Carbon footprint of building restoration - Poland

Version 1

2019

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Summary

Introduction

This document reports the results obtained using ERE App to evaluate restoration activities of building envelope in school's buildings investigated during FEEDSCHOOLS project.
Each school building analysis is reported in a module containing a short description, the source of data utilized, and results obtained using ERE app.
Prices utilized to calculate the total amount of material utilized in the renovation actions in Polish schools building are reported in Table 1 deduced from D3.2.3 deliverable.
To have deeper information concerning the app, its database and mode of operation, please refer to the general introduction of deliverable D3.2.5, and to deliverable D1.3.2 and D1.3.3.

Table 1 - Assumptions of modernizations' prices

No.	Measure	Unit measured	Price per unit [EUR/unit]	Additional cost [EUR]
1.	External walls insulation	1 m^2	42	-
2.	Windows modernisation	1 m^2	233	-
3.	Roof insulation	1 m^2	35	-
4.	Foundation walls	1 m^2	105	-

SCHOOL: SP 61 - Warsaw

Description

The building was built in 1956 and stays in unchanged form till today. Envelope is well preserved however it has not been modernized since original state, except windows and roof modernization in 1998. Furthermore in 2015 windows in the sport hall have been changed. External partitions are not thermally insulated, thus heat resistance is very low. Windows are in very bad condition thus modernization should be considered, possibly together with a thermal insulation of external walls. In 1998 heating system and electric system have been modernized. The building is heated with heat exchanger powered by district heating. The heating installation is in a good condition. Heat is distributed with plate water convectors equipped with thermostats. The building does not have any mechanical ventilation or other HVAC system except kitchen which has been equipped with exhaust fans. The lighting in almost the whole building is provided with 2x58 W fluorescent fittings, except small rooms such as toilets, storage rooms etc. The lighting is controlled manually by users. The building does not have any BMS system.

Initial Energy Requirement

Information can be found in the D3.2.2 Energy Audit Deliverable Chapter 4

Tool Initial Results

NORMALIZED ENERGY INDEX

SCHOOL DETAILS:

Name: SP 61

Grade: primary

Municipality: Warsaw

Date: 28/01/2020

YEARLY AVERAGE CONSUMPTION:

Heating: **576,625.50 kWh_t**
Electricity:**64,938.00 kWh**

Equivalent Carbon Footprint
Total emission:**295,736.72 kg CO_2**

NORMALIZED ENERGY INDEX FOR HEATING

NEIh = 4.80 Wht/m^3 x DD x year

Heating rating:

☺ **ABOVE AVERAGE**

Good, but you can still improve.
Check how by clicking NEXT.

NORMALIZED ENERGY INDEX FOR ELECTRICITY

NEIe = 26.51 kWhe/m^2 x year

Electricity rating:

☹ **BELOW AVERAGE**

Not good, you **NEED** to improve
Check how by clicking NEXT.

To reach **nZEB** classification the COMMISSION RECOMMENDATION (EU) 2016/1318 suggests the following indicators for Mediterranean area:

Offices and Schools: **20-30 kWh/(m^2*y)** of net *primary energy* with, typically, **80-90 kWh/(m^2*y)** of *primary energy* use covered by **60 kWh/(m^2*y)** of on-site renewable sources;

Summary of the energy performance of the building and suggested improvement options

Information concerning building performances after renovation actions can be found in chapter 1 of D3.2.3 Energy simulation and technical improvement options deliverable.

Tool Improvement Actions and Results

Select one or more renovation options

> *U_{old} =transmittance of the element before the renovation*
> *U_{new} = transmittance of the element after the renovation*
> *A = total area of the element affected by the renovation*
> *% Contribution = contribution of the single improvement to the total energy saving*

Elements	U_{old} [W/m²K]	U_{new} [W/m²K]	Area [m²]	Energy Saving [kWh]	% Contribution	Cost [€]	CO_2 emitted [kg CO_2eq]
☑ Glazing	single gl	LE glass	585	221,276	29.6 %	136,305.00 [€]	906.75
☑ Roof	Bricks +	Ventilate	1050	161,771	21.6 %	18,900.00 [€]	546.00
☑ Walls	Solid ma	Bricks wi	2188	365,360	48.8 %	48,136.00 [€]	918.96
☑ Floor	Bricks +	Concrete		0	0.0 %	0.00 [€]	0.00

RESULTS

The table below shows the potential CO_2e* savings associated to the type of energy sourches used for the heating system.

Total THERMAL Energy Saved:	**748,407 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e***
equivalent to save:	42,967.00 [€]	Natural Gas	180,366
Improvement action cost:	203,341.00 [€]		
Total ELECTRIC Energy Saved:	**0 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e***
equivalent to save:	0.00 [€]	Electric energy	0.00
Improvement action cost:	0.00 [€]		
Total Primary Energy Saved	**748,407.00 [kWh]**	**Total CO_2 Saved:**	**180,366.00 [kg CO_2e*]**
Total improvement cost	**203,341.00 [€]**	Improvement CO_2 emitted:	2,371.71 [kg CO_2e*]
Total saved	42,967.00 [€]		

Several examples of Best Practices have been implemented in Mediterranean countries. Check it on this BAT page

Considerations

Information concerning school's building consumption and renovation in the Energy Audit and in the Energy Simulations and Technical Improvement options (D3.2.2 and D3.2.3) technical deliverables were clear but not exhaustive for their use in the ERE App.

