conditions, the surroundings of the building. In addition, construction data is an example for similar construction solutions.

Type of building: Grammar School
Owner / investor: Zlín region
Year of construction: 1906 historical part and 1995 newer part
Year of use (if different from year of construction): -
Gross building area [m^2]: 4 649,83
Building volume [m^3]: 20 835
Building envelope total surface area [m^2]: 11 491,27
Shape factor (A/V ratio) [m^{-1}]: 0,55
The shape factor A/V is the ratio of the total surface area of all external walls (including windows and doors), roofs, floors on the ground or ceilings over the unheated basement, ceilings above the crossings, separating the heated part of the building from outside air to the volume of the heated part of the building,

increased by the volume of heated rooms in the utility attic or in the basement and reduced by the volume of separate staircases, elevator shafts, open recesses, loggias and galleries.
It is best if the building shape factor is as low as possible. This means that the building should be as compact as possible, similar in shape to a sphere or cube, that is, solids characterized by the lowest A/V ratio. Considering energy consumption, a building with a high A/V ratio "consumes" more energy.
Typology (number of floors): 4
Number of building users: 210 students + 23 teachers + 11 other stuff
Location: Valasske Klobouky city is situated in the southeast part of the Zlín region cca 35 km far from Zlín by car.

Available technical documentation: (•) **Yes** ( ) **No**

Energy audit Year: 2016

Technical drawings Year: 2015

Building project for thermo-modernization of the building Year: 2015

Figure 19: Photo of building available for the PA3 – Grammar school Valasske Klobouky (source: Energy Agency of the Zlín Region).

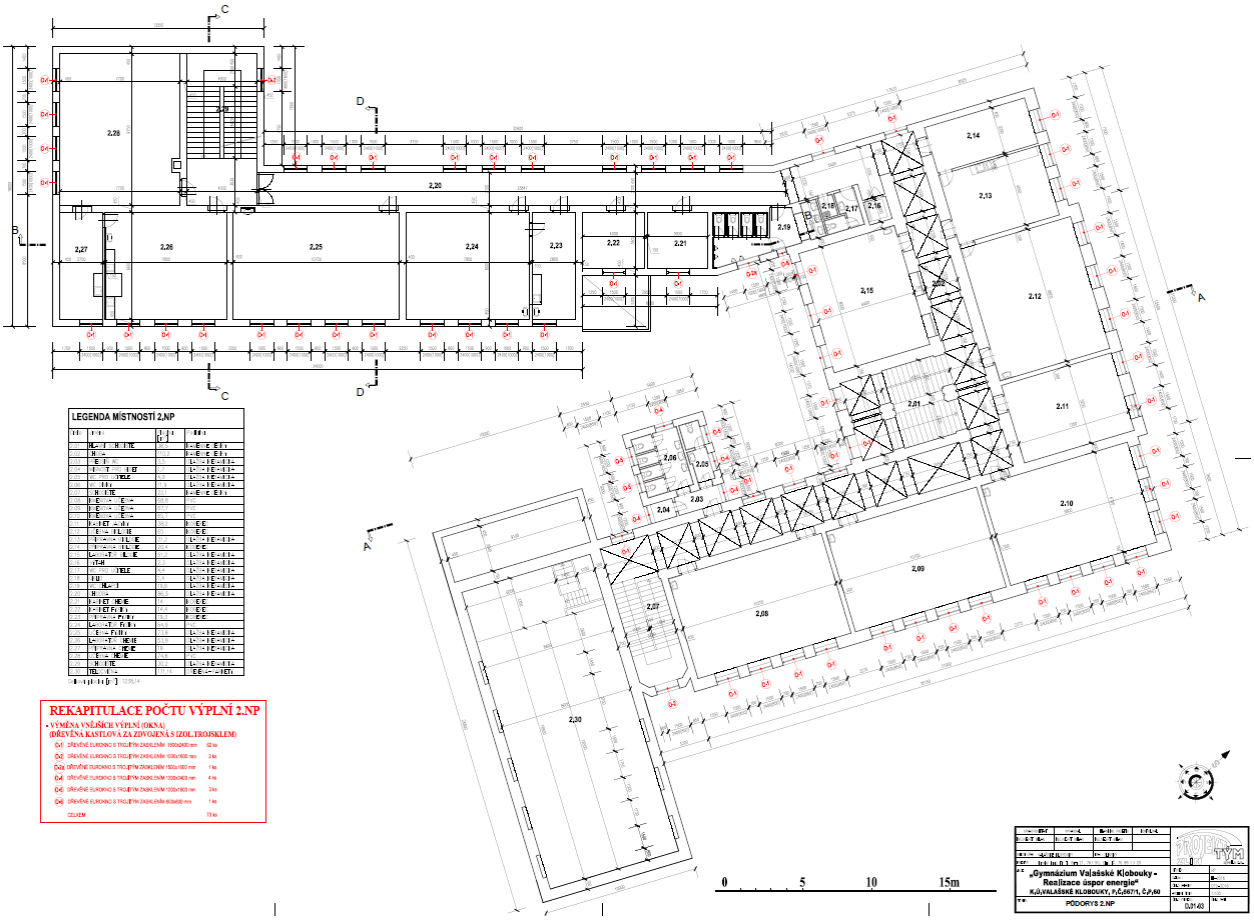


Figure 20: Typology of building available for the PA3 – Grammar school Valasske Klobouky (source: Energy Agency of the Zlín Region).

