Interreg CENTRAL EUROPE

ENERGY@SCHOOL

European Union
European Regional
Development Fund

INVENTORY OF SCHOOL-FACILITIES STOCK IN THE CITY OF BYDGOSZCZ (POLAND) REQUIRING DEVELOPMENT OF EGSMP

N. DELIVERABLE D.T1.1.3

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In cooperation with Miasto Bydgoszcz

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1. Energy@School – Project overview

The building sector has high potential for energy optimization being the most consuming one in EU. In terms of public buildings heritage, energy consumption in schools is the second highest expenditure of Municipalities total running costs. This sector offers potential remarkable achievements in terms of Energy Efficiency (EE), Renewable Energy Sources (RES) application and carbon footprint reduction and several disparities exist among Central Europe countries as for planning and implementing performances of proper sector-based strategies, action plans and managerial capacities.

With reference to the **public stock of buildings and infrastructures**, for sure educational facilities are an important opportunity to achieve substantial energy savings, as they constitute a relevant part of the overall amount of energy consumption and therefore of the expenses paid by the national budgets. Energy consumption in schools is the second most significant expense to total running costs and they account up to 70% of the thermal energy cost of Municipalities. Schools, being such an important line in energy-related budget, represent an important sector of public administration to tackle with reference to buildings' upgrade, retrofitting and renovation. Furthermore, schools are the best environment for behavior change and awareness raising of students and, indirectly, their families because they are the privileged place for the dissemination of culture and information as a whole and therefore also in the field of energy saving and efficiency. Consumption in schools can be quite variable depending on country, climate, building year of construction and type. However considering an average energy use profile, consumes can be roughly divided as follows: 47% heating; 14% lighting; 10% cooling; 9% ventilation; 7% water heating; 4% PC; 2% refrigeration; 1% cooking; 1% office equipment; 5% other. It is estimated that just by making small changes in behavior, schools could save up to 20% of their energy use (and bills). This amount can noticeably increase if energy retrofit interventions are associated to behavioral changes (e.g. around 50% with 0.5 to only 2 years payback period).
Public building sector with reference to schools is therefore one of the main issues and there is concrete need to develop energy-efficient management for schools and strategies on how to improve the energy efficiency. There is also need to raise the awareness of school staff and students, and to involve them in the energy saving activities. People have a crucial role in this process, therefore they need to be supported and provided with the best available solutions.

Main ENERGY@SCHOOL objective is to increase the capacity of the public sector to **implement Energy Smart Schools**, by application of an integrated approach that **educate and train schools**

staff and pupils to become Senior and Junior Energy Guardians (EGs) who will engage on progressive and sustainable energy efficiency of buildings and an adequate transfer of a correct attitude towards energy consumption ("energy culture"). Thanks to a commitment to high-performance schools, many school districts are discovering that smart energy choices can have lasting benefits for their students, communities, environment. The key idea is to provide concrete technical Tools and Devices and specialized trainings for School Planning Managers on financing opportunities, designing, operating & maintaining energy solutions. The innovative character lies in the active involvement of employees, experts, students, teachers, families in the process of transforming the school into an energy smart school through specific and targeted training and education activities.

The project will therefore address common barriers associated with energy smart-school management, it will develop and provide a Methodology & Approach usable and replicable within other school buildings, together with the necessary Tools, Devices & Protocols. In this way all parties involved in the energy decisions of a public school (technicians and ICT professionals, administrators, school employees Energy managers) can face in a coordinated manner the issue of Energy Efficiency by implementing effective and validated solutions.

The project will deliver:

- ⇒ 1 Common/Transferrable and 8 customized Strategies for Smart Schools,
- ⇒ 1 joint and 7 customized Energy Smart-school Management Plans,
- ⇒ 3 smart phones APPs for Energy Guardians,
- ⇒ 8 tested pilot solutions of EE & RES application in schools under direct contribution of Energy Guardians, in the form of Guidelines, Toolbox, Best Practices as reference documents and experiences to be capitalized far beyond the project end.
- ⇒ Training & education programs as adaptable & replicable models for capacity-raising and Energy Culture rooting.

ENERGY@SCHOOL expected results:

I. Optimization of energy consumption in schools,

II. Concrete and progressive increase of EE and RES use in schools not only thanks to technical application of smart solutions, but also to non-technical factors such as a better management capacity and responsible behavior toward energy use,

III. Increase of capacity of public sector to deal with increase of EE and RES use in schools thanks to strategy, action plans, tools (methods, approaches), trainings, pilot actions defined and implemented within the project,

IV. Increase in managerial and organizational competences as well as in human resources to ensure the progressive and sustainable energy efficiency and renewable energy se in public schools (trainings),

V. Creation of conditions for new job opportunities (trainings),

VI. Creation of "energy culture", thus responsible attitude towards energy use, thanks to education and raising awareness activities, as it is demonstrated that amount of saved energy can noticeably increase if energy retrofit interventions are associated to behavioral changes.

List of Project Partners

1 Union of Municipalities of Low Romagna Region , Lead Partner – Italy
2 CertiMaC s.c.r.l. - Italy
3 City of Bydgoszcz - Poland
4 ENERGY AGENCY OF SAVINJSKA, ŠALEŠKA AND KOROŠKA REGION - Slovenia
5 City of Karlovac - Croatia
6 University of Bologna - Dept of Industrial Chemistry - Italy
7 Municipality of the CITY Szolnok with County Rank - Hungary
8 Local Government of Town Újszilvás - Hungary
9 City of Stuttgart - Germany
10 Klagenfurt - Austria
11 Graz Energy Agency - Austria
12 City municipality of Celje - Slovenia

Responsible Partner of Thematic Work Package "*Analysis phase and definition of Energy Guardians Smart-school Management Plans*" and the present document: CertiMaC – Research Laboratory -Italy

2. Rationale of the Inventory

The present Deliverable/technical document has been developed in the framework of several project core activities specifically designed for the set-up of **Energy Guardians Smarts-school Management Plans (EGSMPs)** indicating actions necessary to achieve higher energy savings. All such activities contribute to carry out a customized analysis within the territories of the Partner organizations involved so as to create a **Common Strategy For Smart Schools (CSSS)** and sustain both Energy Guardians and schools during implementation and management of own Energy-Efficiency and Renewable-Energy-Sources interventions.

Purpose of the present Inventory is to describe the analysis carried out within 12 school facilities and, in 6 of them, also within gym or swimming pool, located in the city of Bydgoszcz. The results shown within the Inventory will support Energy Guardians and Energy Managers to evaluate which interventions would be implemented into EGSMP (Energy Guardian School Management Plain) in order to foster a virtuous approach devoted to energy-consumption reduction. In this sense, the Inventory represents a real operational decision-support Tool at their availability. Actually, it has to be underlined that the document is much more than a mere Inventory since it presents the results of an in-depth and thorough energy analysis (very close to an energy audit) of each school involved: it detects energy consumption trends and energy performance indicators then, according to pre-defined evaluation criteria, it displays and suggests a set of priorities of interventions in terms of Energy Efficiency and Renewable Energy Sources implementation, together with standards costs of each intervention and related energy-consumption reductions.

The above explained completeness of results within the present Inventory has been technically possible thanks to the application – during data collection and analysis phases carried out - of the specific Tools and Models (developed by Partner CertiMaC for project purposes) referred in ENERGY@SCHOOL as Deliverables D.T1.1.1 and D.T1.1.2, namely "List of jointly defined homogeneous criteria for implementation of the transnational school-facilities inventory" and "Common methodology for evaluation of school-facilities energy consumption and for assessment of priority EE interventions" (these Deliverables are available for open and free re-use by any interested Municipality and school, at website http://www.interreg-central.eu/Content.Node/ENERGYATSCHOOL.html).

3. Context of the City area

City name	Bydgoszcz
Number of inhabitants	Ca. 355 645
Area [km2]	175,98

Picture 1 - Map of the City of Bydgoszcz

Bydgoszcz is the capital of Kujawsko - Pomorskie Voivodeship and the eighth biggest city in Poland. It is picturesquely located on the rivers Brda, Vistula, and the Bydgoszcz Canal. the city the climate can be described as temperated and continental.

Major motor roads, railways and waterways (international waterway E70) intersect in the area. Ignacy Jan Paderewski Airport operates in the city. The city with its centuries-old traditions is a popular tourist destination thanks to its attractive location on the river and canals running through its centre. Bydgoszcz places growing emphasis on water, since the daily life, cultural, sports and business activities of the city take place

Bydgoszcz is a city with three state universities and sixteen other universities and colleges.

4. Energy consumptions analysis carried out within 12 schools: results and priority of interventions towards Energy Efficiency

In the above described city context, the following table shows the total number of existing schools and the number of schools for which the in-depth energy consumptions analysis and related energy data collections have been carried out in the framework of Energy@School project:

	Total number of schools in the city area	Number of analysed schools in the framework of Energy@Scool project
Kindergarten	24	0
Primary	18	3
Junior High School	10	0
Secondary (High School, Technical School)	0	0
Vocational School	1	0
General Education Schools Team (Junior High School and High School)	7	1
Vocational Schools Team	14	4
Schools Team (Kindegarten and Primary School and Junior High School)	31	4
Special Educational Center	2	0

As already explained, the data collected for each school – of the 12 analysed ones - allowed to detect *energy consumption trends* and *energy performance indicators* then, according to predefined evaluation criteria, it has been possible to obtain as a result a set of priorities of interventions in terms of Energy Efficiency and Renewable Energy Sources implementation.

The achieved results for each school are showed as follows.

4.1. Secondary school “Zespół Szkół nr 12 im. Jana III Sobieskiego, General Education Schools Team” (Junior High School and High School)

Picture 2 – Zespół Szkół nr 12 im. Jana III Sobieskiego, General Education Schools Team (Junior High School and High School):

GENERALITIES

School type	Secondary
Student age range	13-21

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

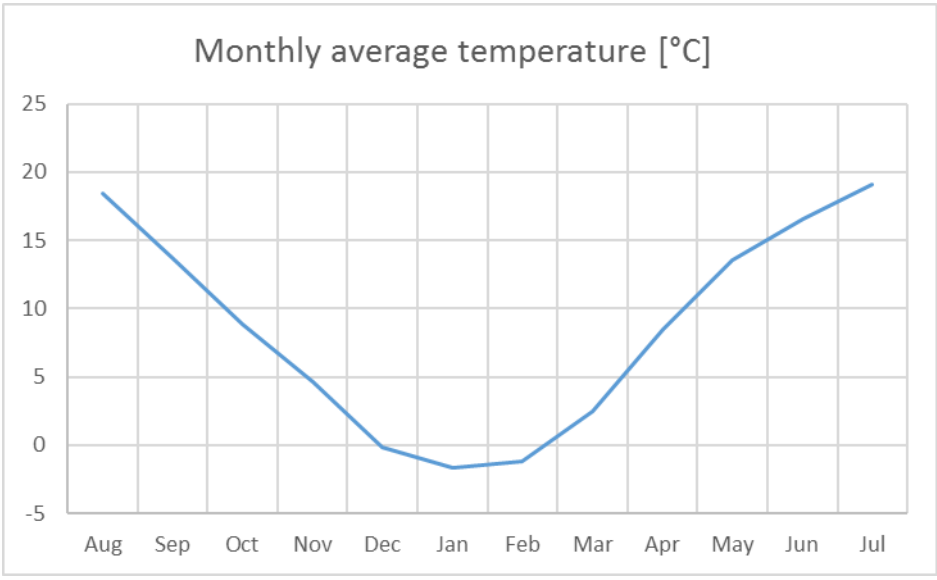
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

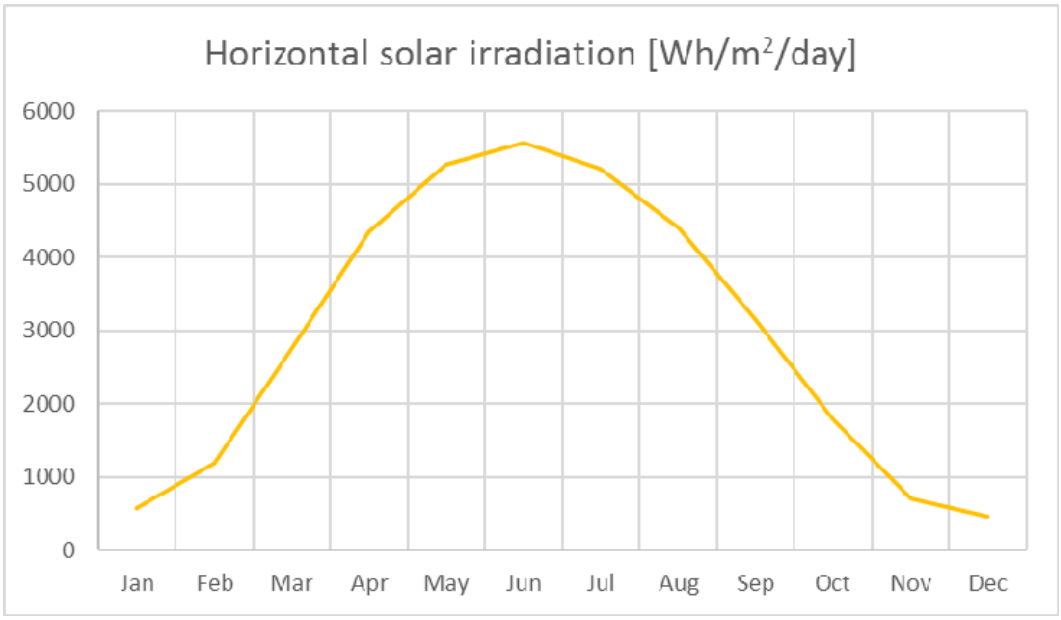
Total floor heated area [m²]	3685
Volume [m³]	48495
S/V	0,12

OCCUPATION AND USE OF THE BUILDING

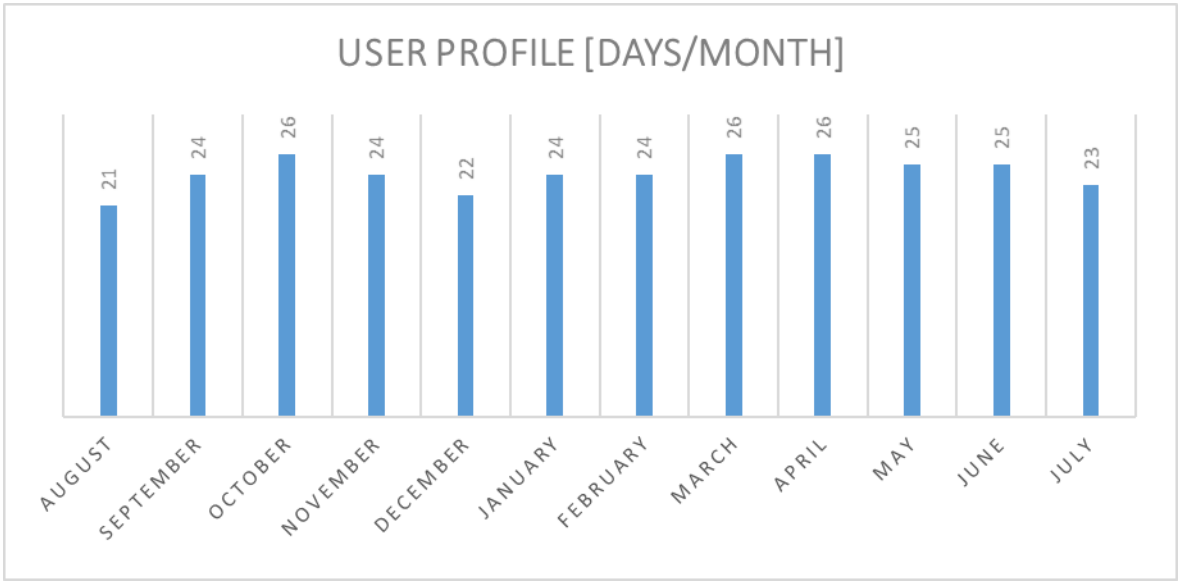
Number of students	491
Total days of use	290
Daily hours of use	13
Total area allocated to classrooms [%]	10



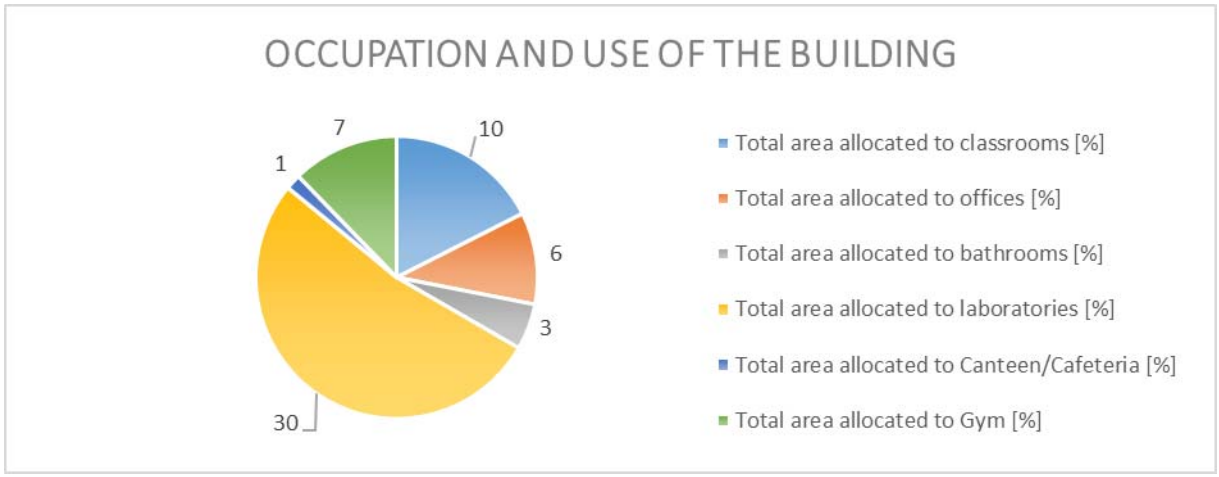
Picture 3 - Graphic representation of monthly average temperature [°C]



Picture 4 – Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 5 – Graphic representation of the user profile during school period [working days/month]



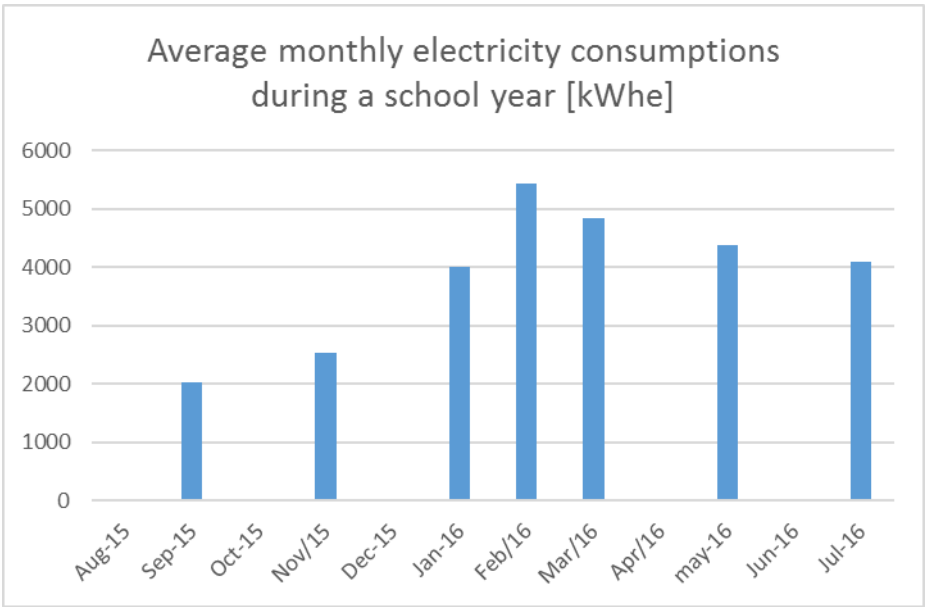
Picture 6 – Division of the School areas for intended use [%]

BUILDING ENVELOPE

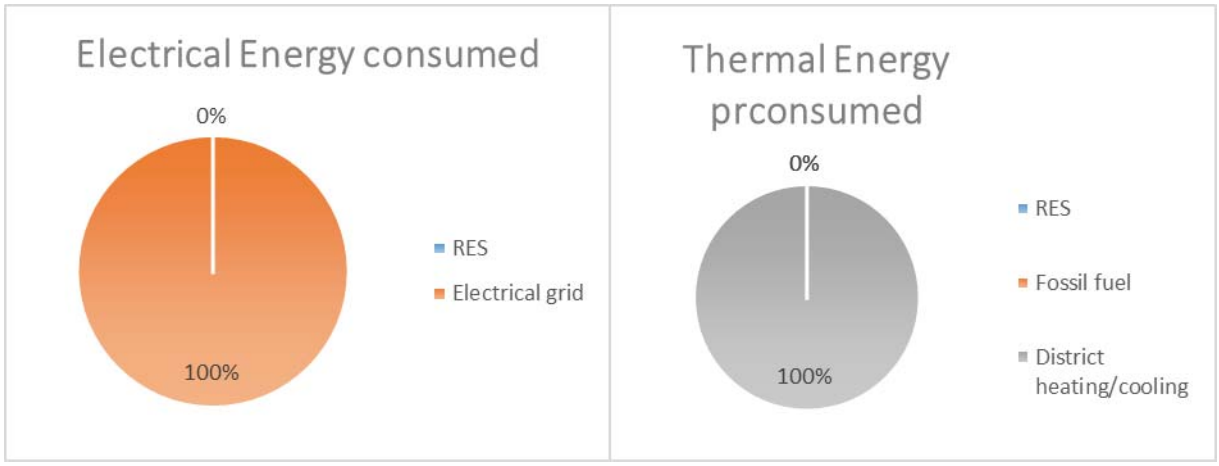
Year of construction	1960-1970
Type of structure	Reinforced concrete structure
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 7 – Average monthly electricity consumptions during a school year [kWhe]



Picture 8 – Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	27298	0,56	7,41	74,08	55,60	94,13	27298	11825	5
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	316741	6,53	85,95	859,54	645,09	1092,21	0	114027	30
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	35,4	0,00	0,01	0,10	0,07	0,12		125852	35

Table 1 – Energy performance indicators

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	2432,4	m2	0	€		
	Retrofit roof with insulation	200	€/m2	1416,8	m2	0	€		
	Replace windows	450	€/m2	919,6	m2	0	€		
	Install solar shading systems	150	€/m2	919,6	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**59**	**valves***	**4124**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**457,0**	**lamps**	**11425**	**€**	**-53%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-81%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**3685,0**	**m2**	**92125**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

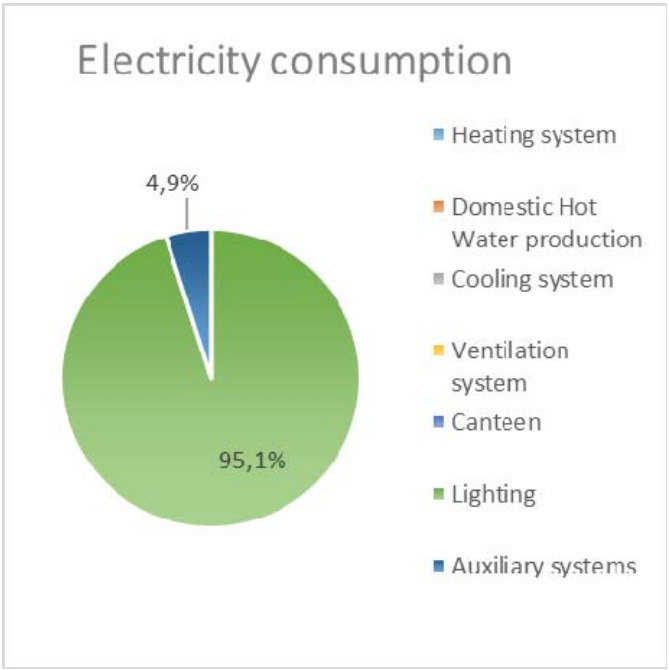
*Table 2 – Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values.*

***Most relevant energy consumption reduction*

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	47603,9764
After intervention	22250,25
Energy consumption reduction [%]	**-53%**

Electrical energy reduction with PV system	Q[kWh_el/year]
Current situation	27297,8333
Energy produced by RES	22000
After intervention	5297,83333
Eletrical energy reduction [%]	**-81%**



Picture 9 – Pie Graph of Electrical consumptions subdivision [%] for each final intended use

4.2. Secondary school "Zespół Szkół Budowlanych im. J. Gagarina ul. Jana Pestalozziego 18. Technical School, Vocational Schools Team"


Picture 10 - *Zespół Szkół Budowlanych im. J. Gagarina, Technical School, Vocational Schools Team*