The quantities of materials used for the improvement actions are not available, to obtain an estimation of these quantities, the user had to calculate it from the expenses claimed for the renovation and prices reported (Table 1) that in some case are different from prices present in the tool.

Results of initial situation confirm the need to act improvement actions in the school building to optimize energy consumption.

Deliverable D3.2.3 includes information to evaluate improvement solutions for the school building that give an estimated savings of around 180 tons of CO2 eq. The CO2 eq. emitted in the production phase of the materials used to improve the performances of the building are 2,7 tons.

Results obtained give an indication to the user about some possible improving solution.

SCHOOL: SP340 - Warsaw

Description

The building was built between 1993 and 1997. It was constructed and designed in 3-stages. The building envelope is well preserved. Since the beginning, thermal insulation has been never upgraded. Only windows were changed around 2014. In one of the sport halls (fencing hall), a mechanical ventilation and air conditioning have been installed. The building is connected to the district heating network. Both central heating and domestic hot water system is supplied by a heat exchanger. The building has been insulated with a thick layer of polystyrene (6-8 cm) on the external walls, 16 cm of mineral wool on the roof, and 6 cm of hard polystyrene on the ground floor. The building is ventilated naturally except the large sport hall and the fencing hall. The large sport hall is equipped with mechanical exhaust fans located on the ceiling, however they have not been used for a long time. The fencing hall has been recently equipped with new air handling unit with heat recovery. The lighting system is composed of traditional fluorescent bulbs controlled manually by users. The building does not have any BMS system.

Initial Energy Requirement

Information can be found in the D3.2.2 Energy Audit Deliverable Chapter 4

Tool Initial Results

NORMALIZED ENERGY INDEX

SCHOOL DETAILS:

Name: SP 340

Grade: primary

Municipality: Warsaw

Date: 28/01/2020

YEARLY AVERAGE CONSUMPTION:

Heating: **727,306.80 kWh_t**
Electricity:**114,273.00 kWh**

Equivalent Carbon Footprint
Total emission:**410,917.57 kg CO_2**

NORMALIZED ENERGY INDEX FOR HEATING

NEIh = **1.69** Wht/m^3 x DD x year

Heating rating:

☺ **ABOVE AVERAGE**

Good, but you can still improve.
Check how by clicking NEXT.

NORMALIZED ENERGY INDEX FOR ELECTRICITY

NEIe = **19.32** kWhe/m^2 x year

Electricity rating:

☹ **BELOW AVERAGE**

Not good, you **NEED** to improve
Check how by clicking NEXT.

To reach **nZEB** classification the COMMISSION RECOMMENDATION (EU) 2016/1318 suggests the following indicators for Mediterranean area:

Offices and Schools: **20-30 kWh/(m^2*y)** of net *primary energy* with, typically, **80-90 kWh/(m^2*y)** of *primary energy* use covered by **60 kWh/(m^2*y)** of on-site renewable sources;

Summary of the energy performance of the building and suggested improvement options

Information concerning building performances after renovation actions can be found in chapter 1 of D3.2.3 Energy simulation and technical improvement options deliverable.

Tool Improvement Actions and Results

Select one or more renovation options

> *U_{old} =transmittance of the element before the renovation*
> *U_{new} = transmittance of the element after the renovation*
> *A = total area of the element affected by the renovation*
> *% Contribution = contribution of the single improvement to the total energy saving*

Elements	U_{old} [W/m²K]	U_{new} [W/m²K]	Area [m²]	Energy Saving [kWh]	% Contribution	Cost [€]	CO_2 emitted [kg CO_2eq]
☐ Glazing	single gl	LE glass					
☑ Roof	Bricks t	Ventilate	2608	401,808	48.2 %	46,944.00 [€]	1,356.16
☑ Walls	Solid ma	Bricks wi	2434	406,437	48.8 %	53,548.00 [€]	1,022.28
☑ Floor	Bricks t	Concrete	197	25,444	3.1 %	2,167.00 [€]	102.44

RESULTS

The table below shows the potential CO_2e* savings associated to the type of energy sourches used for the heating system.

Total THERMAL Energy Saved:	**833,689 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e***
equivalent to save:	47,863.15 [€]	Natural Gas	200,919
Improvement action cost:	102,659.00 [€]		
Total ELECTRIC Energy Saved:	**0 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e***
equivalent to save:	0.00 [€]	Electric energy	0.00
Improvement action cost:	0.00 [€]		
Total Primary Energy Saved	**833,689.00 [kWh]**	**Total CO_2 Saved:**	**200,919.00 [kg CO_2e*]**
Total improvement cost	**102,659.00 [€]**	Improvement CO_2 emitted:	2,480.88 [kg CO_2e*]
Total saved	47,863.15 [€]		

Several examples of Best Practices have been implemented in Mediterranean countries. Check it on this BAT page

Considerations

Information concerning school's building consumption and renovation in the Energy Audit and in the Energy Simulations and Technical Improvement options (D3.2.2 and D3.2.3) technical deliverables were clear but not exhaustive for their use in the ERE App.