3. Energy PA building(s) profile

Collecting energy data allows to determine the energy profile of the building. It provides information on the insulation of external partitions and the condition of energy systems (heating/cooling, ventilation, electricity, hot water preparation) in buildings.

3.1. External partitions

The technical and construction status of the building envelope influences significantly the heat loss to the environment. The used construction and thermal insulation material is important. In order to improve standards, a norm, regulation is established for each partition in each country. For existing buildings in the case of low insulation, it is recommended to carry out thermo-modernization.

3.1.1. External walls

Walls total surface area [m^2]: 3 115,6

Envelope material (different layers):

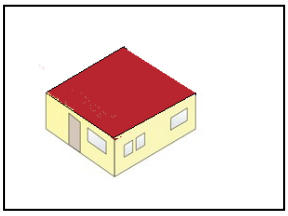
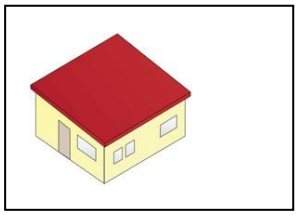
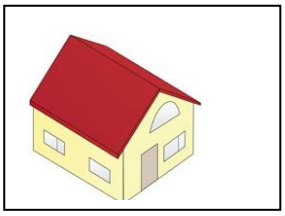
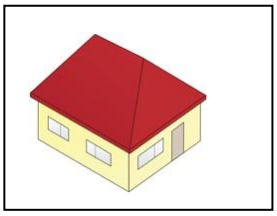
No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K][7]
WALL 1 – newer part from 1995					
1	Lime-cast	0,02	0,88	0,49	0,3 required/0,25 recommended
2	Brick with air spaces	0,44	0,187		
3	Limecement cast	0,02	0,99		
WALL 2 – historic part from 1906					
1	Lime-cast	0,02	0,88	0,944	0,3 required/0,25 recommended
2	Full brick	0,75	0,78		
3	Limecement cast	0,03	0,99		
WALL 3 – historic part from 1906					
1	Lime-cast	0,02	0,88	1,108	0,3 required/0,25 recommended
2	Full brick	0,6	0,78		
3	Limecement cast	0,03	0,99		
WALL 4– historic part from 1906					
1	Lime-cast	0,02	0,88	1,35	0,3 required/0,25 recommended
2	Full brick	0,45	0,78		
3	Limecement cast	0,03	0,99		

Thermo-modernization of the fasade is not possible because the building is "listed "(must be preserved).

3.1.2. Roof

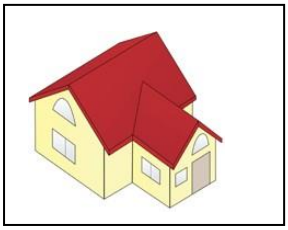
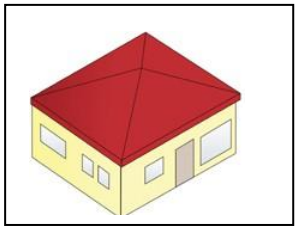
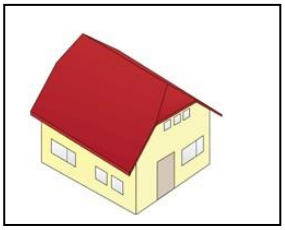
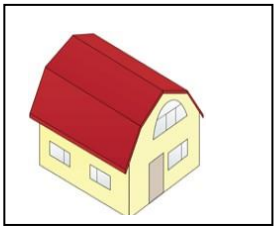
Type of roof:

☐ Flat roof ☐ Pent roof ☐ Gable roof ☐ Hip roof

[7] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

☒ Multi-hip roof ☐ Tented roof ☐ Half-hipped roof ☐ Mansard roof

Roof slope [°]**:** no data **in direction:** no data
Roof total surface area [m²]: 1 574,6
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m²K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m²K]
1	Lime-cast	0,02	0,88	0,152 after heat insulation	0,3 required/0,2 recommended
2	Dry wood files	0,014	0,224		
3	Wood	0,025	0,18		
4	Climatizer	0,16	0,043		
5	Wood	0,025	0,18		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 20
Thermal conductivity [W/mK]: 0,039

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m²K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m²K]
1	Lime-cast	0,02	0,88	0,184 after heat insulation	0,24 required/ 0,16 recommended
2	Wood	0,03	0,18		
3	Air space	0,3	-		
4	Wood	0,03	0,18		
5	Trapezial metal plate	0,002	58		
6	Concrete	0,05	1,3		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 24
Thermal conductivity [W/mK]: 0,039

Envelope material (different layers): Only layers that improve heat transfer

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m²K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m²K]
1	Lime-cast	0,02	0,88	0,147 after heat insulation	0,24 required/ 0,16 recommended
2	Dry Wood	0,014	0,224		
3	Wood	0,025	0,18		
4	Climatizer	0,16	0,043		
5	wood	0,025	0,18		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: PIR isolation and mineral wool
Thickness [cm]: 10 and 16
Thermal conductivity [W/mK]: 0,022 and 0,039