GENERALITIES

School type	Secondary
Student age range	16-20

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

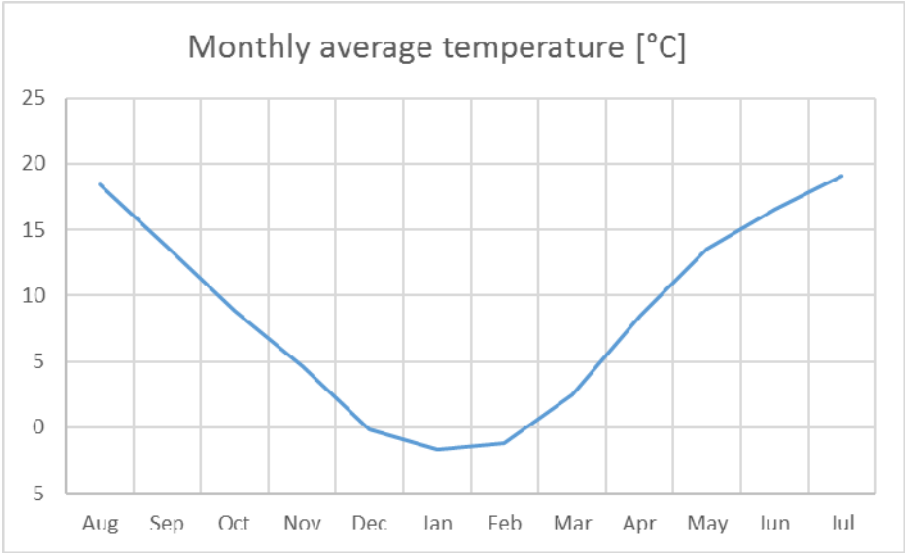
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

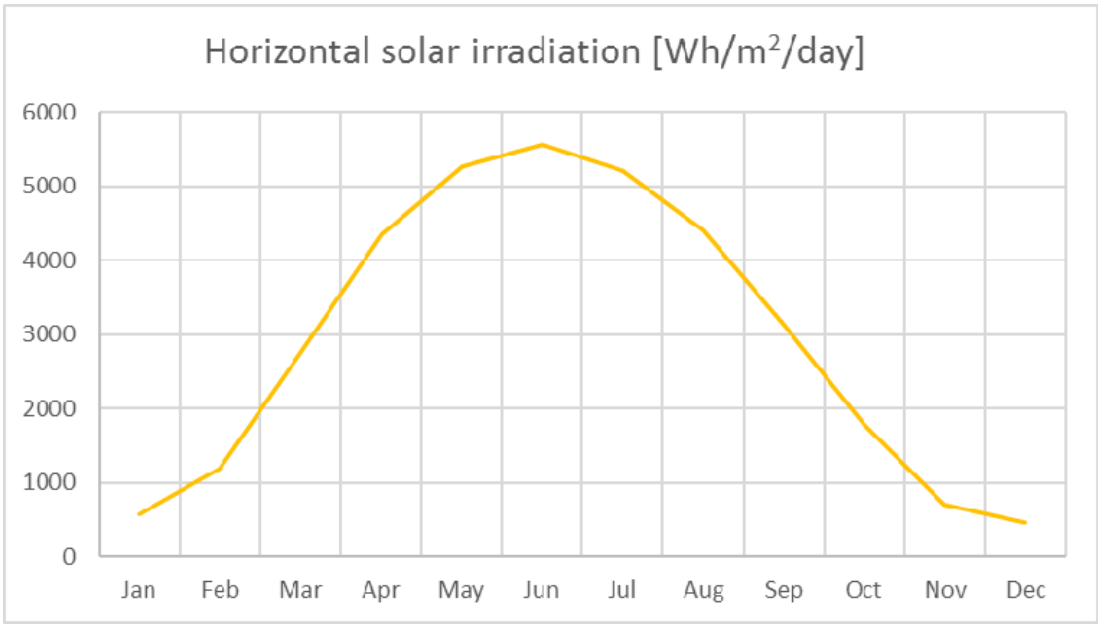
Total floor heated area [m^2]	5747
Volume [m^3]	73562
S/V	0,14

OCCUPATION AND USE OF THE BUILDING

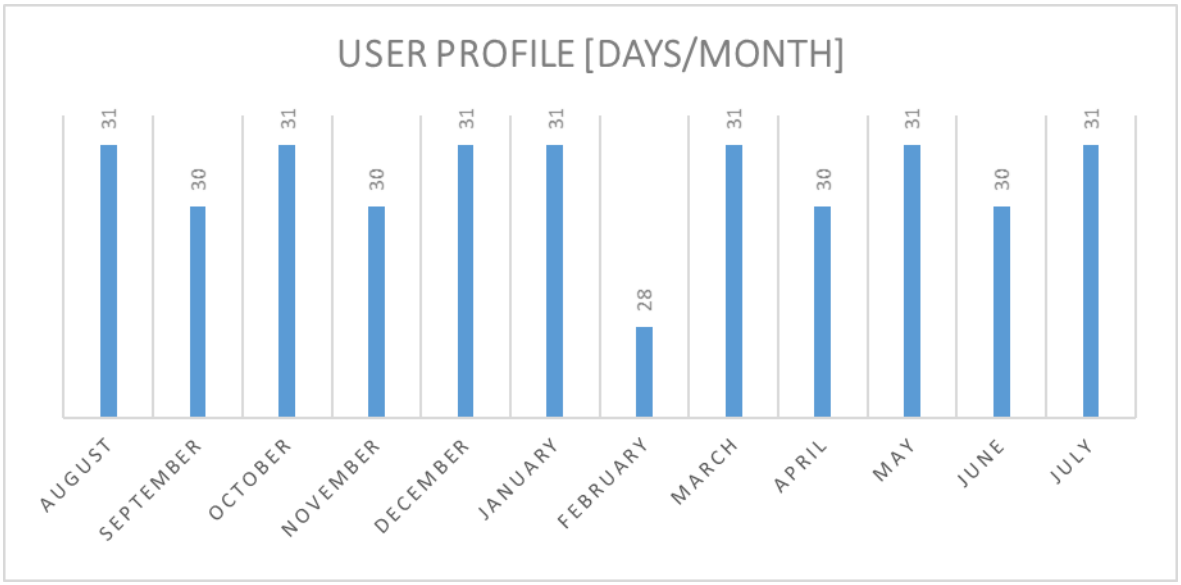
Number of students	416
Total days of use	365
Daily hours of use	4
Total area allocated to classrooms [%]	27



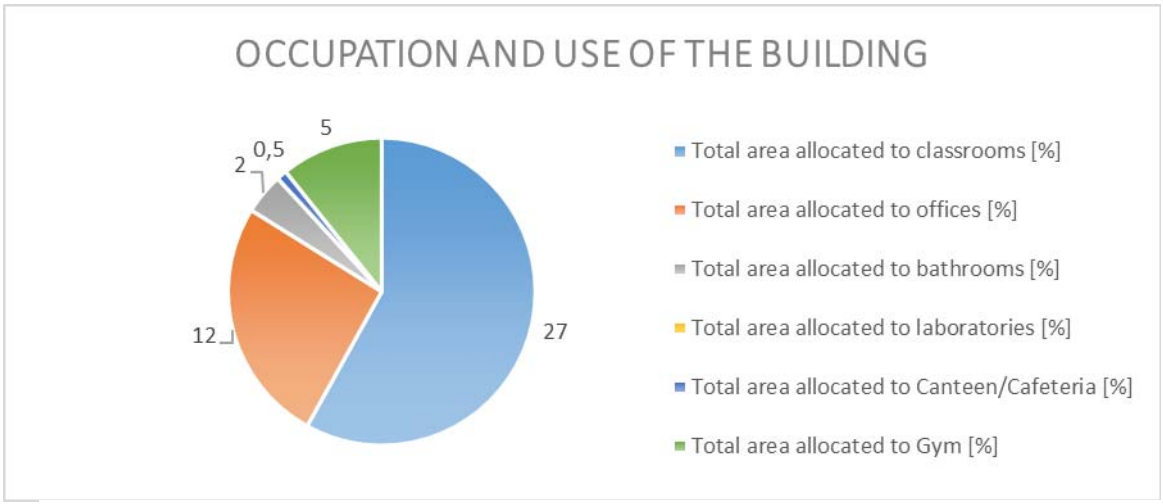
Picture 11 - Graphic representation of monthly average temperature [°C]



Picture 12 - Graphic representation of the Horizontal solar irradiation [Wh/m^2/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 13 - Graphic representation of the user profile during school period [working days/month]



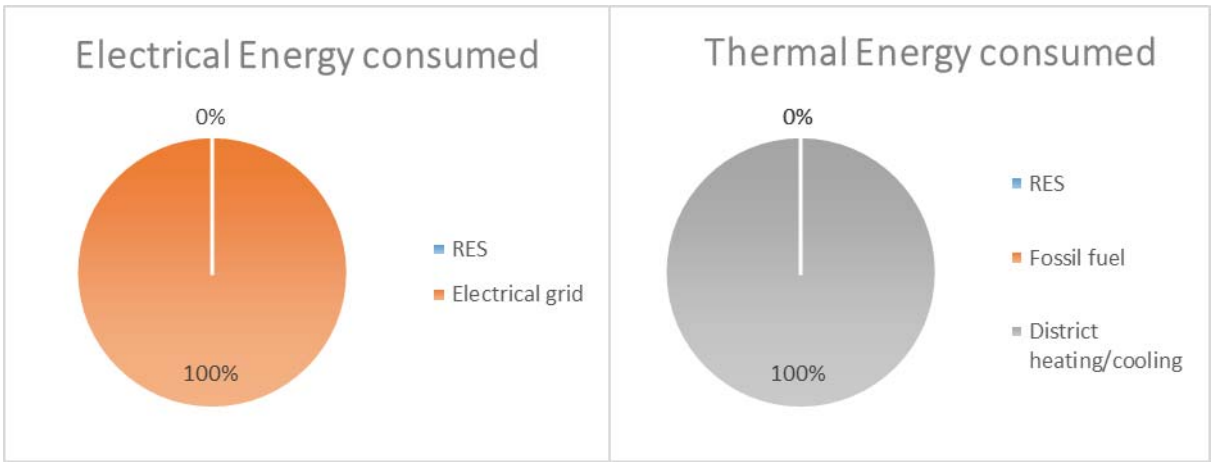
Picture 14 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

Year of construction	1960-1970
Type of structure	Load bearing masonry wall
External wall insulation	No insulation

HVAC AND RES SYSTEMS

Heat generation system	
	District heating
RES systems	



Picture 15 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school.

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	73423	1,00	12,78	47,32	176,50	201,16	73423	31807	14
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	763972	10,39	132,93	492,35	1836,47	2093,07	0	275030	73
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	87	0,00	0,02	0,06	0,21	0,24		306837	87

Table 3 - Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%]**	
✓	**Retrofit external walls with insulation**	**100**	**€/m2**	**3306,3**	**m2**	**330628**	**€**	**-40%**	**Energy need for space heating reduction [%]**
✓	**Retrofit roof with insulation**	**200**	**€/m2**	**3253,0**	**m2**	**650600**	**€**		
✓	**Replace windows**	**450**	**€/m2**	**1323,7**	**m2**	**595674**	**€**		
	Install solar shading systems	150	€/m2	1323,7	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**50**	**valves***	**3494**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**424,0**	**lamps**	**10600**	**€**	**-55%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-30%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**5747,0**	**m2**	**143675**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 4 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values.*

***Most relevant energy consumption reduction*

Energy need for space heating - envelope

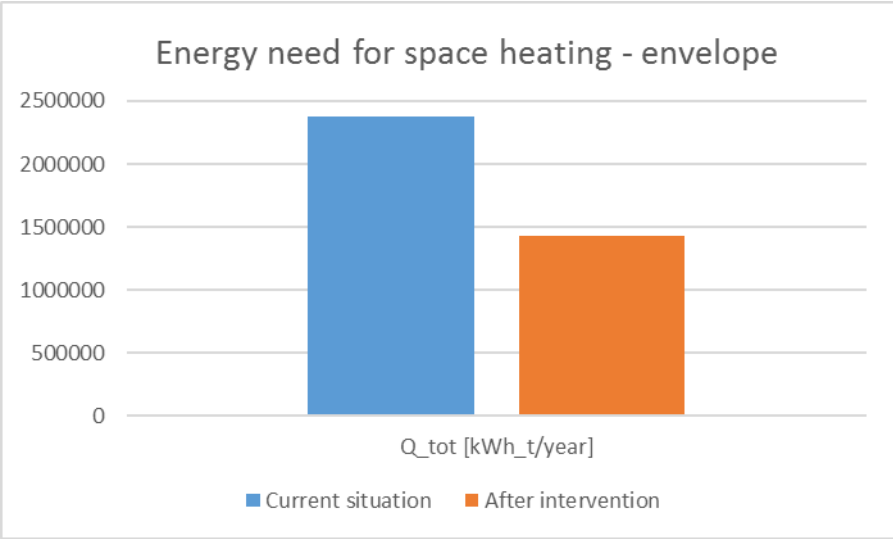
	Q_tot[kWh_t/year]
Current situation	2373580,482
After intervention	1432190,229
Energy need for space heating reduction [%]	**-40%**

Lamp replacement with LED

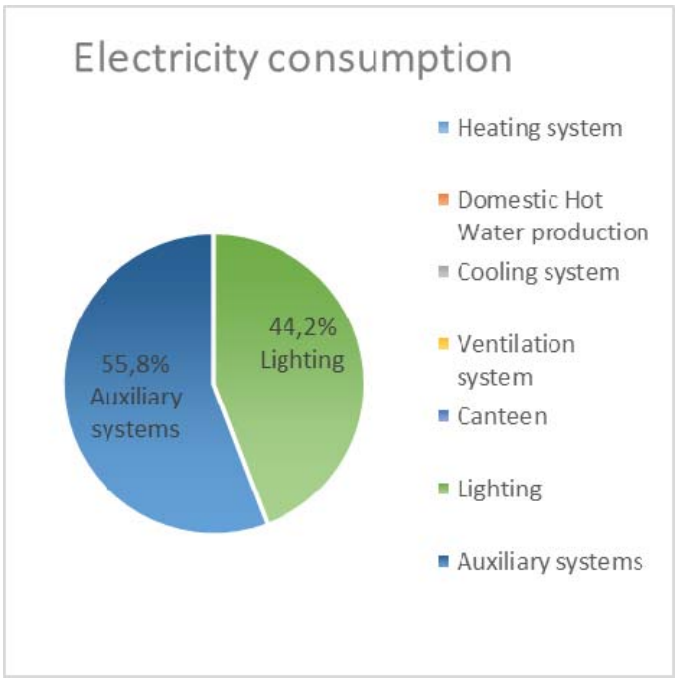
	Q [kWh_t/year]
Current situation	18072,61
After intervention	8194,25
Energy consumption reduction [%]	**-55%**

Electrical energy reduction with PV system

	Q [kWh_el/year]
Current situation	73423,00133
Energy produced by RES	22000
After intervention	51423,00133
Eletrical energy reduction [%]	**-30%**

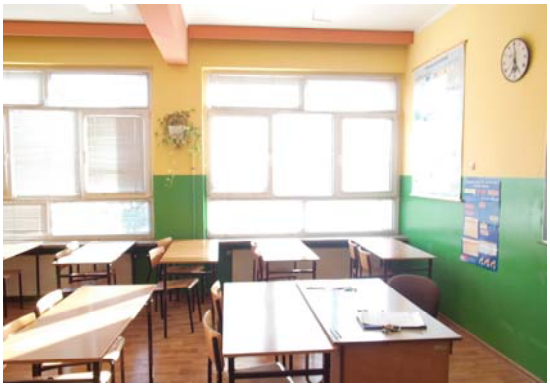


Picture 16 - Energy need for space heating before and after (predicted) the intervention - envelope [kWh_t/year]



Picture 17 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use

4.3. Primary school "Zespół Szkół Ogólnokształcących nr 4, General Education Schools Team" - Main school building



***Picture 18** - Zespół Szkół Ogólnokształcących nr 4, General Education Schools Team*

GENERALITIES

School type	Secondary
Student age range	13-19

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

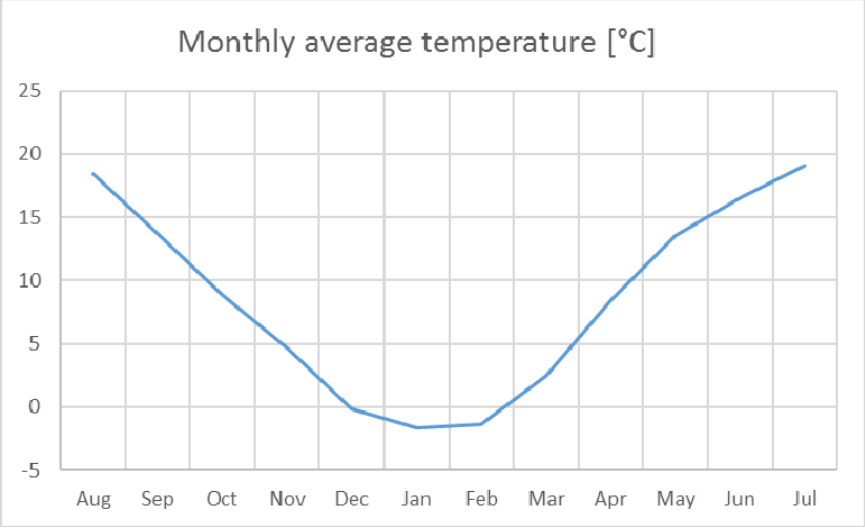
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

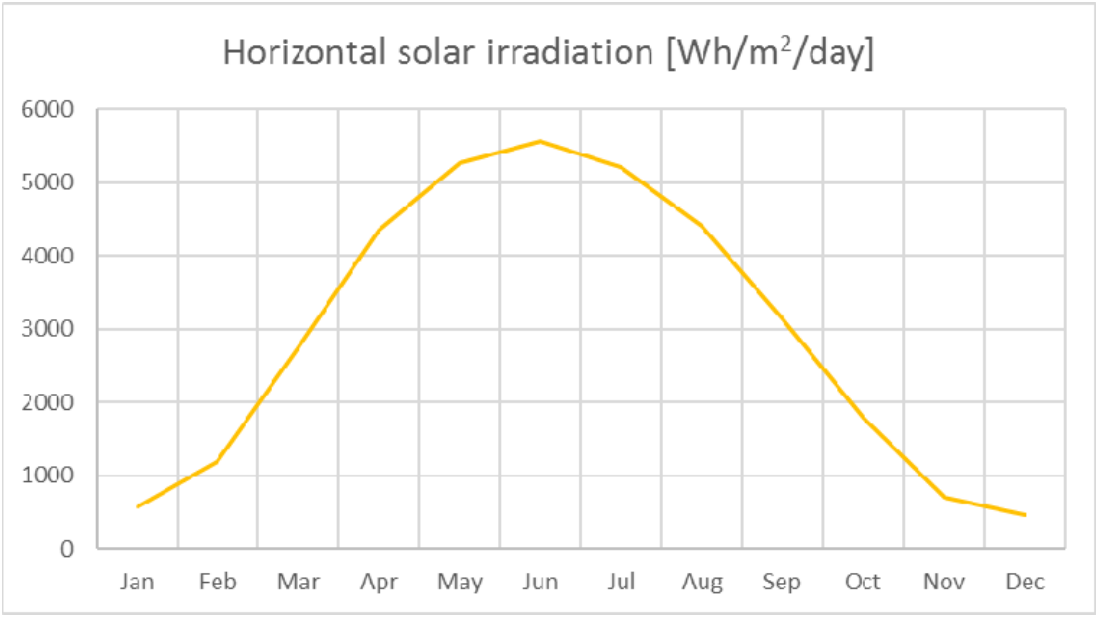
Total floor heated area [m^2]	3646
Volume [m^3]	47403
S/V	0,14

OCCUPATION AND USE OF THE BUILDING

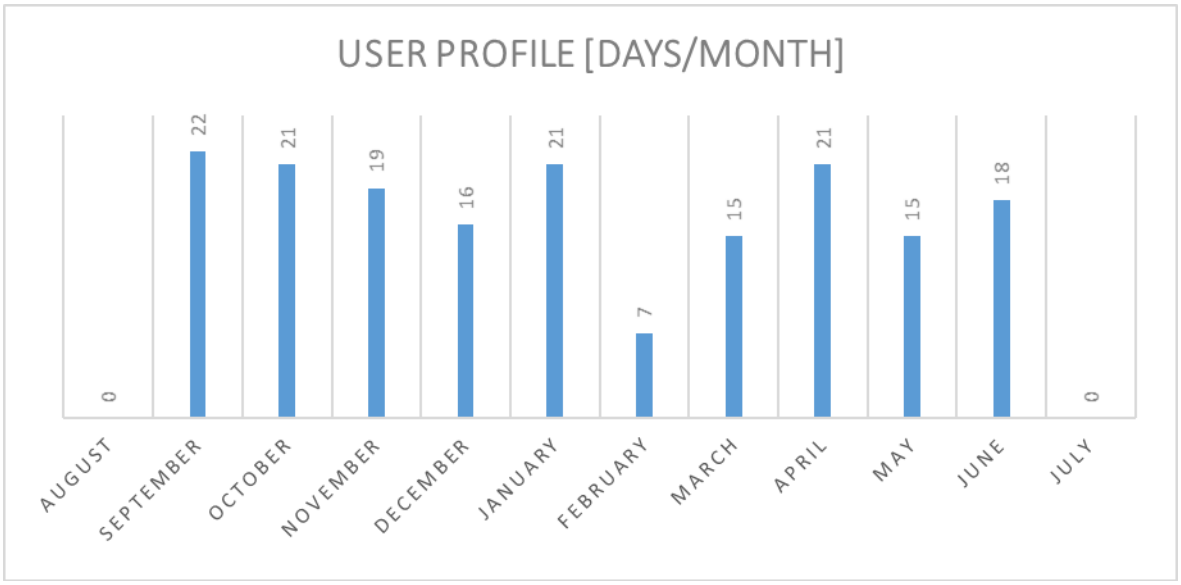
Number of students	467
Total days of use	175
Daily hours of use	16
Total area allocated to classrooms [%]	37



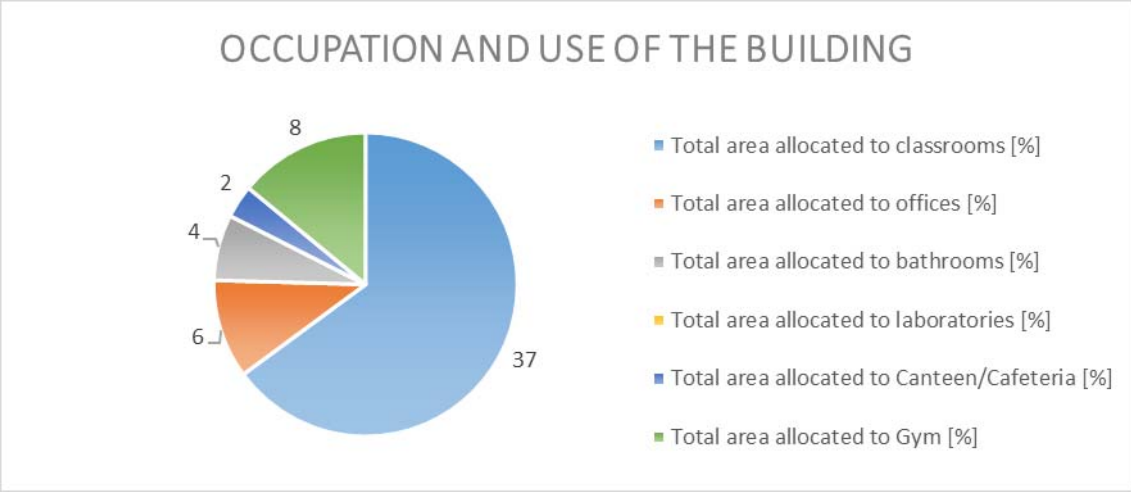
Picture 19- *Graphic representation of monthly average temperature [°C]*



Picture 20 - Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 21 - Graphic representation of the user profile during school period [working days/month]



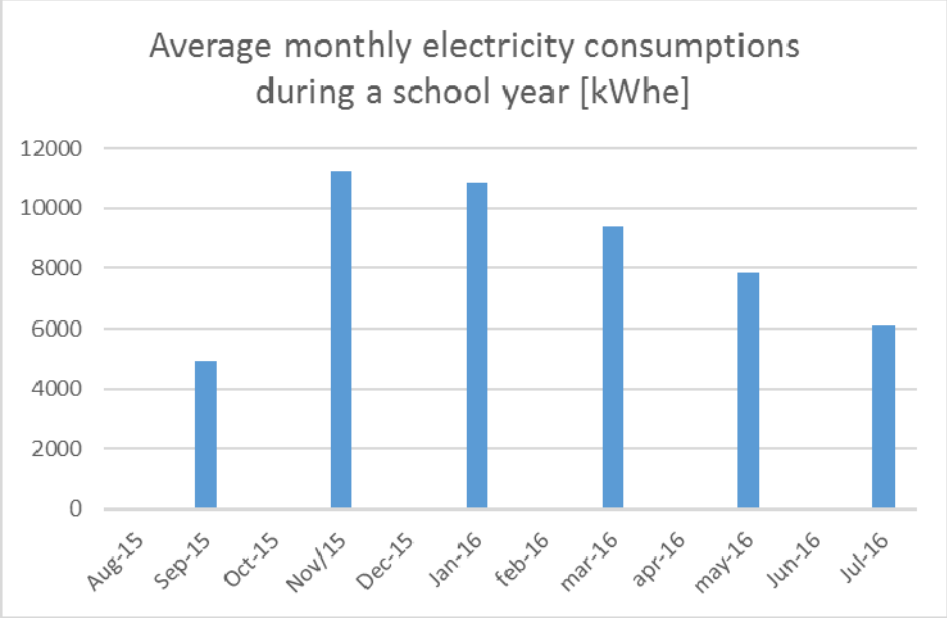
Picture 22 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

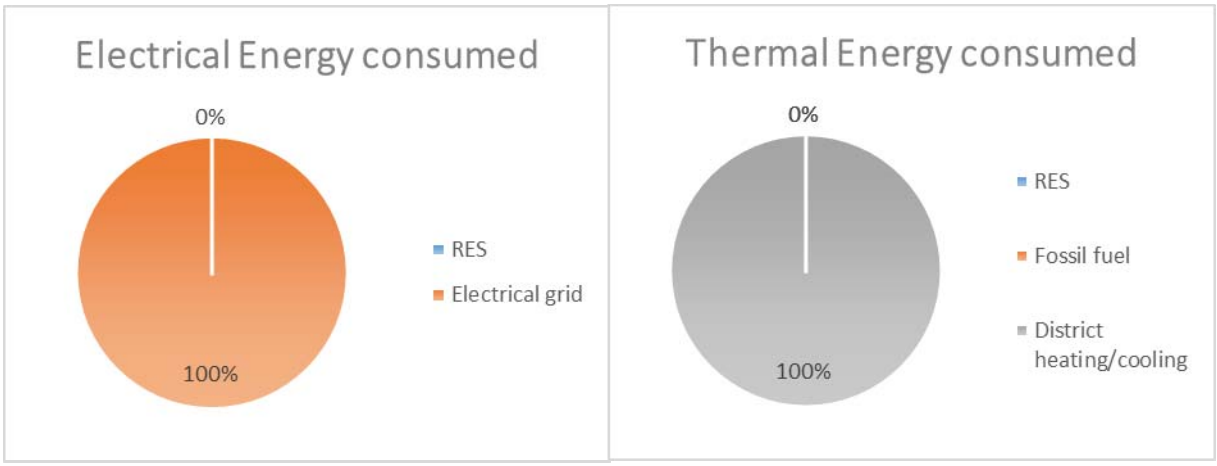
Year of construction	1960-1970
Type of structure	Prefab modules
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 23 - Average monthly electricity consumptions during a school year [kWhe]



Picture 24 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school.