The quantities of materials used for the improvement actions are not available, to obtain an estimation of these quantities, the user had to calculate it from the expenses claimed for the renovation and prices reported (Table 1) that in some case are different from prices present in the tool.

Results of initial situation confirm the need to act improvement actions in the school building to optimize energy consumption.

Deliverable D3.2.3 includes information to evaluate improvement solutions for the school building that give an estimated savings of around 200 tons of CO2 eq. The CO2 eq. emitted in the production phase of the materials used to improve the performances of the building are 2,4 tons.

Results obtained give an indication to the user about some possible improving solution.Results obtained give an indication to the user about some possible improving solution.

SCHOOL: SP 378 - Warsaw

Description

The building was built between 1974 and 1976. The building envelope is well preserved. It has been slightly renewed since original state but it has not been thermally insulated. Windows were exchanged in 2006 with PCV framed double-glazed ones. In 2006 there was a modernization of the sport hall, and new mechanical ventilation with heat recovery and a water heating coil was installed. The mechanical ventilation is also installed in a canteen and in the kitchen. Its installation is dated for 1975 when the building was built. The rest of the building is ventilated naturally. The building is heated by heat exchanger connected to the district heating. The pipes with heating factor are insulated, but insulation is not tight. The heat is distributed by old pipe heaters on the corridors and old iron ribbed heaters in other rooms. The most of the convectors does not have thermostats. There are also some leakages in installation, so the water must be refilled periodically. The sports hall is also heated with ventilation air from air handling unit. The whole building is equipped with traditional T8 fluorescent bulbs manually controlled by users. The building does not have any BMS system.

Initial Energy Requirement

Information can be found in the D3.2.2 Energy Audit Deliverable Chapter 4

Tool Initial Results

NORMALIZED ENERGY INDEX

SCHOOL DETAILS:

Name: SP 378

Grade: primary

Municipality: Warsaw

Date: 28/01/2020

YEARLY AVERAGE CONSUMPTION:

Heating: **928,106.30 kWh_t**

Electricity:**126,927.33 kWh**

Equivalent Carbon Footprint

Total emission:**502,240.40 kg CO_2**

NORMALIZED ENERGY INDEX FOR HEATING

NEIh = 2.49 Wht/m^3 x DD x year

Heating rating:

☺ **ABOVE AVERAGE**

Good, but you can still improve.
Check how by clicking NEXT.

NORMALIZED ENERGY INDEX FOR ELECTRICITY

NEIe = 17.99 kWhe/m^2 x year

Electricity rating:

☹ **BELOW AVERAGE**

Not good, you **NEED** to improve
Check how by clicking NEXT.

To reach **nZEB** classification the COMMISSION RECOMMENDATION (EU) 2016/1318 suggests the following indicators for Mediterranean area:

Offices and Schools: **20-30 kWh/(m^2*y)** of net *primary energy* with, typically, **80-90 kWh/(m^2*y)** of *primary energy* use covered by **60 kWh/(m^2*y)** of on-site renewable sources;

Summary of the energy performance of the building and suggested improvement options

Information concerning building performances after renovation actions can be found in chapter 1 of D3.2.3 Energy simulation and technical improvement options deliverable.

Tool Improvement Actions and Results

Select one or more renovation options

> *U_{old} =transmittance of the element before the renovation*
> *U_{new} = transmittance of the element after the renovation*
> *A = total area of the element affected by the renovation*
> *% Contribution = contribution of the single improvement to the total energy saving*

Elements	U_{old} [W/m²K]	U_{new} [W/m²K]	Area [m²]	Energy Saving [kWh]	% Contribution	Cost [€]	CO_2 emitted [kg CO_2eq]
☑ Glazing	single gl	LE glass	1261	476,973	34.7 %	293,813.00 [€]	1,954.55
☑ Roof	Bricks t	Ventilate	2744	422,761	30.8 %	49,392.00 [€]	1,426.88
☑ Walls	Solid ma	Bricks w	2086	348,327	25.4 %	45,892.00 [€]	876.12
☑ Floor	Bricks t	Concrete	975	125,929	9.2 %	10,725.00 [€]	507.00

RESULTS

The table below shows the potential CO_2e^* savings associated to the type of energy sourches used for the heating system.