3.1.3. Ground floor

Floor total surface area [m²]: 1 542,8
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m²K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m²K]
1	PVC	0,005	0,16	1,553 (0,388 equivalent)	0,45 required/ 0,3 recommended
2	Concrete	0,05	1,1		
3	Asphalt straps	0,005	0,21		
4	Concrete	0,15	1,1		
5	gravel	0,15	0,58		

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m²K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m²K]
1	Ceramic pave	0,008	1,01	0,813 (0,285 equivalent)	0,45 required/ 0,3 recommended
2	Disperse glue	0,005	0,6		
3	Concrete	0,045	1,1		
4	Asphalt straps	0,0002	0,21		
5	Prefizol	0,04	0,047		
6	Concrete	0,05	1,1		
7	Asphalt straps	0,005	0,21		
8	concrete	0,15	1,1		

3.1.4. Basement ceiling (if the building has a basement)

Total surface area [m^2]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1					

Basement
Is the basement heated ? ☐ **Yes** ☒ **No**
Basement walls total surface area [m^2]:
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^2K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^2K]
1					

3.1.5. Windows

Type:
☐ single window, single glazed
☐ combined window, double glazed
☐ combined window, three panes
☐ single-frame window, double low-emission glass, argon chamber
☐ single-frame window, three glass panes, two (external) glasses are made of ordinary glass, and the inner glass of low-emission glass, the chambers between the glasses are filled with argon
☐ single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
☒ other (what ?) ……combined window, single glazed……..

Shading (sun protection):
☒ curtains
☐ roller shutters
☐ wooden shutters
☐ internal blinds
☐ awnings
☐ other (what ?) ……

Material (PVC, wood, aluminum, wood-aluminum): Wood
Number of windows: 270
Windows total surface area [m^2]: 809,6
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m^2K]: 2,35

Defined heat transfer coefficient (according to the norm, national regulations) [W/m^{2}K]: 1,5 requested/1,2 recommended

Thermo-modernization (if carried out)
Year: 2017
Type of windows: single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
Material: Wood
Number of windows (if all windows are not replaced on the new ones): 270
Windows total surface area [m^2]: 809,6
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m^{2}K]: 0,9 for classic windows and 1,1 for roof windows

3.1.6. Doors

Material (wood, aluminum, PVC etc.): Wood
Number of doors: 5
Doors total surface area [m^2]: 22,9
Heat transfer coefficient [W/m^{2}K]: 4,5
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^{2}K]: 3,5 requested/2,3 recommended

3.2. Systems energy data

High efficiency of energy systems and the type of energy source determines its consumption. Also important is the issue of installed control and control systems that help ensure optimal thermal conditions.
Energy parameters characterizing the building:
Total non renewable primary energy demand [GJ/year or kWh/year]: 1 121 291 kWh/year after investment
Energy consumption (heating) [GJ/year or kWh/year]: 1 621,4 GJ/year before, 1 089,7 GJ/year after
Efficiency of the heating system [%]: 88
Energy consumption (hot water preparation) [GJ/year or kWh/year]: 263 GJ/year
Efficiency of the hot water preparation system [%]: 88
Energy consumption (cooling) [GJ/year or kWh/year]: no cooling system
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): natural gas boiler for heat and natural gas boiler for hot water
Regulation and control of systems in the building:
☒ thermostatic valves
☐ heat dividers
☐ motion sensors
☐ electricity meters
☐ water meters
☐ other (what ?)……
Annual fuel consumption [kg or m^3 or kWh or GJ]: 1884,4 GJ before the investment, 1352,7 GJ after investment
Electricity consumption [kWh/year]: 68 700
Ordered power [MW]: -

Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps
Power of light bulbs [W]: fluorescent tubes 40-200 W
Number of lighting points: -
Ventilation type (according to the table 1): natural ventilation

Building energy profile

The energy consumption in construction is distinguished by three types of energy - primary energy (EP), final energy (EK) and utility energy (EU). Primary energy refers to the energy contained in sources, including fuels and carriers, necessary to cover the final energy demand, taking into account the efficiency of the entire chain of acquisition, conversion and transport to the end user. A concept that is important from the point of view of a sustainable development strategy. The ratio of non-renewable primary energy inputs to the generation and delivery of an energy or energy carrier for technical systems is the difference between primary energy and final energy. The final energy is heat and auxiliary energy, which must be delivered to the boundary of the heating system (building) with a given efficiency in order to cover the energy demand for heating and ventilation of rooms. A concept that is important from the point of view of the building's user who incurs costs related to the operation of the building. The efficiency of the system is a conversion of final energy into utility energy. The utility energy concerns energy for heating and ventilation as well as for preparing domestic hot water, regardless of the type and efficiency of the heating device. A concept that is important from the designer's point of view, characterizing thermal insulation and building tightness. The concepts are presented below.

$$EU \xrightarrow{\eta} EK \xrightarrow{w_i} EP$$

Annual demand for non renewable primary energy EP [kWh/m²/year]

Non renewable primary energy demand for heating	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation	Non renewable primary energy demand for preparation of hot water	Non renewable primary energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
185	0	0	11	45	241

Annual final energy demand EK [kWh/m²/year]

Final energy demand for heating	Final energy demand for cooling	Final energy demand for ventilation	Final energy demand for preparation of hot water	Final energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
185	0	0	11	48	244

Annual utility energy demand EU [kWh/m²/year]