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	**50280**	**1,06**	**13,79**	**37,27**	**107,67**	**287,31**	**50280**	**21781**	**9**
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	**382278**	**8,06**	**104,84**	**283,34**	**818,58**	**2184,44**	**0**	**137620**	**37**
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	**46**	**0,00**	**0,01**	**0,03**	**0,10**	**0,26**		**159401**	**46**

Table 5 - Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	2024,4	m2	0	€		
	Retrofit roof with insulation	200	€/m2	2034,9	m2	0	€		
	Replace windows	450	€/m2	959,6	m2	0	€		
	Install solar shading systems	150	€/m2	959,6	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**56**	**valves***	**3923**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**668,0**	**lamps**	**16700**	**€**	**-56%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-44%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**3646,4**	**m2**	**91160**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 6 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values.*

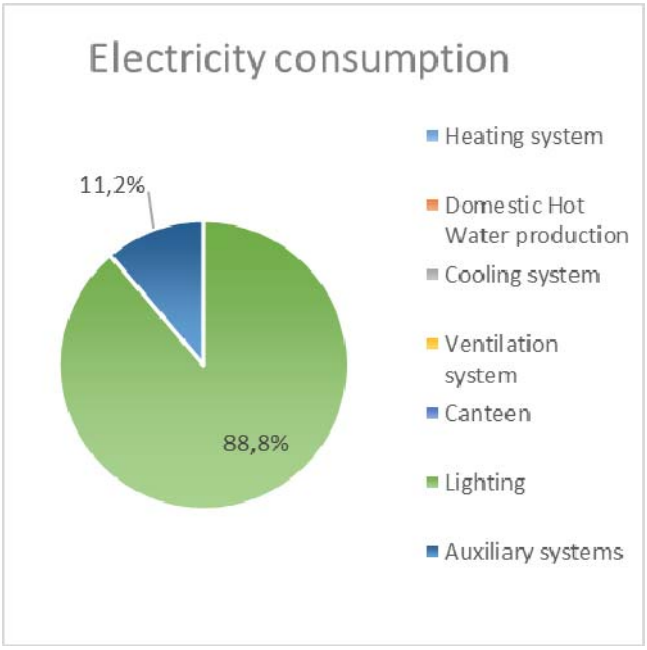
**Most relevant energy consumption reduction

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	52987,65
After intervention	23486,25
Energy consumption reduction [%]	**-56%**

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	50279,66667
Energy produced by RES	22000
After intervention	28279,66667
Eletrical energy reduction [%]	**-44%**



Picture 25 - Pie Graph of Electrical and consumptions subdivision [%] for each final intended use

4.4. Primary and Secondary school "Zespół Szkół Ogólnokształcących nr 4, General Education Schools Team" - Swimming pool

GENERALITIES

School type	Primary and secondary
Student age range	7-19

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

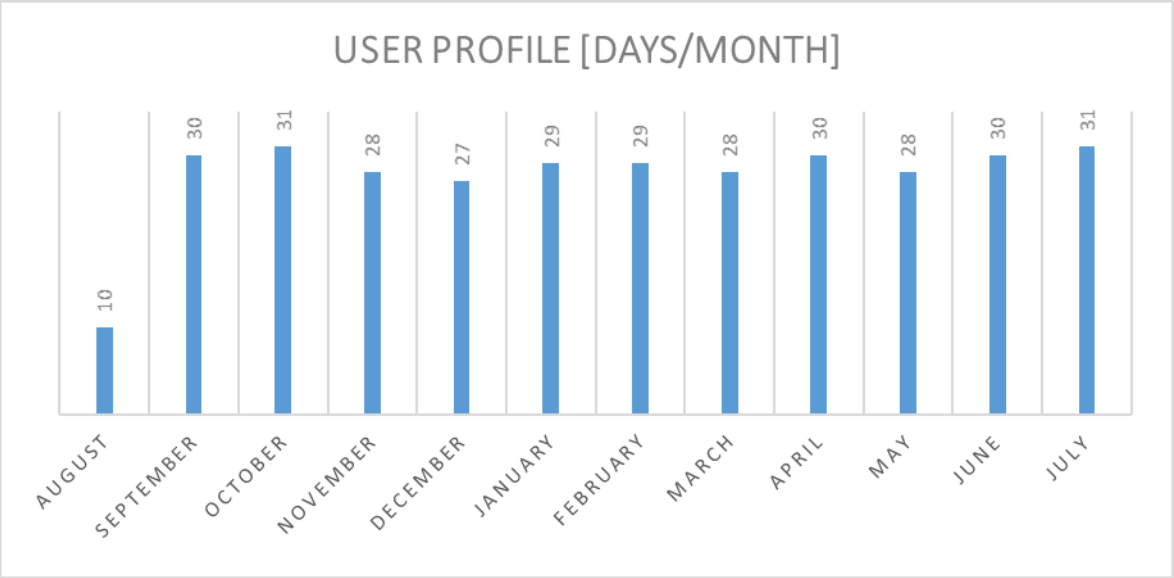
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

Total floor heated area [m²]	2024
Volume [m³]	70435
S/V	0,07

OCCUPATION AND USE OF THE BUILDING

Number of students	390
Total days of use	331
Daily hours of use	15



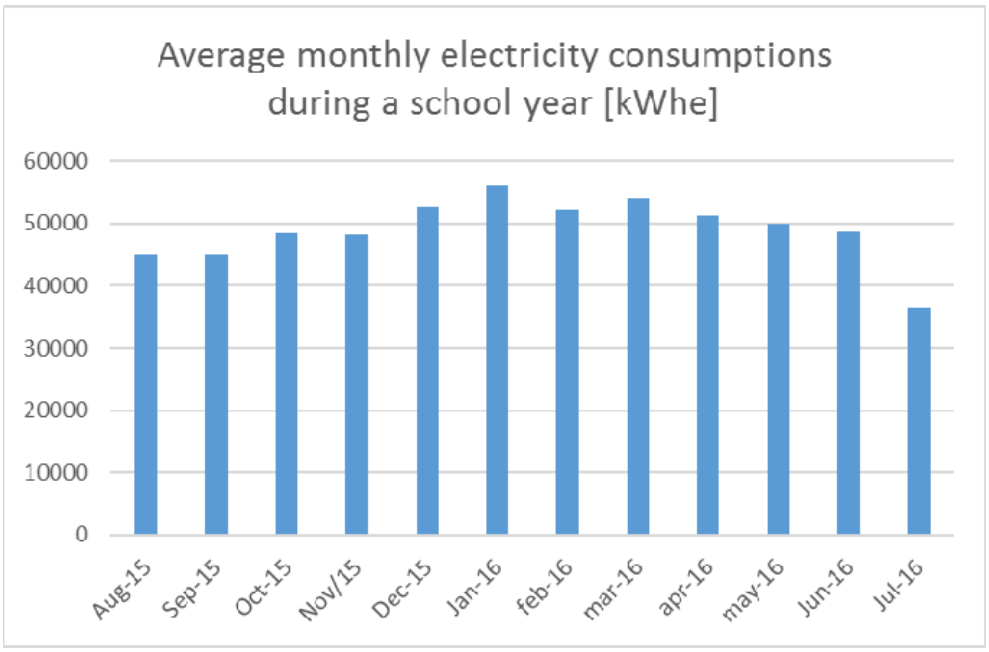
Picture 26 - Graphic representation of the user profile during school period [working days/month]

BUILDING ENVELOPE

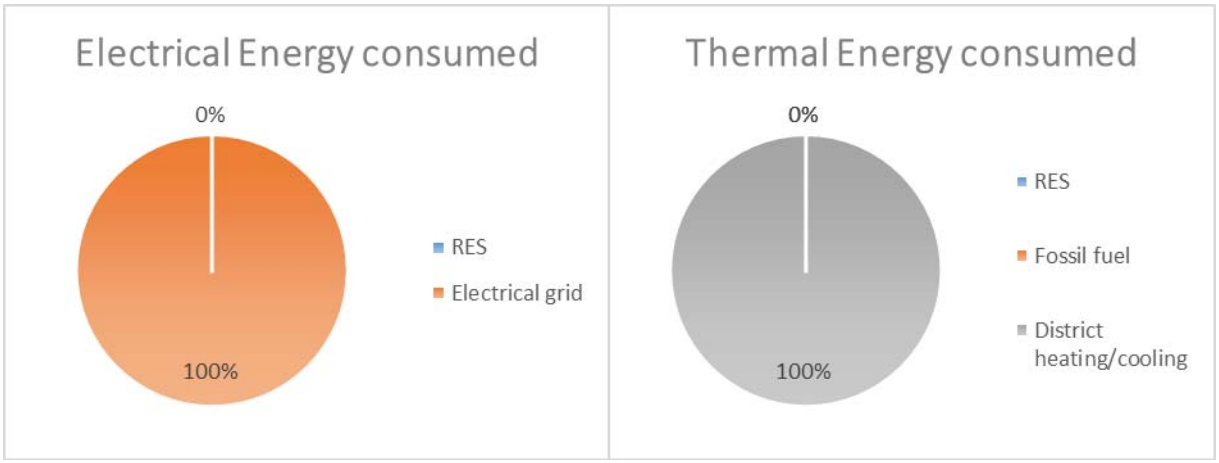
Year of construction	>2010
Type of structure	Steel frame structure
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 27 - Average monthly electricity consumptions during a school year [kWhe]



Picture 28 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school.

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	588405	8,35	290,71	/	1508,73	1777,66	588405	254897	110
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	615463	8,74	304,08	/	1578,11	1859,40	0	221567	59
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	169	0,00	0,08	/	0,43	0,51		476464	169

Table 7 - Energy performance indicators

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	1108,6	m2	0	€		
	Retrofit roof with insulation	200	€/m2	1834,0	m2	0	€		
	Replace windows	450	€/m2	759,0	m2	0	€		
	Install solar shading systems	150	€/m2	759,0	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
	Install thermostatic valves	70	€/valve	0	valves*	0	€		
✓	**Replace lights with LED**	**25**	**€/lamp**	**32,0**	**lamps**	**800**	**€**	**-38%**	**light consumptions**
	Install Energy Saving Switchs and Presence Sensors	250	€/point	50,0	points*	0	€		
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-4%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**2024,0**	**m2**	**50600**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 8 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values.*

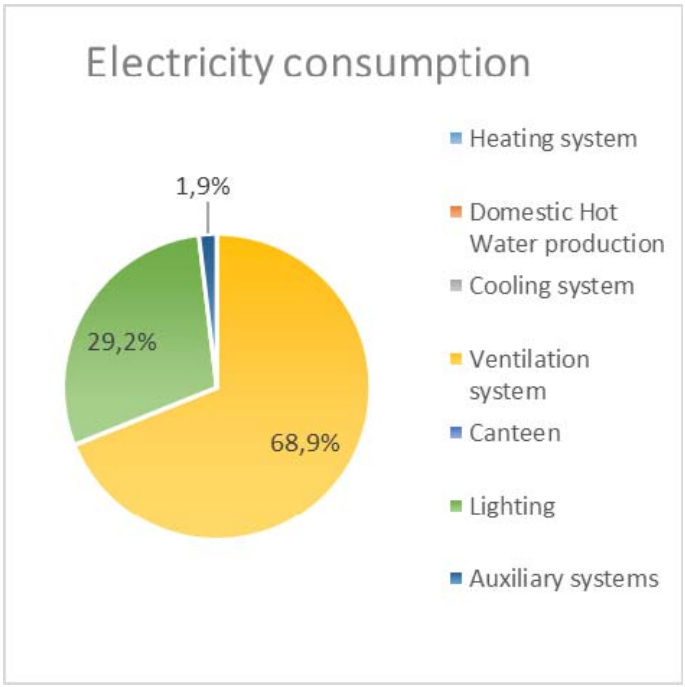
**Most relevant energy consumption reduction

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	6711,450571
After intervention	4139,864286
Energy consumption reduction [%]	**-38%**

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	588405,45
Energy produced by RES	22000
After intervention	566405,45
Eletrical energy reduction [%]	**-4%**



Picture 29 - Pie Graph of Electrical and Natural gas consumptions subdivision [%] for each final intended use.

4.5. Primary and Secondary school “Zespół Szkół nr 10” - Main building

GENERALITIES

School type	Primary and Secondary
Student age range	6-15

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

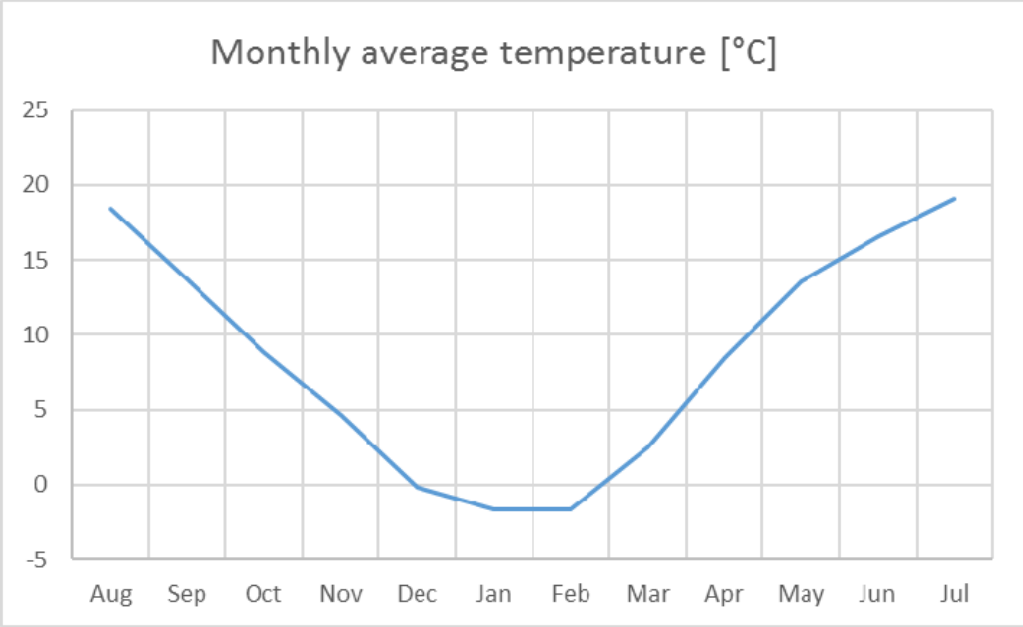
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

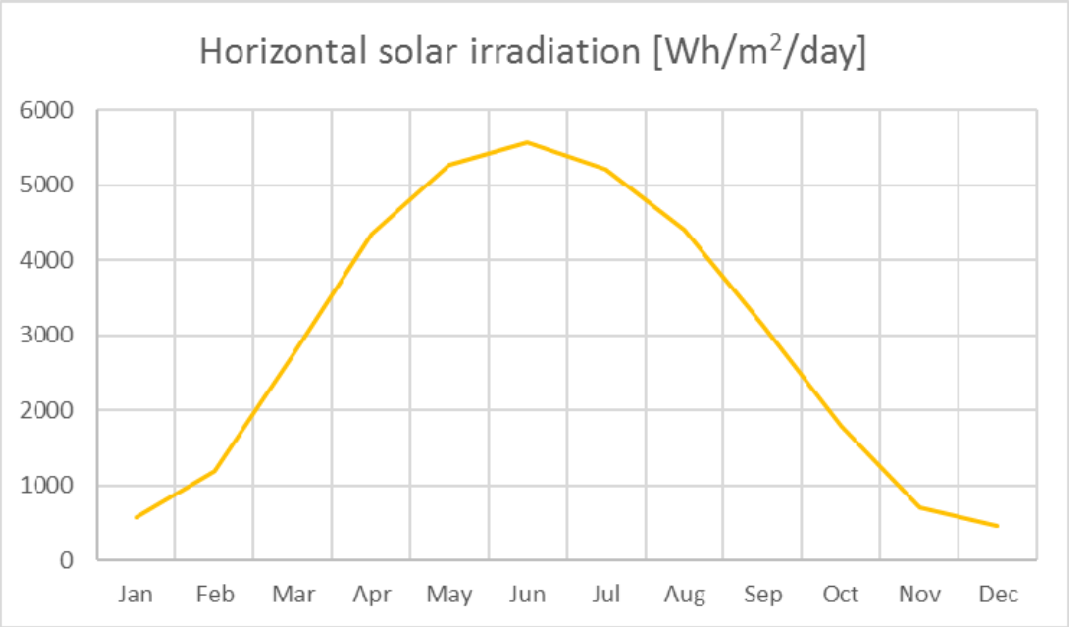
Total floor heated area [m²]	3094
Volume [m³]	40835
S/V	0,11

OCCUPATION AND USE OF THE BUILDING

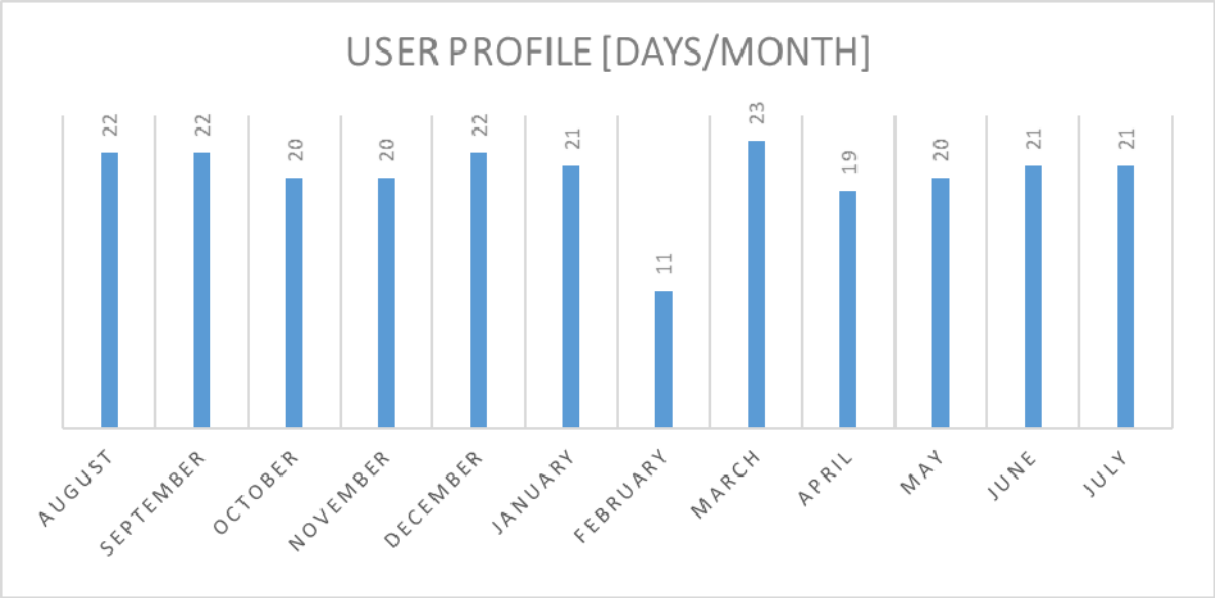
Number of students	809
Total days of use	242
Daily hours of use	14
Total area allocated to classrooms [%]	48



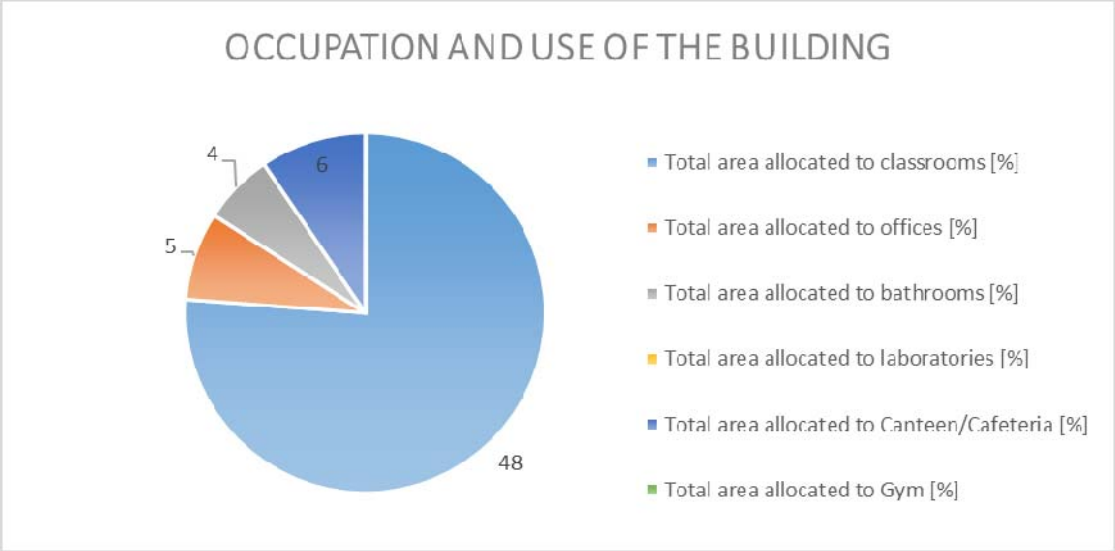
Picture 30 - Graphic representation of monthly average temperature [°C]



Picture 31 - Graphic representation of the Horizontal solar irradiation [Wh/m^2/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 32 - Graphic representation of the user profile during school period [working days/month]



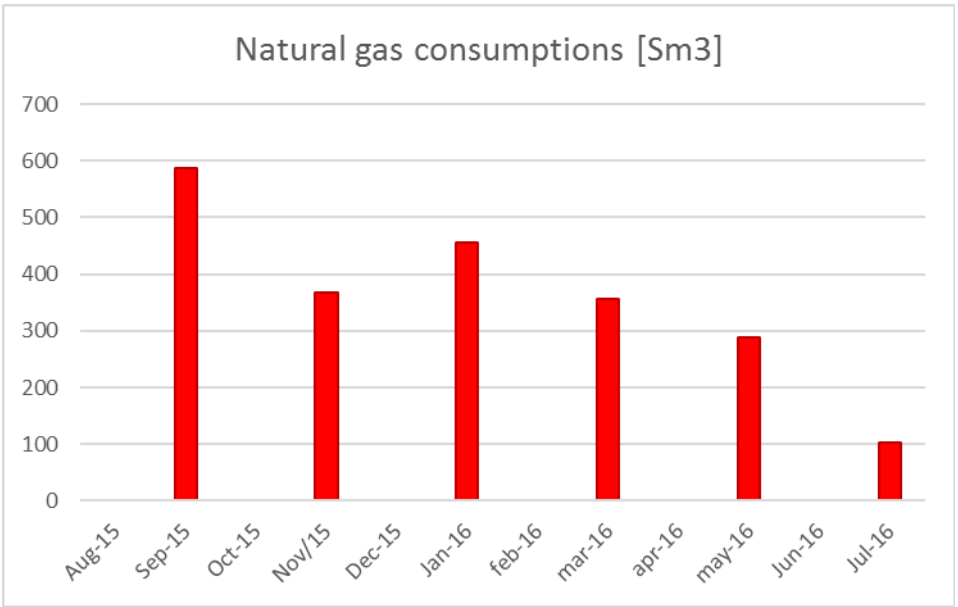
Picture 33 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

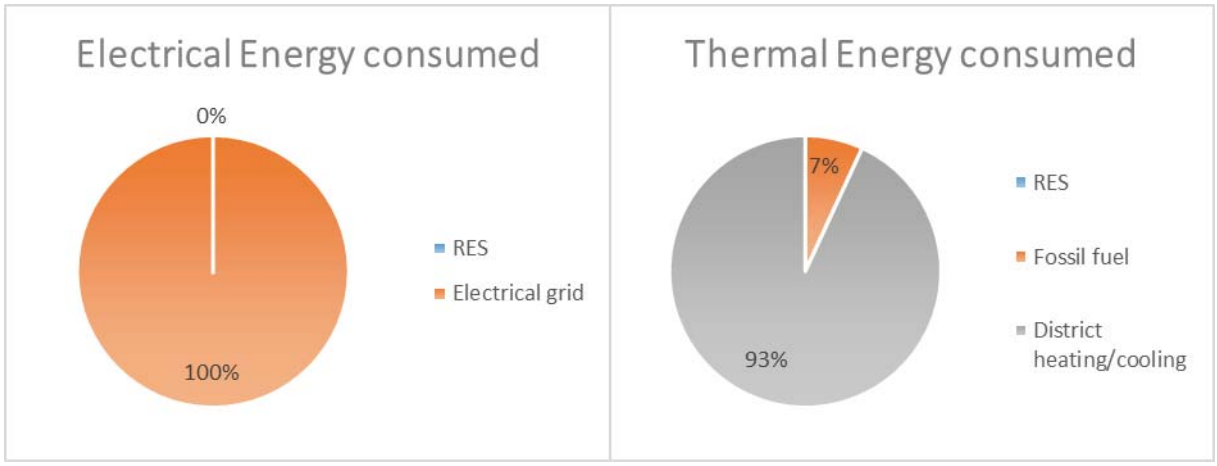
Year of construction	1970-1980
Type of structure	Prefab modules
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 34 - Natural gas consumptions during a school year [Sm³]



Picture 35 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school.