Total THERMAL Energy Saved:	**1,373,990 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e^***
equivalent to save:	78,882.52 [€]	Natural Gas	331,132
Improvement action cost:	399,822.00 [€]		
Total ELECTRIC Energy Saved:	**0 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e^***
equivalent to save:	0.00 [€]	Electric energy	0.00
Improvement action cost:	0.00 [€]		
Total Primary Energy Saved	**1,373,990.00 [kWh]**	**Total CO_2 Saved:**	**331,132.00 [kg CO_2e^*]**
Total improvement cost	**399,822.00 [€]**	Improvement CO_2 emitted:	4,764.55 [kg CO_2e^*]
Total saved	78,882.52 [€]		

Several examples of Best Practices have been implemented in Mediterranean countries. Check it on this BAT page

Considerations

Information concerning school's building consumption and renovation in the Energy Audit and in the Energy Simulations and Technical Improvement options (D3.2.2 and D3.2.3) technical deliverables were clear but not exhaustive for their use in the ERE App.

The quantities of materials used for the improvement actions are not available, to obtain an estimation of these quantities, the user had to calculate it from the expenses claimed for the renovation and prices reported (Table 1) that in some case are different from prices present in the tool.

Results of initial situation confirm the need to act improvement actions in the school building to optimize energy consumption.

Deliverable D3.2.3 includes information to evaluate improvement solutions for the school building that give an estimated savings of around 331 tons of CO2 eq. The CO2 eq. emitted in the production phase of the materials used to improve the performances of the building are 4,7 tons.

SCHOOL: SP 341 - Warsaw

Description

The building was built between 1993 and 1998. It was designed in 4 stages. The building envelope is well preserved. Since the beginning, it has been well thermally insulated, with mineral wool on the roofs of 10-20 cm, and polystyrene on the external walls of 9-10 cm. The ground floor is insulated with 4 cm of hard polystyrene. There were no modernizations performed in the building yet. The building is ventilated naturally except the sport hall and the canteen kitchen which are equipped with mechanical ventilation. There are 13 cooling units installed in the building. The building is connected to the district heating network. Both the central heating and domestic hot water are supplied by the heat exchanger. The lighting system in the building is composed of traditional fluorescent bulbs controlled manually by users. The building does not have any BMS system.

Initial Energy Requirement

Information can be found in the D3.2.2 Energy Audit Deliverable Chapter 4

Tool Initial Results

NORMALIZED ENERGY INDEX

SCHOOL DETAILS:

Name: SP 341

Grade: primary

Municipality: Warsaw

Date: 28/01/2020

YEARLY AVERAGE CONSUMPTION:

Heating: **992,605.35 kWh$_t$**

Electricity:**188,070.00 kWh**

Equivalent Carbon Footprint

Total emission:**598,412.61 kg CO_2**

NORMALIZED ENERGY INDEX FOR HEATING

NEIh = 1.61 Wht/m^3 x DD x year

Heating rating:

☺ **ABOVE AVERAGE**

Good, but you can still improve.
Check how by clicking NEXT.

NORMALIZED ENERGY INDEX FOR ELECTRICITY

NEIe = 21.73 kWhe/m^2 x year

Electricity rating:

☹ **BELOW AVERAGE**

Not good, you **NEED** to improve
Check how by clicking NEXT.

To reach **nZEB** classification the COMMISSION RECOMMENDATION (EU) 2016/1318 suggests the following indicators for Mediterranean area:

Offices and Schools: **20-30 kWh/(m^2*y)** of net *primary energy* with, typically, **80-90 kWh/(m^2*y)** of *primary energy* use covered by **60 kWh/(m^2*y)** of on-site renewable sources;

Summary of the energy performance of the building and suggested improvement options

Information concerning building performances after renovation actions can be found in chapter 1 of D3.2.3 Energy simulation and technical improvement options deliverable.

Tool Improvement Actions and Results

Select one or more renovation options

> *U_{old} =transmittance of the element before the renovation*
> *U_{new} = transmittance of the element after the renovation*
> *A = total area of the element affected by the renovation*
> *% Contribution = contribution of the single improvement to the total energy saving*

Elements	U_{old} [W/m²K]	U_{new} [W/m²K]	Area [m²]	Energy Saving [kWh]	% Contribution	Cost [€]	CO_2 emitted [kg CO_2eq]
☑ Glazing	single gl	LE glass	1147	433,852	25.6 %	267,251.00 [€]	1,777.85
☑ Roof	Bricks t	Ventilate	4351	670,348	39.6 %	78,318.00 [€]	2,262.52
☑ Walls	Solid ma	Bricks wi	3527	588,950	34.8 %	77,594.00 [€]	1,481.34
☐ Floor	Bricks t	Concrete					

RESULTS

The table below shows the potential CO_2e* savings associated to the type of energy sourches used for the heating system.

Total THERMAL Energy Saved:	**1,693,150 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e***
equivalent to save:	97,205.90 [€]	Natural Gas	408,049
Improvement action cost:	423,163.00 [€]		
Total ELECTRIC Energy Saved:	**0 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e***
equivalent to save:	0.00 [€]	Electric energy	0.00
Improvement action cost:	0.00 [€]		
Total Primary Energy Saved	**1,693,150.00 [kWh]**	**Total CO_2 Saved:**	**408,049.00 [kg CO_2e*]**
Total improvement cost	**423,163.00 [€]**	Improvement CO_2 emitted:	5,521.71 [kg CO_2e*]
Total saved	97,205.90 [€]		

Several examples of Best Practices have been implemented in Mediterranean countries. Check it on this BAT page

Considerations

Information concerning school's building consumption and renovation in the Energy Audit and in the Energy Simulations and Technical Improvement options (D3.2.2 and D3.2.3) technical deliverables were clear but not exhaustive for their use in the ERE App.

