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

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Authors		
	Name (organization)	**Name, e-mail**
WP leader	Mazovia Energy Agency (MAE), PP5	Aleksandra Luks, a.luks@mae.com.pl
Contributing participants	City Municipality of Plonsk (CMoP) (PP13)	Kamil Wyrzykowski, k.wyrzykowski@plonsk.pl Julia Chlewicka, j.chlewicka@plonsk.pl Jerzy Żelichowski, j.zelichowski@plonsk.pl Adrian Klimiuk, a.klimiuk@plonsk.pl

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 - **PA5. Monitor and control energy flows in a public building in Plonsk (PL)**

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: School
Owner: City Municipality of Plonsk
Year of construction: 1905
Year of use (if different from year of construction): -
Gross building area [m^2]: 2 155,25
Building volume [m^3]: 15 760,00
Building envelope total surface area [m^2]: 309,36
Shape factor (A/V ratio) [m^{-1}]: 0,46
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 - attic + 2 floors + basement
Number of building users: 416
Location: Wolności 4 Street, Plonsk, Mazovia Region, Poland

Available technical documentation: ◉ **Yes** ○ **No**

Energy audit Year: 2018

Figure 1: Photo of building available for the PA5 (source: City Municipality of Plonsk).

Figure 2: Typology of building available for the PA5 (source: City Municipality of Plonsk).

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]: 1 504,03
Envelope material (different layers):

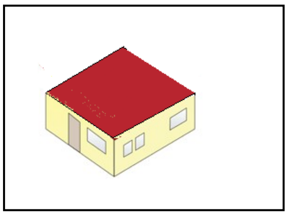
No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for external wall [W/m^{2}K]	Defined heat transfer coefficient for external wall (according to the norm, national regulations) [W/m^{2}K][1]
External and plinth walls					
1	Lime cement-plaster	0,015	0,82	0,318	0,20
2	Ceramic brick		0,77		
3	Styrofoam	0,10	0,04		
4	Lime cement-plaster	0,015	0,82		
Walls near the ground					
1	Lime cement-plaster	0,015	0,82	0,514	0,20
2	Ceramic brick		0,77		
3	Lime cement-plaster	0,015	0,82		

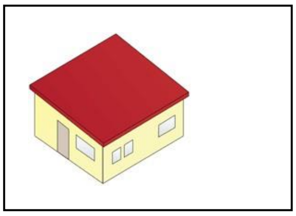
Thermo-modernization
Year: 2004
Applied thermal insulation material: Styrofoam
Thickness [cm]: 10
Thermal conductivity [W/mK]: 0,04

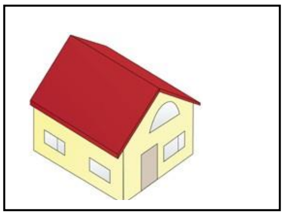
3.1.2. Roof

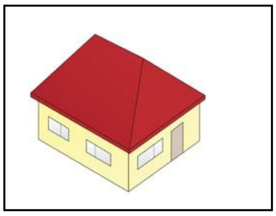
Type of roof:

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



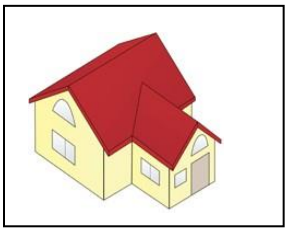
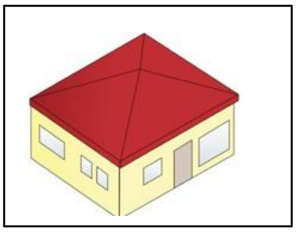
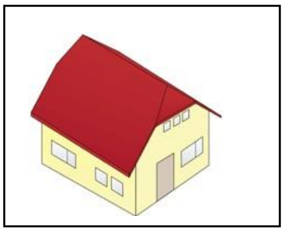
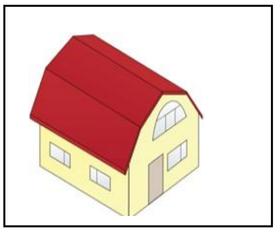






[1] If there are more U coefficients than one in your country, exchange all of them with the division, what they mean (e.g. recommended, required etc.)

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

Roof slope [°]**:** no data **in direction:** N/A
Roof total surface area [m^2]: 271,91
Envelope material (different layers):

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]
School building roof (with usable attic)					
1	Tiles		0,82	0,871	0,15
2	Wood				
School building roof (with non-usable attic)					
1				0,873	0,15
Boiler room roof					
1	Roofing paper		0,18	1,536	0,15

3.1.3. Ground floor

Floor total surface area [m^2]: 309,36
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^{2}K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^{2}K]
1				0,538	0,30

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

Total surface area [m^2]: 752,05
Envelope material (different layers):

No.	Material	Thickness [m]	Thermal conductivity [W/mK]	Heat transfer coefficient for floor [W/m^{2}K]	Defined heat transfer coefficient for floor (according to the norm, national regulations) [W/m^{2}K]
1				1,23	1,00 / 0,25

Basement
Is the basement heated ? ☒ **Yes (partly)** ☐ **No**
Basement walls total surface area [m^2]: 293,26

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				0,514	0,20
2					
3					
4					
5					