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	82199	2,01	26,57	55,36	101,61	339,67	82199	35609	15
Natural gas	Sm3	2159	0,05	0,70	1,45	2,67	8,92	20731	431	2
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	279991	6,86	90,51	188,56	346,09	1156,99	0	100797	27
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	44	0,00	0,01	0,03	0,05	0,18		136837	44

Table 9 - Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	1619,1	m2	0	€		
✓	**Retrofit roof with insulation**	**200**	**€/m2**	**1107,0**	**m2**	**221400**	**€**	**-18%**	**Energy need for space heating reduction [%]**
	Replace windows	450	€/m2	537,9	m2	0	€		
	Install solar shading systems	150	€/m2	537,9	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**97**	**valves***	**6796**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**463,0**	**lamps**	**11575**	**€**	**-57%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-27%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**3093,5**	**m2**	**77339**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 10 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values.*

***Most relevant energy consumption reduction*

Energy need for space heating - envelope

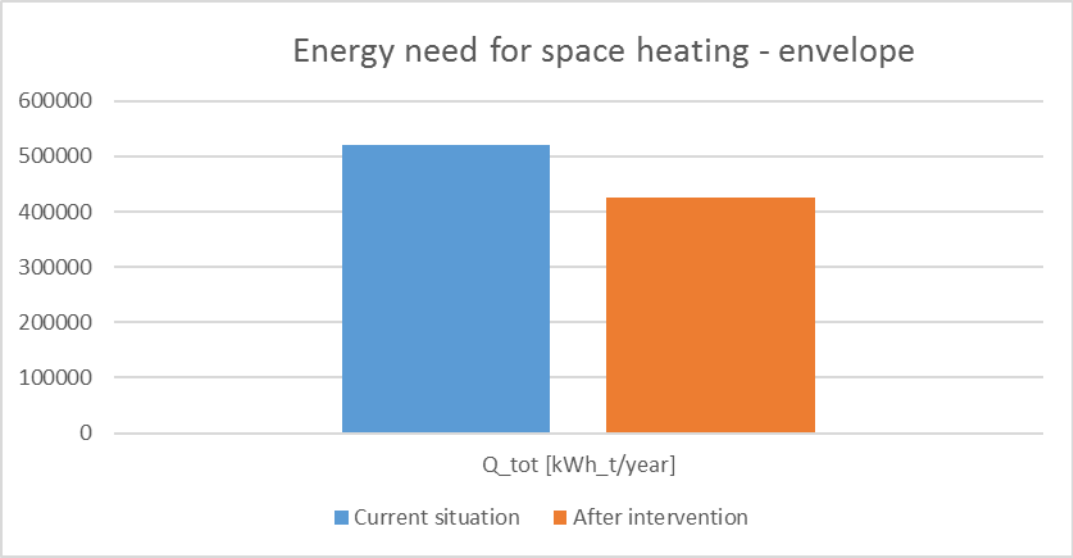
	Q_tot[kWh_t/year]
Current situation	519689,1755
After intervention	426033,2505
Energy need for space heating reduction [%]	**-18%**

Lamp replacement with LED

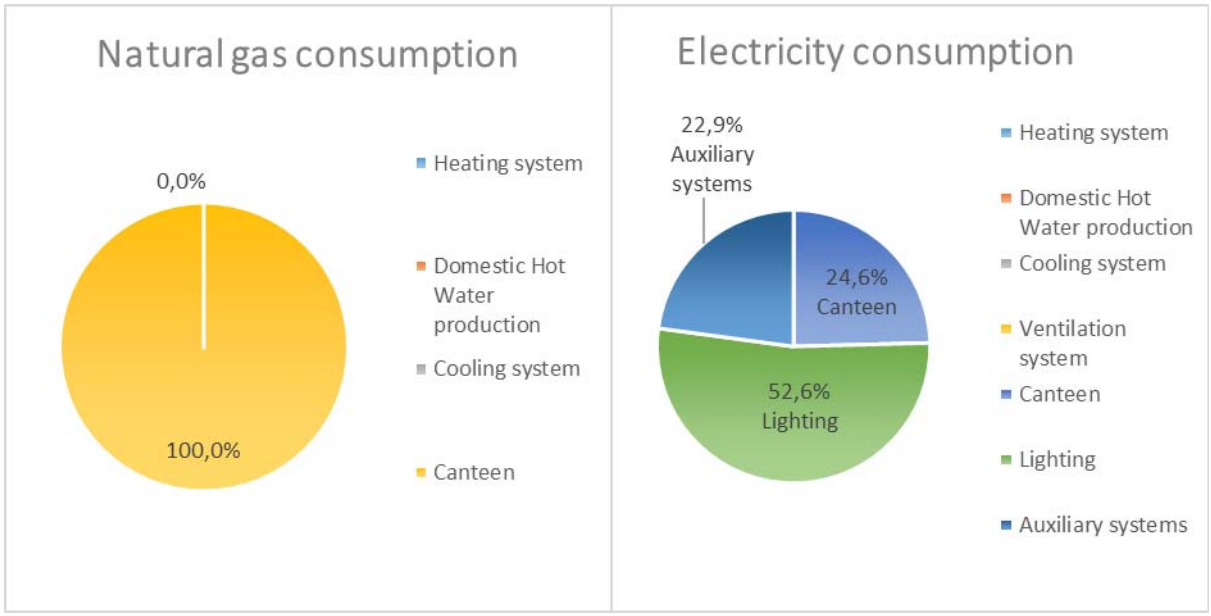
	Q [kWh_t/year]
Current situation	44255,20429
After intervention	19044,375
Energy consumption reduction [%]	**-57%**

Electrical energy reduction with PV system

	Q [kWh_el/year]
Current situation	82199
Energy produced by RES	22000
After intervention	60199
Eletrical energy reduction [%]	**-27%**



Picture 36 - Energy need for space heating before and after (predicted) the intervention - envelope [kWh_t/year]



Picture 37 - Pie Graph of Electrical and Natural gas consumptions subdivision [%] for each final intended use.

4.6. Primary and Secondary school "Zespół Szkół nr 10" - Ggym

GENERALITIES

School type	Primary and Secondary
Student age range	6-15

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

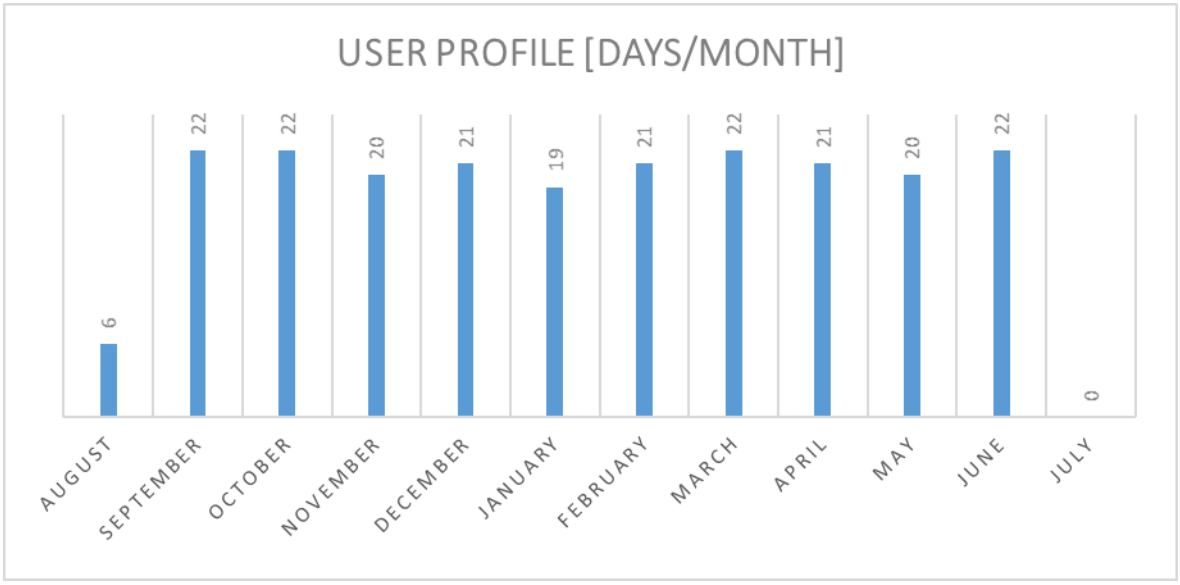
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

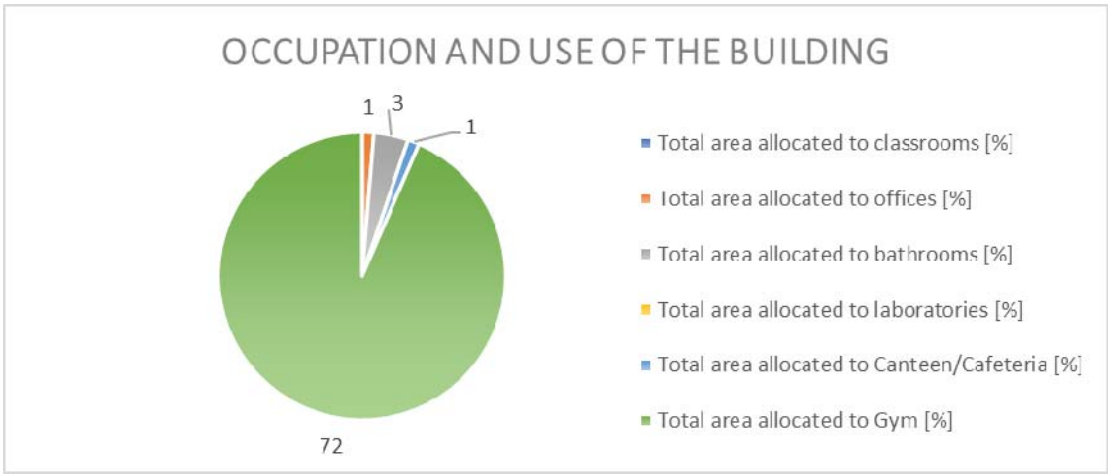
Total floor heated area [m²]	2578
Volume [m³]	82496
S/V	0,08

OCCUPATION AND USE OF THE BUILDING

Number of students	809
Total days of use	2016
Daily hours of use	13



Picture 38 - Graphic representation of the user profile during school period [working days/month]



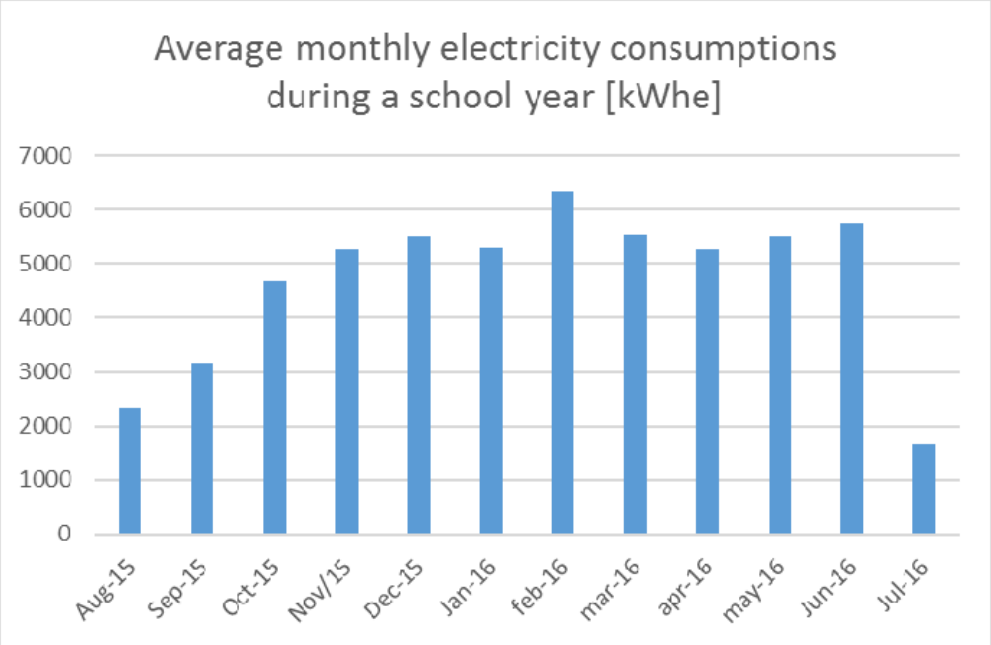
Picture 39 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

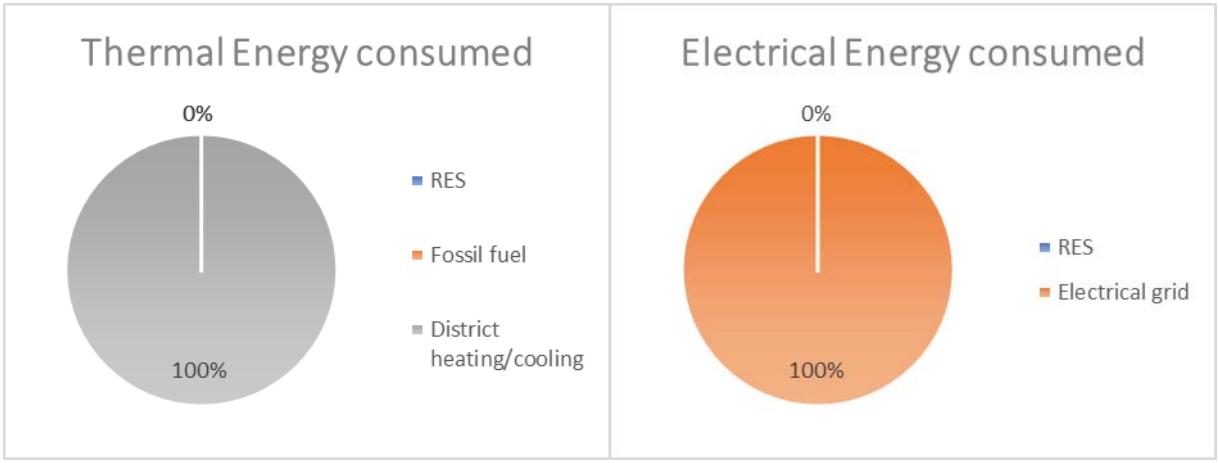
Year of construction	>2010
Type of structure	Prefab modules
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 40 - Average monthly electricity consumptions during a school year [kWhe]



Picture 41 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the gym

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m³	u.m./m²	u.m./m²	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	56331	0,68	21,85	/	69,63	260,79	56331	24402	11
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	141898	1,72	55,04	/	175,40	656,94	0	51083	14
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	24	0,00	0,01	/	0,03	0,11		75486	24

Table 11 - Energy performance indicators

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	1793,4	m2	0	€		
	Retrofit roof with insulation	200	€/m2	2310,0	m2	0	€		
	Replace windows	450	€/m2	366,6	m2	0	€		
	Install solar shading systems	150	€/m2	366,6	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**97**	**valves***	**6796**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**53,0**	**lamps**	**1325**	**€**	**-32%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-39%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**2578,0**	**m2**	**64450**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 12 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values.*

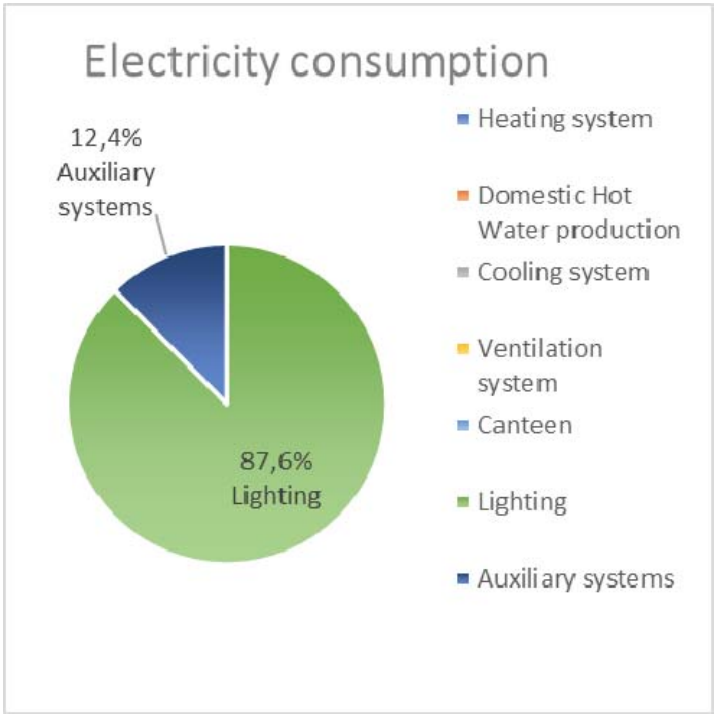
**Most relevant energy consumption reduction

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	2722,988571
After intervention	1839,857143
Energy consumption reduction [%]	**-32%**

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	56330,7
Energy produced by RES	22000
After intervention	34330,7
Eletrical energy reduction [%]	**-39%**



Picture 42 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use.

4.7. Secondary school “Zespół Szkół Mechanicznych nr 2, Technical School, Vocational Schools Team” – Main school building

Picture 43 - Zespół Szkół Mechanicznych nr 2, Technical School, Vocational Schools Team – main building

GENERALITIES

School type	Secondary
Student age range	16-50

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

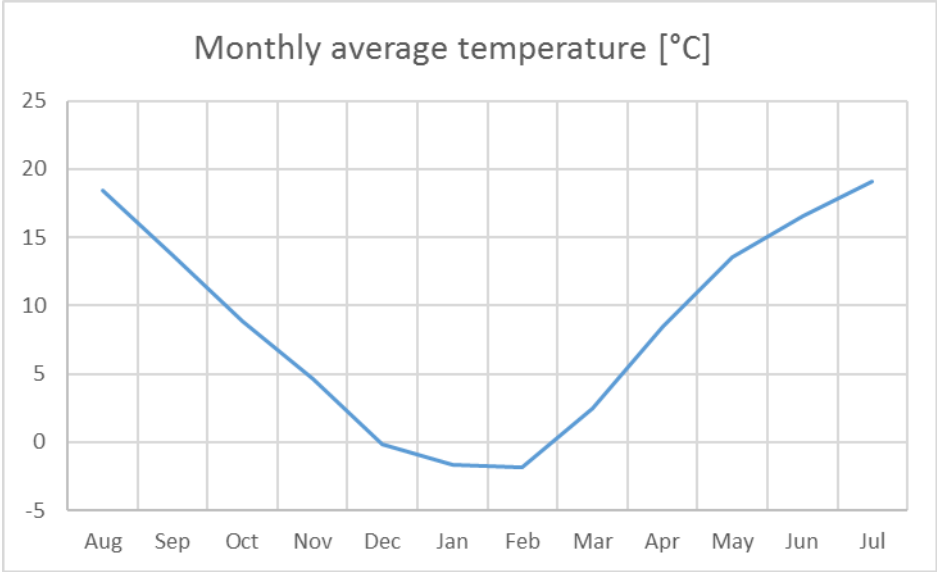
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

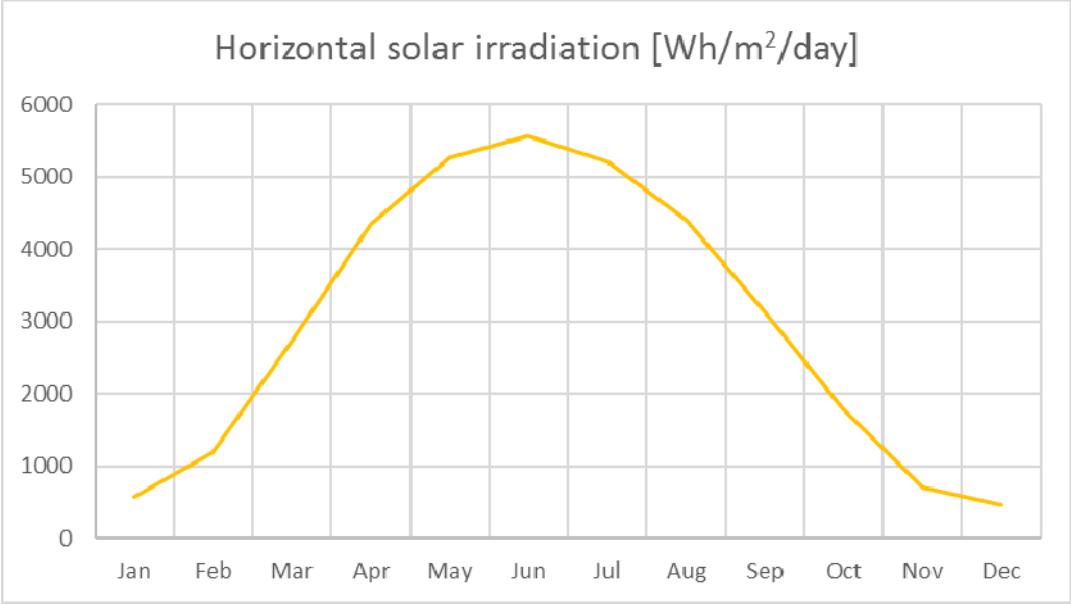
Total floor heated area [m²]	3674
Volume [m³]	48503
S/V	0,10

OCCUPATION AND USE OF THE BUILDING

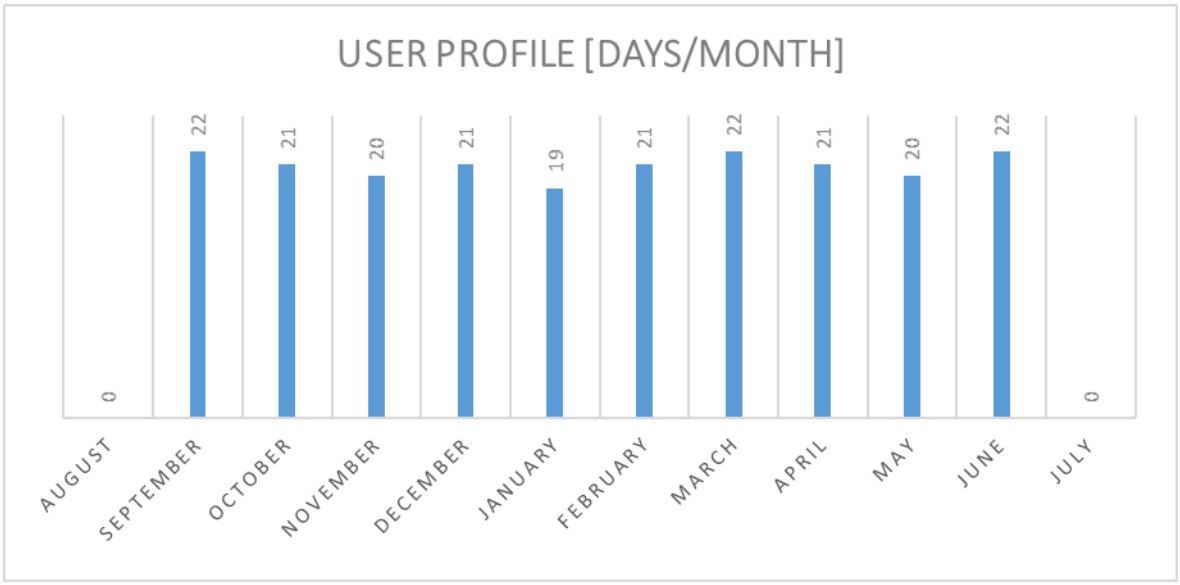
Number of students	549
Total days of use	209
Daily hours of use	14
Total area allocated to classrooms [%]	42