The quantities of materials used for the improvement actions are not available, to obtain an estimation of these quantities, the user had to calculate it from the expenses claimed for the renovation and prices reported (Table 1) that in some case are different from prices present in the tool.

Results of initial situation confirm the need to act improvement actions in the school building to optimize energy consumption.

Deliverable D3.2.3 includes information to evaluate improvement solutions for the school building that give an estimated savings of around 408 tons of CO2 eq. The CO2 eq. emitted in the production phase of the materials used to improve the performances of the building are 5,5 tons.

SCHOOL: SP 77 - Warsaw

Description

The building was built in 1963. Last year (2017) the building has been completely modernized, including thermal modernization and a new storey over a part of a building has been added. The building envelope is new. A thermal modernization included an insulation of the building, which has been performed with graphite polystyrene. Insulation parameters are very good. Windows have been exchanged with 3-glazed ones. The building is heated with its own gas boiler, which is also planned to be exchanged to a new, condensing boiler during the upcoming summer. Pipes transporting heat are insulated, a boiler is located in the non-heated basement with separate entrance from the outside of the building. The boiler generates heat for a central heating and domestic hot water. There is an accumulation tank in the system of 500 dm^3. A heat distribution system in the school is new and all plate convectors are equipped with thermostats, however most of convectors are covered with shield with holes for safety issues. This decreases the efficiency of radiant heating of plate heaters. A sport hall is heated and ventilated with two fans with heating coils transferring fresh air into the room. Most of the building is ventilated naturally with assist of small exhaust fans in toilets, except the sport hall, new classrooms in the recently added part of the building and the kitchen. There are two classrooms that have air conditioning units. In the whole building there is energy efficient fluorescent lighting installed. Most of the fittings are 2x58W, some are 2x36W. There are a few individual CLFs in the small rooms (sanitary etc.) The sport hall is equipped with 3x36W fittings. There is one general switch for lighting that is used during the unoccupied period. The building does not have any BMS system, however it has well organized security monitoring system.

The School owns also a balloon-covered football field that is heated with gas heater mounted on the pressurizing fan for the balloon.

Initial Energy Requirement

Information can be found in the D3.2.2 Energy Audit Deliverable Chapter 4

Tool Initial Results

NORMALIZED ENERGY INDEX

SCHOOL DETAILS:

Name: SP 77

Grade: primary

Municipality: Warsaw

Date: 28/01/2020

YEARLY AVERAGE CONSUMPTION:

Heating: **403,844.49 kWh_t**
Electricity:**57,497.00 kWh**

Equivalent Carbon Footprint
Total emission:**164,655.51 kg CO_2**

NORMALIZED ENERGY INDEX FOR HEATING

NEIh = 3.22 Wht/m^3 x DD x year

Heating rating:

☺ **ABOVE AVERAGE**

Good, but you can still improve.
Check how by clicking NEXT.

NORMALIZED ENERGY INDEX FOR ELECTRICITY

NEIe = 19.70 kWhe/m^2 x year

Electricity rating:

☹ **BELOW AVERAGE**

Not good, you **NEED** to improve
Check how by clicking NEXT.

To reach **nZEB** classification the COMMISSION RECOMMENDATION (EU) 2016/1318 suggests the following indicators for Mediterranean area:

Offices and Schools: **20-30 kWh/(m^2*y)** of net *primary energy* with, typically, **80-90 kWh/(m^2*y)** of *primary energy* use covered by **60 kWh/(m^2*y)** of on-site renewable sources;

Summary of the energy performance of the building and suggested improvement options
Information concerning building performances after renovation actions can be found in chapter 1 of D3.2.3 Energy simulation and technical improvement options deliverable.
Tool Improvement Actions and Results
As reported in D3.2.3 the school building has no need of improvement concerning glazing, roof, walls and floor renovation.
Considerations
Information concerning school's building consumption and renovation in the Energy Audit and in the Energy Simulations and Technical Improvement options (D3.2.2 and D3.2.3) technical deliverables were clear but information concerning glazing, roof, walls and floor areas were missing. Results of initial situation confirm the need to act improvement actions in the school building to optimize energy consumption. Deliverable D3.2.3 does not include information to evaluate improvement solutions for the school building. It is not possible to get significant results about possible improving solutions.