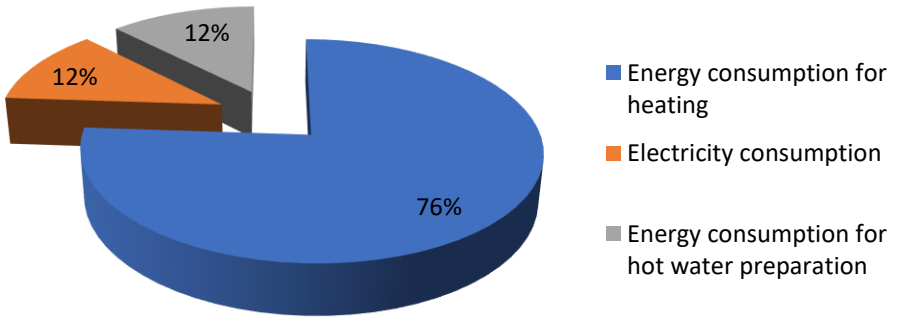
Utility energy demand for heating	Utility energy demand for cooling	Utility energy demand for ventilation	Utility energy demand for preparation of hot water	Utility energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
166	0	0	10	15	191

Energy class of the building (according to the table 2): E energy-consuming building
The EU indicator is a building quality indicator. In general, the smaller the EU, the less energy we lose through the outer baffles of the building. It refers to the energy which is consumed and goes from the building's heating system to the individual rooms, and the heat loss (through penetration and ventilation) to the environment. The EU indicator value in the table below includes only heating/cooling.

Electricity price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]: 3,76 CZK per month with tax (average for all supply points)
Variable fee [per kWh]: 1131 CZK per kWh (average for all supply points)
Subscription [per month]: -

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per GJ]: Overall price is 846 CZK/MWh with tax (235 CZK/GJ). All parts of price depend on the consumption.
Subscription [per month]:

Summary and evaluation of the energy building status
The external walls and doors do not meet the technical requirements in terms of the value of heat transfer coefficient. The façade is ”listed “(must be preserved). The thermo-modernization in 2017 included the replacement of window joinery and roof insulation.
The building's energy system includes the heating system, the hot water preparation system and the power system. The efficiency of the heating system and the preparation of hot water is high (88%). In total, the building uses annually 592 143 kWh, 76% of which is for heating despite installed thermostatic valves. The energy class classifies it as an energy consuming building. After completing the investment, the total energy consumption will be 444 449 kWh/year, 68% of which will be for heating.
The building is not equipped with cooling systems and ventilation is done through windows and ventilation ducts.



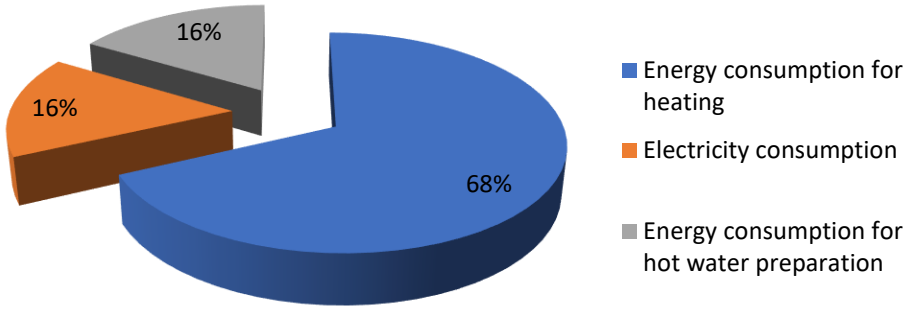


Figure 21: Energy consumption balance of the building for the PA3 – Valasske Klobouky grammar school (before and after)

4. Definition of the required resources to run the investment

This chapter describes the measures and activities that were implemented to start the investment in the appropriate order and assign a time schedule and costs. These are only preparatory activities to undertake investment.
The steps that were taken in order to prepare an investment or to carry out other activities are presented in the appropriate order.

PA 3 – Valasske Klobouky						
No.	Preparatory work	Preparatory work description	Time schedule	Cost (EUR)	Market research	Selected external expert
1	Preparation	Based on energy management of the building and possibility of donation Zlín region decided that this school will be prepared for the Windows changing and heat insulation of the roof and heat insulation o the non-historic wall	2015	-	DONE	EAZK and Zlín region
2	Project blueprints	Zlín region order the blueprints necessary for the further progress of the project.	09/2015-08/2016	19 550	DONE	Projekt-tým Zlín, spol. s.r.o.
3	Energy audit	EAZK supported Energy expert with all necessary	02/2016-03/2016	500	DONE	TESPORA

		data related to the project				
4	Donation application	EAZK prepared donation application	03/2016	-	DONE	EAZK
5	Public procurement	EAZK prepared blueprints for the public procurement	08/2016-10/2016	3 630	DONE	RTS
6	Realization of windows changing and roof insulation and non-historic wall heat insulation	Whole realization was done during summer holidays	04/2017-08/2017	743 000	DONE	3V & H, s.r.o.
7	Evaluation of realization	EAZK continuously collect data to be able to evaluate the project	06/2018	0	NOT STARTED	EAZK
8	Evaluation of the project	EAZK continuously collect data to be able to evaluate the project	10/2019	0	NOT STARTED	EAZK

Table 15: Time schedule and cost estimate of preparatory activities in the PA3 – Valasske Klobouky grammar school.