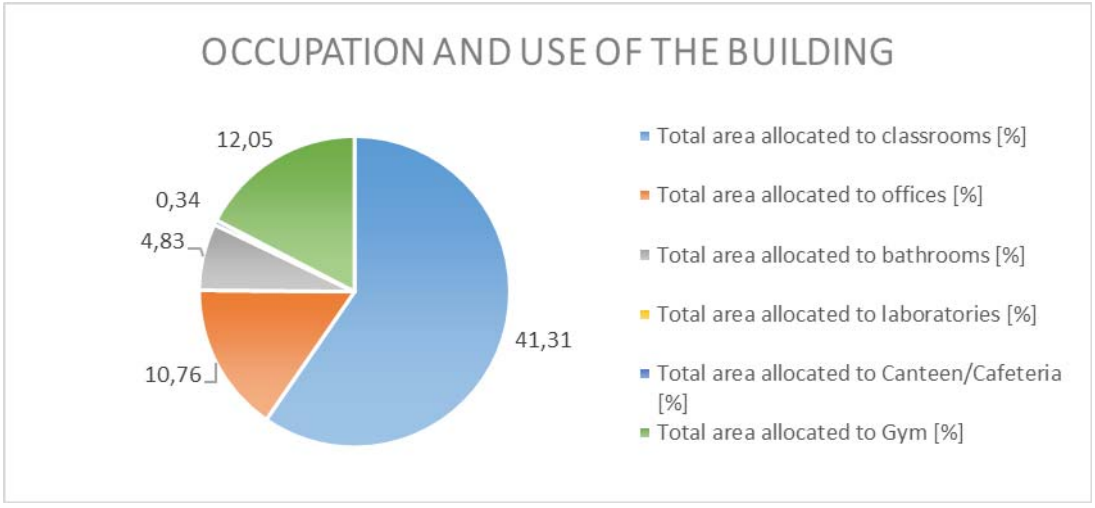
Picture 44 - Graphic representation of monthly average temperature [°C]



Picture 45 - Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 46 - Graphic representation of the user profile during school period [working days/month]



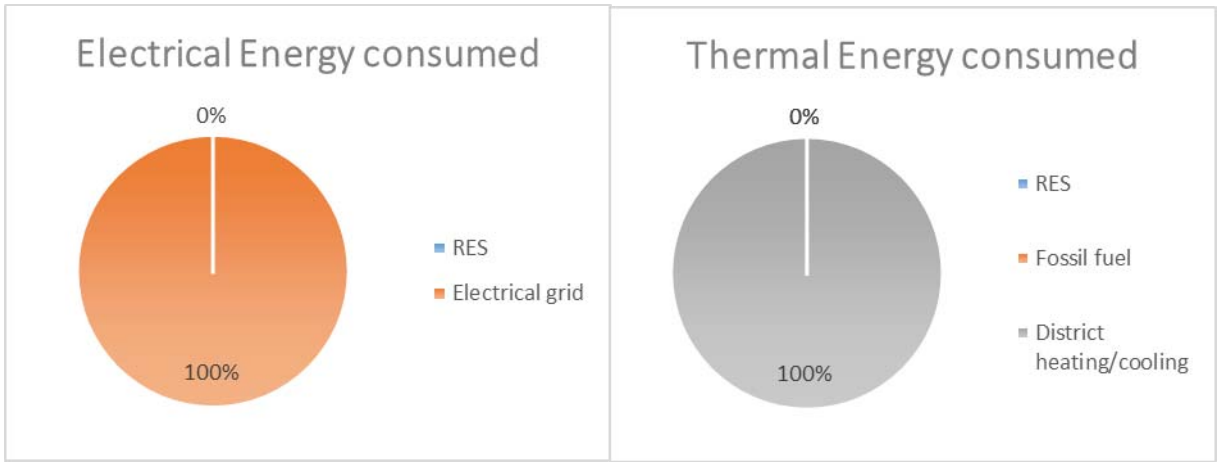
Picture 47 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

Year of construction	1970-1980
Type of structure	Prefab modules
External wall insulation	No insulation

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 48 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school.

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	58202	1,20	15,84	38,34	106,02	278,48	58202	25213	11
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	556024	11,46	151,32	366,31	1012,79	2660,40	0	200168	53
District cooling	kWh_t	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	64,02	0,00	0,02	0,04	0,12	0,31		225382	64

Table 13 - Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
✓	**Retrofit esternal walls with insulation**	**100**	**€/m2**	**1806,1**	**m2**	**180607**	**€**	**-20%**	**Energy need for space heating reduction [%]**
✓	**Retrofit roof with insulation**	**200**	**€/m2**	**1212,6**	**m2**	**242518**	**€**		
	Replace windows	450	€/m2	855,4	m2	0	€		
	Install solar shading systems	150	€/m2	855,4	m2	0	€		
	Reaplace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**66**	**valves***	**4612**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
	Replace lights with LED	25	€/lamp		lamps	0	€		
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-38%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**3674,5**	**m2**	**91861**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 14 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

***Most relevant energy consumption reduction*

Energy need for space heating - envelope

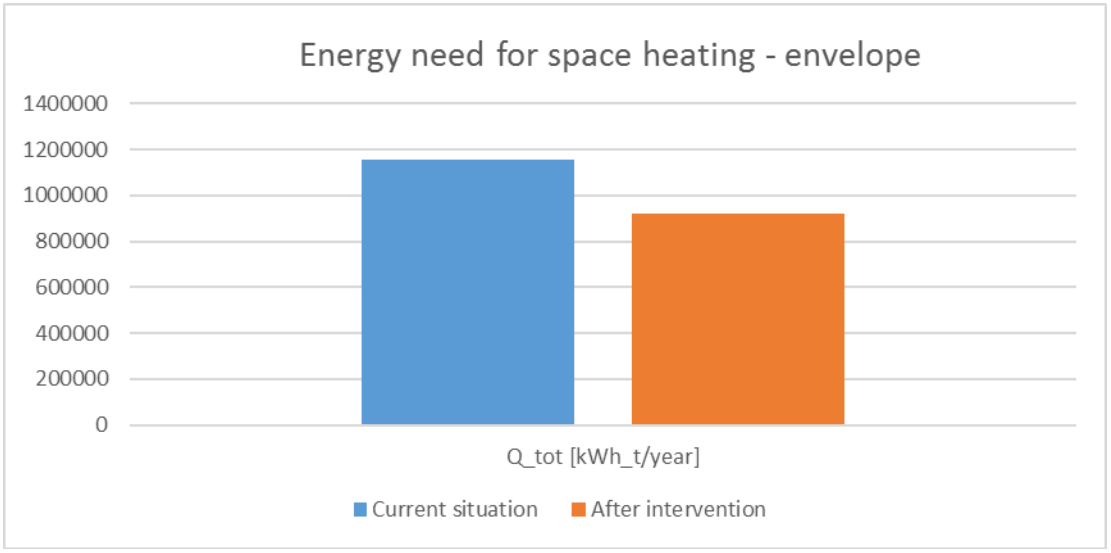
	Q_tot[kWh_t/year]
Current situation	1157918,83
After intervention	922881,531
Energy need for space heating reduction [%]	**-20%**

Lamp replacement with LED

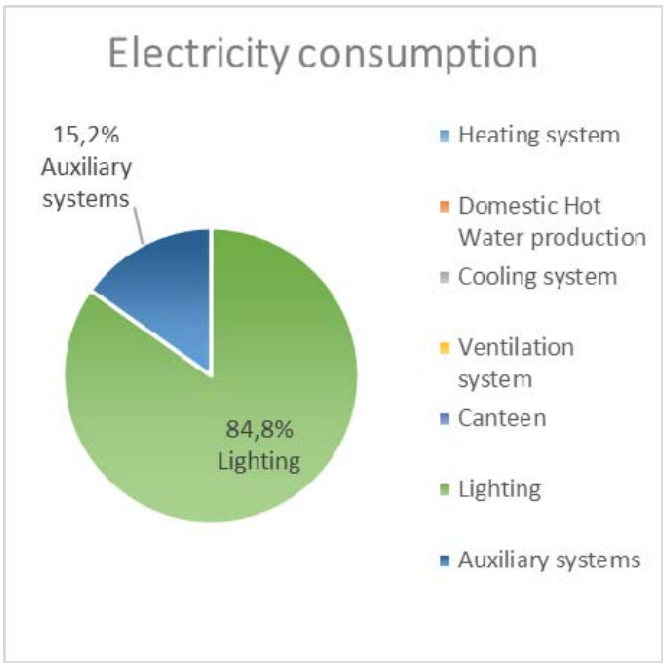
	Q [kWh_t/year]
Current situation	40643,275
After intervention	17601,25
Energy consumption reduction [%]	**-57%**

Electrical energy reduction with PV system

	Q [kWh_el/year]
Current situation	58202,458
Energy produced by RES	22000
After intervention	36202,458
Eletrical energy reduction [%]	**-38%**



Picture 49 - Energy need for space heating before and after (predicted) the intervention - envelope [kWh_t/year]



Picture 50 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use.

4.8. Secondary school "Zespół Szkół Mechanicznych nr 2, Technical School, Vocational Schools Team" - Practical education centre

Picture 51 – Zespół Szkół Mechanicznych nr 2, Technical School, Vocational Schools Team – Practical education centre

GENERALITIES

School type	Secondary
Student age range	16-50

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

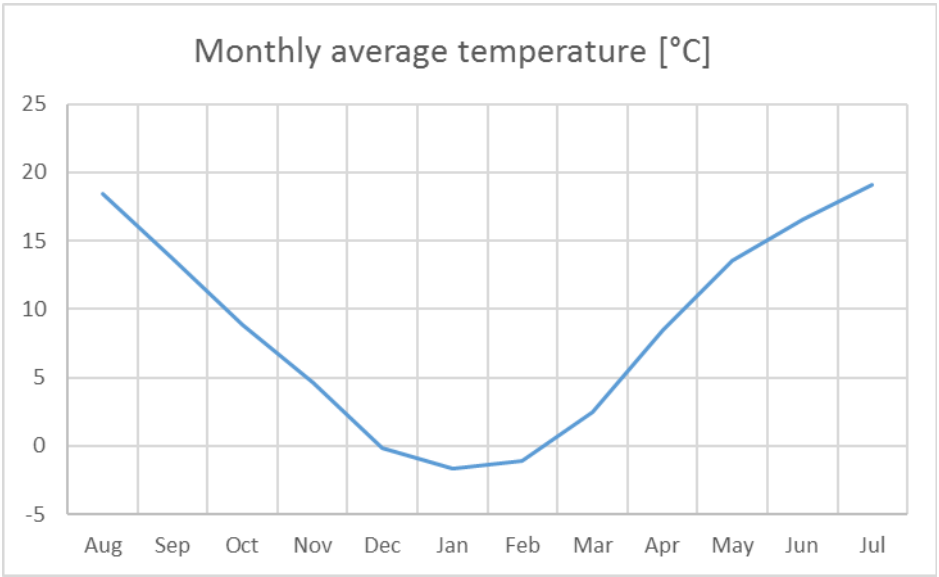
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

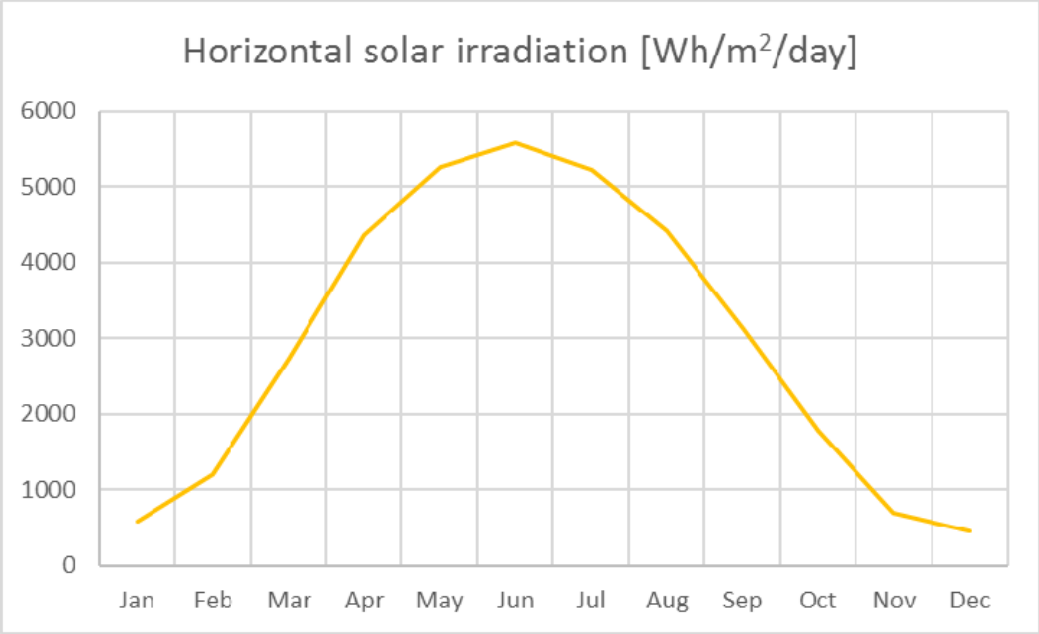
Total floor heated area [m²]	4481
Volume [m³]	80656
S/V	0,11

OCCUPATION AND USE OF THE BUILDING

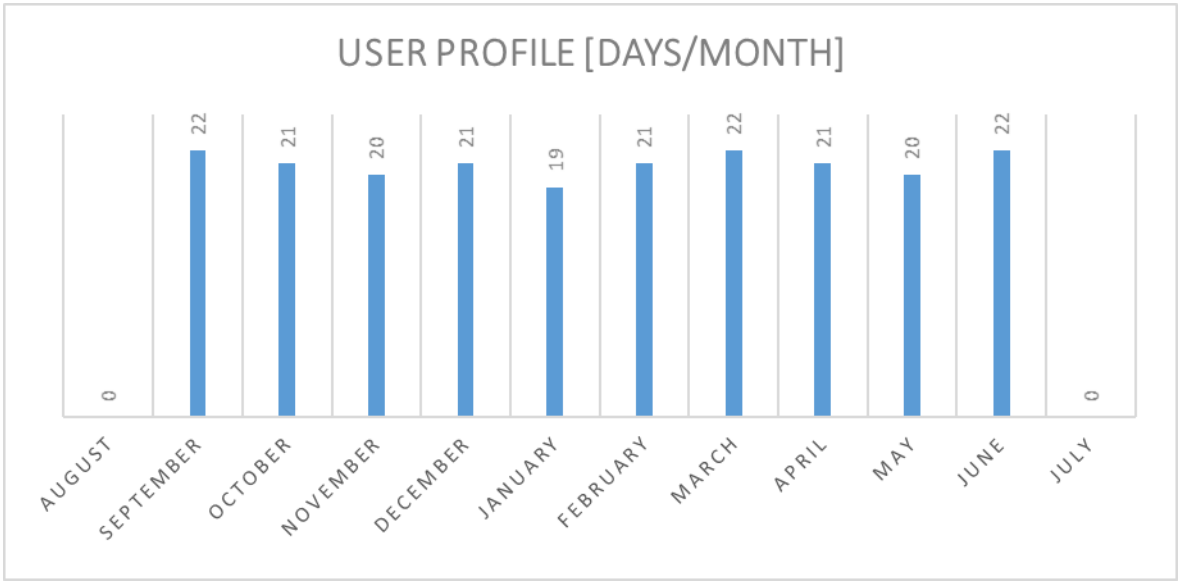
Number of students	549
Total days of use	209
Daily hours of use	14
Total area allocated to classrooms [%]	2,3



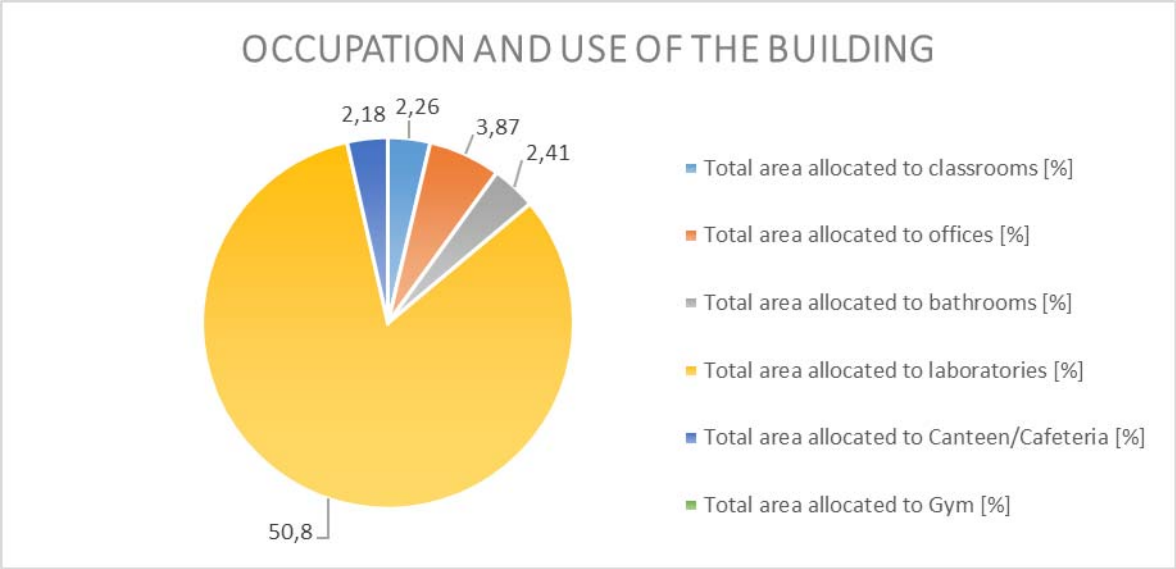
Picture 52 - Graphic representation of monthly average temperature [°C]



Picture 53 -Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 54 - Graphic representation of the user profile during school period [working days/month]



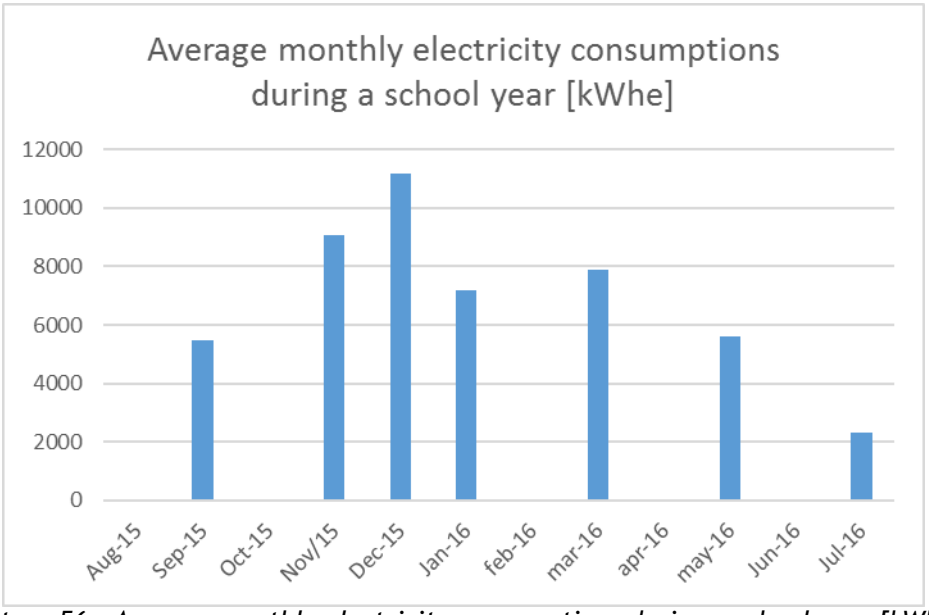
Picture 55 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

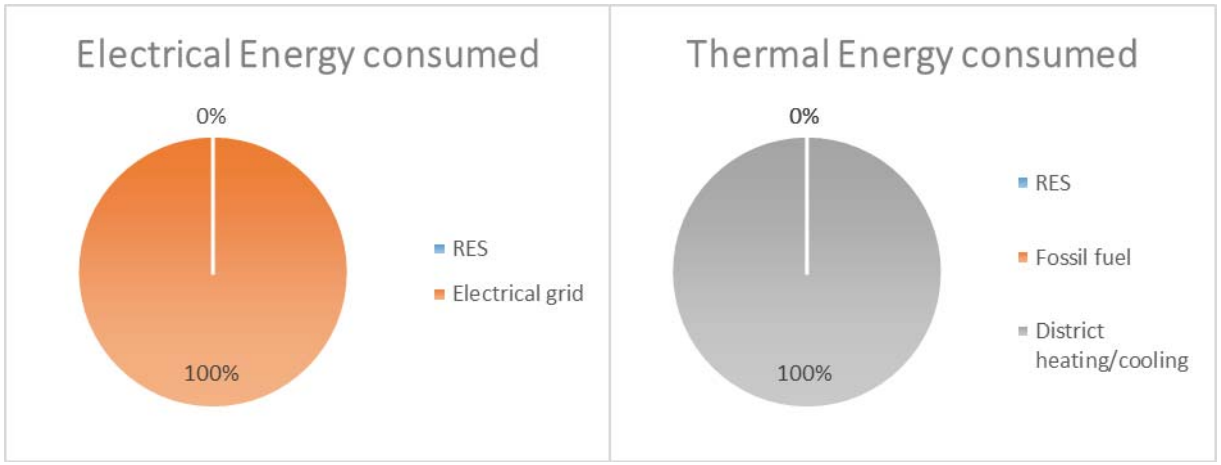
Year of construction	1960-1970
Type of structure	Reinforced concrete structure
External wall insulation	No insulation

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 56 - Average monthly electricity consumptions during a school year [kWhe]



Picture 57 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school.