SCHOOL: SP 28 - Warsaw

Description

The building was built in 1964. The building envelope is well preserved, however it has not been modernized since original state, so the heat parameters of external partitions are poor. Windows were changed around 2000-2002 and have an acceptable heat transfer coefficient, however some of them are leaky. In 1994 the heat source in the building has been modernized and exchanged with insulated district heating heat exchanger. Pipes with heating factor are insulated since then. The insulation condition is satisfactory. Old iron ribbed convectors in classrooms and corridors have not been exchanged since original state and they lack thermostats. Only sport hall heating units have been changed to plate convectors and are now equipped with thermostats. The building does not have any HVAC systems except a dedicated mechanical ventilation in the kitchen and cooling unit in the computer server room. The whole building is equipped with traditional T8 fluorescent bulbs manually controlled by users. The building does not have any BMS system.

Initial Energy Requirement

Information can be found in the D3.2.2 Energy Audit Deliverable Chapter 4

Tool Initial Results

NORMALIZED ENERGY INDEX

SCHOOL DETAILS:

Name: SP 28

Grade: primary

Municipality: Warsaw

Date: 28/01/2020

YEARLY AVERAGE CONSUMPTION:

Heating: **519,489.30 kWh_t**

Electricity:**110,284.00 kWh**

Equivalent Carbon Footprint

Total emission:**327,067.98 kg CO_2**

NORMALIZED ENERGY INDEX FOR HEATING

NEIh = 3.55 Wht/m^3 x DD x year

Heating rating:

☺ **ABOVE AVERAGE**

Good, but you can still improve.
Check how by clicking NEXT.

NORMALIZED ENERGY INDEX FOR ELECTRICITY

NEIe = 34.45 $kWhe/m^2$ x year

Electricity rating:

☹ **BELOW AVERAGE**

Not good, you **NEED** to improve
Check how by clicking NEXT.

To reach **nZEB** classification the COMMISSION RECOMMENDATION (EU) 2016/1318 suggests the following indicators for Mediterranean area:

Offices and Schools: **20-30 kWh/(m^2*y)** of net *primary energy* with, typically, **80-90 kWh/(m^2*y)** of *primary energy* use covered by **60 kWh/(m^2*y)** of on-site renewable sources;

Summary of the energy performance of the building and suggested improvement options

Information concerning building performances after renovation actions can be found in chapter 1 of D3.2.3 Energy simulation and technical improvement options deliverable.

Tool Improvement Actions and Results

Select one or more renovation options

U_{old} =transmittance of the element before the renovation
U_{new} = transmittance of the element after the renovation
A = total area of the element affected by the renovation
% Contribution = contribution of the single improvement to the total energy saving

Elements	U_{old} [W/m²K]	U_{new} [W/m²K]	Area [m²]	Energy Saving [kWh]	% Contribution	Cost [€]	CO_2 emitted [kg CO_2eq]
☑ Glazing	single gl	LE glass	118	44,633	6.8 %	27,494.00 [€]	182.90
☑ Roof	Bricks t	Ventilate	1782	274,548	41.9 %	32,076.00 [€]	926.64
☑ Walls	Solid ma	Bricks wi	1944	324,616	49.6 %	42,768.00 [€]	816.48
☑ Floor	Bricks t	Concrete	87	11,237	1.7 %	957.00 [€]	45.24

RESULTS

The table below shows the potential CO_2e^* savings associated to the type of energy sourches used for the heating system.

Total THERMAL Energy Saved:	**655,034 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e^***
equivalent to save:	37,606.34 [€]	Natural Gas	157,863
Improvement action cost:	103,295.00 [€]		
Total ELECTRIC Energy Saved:	**0 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e^***
equivalent to save:	0.00 [€]	Electric energy	0.00
Improvement action cost:	0.00 [€]		
Total Primary Energy Saved	**655,034.00 [kWh]**	**Total CO_2 Saved:**	**157,863.00 [kg CO_2e^*]**
Total improvement cost	**103,295.00 [€]**	Improvement CO_2 emitted:	1,971.26 [kg CO_2e^*]
Total saved	37,606.34 [€]		

Several examples of Best Practices have been implemented in Mediterranean countries. Check it on this BAT page

Considerations

Information concerning school's building consumption and renovation in the Energy Audit and in the Energy Simulations and Technical Improvement options (D3.2.2 and D3.2.3) technical deliverables were clear but not exhaustive for their use in the ERE App.

The quantities of materials used for the improvement actions are not available, to obtain an estimation of these quantities, the user had to calculate it from the expenses claimed for the renovation and prices reported (Table 1) that in some case are different from prices present in the tool.

Results of initial situation confirm the need to act improvement actions in the school building to optimize energy consumption.

Deliverable D3.2.3 includes information to evaluate improvement solutions for the school building that give an estimated savings of around 157 tons of CO2 eq. The CO2 eq. emitted in the production phase of the materials used to improve the performances of the building are 1,9 tons.