Table 16 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results.

	2018												2019												2020				
Month	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Project month	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
PA3																													

Table16: PA3 Grammar school Valasske klobouky Activities plan.

start of WPT3 | PA preparations | PA implementation | PA monitoring/evaluation | end of PA | end of WPT3

Explanation:

PA preparations – A set of activities that are used to initiate the right investment, such as the selection of experts, contractors, collecting data and information, and other administrative work.

PA implementation – A set of activities like installation of equipment, systems, implementation of the OnePlace platform, promotional activities.

PA monitoring/evaluation – Checking whether the expected results are received.

PILOT ACTION - **PA3. Zero-energy public buildings in Zlin Region (CZ) - Vsetin**

2. Description of the PA building(s)

The description of the building provides basic building and administrative information. It allows to determine the location and the prevailing geographical conditions, the surroundings of the building. In addition, construction data is an example for similar construction solutions.

Type of building: Grammar School and secondary school
Owner / investor: Zlín region
Year of construction: Beginning of 20th century
Year of use (if different from year of construction): -
Gross building area [m^2]: 2 929,99
Building volume [m^3]: 13 476,4
Building envelope total surface area [m^2]: 4 722,1
Shape factor (A/V ratio) [m^{-1}]: 0,35
The shape factor A/V is the ratio of the total surface area of all external walls (including windows and doors), roofs, floors on the ground or ceilings over the unheated basement, ceilings above the crossings, separating the heated part of the building from outside air to the volume of the heated part of the building, increased by the volume of heated rooms in the utility attic or in the basement and reduced by the volume of separate staircases, elevator shafts, open recesses, loggias and galleries.
It is best if the building shape factor is as low as possible. This means that the building should be as compact as possible, similar in shape to a sphere or cube, that is, solids characterized by the lowest A/V ratio. Considering energy consumption, a building with a high A/V ratio "consumes" more energy.
Typology (number of floors): 3
Number of building users: 276 students and 20 teachers and other staff
Location: Vsetin city is situated in the northeast part of the Zlín region cca 35 km far from Zlín by car.

Available technical documentation: (•) **Yes** ( ) **No**

Energy audit Year: 2016

Technical drawings Year: 2015

Building project for thermo-modernization of the building Year: 2015

Figure 22: Photo of building available for the PA3 – Secondary school in Vsetin (source: Energy Agency of the Zlín Region).

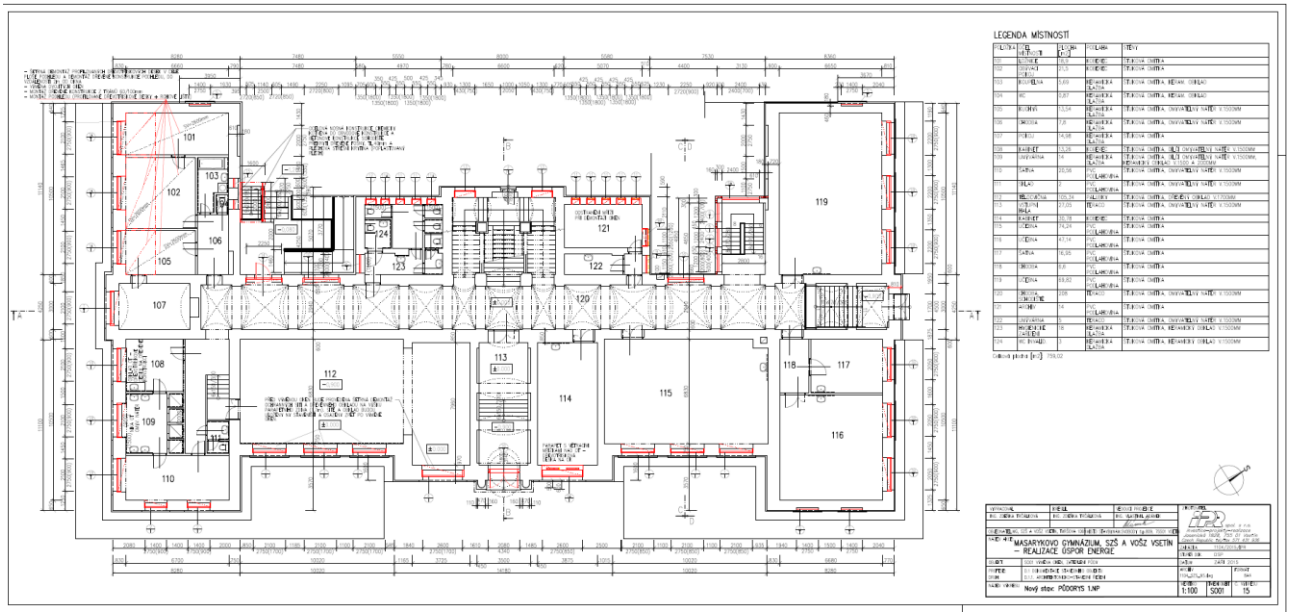


Figure 23: Typology of building available for the PA3 – Secondary school in Vsetin (source: Energy Agency of the Zlín Region).