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	48704	0,60	10,87	480,94	88,71	233,03	48704	21099	9
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	110724	1,37	24,71	1093,38	201,68	529,78	0	39861	11
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	20	0,00	0,00	0,19	0,04	0,09		60959	20

Table 15 - Energy performance indicators

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
✓	**Retrofit external walls with insulation**	**100**	**€/m2**	**1284,9**	**m2**	**128488**	**€**	**-21%**	**Energy need for space heating reduction [%]**
✓	**Retrofit roof with insulation**	**200**	**€/m2**	**3593,8**	**m2**	**718750**	**€**		
	Replace windows	450	€/m2	536,3	m2	0	€		
	Install solar shading systems	150	€/m2	536,3	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**66**	**valves***	**4612**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**399,0**	**lamps**	**9975**	**€**	**-57%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
	Install smart metering	5000	€			0	€		
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-45%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**4480,9**	**m2**	**112022**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 16 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

***Most relevant energy consumption reduction*

Energy need for space heating - envelope

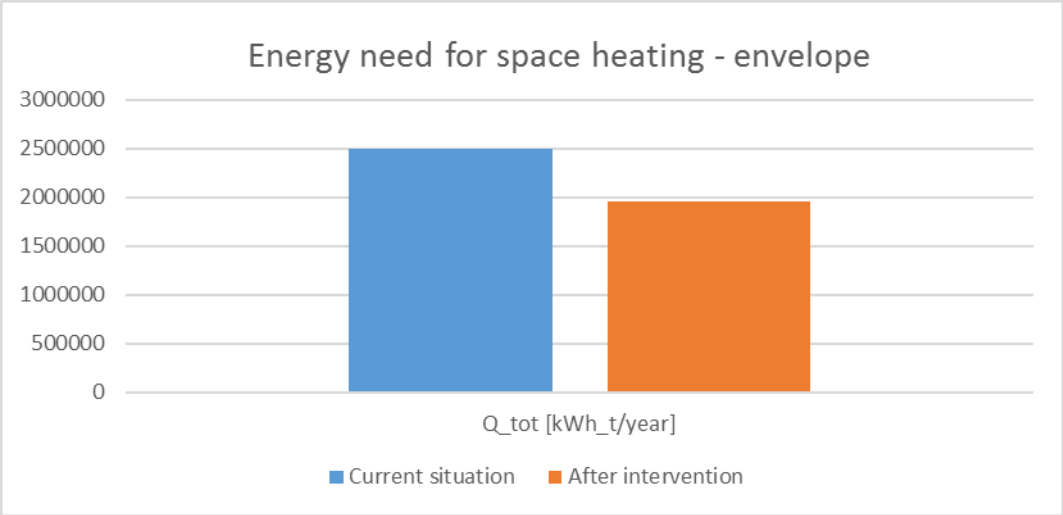
	Q_tot[kWh_t/year]
Current situation	2495846,407
After intervention	1959863,117
Energy need for space heating reduction [%]	**-21%**

Lamp replacement with LED

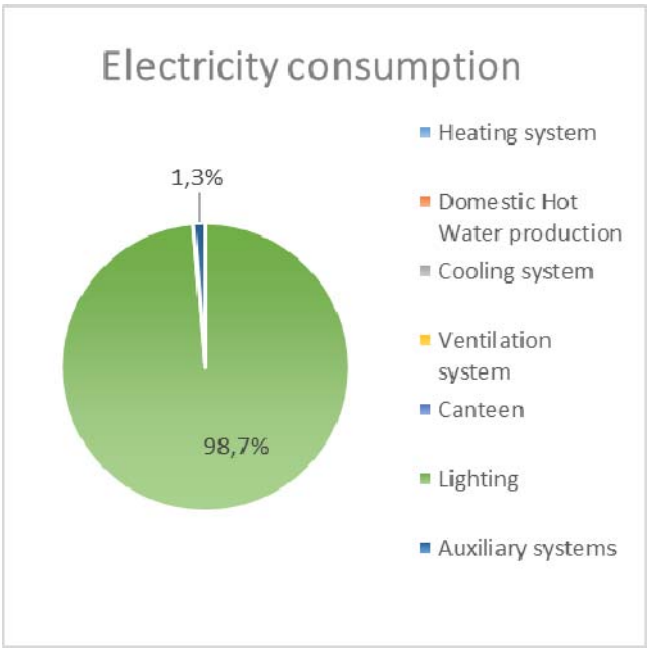
	Q [kWh_t/year]
Current situation	33856,746
After intervention	14593,425
Energy consumption reduction [%]	**-57%**

Electrical energy reduction with PV system

	Q [kWh_el/year]
Current situation	48704,12667
Energy produced by RES	22000
After intervention	26704,12667
Eletrical energy reduction [%]	**-45%**



Picture 58 - Energy need for space heating before and after (predicted) the intervention - envelope [kWh_t/year]



Picture 59 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use

4.9. Primary school "Szkoła Podstawowa nr 10"

Picture 60 – Primary School "Szkoła Podstawowa nr 10"

GENERALITIES

School type	Primary
Student age range	6-13

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

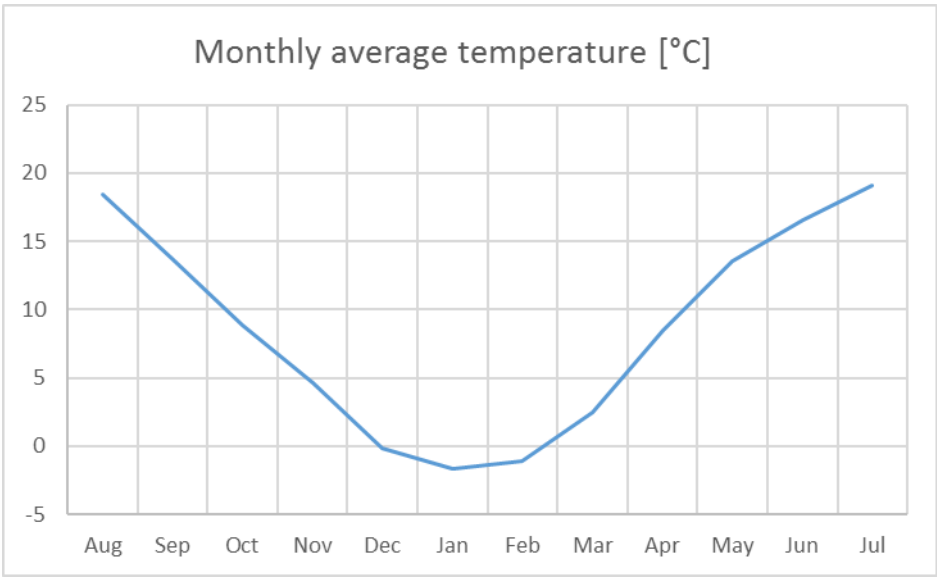
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

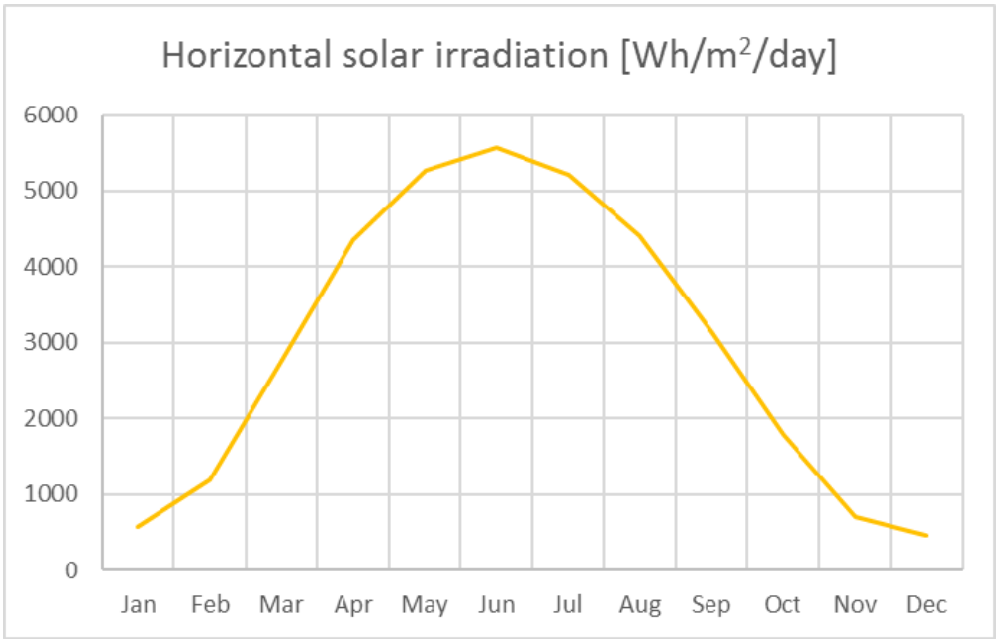
Total floor heated area [m²]	2799
Volume [m³]	35715
S/V	0,14

OCCUPATION AND USE OF THE BUILDING

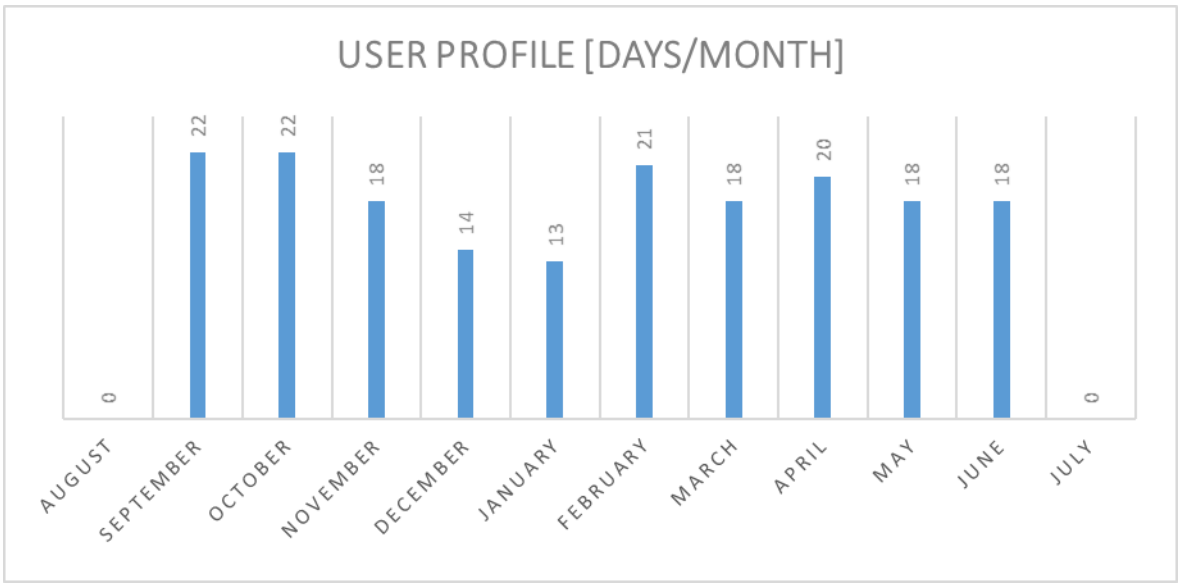
Number of students	329
Total days of use	184
Daily hours of use	14
Total area allocated to classrooms [%]	36



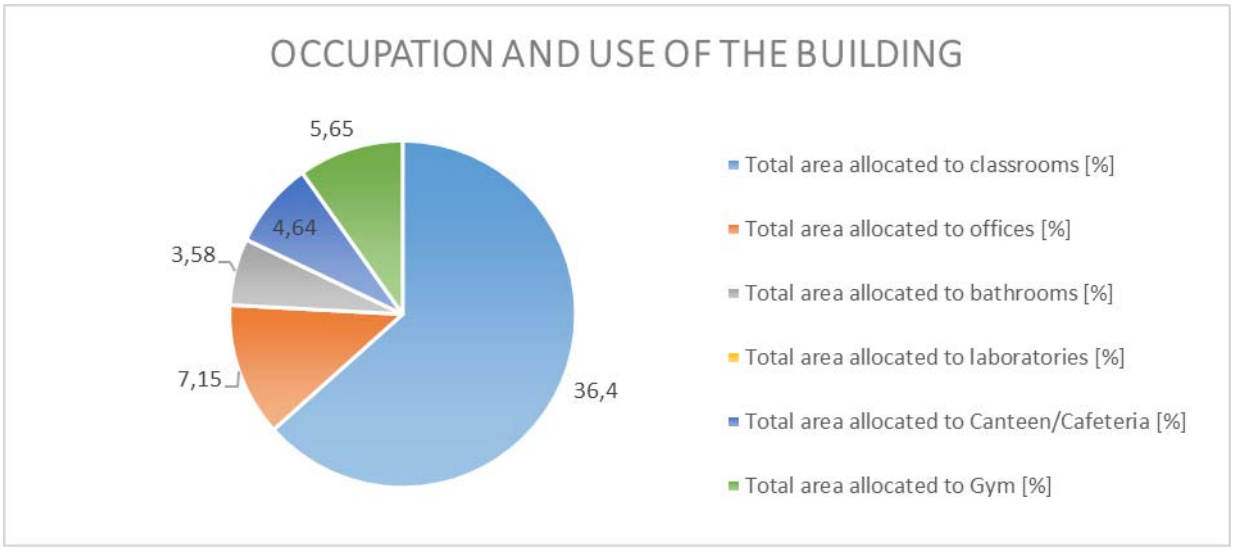
Picture 61 - Graphic representation of monthly average temperature [°C]



Picture 62 - Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 63 - Graphic representation of the user profile during school period [working days/month]



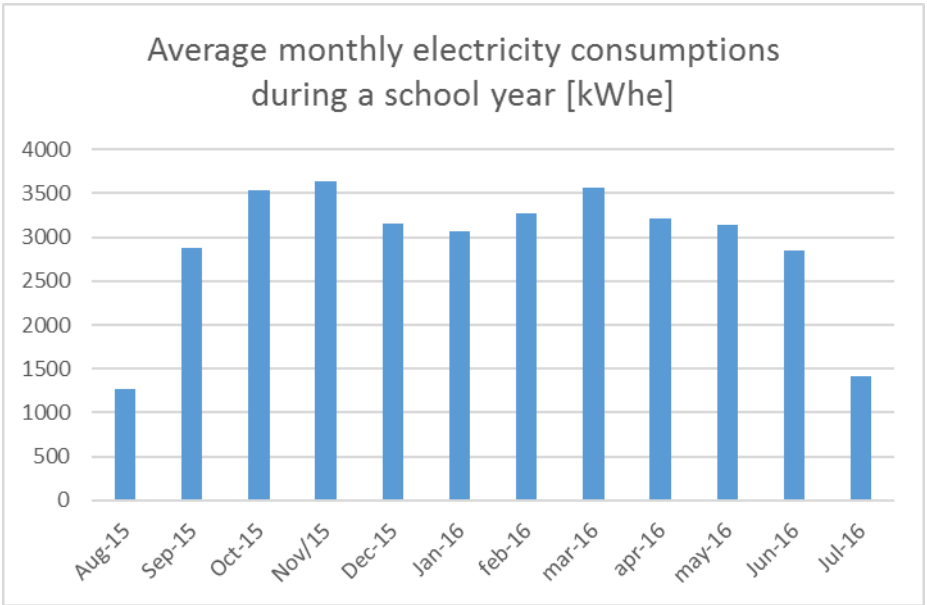
Picture 64 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

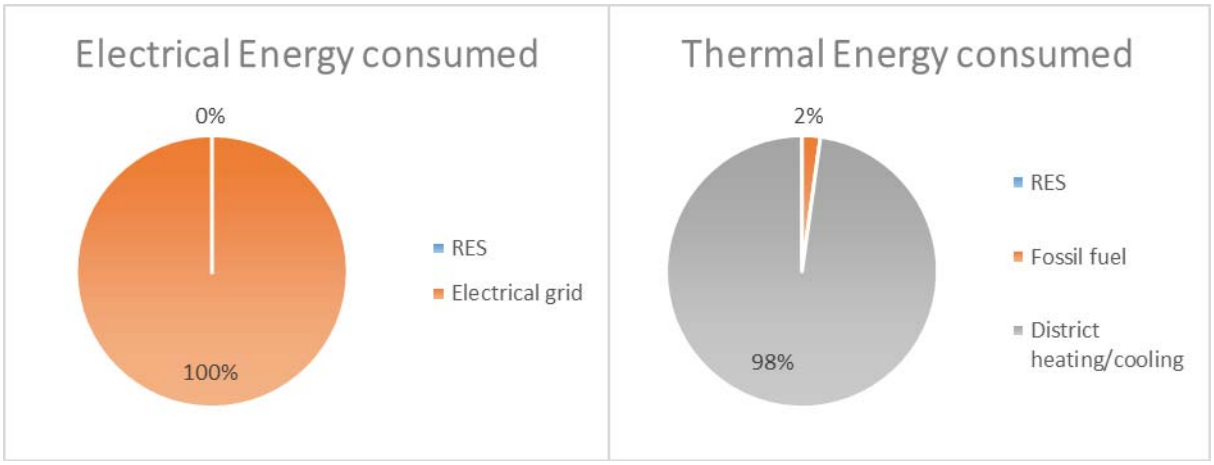
Year of construction	1950-1960
Type of structure	Load bearing masonry wall
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 65 - Average monthly electricity consumptions during a school year [kWhe]



Picture 66 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school.

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	34986	0,98	12,50	34,34	106,34	190,14	34986	15156	7
Natural gas	Sm3	504	0,01	0,18	0,50	1,53	2,74	4842	101	0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	216889	6,07	77,49	212,88	659,24	1178,74	0	78080	21
District cooling	kWh_t	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	28	0,00	0,01	0,03	0,08	0,15		93337	28

Table 17 - Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	2664,0	m2	0	€		
	Retrofit roof with insulation	200	€/m2	1164,6	m2	0	€		
	Replace windows	450	€/m2	415,3	m2	0	€		
	Install solar shading systems	150	€/m2	415,3	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**39**	**valves***	**2764**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**469,0**	**lamps**	**11725**	**€**	**-57%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-63%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**2799,0**	**m2**	**69975**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 18 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

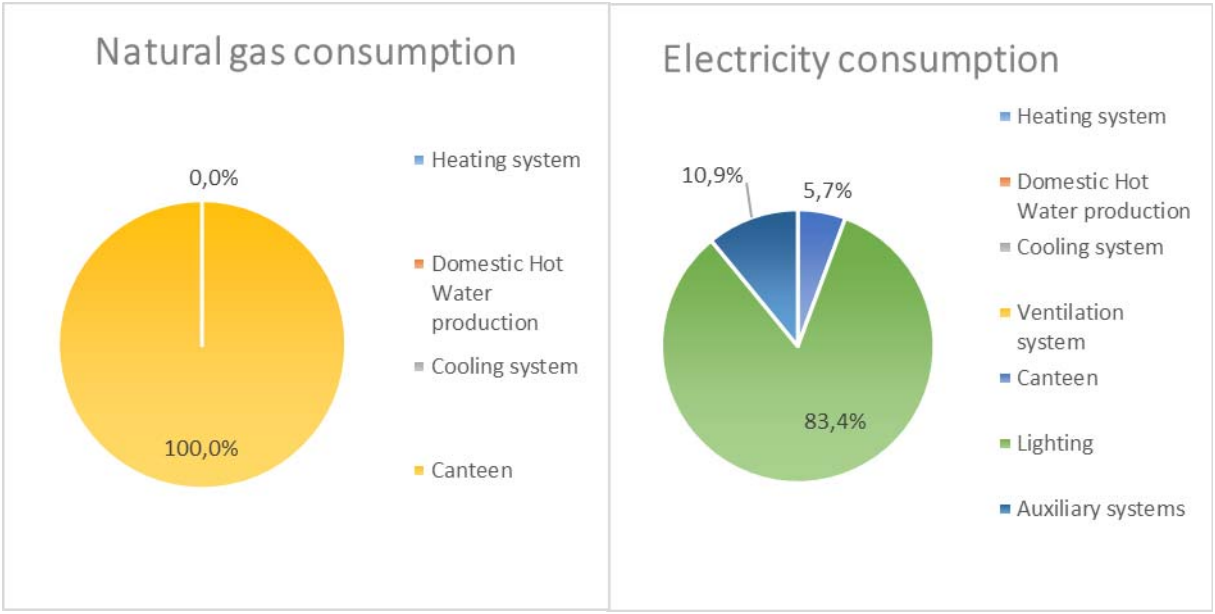
**Most relevant energy consumption reduction

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	35285,344
After intervention	15209,2
Energy consumption reduction [%]	**-57%**

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	34986,285
Energy produced by RES	22000
After intervention	12986,285
Eletrical energy reduction [%]	**-63%**



Picture 67 - Pie Graph of Electrical and Natural gas consumptions subdivision [%] for each final intended use

4.10. Primary school “Szkoła Podstawowa nr 65” – Main school building

Picture 68 – Primary school “Szkoła Podstawowa nr 65”

GENERALITIES

School type	Primary
Student age range	6-13

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

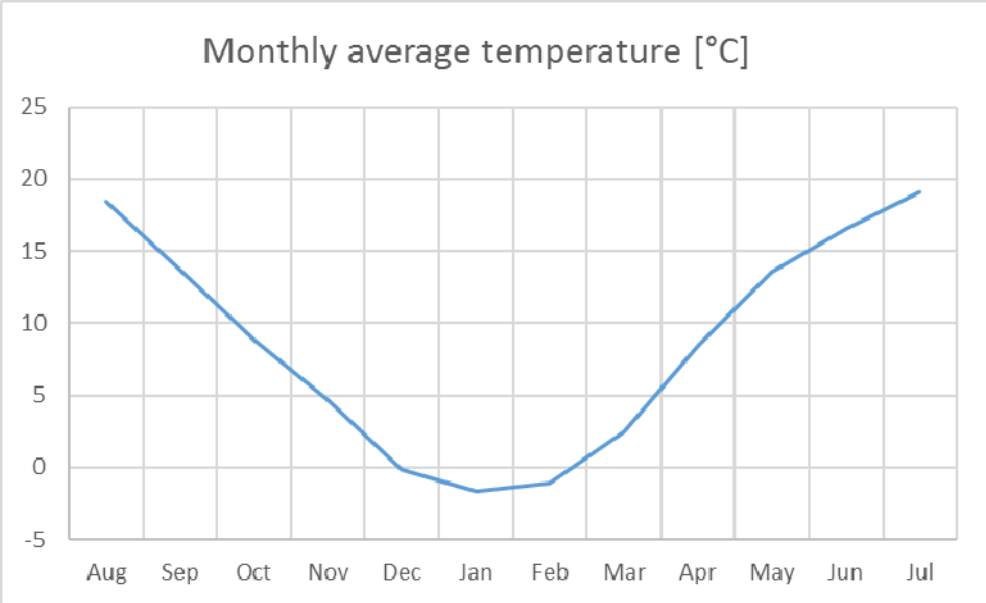
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

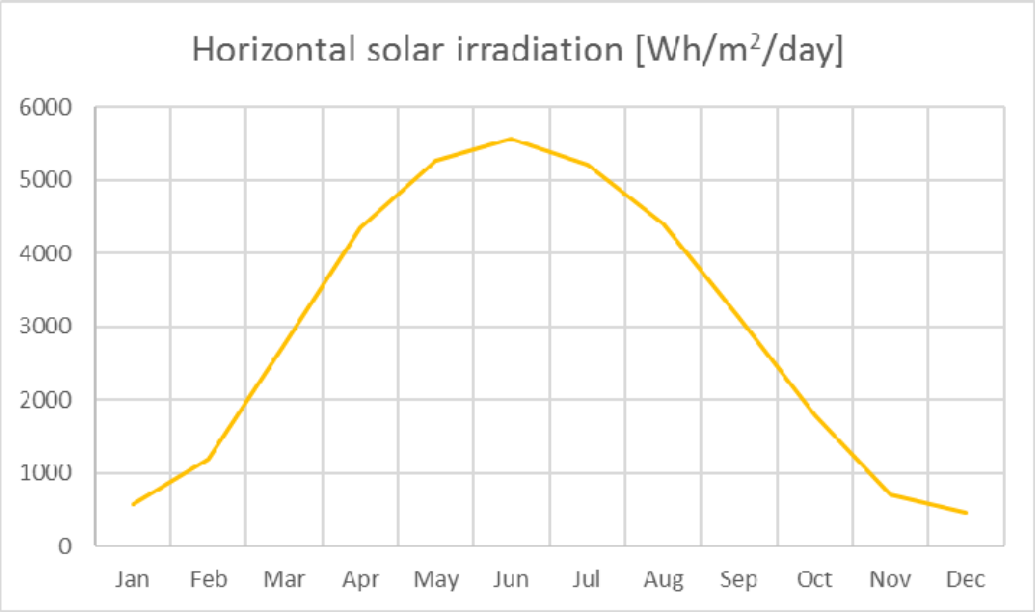
Total floor heated area [m²]	10463
Volume [m³]	138112
S/V	0,10

OCCUPATION AND USE OF THE BUILDING

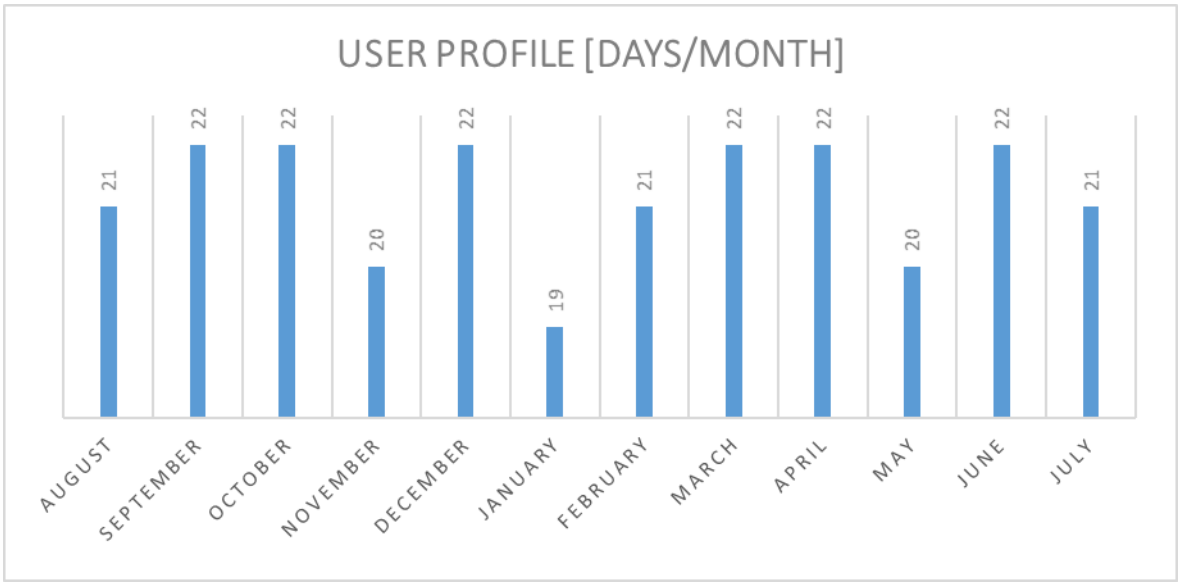
Number of students	958
Total days of use	254
Daily hours of use	16
Total area allocated to classrooms [%]	27



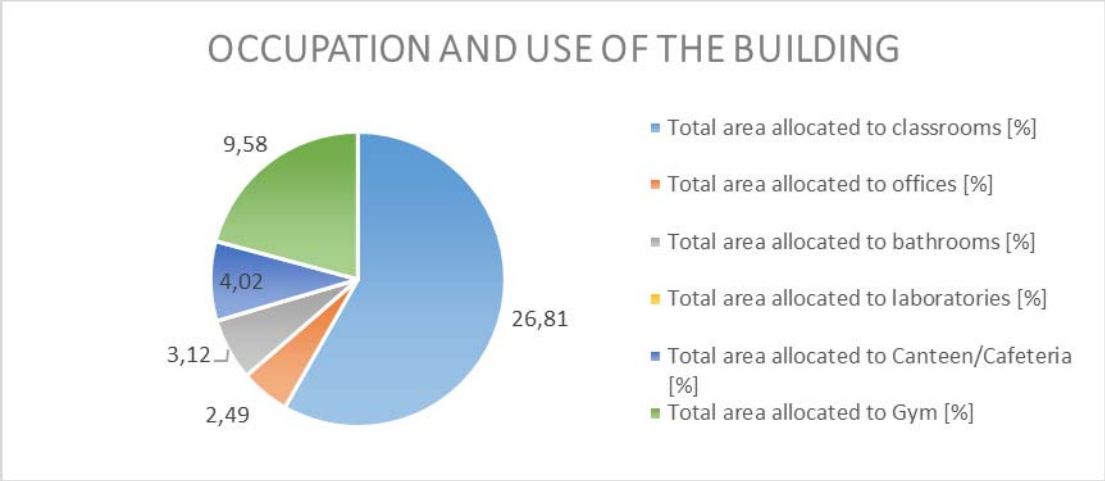
Picture 69 - Graphic representation of monthly average temperature [°C]