SCHOOL: SP 277 - Warsaw

Description

The building was built in 1970. Since then, there were a few modernizations of the building envelope and systems: a modernization of a district heating heat exchanger in 1980, a modernization of windows and walls in a sport hall in 1995 (walls were insulated), exchange of windows in the rest of the building in 2000.. In 2005 there was a modernization of roof in the sport hall and it was thermally insulated. Heat parameters of external partitions are poor. New PVC windows are leaky, and it is often cold in the building. The installation of the central heating system is old, and it often gets aerated, so the city hall technical crew must intervene even a few times during the heating season. The building is heated with the district heating, the system is weather controlled and the heating schedules are applied. Old iron ribbed convectors in classrooms and corridors have never been exchanged and they lack thermostats. The building does not have any HVAC systems except dedicated mechanical ventilation in the kitchen and one cooling unit in the computer room. The whole building is equipped with traditional fluorescent bulbs manually controlled by users. The building does not have any BMS system.

Initial Energy Requirement

Information can be found in the D3.2.2 Energy Audit Deliverable Chapter 4

Tool Initial Results

NORMALIZED ENERGY INDEX

SCHOOL DETAILS:

Name: SP 277

Grade: primary

Municipality: Warsaw

Date: 28/01/2020

YEARLY AVERAGE CONSUMPTION:

Heating: **648,384.55 kWh$_t$**
Electricity:**220,599.00 kWh**

Equivalent Carbon Footprint
Total emission:**505,355.94 kg CO_2**

NORMALIZED ENERGY INDEX FOR HEATING

NEIh = 3.85 Wht/m^3 x DD x year

Heating rating:

☺ **ABOVE AVERAGE**

Good, but you can still improve.
Check how by clicking NEXT.

NORMALIZED ENERGY INDEX FOR ELECTRICITY

NEIe = 52.90 kWhe/m^2 x year

Electricity rating:

☹ **BELOW AVERAGE**

Not good, you **NEED** to improve
Check how by clicking NEXT.

To reach **nZEB** classification the COMMISSION RECOMMENDATION (EU) 2016/1318 suggests the following indicators for Mediterranean area:

Offices and Schools: **20-30 kWh/(m^2*y)** of net *primary energy* with, typically, **80-90 kWh/(m^2*y)** of *primary energy* use covered by **60 kWh/(m^2*y)** of on-site renewable sources;

Summary of the energy performance of the building and suggested improvement options

Information concerning building performances after renovation actions can be found in chapter 1 of D3.2.3 Energy simulation and technical improvement options deliverable.

Tool Improvement Actions and Results

Select one or more renovation options

> *U_{old} =transmittance of the element before the renovation*
> *U_{new} = transmittance of the element after the renovation*
> *A = total area of the element affected by the renovation*
> *% Contribution = contribution of the single improvement to the total energy saving*

Elements	U_{old} [W/m²K]	U_{new} [W/m²K]	Area [m²]	Energy Saving [kWh]	% Contribution	Cost [€]	CO_2 emitted [kg CO_2eq]
☑ Glazing	single gl	LE glass	894	338,155	36.1 %	208,302.00 [€]	1,385.70
☑ Roof	Bricks +	Ventilate	1537	236,802	25.3 %	27,666.00 [€]	799.24
☑ Walls	Solid ma	Bricks wi	2009	335,470	35.8 %	44,198.00 [€]	843.78
☑ Floor	Bricks +	Concrete	211	27,252	2.9 %	2,321.00 [€]	109.72

RESULTS

The table below shows the potential CO_2e* savings associated to the type of energy sourches used for the heating system.

Total THERMAL Energy Saved:	**937,679 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e***
equivalent to save:	53,833.35 [€]	Natural Gas	225,981
Improvement action cost:	282,487.00 [€]		
Total ELECTRIC Energy Saved:	**0 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e***
equivalent to save:	0.00 [€]	Electric energy	0.00
Improvement action cost:	0.00 [€]		
Total Primary Energy Saved	**937,679.00 [kWh]**	**Total CO_2 Saved:**	**225,981.00 [kg CO_2e*]**
Total improvement cost	**282,487.00 [€]**	Improvement CO_2 emitted:	3,138.44 [kg CO_2e*]
Total saved	53,833.35 [€]		

Several examples of Best Practices have been implemented in Mediterranean countries. Check it on this BAT page

Considerations

Information concerning school's building consumption and renovation in the Energy Audit and in the Energy Simulations and Technical Improvement options (D3.2.2 and D3.2.3) technical deliverables were clear but not exhaustive for their use in the ERE App.

The quantities of materials used for the improvement actions are not available, to obtain an estimation of these quantities, the user had to calculate it from the expenses claimed for the renovation and prices reported (Table 1) that in some case are different from prices present in the tool.

Results of initial situation confirm the need to act improvement actions in the school building to optimize energy consumption.

Deliverable D3.2.3 includes information to evaluate improvement solutions for the school building that give an estimated savings of around 225 tons of CO2 eq. The CO2 eq. emitted in the production phase of the materials used to improve the performances of the building are 3,1 tons.