3. Energy PA building(s) profile

Collecting energy data allows to determine the energy profile of the building. It provides information on the insulation of external partitions and the condition of energy systems (heating/cooling, ventilation, electricity, hot water preparation) in buildings.

3.1. External partitions

The technical and construction status of the building envelope influences significantly the heat loss to the environment. The used construction and thermal insulation material is important. In order to improve standards, a norm, regulation is established for each partition in each country. For existing buildings in the case of low insulation, it is recommended to carry out thermo-modernization.

3.1.1. External walls

Walls total surface area [m^2]: 2 053,9
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^2K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^2K][8]
WALL 1 - historic wall					
1	Lime-cast	0,03	0,88	0,936	0,3 required/0,25 recommended
2	Brick with air spaces	0,75	0,78		
3	Limecement cast	0,03	0,99		
WALL 2 – historic wall					
1	Lime-cast	0,03	0,88	1,096	0,3 required/0,25 recommended
2	Full brick	0,6	0,78		
3	Limecement cast	0,03	0,99		
WALL 3 – historic wall					
1	Lime-cast	0,03	0,88	1,333	0,3 required/0,25 recommended
2	Full brick	0,45	0,78		
3	Limecement cast	0,03	0,99		
WALL 4– non historic wall (wall related to the stirs to garret) - insulated					
1	Lime-cast	0,03	0,88	0,224	0,3 required/0,25 recommended
2	Full brick	0,29	0,78		
3	Limecement cast	0,03	0,99		
4	EPS F	0,16	0,037		

[8] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

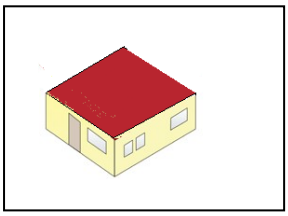
Thermo-modernization (if carried out) – only for 22,8 m^2 wall inside
Year: 2017
Applied thermal insulation material: EPS 100 F
Thickness [cm]: 16
Thermal conductivity [W/mK]: 0,037

Thermo-modernization of the fasade is not possible because the building is "listed "(must be preserved).

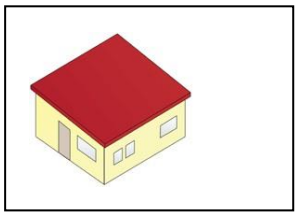
3.1.2. Roof

Type of roof:

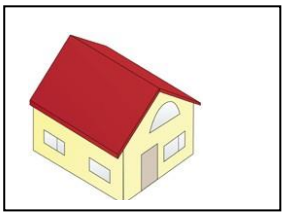
☐ Flat roof



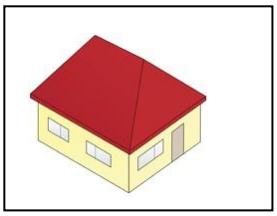
☐ Pent roof



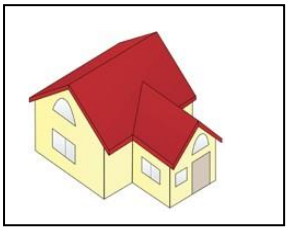
☐ Gable roof



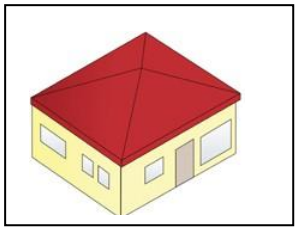
☐ Hip roof



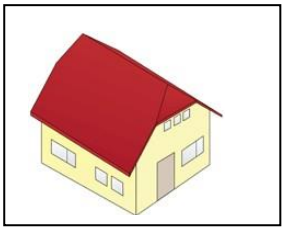
☒ Multi-hip roof



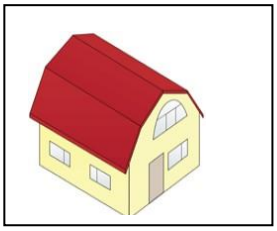
☐ Tented roof



☐ Half-hipped roof



☐ Mansard roof



Roof slope [°]**:** no data **in direction:** no data
Roof total surface area [m^2]: 987,1
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m^2K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m^2K]
1	Lime-cast	0,02	0,88	0,169 after heat insulation	0,3 required/0,2 recommended
2	Wood	0,025	0,18		
3	Air space	0,22	-		
4	Wood	0,025	0,18		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 26
Thermal conductivity [W/mK]: 0,039

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m²K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m²K]
1	Lime-cast	0,02	0,88	0,168 after heat insulation	0,3 required/0,2 recommended
2	Wood	0,025	0,18		
3	Air space	0,3	-		
4	Wood	0,03	0,18		
5	Asphalt	0,001	0,21		
6	Sand	0,03	0,95		
7	Full bricks	0,065	0,86		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 26
Thermal conductivity [W/mK]: 0,039

Envelope material (different layers): Only layers that improve heat transfer

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m²K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m²K]
1	Lime-cast	0,02	0,88	0,175 after heat insulation	0,3 required/0,2 recommended
2	Wood	0,025	0,224		
3	Air space	0,4	-		
4	Chipboard	0,025	0,18		
5	EPS 100 Z	0,05	0,037		
6	Asphalt	0,001	0,21		
7	Concrete	0,05	1,3		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: PIR isolation and mineral wool
Thickness [cm]: 20
Thermal conductivity [W/mK]: 0,039