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: 98
Windows total surface area [m²]: 360,22
Diffusers in windows (YES or NO): NO
Heat transfer coefficient [W/m²K]: 2,3/4,5
Defined heat transfer coefficient (according to the norm, national regulations) [W/m²K]: 0,9

3.1.6. Doors

Material (wood, aluminum, PVC etc.): PVC
Number of doors: 2
Doors total surface area [m²]: 9,68
Heat transfer coefficient [W/m²K]: 2,0/4,2
Defined heat transfer coefficient (according to the norm, national regulations) [W/m²K]: 1,3

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 [kWh/year]: 332 996,60
Energy consumption (heating and hot water preparation) [kWh/year]: 229 996
Efficiency of the heating system [%]: 73
Efficiency of the hot water preparation system [%]: 32
Energy consumption (cooling) [kWh/year]: no cooling system
Type of energy source (gas boiler, coal boiler, electricity, municipal heating network, biomass boiler, cogeneration, RES etc.): 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]: 20 466 m^3
Electricity consumption [kWh/year]: 26 667
Ordered power [kW]: 16,5
Lighting type (traditional incandescent lamps; halogen bulbs; fluorescent lamps; LED lamps): fluorescent lamps, traditional incandescent lamps, LED lamps
Power of light bulbs [W]: 18 780
Number of lighting points: 345
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 and preparation of hot water	Non renewable primary energy demand for cooling	Non renewable primary energy demand for ventilation	Non renewable primary energy demand for electricity	Sum (1+2+3+4)
1	**2**	**3**	**4**	**5**
117,38	-	-	37,12	154,50

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

Final energy demand for heating and preparation of hot water	Final energy demand for cooling	Final energy demand for ventilation	Final energy demand for electricity	Sum (1+2+3+4)
1	**2**	**3**	**4**	**5**
106,71	-	-	12,37	119,08

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)
1	**2**	**3**	**4**	**5**	**6**
68,55	-	-	4,10		72,65

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.

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 kW-month]: 5,72 PLN
Variable fee [per kWh]: 0,4728 PLN
Subscription [per month]: 1,80 PLN

Energy (heating) price [in your own currency: CZK or EUR or HRK or HUF or PLN]
Fixed fee [per kW-month]: 0,00611 PLN (in January, February, March, April, May, June, July, August, September, October, December), 0,02444 PLN (in November)
Variable fee [per kWh]: 0,11839 PLN (in January and February), 0,10969 PLN (in February and March), 0,11121 PLN (in April, May, June, July, August, September, October, November, December)
Subscription [per month]: 121,00 PLN

Summary and evaluation of the energy building status

The general condition of the building is poor. However, all external partitions - external walls, roof, floor, windows and doors - do not meet the technical requirements in terms of the value of heat transfer coefficient.
The building's energy system includes only the heating system, the hot water preparation system and the power system. The efficiency of the heating system and the preparation of domestic hot water is low. In total, the building uses annually 256 663 kWh, 90% of which is for heating and hot water despite installed thermostatic valves. However, considering the large area and volume of the building, the energy class classifies it as an energy-saving building.
The building is not equipped with cooling systems and ventilation is done through windows and ventilation ducts.

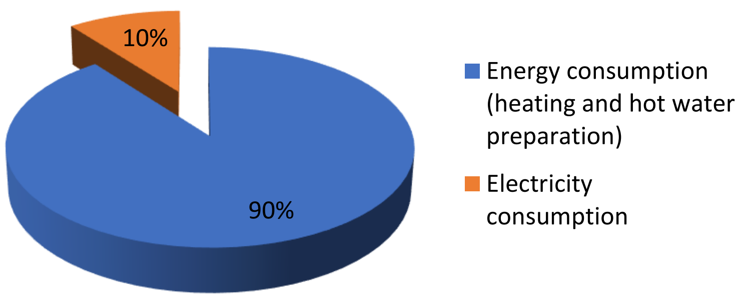


Figure 3: Energy consumption balance of the building for the PA5.

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.

PA5						
No.	**Preparatory work**	**Preparatory work description**	**Time schedule**	**Cost (EUR)**	**Market research**	**Selected external expert**
1	Data collection				NOT APPLICABLE	
2	Investment descriptions				NOT APPLICABLE	
3	Meetings with school management				NOT APPLICABLE	
4	Public procurement procedures to engage external expert	The inquiry was published on the city's website and sent to the potential external experts (6 companies) on April 3rd 2018.	April 2018		DONE	
5	Selection of the external expert	CMoP has chosen an expert on April 11th 2018 form three valid offers. Newly selected expert was obliged to prepare the technical documentation (including the Energy Audit of the PA building) until May 7th 2018.	April 2018	3 500	DONE	PMG Ltd.
6	Public procurement procedures to equipment purchase		July 2018		NOT STARTED	
7	Equipment purchase		July 2018	6 900	NOT STARTED	
8	Public procurement procedures to engage contractor		July 2018		NOT STARTED	

9	Selection of the contractor		July 2018	7 000	NOT STARTED	

Table 3: Time schedule and cost estimate of preparatory activities in the PA5.

Table 4 shows the time periods for the investment preparation period, implementation of activities and subsequent monitoring and evaluation of results. All works must take place before August 2019.

	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
PA5																													

Table 4: PA5 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): No problems so far

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.T3.1.6, D.T3.2.1 and D.T3.2.2).