Picture 70 - Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 71 - Graphic representation of the user profile during school period [working days/month]



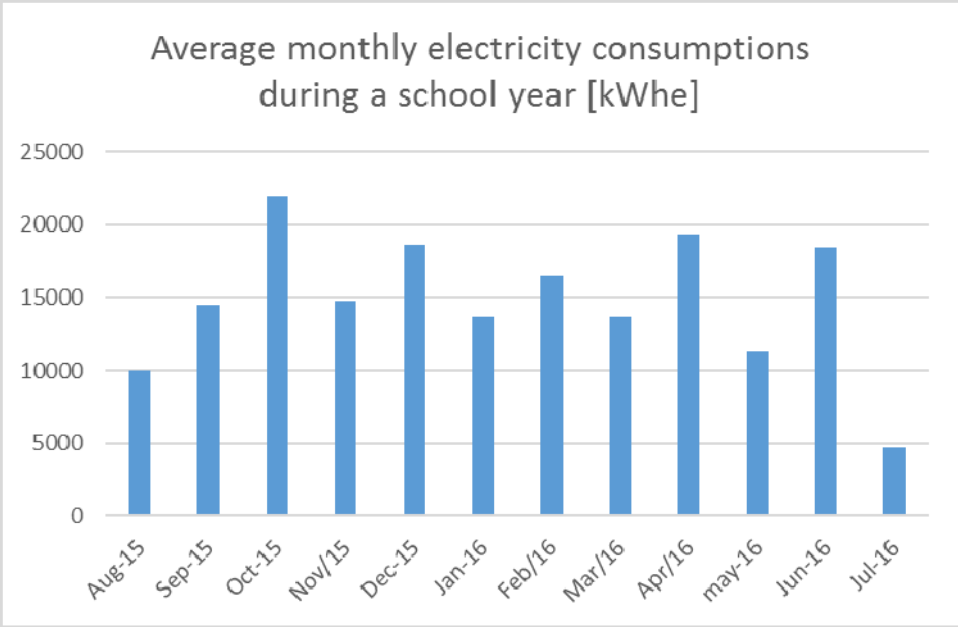
Picture 72 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

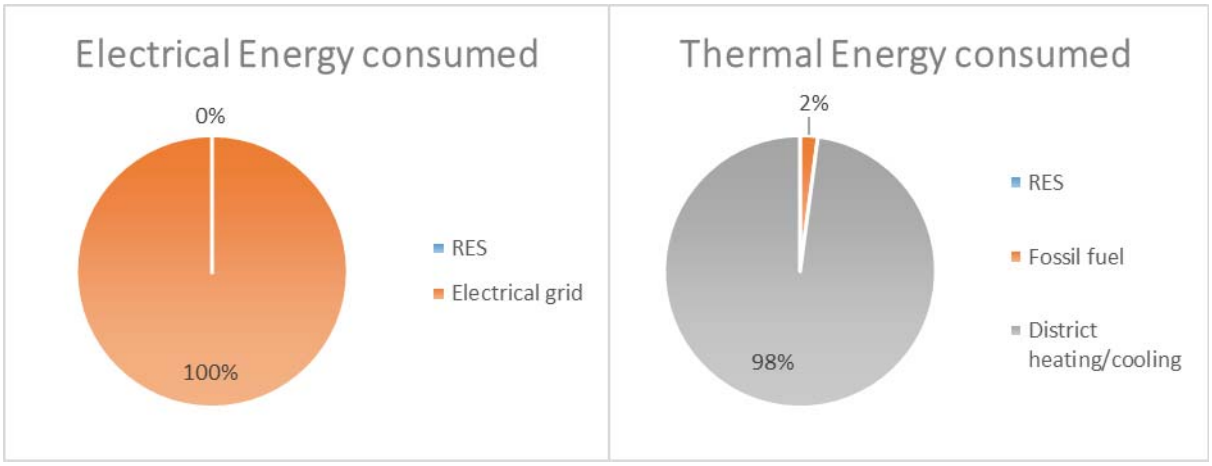
Year of construction	1990-2000
Type of structure	Reinforced concrete structure
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 73 - Average monthly electricity consumptions during a school year [kWhe]



Picture 74 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school.

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	177557	1,29	16,97	63,30	185,34	699,04	177557	76918	33
Natural gas	Sm3	2126	0,02	0,20	0,76	2,22	8,37	20406	425	2
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	949333	6,87	90,73	338,43	990,95	3737,53	0	341760	91
District cooling	kWh_t	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	126	0,00	0,01	0,04	0,13	0,49		419102	126

Table 19 - Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	-3797,1	m2	0	€		
	Retrofit roof with insulation	200	€/m2	3573,8	m2	0	€		
	Replace windows	450	€/m2	10103,1	m2	0	€		
	Install solar shading systems	150	€/m2	10103,1	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**115**	**valves***	**8047**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**578,0**	**lamps**	**14450**	**€**	**-57%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-12%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**10463,0**	**m2**	**261575**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 20 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

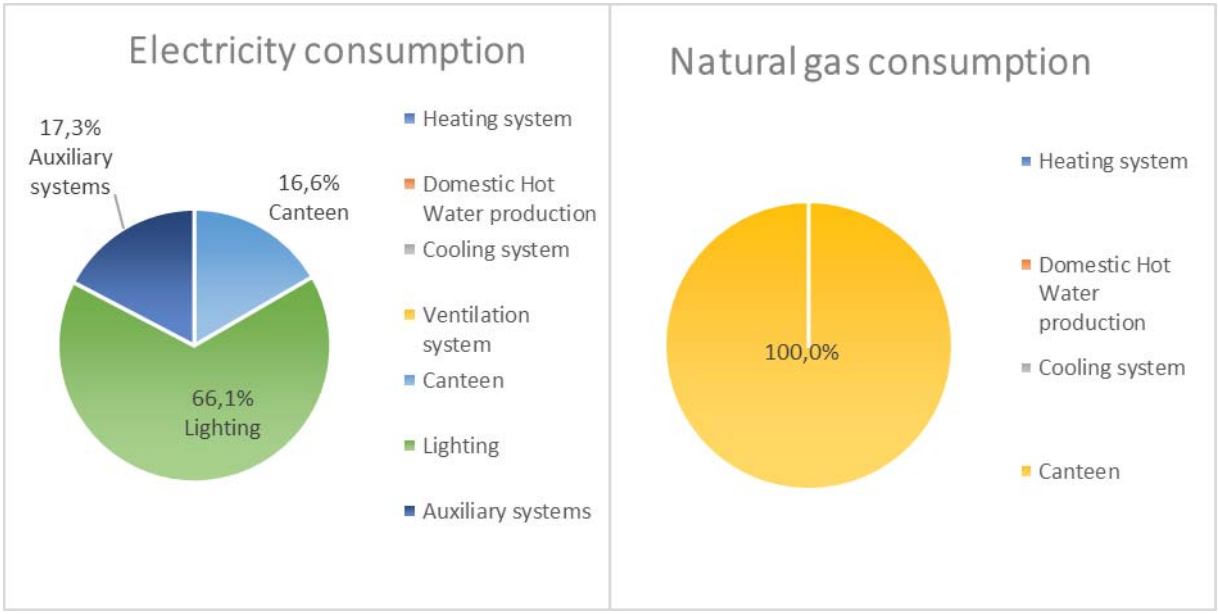
**Most relevant energy consumption reduction

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	68120,768
After intervention	29362,4
Energy consumption reduction [%]	**-57%**

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	177557,2533
Energy produced by RES	22000
After intervention	155557,2533
Eletrical energy reduction [%]	**-12%**



Picture 75 - Pie Graph of Electrical and Natural gas consumptions subdivision [%] for each final intended use

4.11. Primary school “Szkoła Podstawowa nr 65” - Swimming pool

GENERALITIES

School type	Primary
Student age range	6-16

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

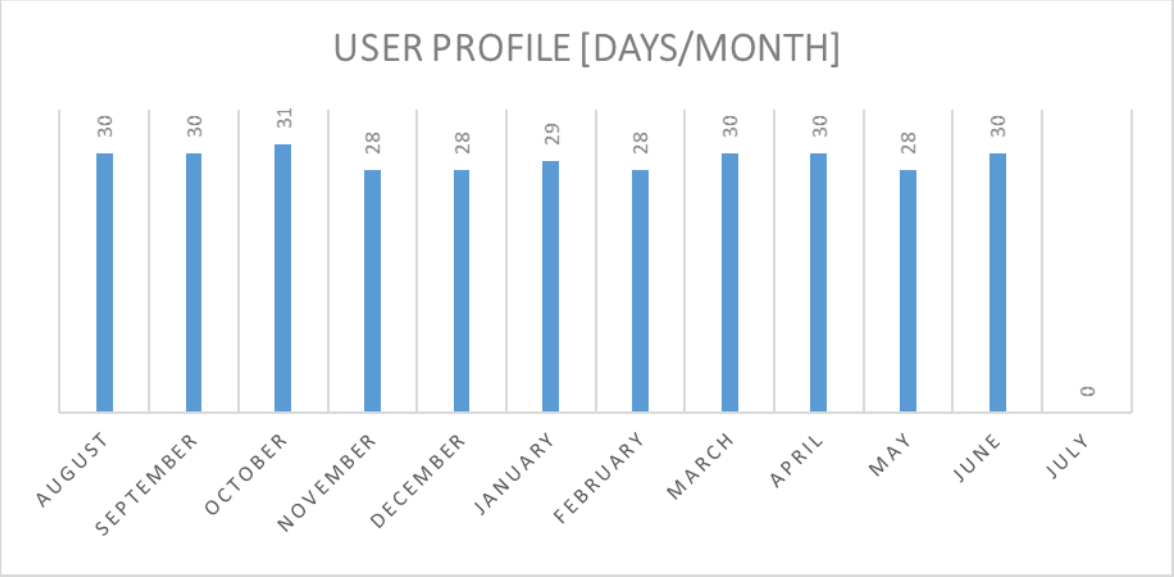
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

Total floor heated area [m²]	2314
Volume [m³]	20826
S/V	0,24

OCCUPATION AND USE OF THE BUILDING

Number of students	500
Total days of use	322
Daily hours of use	15



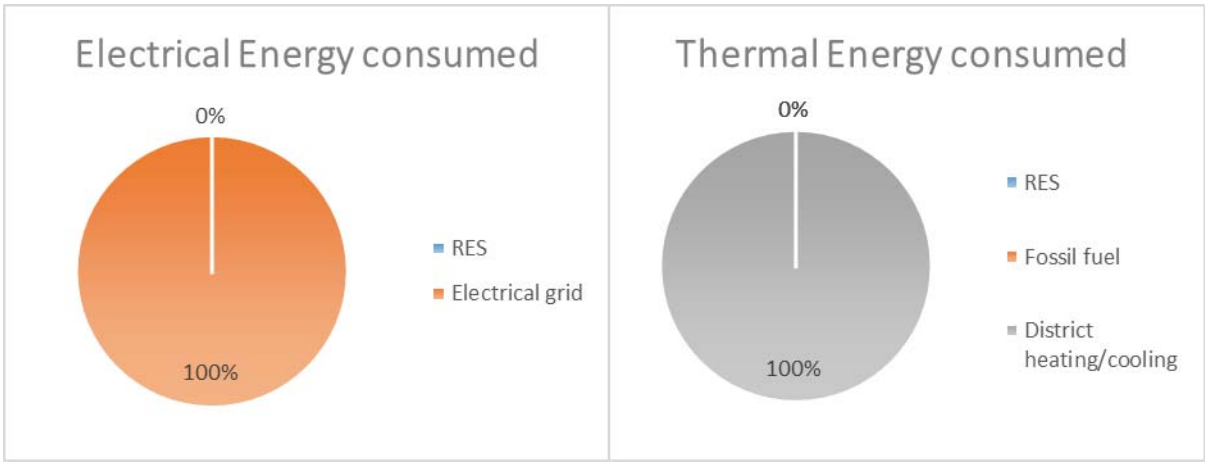
Picture 76 - Graphic representation of the user profile during school period [working days/month]

BUILDING ENVELOPE

Year of construction	2000-2010
Type of structure	Steel frame structure
External wall insulation	Low [2-5 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 77 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	269910	12,96	116,64	#DIV/0!	539,82	838,23	269910	116925	50
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	1170093	56,18	505,66	#DIV/0!	2340,19	3633,83	0	421233	112
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	162	0,01	0,07	#DIV/0!	0,32	0,50		538158	162

Table 21 - Energy performance indicators

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	1426,1	m2	0	€		
	Retrofit roof with insulation	200	€/m2	1850,0	m2	0	€		
	Replace windows	450	€/m2	145,9	m2	0	€		
	Install solar shading systems	150	€/m2	145,9	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**60**	**valves***	**4200**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**159,0**	**lamps**	**3975**	**€**	**-48%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-8%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**2314,0**	**m2**	**57850**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 22 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

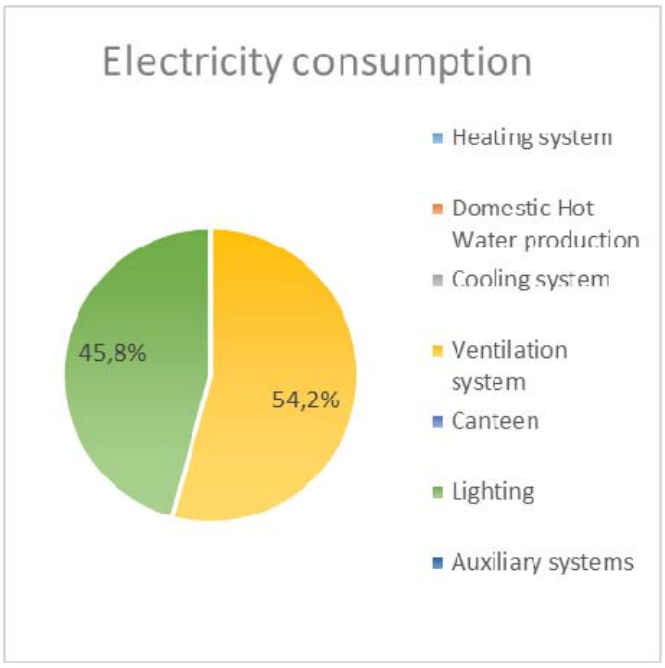
**Most relevant energy consumption reduction

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	18877,894
After intervention	9812,95
Energy consumption reduction [%]	**-48%**

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	269909,7726
Energy produced by RES	22000
After intervention	247909,7726
Eletrical energy reduction [%]	**-8%**



Picture 78 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use

4.12.Secondary school “Zespół Szkół Medycznych - Vocational Schools Team” - Main building


Picture 79 – Secondary school ““Zespół Szkół Medycznych - Vocational Schools Team”

GENERALITIES

School type	Secondary
Student age range	16-21

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

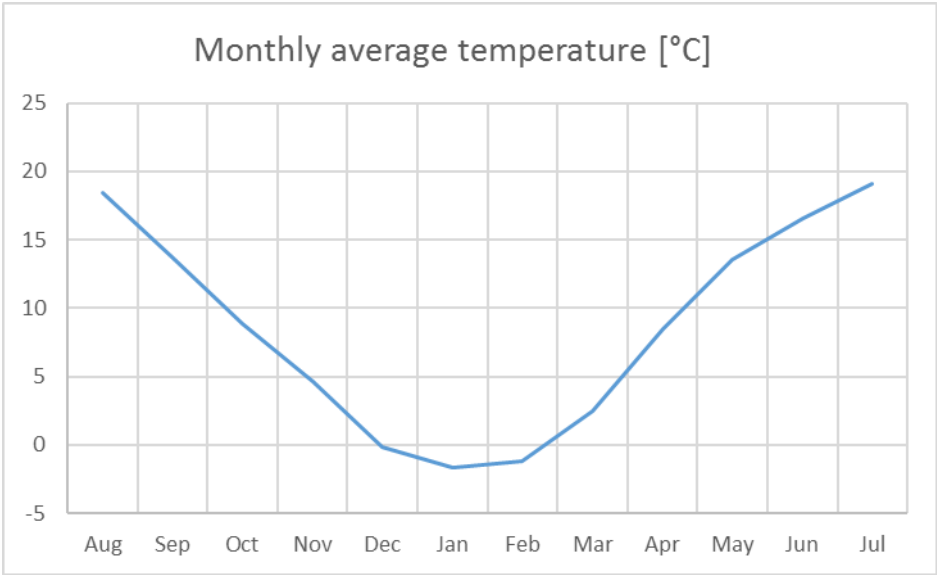
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

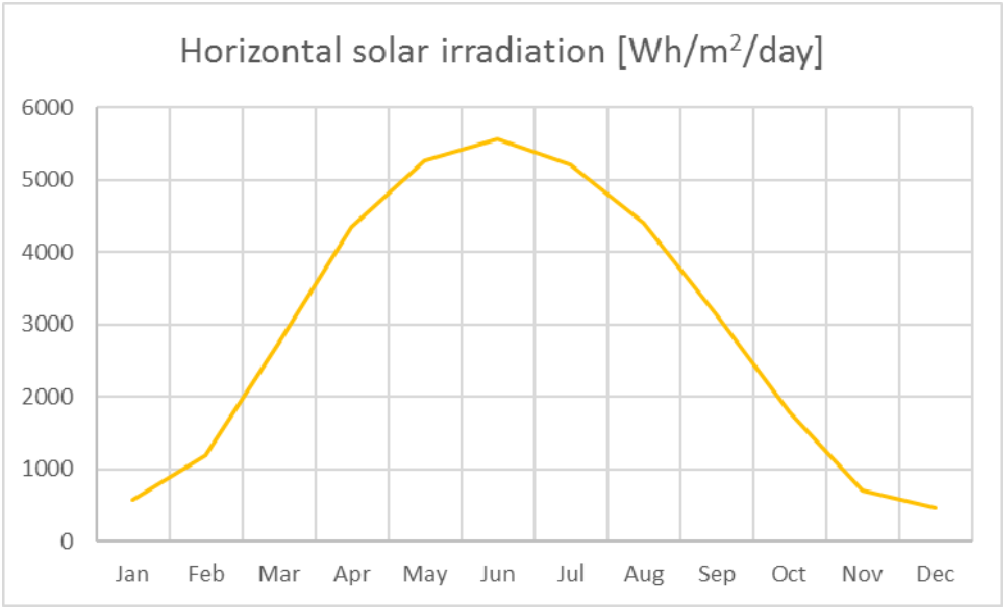
Total floor heated area [m^2]	6669
Volume [m^3]	110033
S/V	0,10

OCCUPATION AND USE OF THE BUILDING

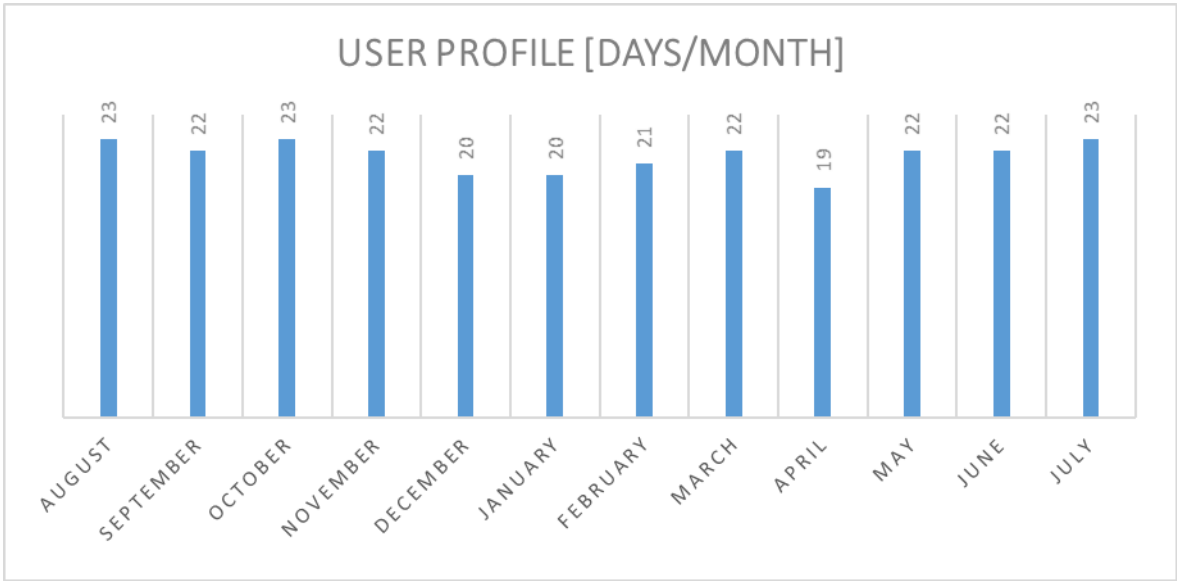
Number of students	486
Total days of use	259
Daily hours of use	13
Total area allocated to classrooms [%]	30



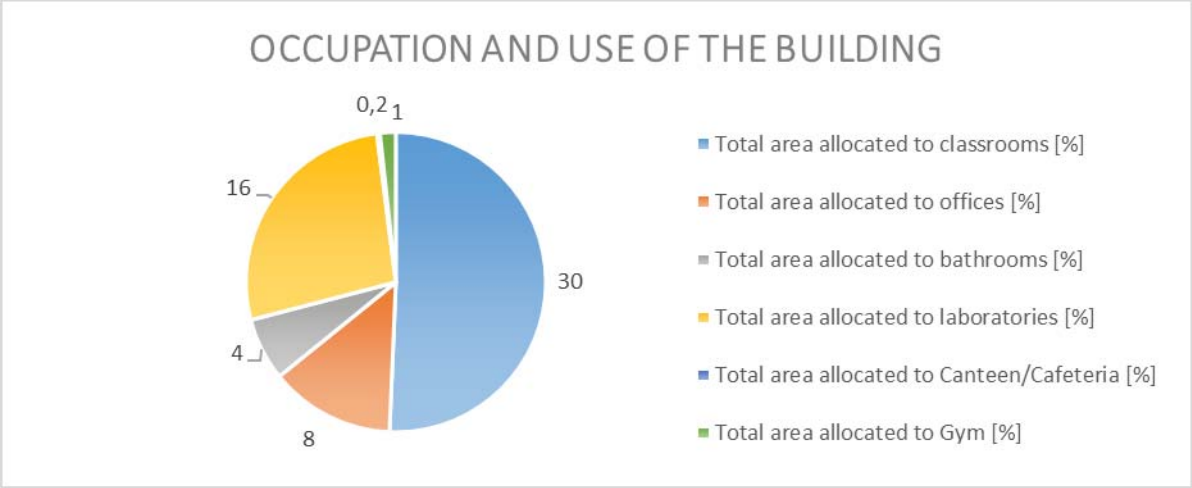
Picture 80 - Average monthly electricity consumptions during a school year [kWhe]



Picture 81 - Graphic representation of the Horizontal solar irradiation [Wh/m^2/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 82 - Graphic representation of the user profile during school period [working days/month]



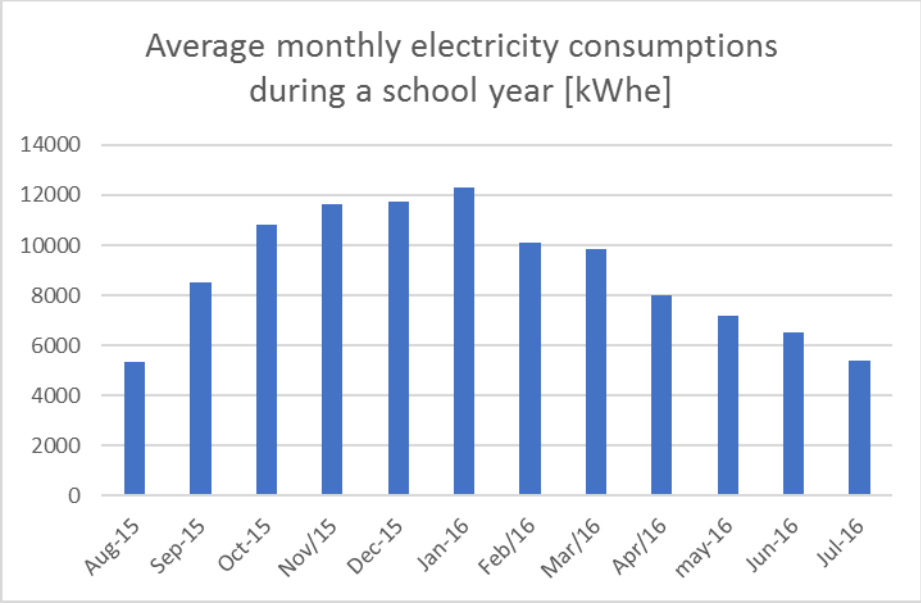
Picture 83 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