Envelope material (different layers): Only layers that improve heat transfer

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for roof [W/m²K]	Defined heat transfer coefficient for roof (according to the norm, national regulations) [W/m²K]
1	Lime-cast	0,02	0,88	0,139 after heat insulation	0,3 required/0,2 recommended
2	Armoured concrete	0,08	1,58		

3	EPS	0,05	0,044		
4	Concrete	0,08	1,3		
5	Asphalt	0,015	0,21		

Thermo-modernization (if carried out)
Year: 2017
Applied thermal insulation material: mineral wool
Thickness [cm]: 26
Thermal conductivity [W/mK]: 0,037

3.1.3. Ground floor

Floor total surface area [m^2]: 493,5
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1	Ceramic tiles	0,008	1,01	1,641 (0,388 equivalent)	0,45 required/ 0,3 recommended
2	Concrete	0,13	1,1		
3	Asphalt straps	0,005	0,21		
4	Concrete	0,15	1,1		
5	gravel	0,15	0,58		

3.1.4. Basement ceiling (if the building has a basement)

Total surface area [m^2]: 493,5
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^2K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^2K]
1	Ceramic tiles	0,004	1,01	0,796	1,05 required/ 0,7 recommended
2	Concrete	0,02	1,1		
3	Armoured concrete	0,12	1,34		
4	Gravel	0,13	0,21		
5	Brick with air spaces	0,15	0,73		
6	Lime cast	0,02	0,7		

Basement
Is the basement heated ? ☐ **Yes** ☒ **No**
Basement walls total surface area [m^2]:

Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m²K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m²K]
1					

3.1.5. Windows

Type:
☐ single window, single glazed
☐ combined window, double glazed
☐ combined window, three panes
☐ single-frame window, double low-emission glass, argon chamber
☐ single-frame window, three glass panes, two (external) glasses are made of ordinary glass, and the inner glass of low-emission glass, the chambers between the glasses are filled with argon
☐ single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
☒ other (what ?) ……combined window, single glazed…….

Shading (sun protection):
☒ curtains
☐ roller shutters
☐ wooden shutters
☐ internal blinds
☐ awnings
☐ other (what ?) …….

Material (PVC, wood, aluminum, wood-aluminum): Wood
Number of windows:
Windows total surface area [m²]: 580
Diffusers in windows (YES or NO): No
Heat transfer coefficient [W/m²K]: 2,35
Defined heat transfer coefficient (according to the norm, national regulations) [W/m²K]: 1,5 requested/1,2 recommended

Thermo-modernization (if carried out)
Year: 2017
Type of windows: single-frame window, three glass panes, all glasses are made of low-emission glass, the chambers between the glasses are filled with argon
Material: Wood
Number of windows (if all windows are not replaced on the new ones): 165
Windows total surface area [m²]: 580
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m²K]: 1,0

3.1.6. Doors

Material (wood, aluminum, PVC etc.): Wood
Number of doors: 5
Doors total surface area [m^2]: 25,7
Heat transfer coefficient [W/m^2K]: 4,5
Defined heat transfer coefficient (according to the norm, national regulations) [W/m^2K]: 3,5 requested/2,3 recommended

Thermo-modernization (if carried out)
Year: 2016
Material: Wood
Number of doors (if all doors are not replaced on the new ones): 3
Doors total surface area [m^2]: 16
Heat transfer coefficient [W/m^2K]: 1,2 and 2,3

3.2. Systems energy data

High efficiency of energy systems and the type of energy source determines its consumption. Also important is the issue of installed control and control systems that help ensure optimal thermal conditions. Energy parameters characterizing the building:
Total non renewable primary energy demand [GJ/year or kWh/year]: 553 797 kWh/year after investment
Energy consumption (heating) [GJ/year or kWh/year]: district heating system measures only one consumption for energy for heating and preparing of hot water
Efficiency of the heating system [%]: 99
Energy consumption (hot water preparation) [GJ/year or kWh/year]: district heating system measures only one consumption for energy for heating and preparing of hot water
Efficiency of the hot water preparation system [%]: 99
Energy consumption (cooling) [GJ/year or kWh/year]: no cooling system
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): District heating system
Regulation and control of systems in the building:
☒ thermostatic valves
☐ heat dividers
☐ motion sensors
☐ electricity meters
☐ water meters
☐ other (what ?)……
Annual fuel consumption [kg or m^3 or kWh or GJ]: 1 108,4 GJ before the investment, 791,3GJ after investment
Electricity consumption [kWh/year]: 59 700
Ordered power [MW]: -
Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps
Power of light bulbs [W]: fluorescent tubes 40-200 W
Number of lighting points: -
Ventilation type (according to the table 1): natural ventilation

Building energy profile

The energy consumption in construction is distinguished by three types of energy - primary energy (EP), final energy (EK) and utility energy (EU). Primary energy refers to the energy contained in sources, including fuels and carriers, necessary to cover the final energy demand, taking into account the efficiency of the entire chain of acquisition, conversion and transport to the end user. A concept that is important from the point of view of a sustainable development strategy. The ratio of non-renewable primary energy inputs to the generation and delivery of an energy or energy carrier for technical systems is the difference between primary energy and final energy. The final energy is heat and auxiliary energy, which must be delivered to the boundary of the heating system (building) with a given efficiency in order to cover the energy demand for heating and ventilation of rooms. A concept that is important from the point of view of the building's user who incurs costs related to the operation of the building. The efficiency of the system is a conversion of final energy into utility energy. The utility energy concerns energy for heating and ventilation as well as for preparing domestic hot water, regardless of the type and efficiency of the heating device. A concept that is important from the designer's point of view, characterizing thermal insulation and building tightness. The concepts are presented below.