SCHOOL: SP 26 - Warsaw

Description

The building consists of two parts. The first one was built around 1890, and was later modernized around 1933, however the precise history of the building is not well known. During the II World War a huge part of the buildings was damaged and rebuild in the next few years. Around 1960 a new part of the building has been added and finally between 2002 and 2007 the whole building has been renovated and the newest part with a new sport hall has been added. A heat distribution system has been modernized and new water convectors with thermostats were installed. It is supposed that the building was refurbished according to construction requirements as of 1960. Therefore, U-value of external partitions U-value equals 1.35 W/(m^{2}K) for external walls and 0.87 W/(m^{2}K) for a flat roof. Windows has been exchanged to new around 2002-2004 with the declared U-value of 1.1 W/(m^{2}K). There is only a natural ventilation in the building, except a part of building with the sport hall and changing rooms, where air handling units with heat recovery are installed. Furthermore, a canteen has its own air handling unit. The only room with air conditioning is a computer classroom. The most of the building is equipped with T8 36W fluorescent bulbs controlled manually. The building does not have any BMS system.

Initial Energy Requirement

Information can be found in the D3.2.2 Energy Audit Deliverable Chapter 4

Tool Initial Results

NORMALIZED ENERGY INDEX

SCHOOL DETAILS:

Name: SP 26

Grade: preschool

Municipality: Warsaw

Date: 29/01/2020

YEARLY AVERAGE CONSUMPTION:

Heating: **639,164.35 kWh$_t$**
Electricity:**101,040.00 kWh**

Equivalent Carbon Footprint
Total emission:**361,839.46 kg CO_2**

NORMALIZED ENERGY INDEX FOR HEATING

NEIh = **1.88** Wht/m^3 x DD x year

Heating rating:

☺ **ABOVE AVERAGE**

Good, but you can still improve.
Check how by clicking NEXT.

NORMALIZED ENERGY INDEX FOR ELECTRICITY

NEIe = **18.07** kWhe/m^2 x year

Electricity rating:

☹ **BELOW AVERAGE**

Not good, you **NEED** to improve
Check how by clicking NEXT.

To reach **nZEB** classification the COMMISSION RECOMMENDATION (EU) 2016/1318 suggests the following indicators for Mediterranean area:

Offices and Schools: **20-30 kWh/(m^2*y)** of net *primary energy* with, typically, **80-90 kWh/(m^2*y)** of *primary energy* use covered by **60 kWh/(m^2*y)** of on-site renewable sources;

Summary of the energy performance of the building and suggested improvement options

Information concerning building performances after renovation actions can be found in chapter 1 of D3.2.3 Energy simulation and technical improvement options deliverable.

Tool Improvement Actions and Results

Select one or more renovation options

> *U_{old} =transmittance of the element before the renovation*
> *U_{new} = transmittance of the element after the renovation*
> *A = total area of the element affected by the renovation*
> *% Contribution = contribution of the single improvement to the total energy saving*

Elements	U_{old} [W/m²K]	U_{new} [W/m²K]	Area [m²]	Energy Saving [kWh]	% Contribution	Cost [€]	CO_2 emitted [kg CO_2eq]
☑ Glazing	single gl	LE glass		0	0.0 %	0.00 [€]	0.00
☑ Roof	Bricks t	Ventilate	1988	306,286	42.9 %	35,784.00 [€]	1,033.76
☑ Walls	Solid ma	Bricks wi	2334	389,739	54.5 %	51,348.00 [€]	980.28
☑ Floor	Bricks t	Concrete	144	18,599	2.6 %	1,584.00 [€]	74.88

RESULTS

The table below shows the potential CO_2e^* savings associated to the type of energy sourches used for the heating system.

Total THERMAL Energy Saved:	**714,624 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e^***
equivalent to save:	41,027.47 [€]	Natural Gas	172,224
Improvement action cost:	88,716.00 [€]		
Total ELECTRIC Energy Saved:	**0 [kWh]**	**Fuel Carbon Footprint**	**kg CO_2e^***
equivalent to save:	0.00 [€]	Electric energy	0.00
Improvement action cost:	0.00 [€]		
Total Primary Energy Saved	**714,624.00 [kWh]**	**Total CO_2 Saved:**	**172,224.00 [kg CO_2e^*]**
Total improvement cost	**88,716.00 [€]**	Improvement CO_2 emitted:	2,088.92 [kg CO_2e^*]
Total saved	41,027.47 [€]		

Several examples of Best Practices have been implemented in Mediterranean countries. Check it on this BAT page

Considerations

Information concerning school's building consumption and renovation in the Energy Audit and in the Energy Simulations and Technical Improvement options (D3.2.2 and D3.2.3) technical deliverables were clear but not exhaustive for their use in the ERE App.

The quantities of materials used for the improvement actions are not available, to obtain an estimation of these quantities, the user had to calculate it from the expenses claimed for the renovation and prices reported (Table 1) that in some case are different from prices present in the tool.

Results of initial situation confirm the need to act improvement actions in the school building to optimize energy consumption.

Deliverable D3.2.3 includes information to evaluate improvement solutions for the school building that give an estimated savings of around 172 tons of CO2 eq. The CO2 eq. emitted in the production phase of the materials used to improve the performances of the building are 2 tons.

Results obtained give an indication to the user about some possible improving solution.