$$EU \xrightarrow{\eta} EK \xrightarrow{w_i} EP$$

Annual demand for non renewable primary energy EP [kWh/m²/year]

Non renewable primary energy demand for heating	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation	Non renewable primary energy demand for preparation of hot water	Non renewable primary energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
121	0	0	6	60	187

Annual final energy demand EK [kWh/m²/year]

Final energy demand for heating	Final energy demand for cooling	Final energy demand for ventilation	Final energy demand for preparation of hot water	Final energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
133	0	0	7	64	204

Annual utility energy demand EU [kWh/m²/year]

Utility energy demand for heating	Utility energy demand for cooling	Utility energy demand for ventilation	Utility energy demand for preparation of hot water	Utility energy demand for electricity	Sum (1+2+3+4+5)
1	**2**	**3**	**4**	**5**	**6**
121	0	0	6	20	147

Energy class of the building (according to the table 2): D average energy-intensive building

The EU indicator is a building quality indicator. In general, the smaller the EU, the less energy we lose through the outer baffles of the building. It refers to the energy which is consumed and goes from the building's heating system to the individual rooms, and the heat loss (through penetration and ventilation) to the environment. The EU indicator value in the table below includes only heating/cooling.

Electricity price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]: 3,76 CZK per month with tax (average for all supply points)
Variable fee [per kWh]: 1131 CZK per kWh (average for all supply points)
Subscription [per month]: -

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per MW-month]:
Variable fee [per GJ]: Overall price is 846 CZK/MWh with tax (235 CZK/GJ). All parts of price depend on the consumption.
Subscription [per month]:

Summary and evaluation of the energy building status
The external walls partly do not meet the technical requirements in terms of the value of heat transfer coefficient. The façade is ”listed “(must be preserved). The thermo-modernization in 2016 and 2017 included the replacement of window and doors joinery, roof and walls (partly) insulation.
The building's energy system includes the heating system, the hot water preparation system and the power system. The efficiency of the heating system and the preparation of hot water is very high (99%). The energy class classifies it as an average energy intensive building.
The building is not equipped with cooling systems and ventilation is done through windows and ventilation ducts.

4. Definition of the required resources to run the investment

This chapter describes the measures and activities that were implemented to start the investment in the appropriate order and assign a time schedule and costs. These are only preparatory activities to undertake investment.
The steps that were taken in order to prepare an investment or to carry out other activities are presented in the appropriate order.

PA 3 – Vsetin						
No.	Preparatory work	Preparatory work description	Time schedule	Cost (EUR)	Market research	Selected external expert
1	Preparation	Based on energy management of the building and possibility of donation Zlín region decided that this school will be prepared for the Windows changing and heat insulation of the roof and heat insulation o the non-historic wall	2015	-	DONE	EAZK and Zlín region
2	Project blueprints	Zlín region order the blueprints necessary for the further progress of the	09/2015-08/2016	15000	DONE	IPR spol. S.r.o.

		project.				
3	Energy audit	EAZK supported Energy expert with all necessary data related to the project	02/2016-03/2016	1700	DONE	TESPORA
4	Donation application	EAZK prepared donation application	03/2016	-	DONE	EAZK
5	Public procurement	EAZK prepared blueprints for the public procurement	08/2016-10/2016		DONE	RTS
6	Realization of windows changing and roof insulation and non-historic wall heat insulation	Whole realization was done during summer holidays	06/2017-09/2017	642 690	DONE	TM stav spol. s r.o.
7	Evaluation of realization	EAZK continuously collect data to be able to evaluate the project	06/2018	0	NOT STARTED	EAZK
8	Evaluation of the project	EAZK continuously collect data to be able to evaluate the project	10/2019	0	NOT STARTED	EAZK

Table 17: Time schedule and cost estimate of preparatory activities in the PA3 - Vsetin.

Table 18 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results.

	2018												2019												2020				
Month	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May
Project month	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
PA3																													

Table 18: PA3 Vsetin Activities plan.

start of WPT3 | PA preparations | PA implementation | PA monitoring/evaluation | end of PA | end of WPT3

Explanation:

PA preparations – A set of activities that are used to initiate the right investment, such as the selection of experts, contractors, collecting data and information, and other administrative work.

PA implementation – A set of activities like installation of equipment, systems, implementation of the OnePlace platform, promotional activities.

PA monitoring/evaluation – Checking whether the expected results are received.

5. Definition of problems in the implementation of PA

Each investment may encounter barriers of a financial, administrative, organizational or substantive nature. Therefore, it is important to define possible problems that may arise when investing in energy efficiency.

Problems (with expected delays): To this day were no problems with implementing the project

6. Conclusions

Energy data and administrative description of the building are valuable and necessary information when developing energy audits and conducting investments aimed at improving energy efficiency. Subsequent implementation of pilot project areas will be based on the presented data and will be described in the next reports (D.T3.1.4, D.T3.2.1 and D.T3.2.2).