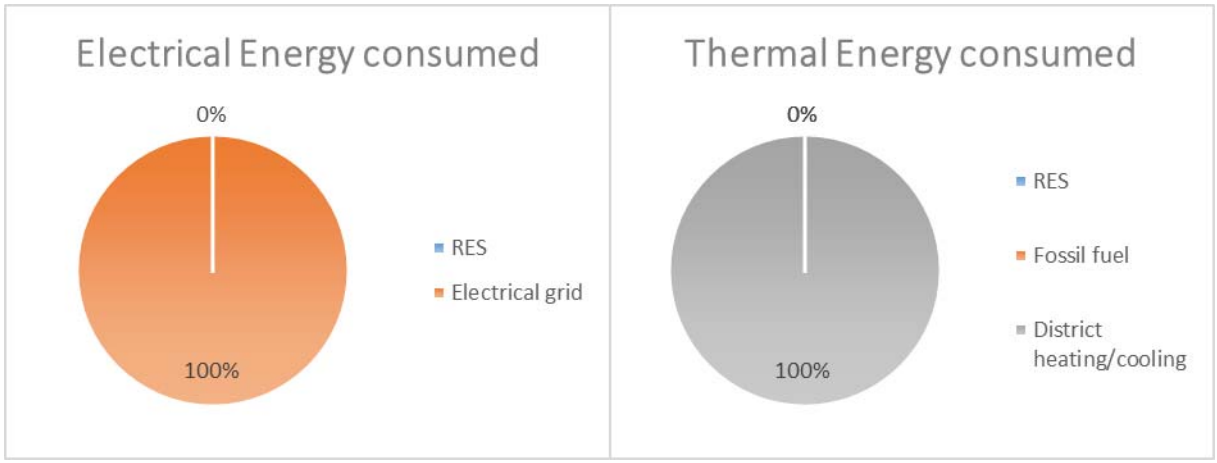
Year of construction	1980-1990
Type of structure	Prefab modules
External wall insulation	No insulation

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 84 - Average monthly electricity consumptions during a school year [kWhe]



Picture 85 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	107466	0,98	16,12	53,72	221,12	414,93	107466	46554	20
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	974838	8,86	146,18	487,27	2005,84	3763,85	0	350942	93
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	113	0,00	0,02	0,06	0,23	0,44		397496	113

Table 23 - Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
✓	**Retrofit external walls with insulation**	**100**	**€/m2**	**4192,9**	**m2**	**419291**	**€**	**-20%**	**Energy need for space heating reduction [%]**
✓	**Retrofit roof with insulation**	**200**	**€/m2**	**3035,8**	**m2**	**607164**	**€**		
	Replace windows	450	€/m2	1037,1	m2	0	€		
	Install solar shading systems	150	€/m2	1037,1	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**58**	**valves***	**4082**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**2015,0**	**lamps**	**50375**	**€**	**-57%**	**light consumptions**
	Install Energy Saving Switchs and Presence Sensors	250	€/point	50,0	points*	0	€		
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-20%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**6668,6**	**m2**	**166716**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 24 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

***Most relevant energy consumption reduction*

Energy need for space heating - envelope

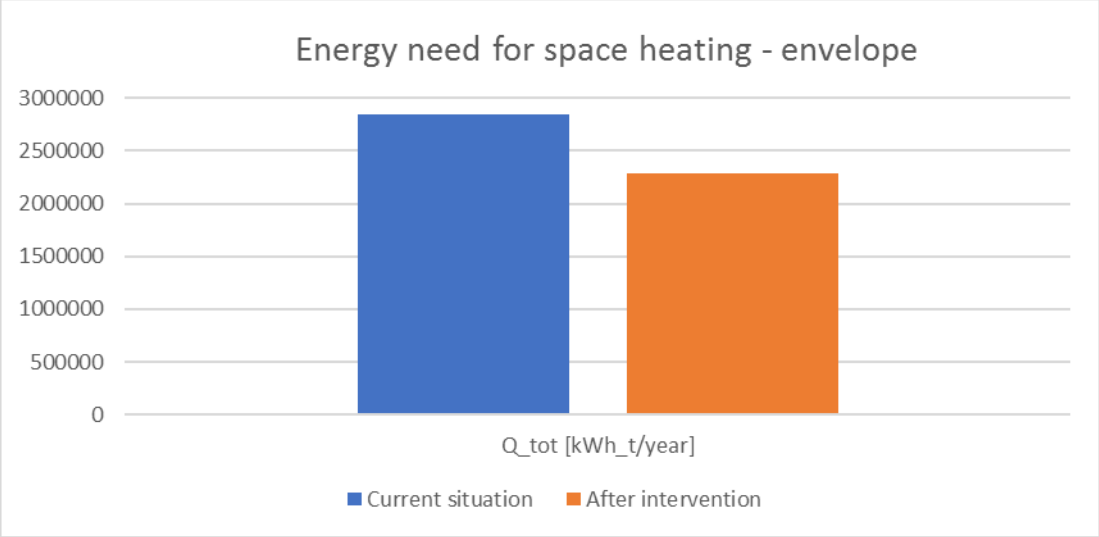
	Q_tot[kWh_t/year]
Current situation	2850181,57
After intervention	2281501,26
Energy need for space heating reduction [%]	**-20%**

Lamp replacement with LED

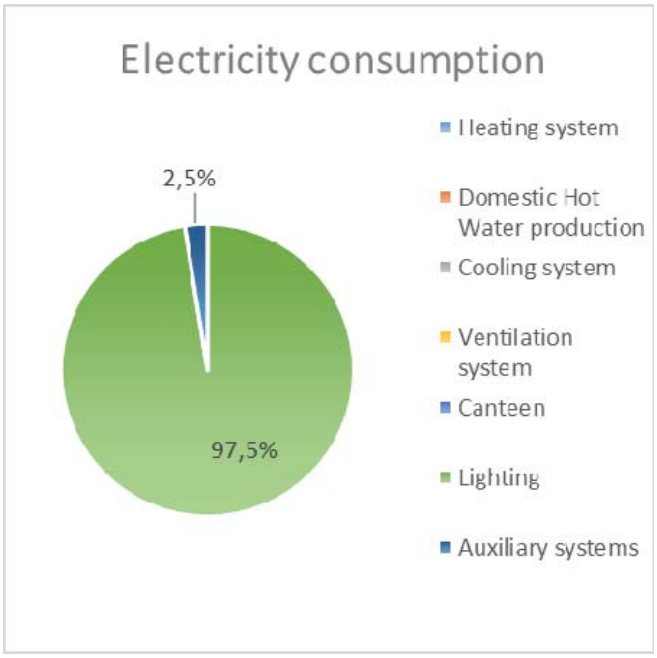
	Q [kWh_t/year]
Current situation	197304,095
After intervention	85262,5625
Energy consumption reduction [%]	**-57%**

Electrical energy reduction with PV system

	Q [kWh_el/year]
Current situation	107466,247
Energy produced by RES	22000
After intervention	85466,2467
Eletrical energy reduction [%]	**-20%**



Picture 86 - Energy need for space heating before and after (predicted) the intervention - envelope [kWh_t/year]



Picture 87 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use

4.13. Secondary school "Zespół Szkół Medycznych - Vocational Schools Team" - Swimming pool

GENERALITIES

School type	Secondary
Student age range	9-21

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

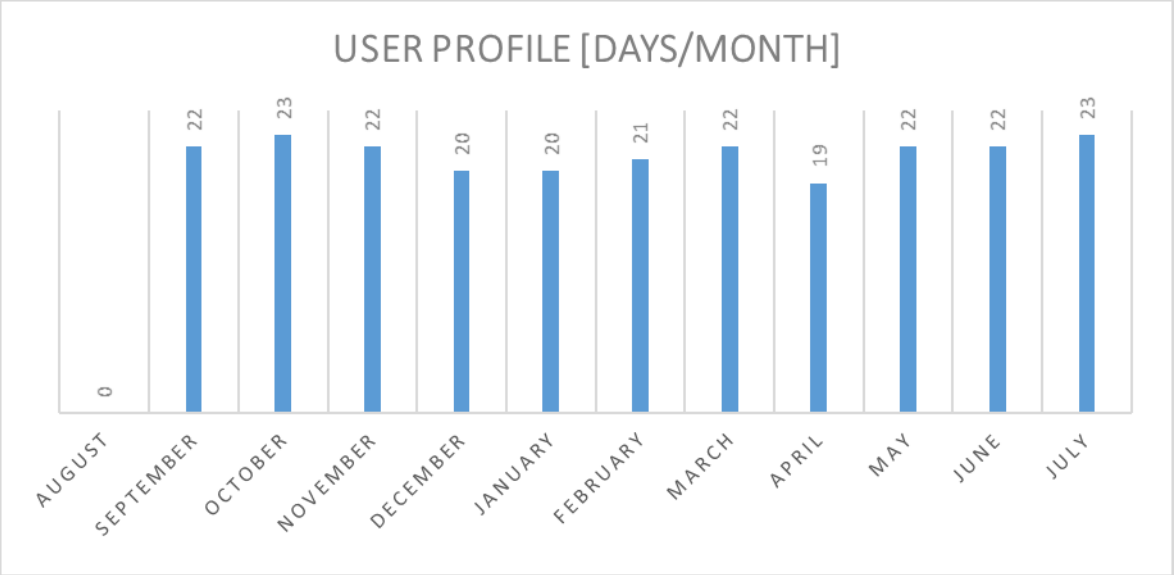
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

Total floor heated area [m²]	1482
Volume [m³]	17784
S/V	0,23

OCCUPATION AND USE OF THE BUILDING

Number of students	819
Total days of use	236
Daily hours of use	8



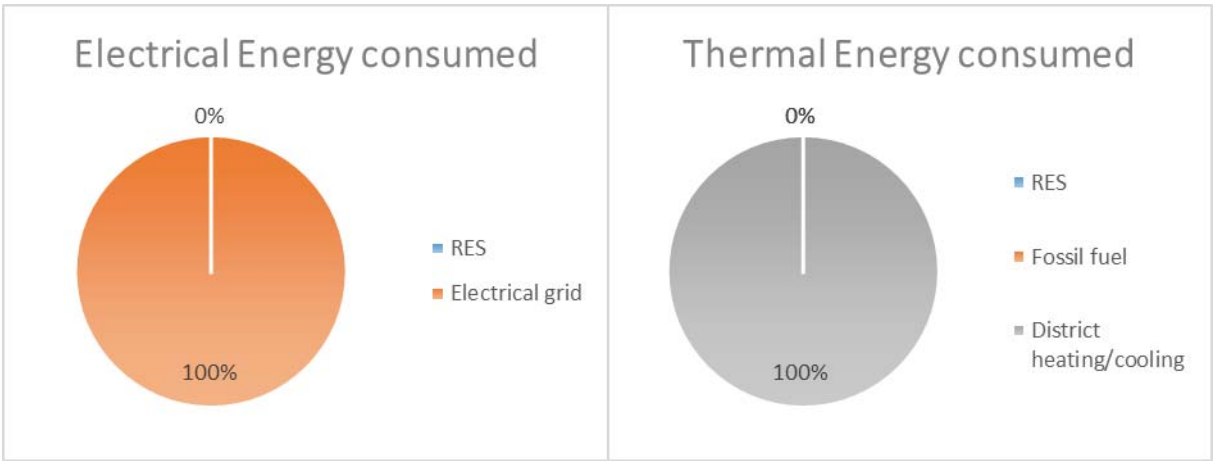
Picture 88 - Graphic representation of the user profile during school period [working days/month]

BUILDING ENVELOPE

Year of construction	1980-1990
Type of structure	Load bearing masonry wall
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 89 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m³	u.m./m²	u.m./m²	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	114081	6,41	76,98	/	139,29	483,39	114081	49420	21
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	928755	52,22	626,69	/	1134,01	3935,40	0	334352	89
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	110	0,01	0,07	/	0,13	0,47		383771	110

Table 25 - Energy performances indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	1102,5	m2	0	€	-20%	Energy need for space heating reduction [%]
	Retrofit roof with insulation	200	€/m2	1100,0	m2	0	€		
✓	**Replace windows**	**450**	**€/m2**	**747,5**	**m2**	**336375**	**€**		
	Install solar shading systems	150	€/m2	747,5	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**98**	**valves***	**6880**	**€**	-2÷5%	thermal energy reduction for heating system
✓	**Replace lights with LED**	**25**	**€/lamp**	**129,0**	**lamps**	**3225**	**€**	-48%	light consumptions
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	-2÷20%	light consumptions
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	-2÷10%	overall consumptions
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	-19%	Eletrical energy reduction [%]
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	up to 50%	thermal energy consumptions for DHW production
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**1482,0**	**m2**	**37050**	**€**	up to 15%	overall consumptions [depending on technology installed]
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	-2÷5%	electricity consumptions

***= estimated values**

*Table 26 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

***Most relevant energy consumption reduction*

Energy need for space heating - envelope

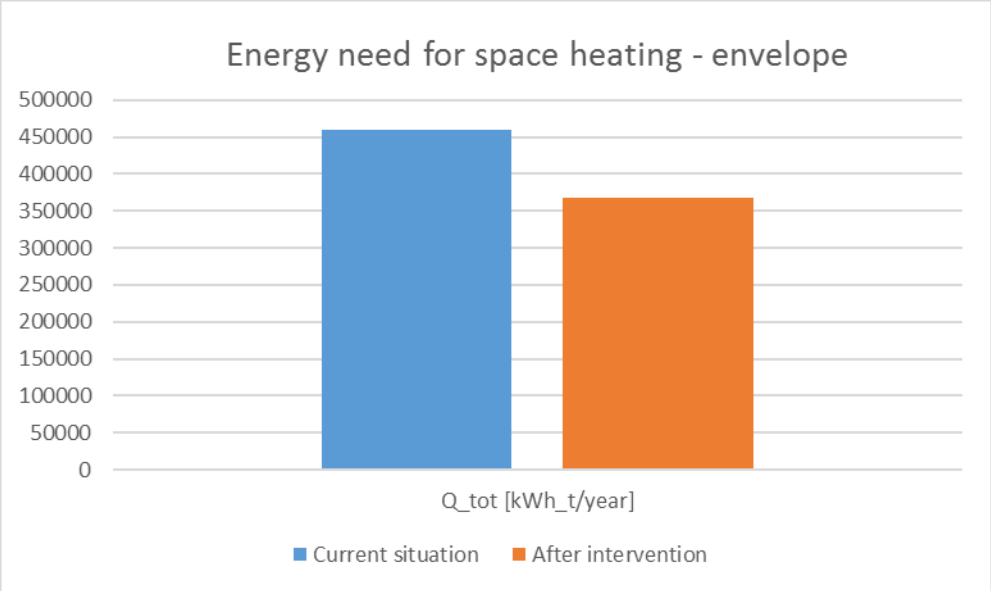
	Q_tot[kWh_t/year]
Current situation	460400,5885
After intervention	366941,4335
Energy need for space heating reduction [%]	**-20%**

Lamp replacement with LED

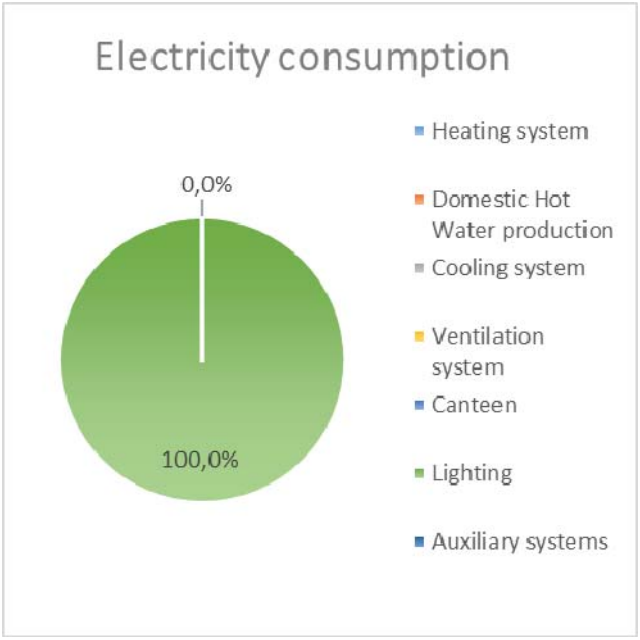
	Q [kWh_t/year]
Current situation	5893,392
After intervention	3044,4
Energy consumption reduction [%]	**-48%**

Electrical energy reduction with PV system

	Q [kWh_el/year]
Current situation	114080,75
Energy produced by RES	22000
After intervention	92080,75
Eletrical energy reduction [%]	**-19%**



Picture 90 - Energy need for space heating before and after (predicted) the intervention - envelope [kWh_t/year]



Picture 91 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use

4.14. Primary school “Szkoła Podstawowa nr 65”- Main school building

Picture 92 – Primary school “Szkoła Podstawowa nr 65”

GENERALITIES

School type	Primary
Student age range	6-13

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

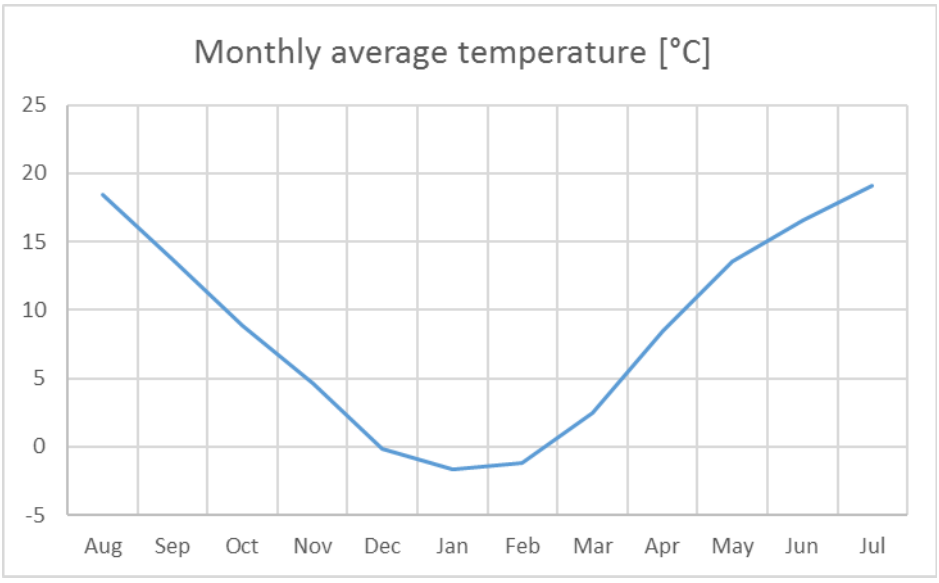
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

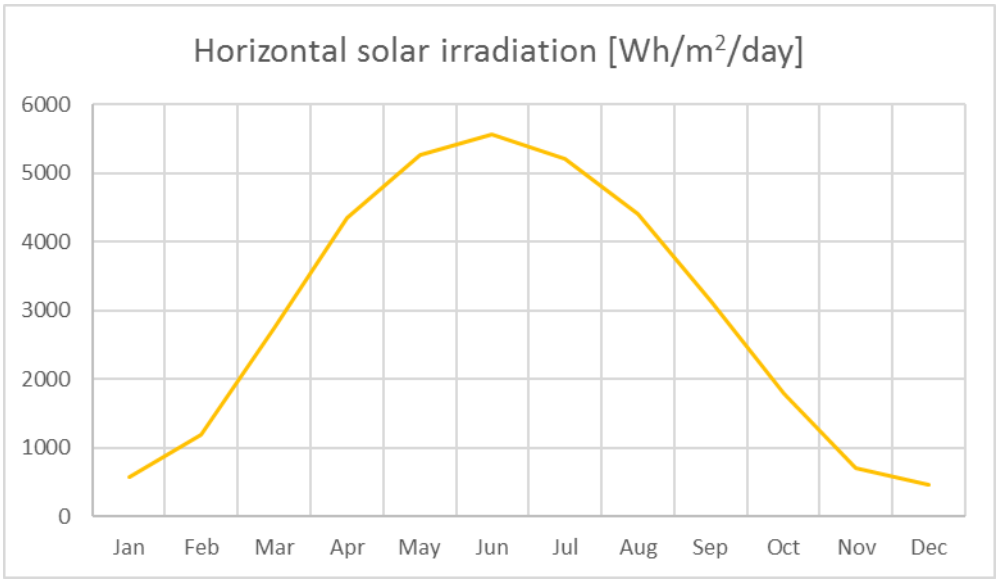
Total floor heated area [m²]	8020
Volume [m³]	339727
S/V	0,04

OCCUPATION AND USE OF THE BUILDING

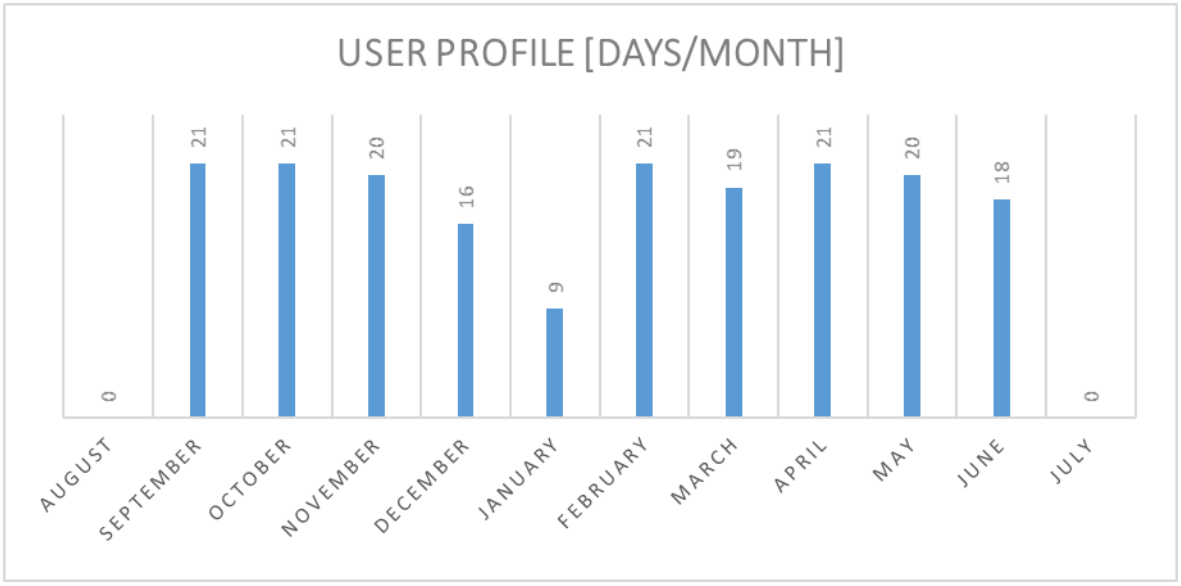
Number of students	923
Total days of use	186
Daily hours of use	14
Total area allocated to classrooms [%]	49



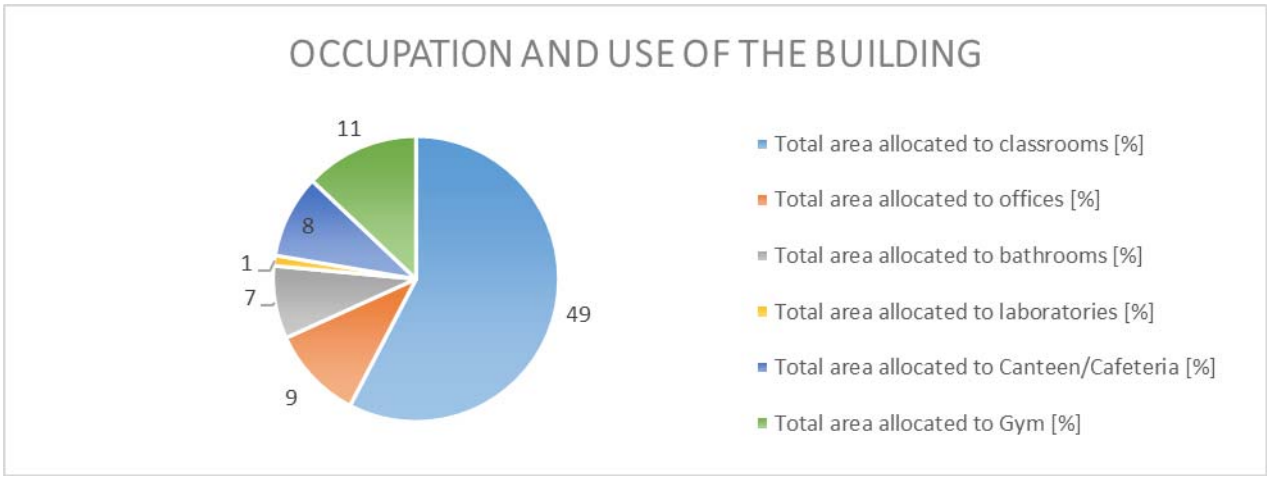
Picture 93 - Average monthly electricity consumptions during a school year [kWhe]



Picture 94 - Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 95 - Graphic representation of the user profile during school period [working days/month]



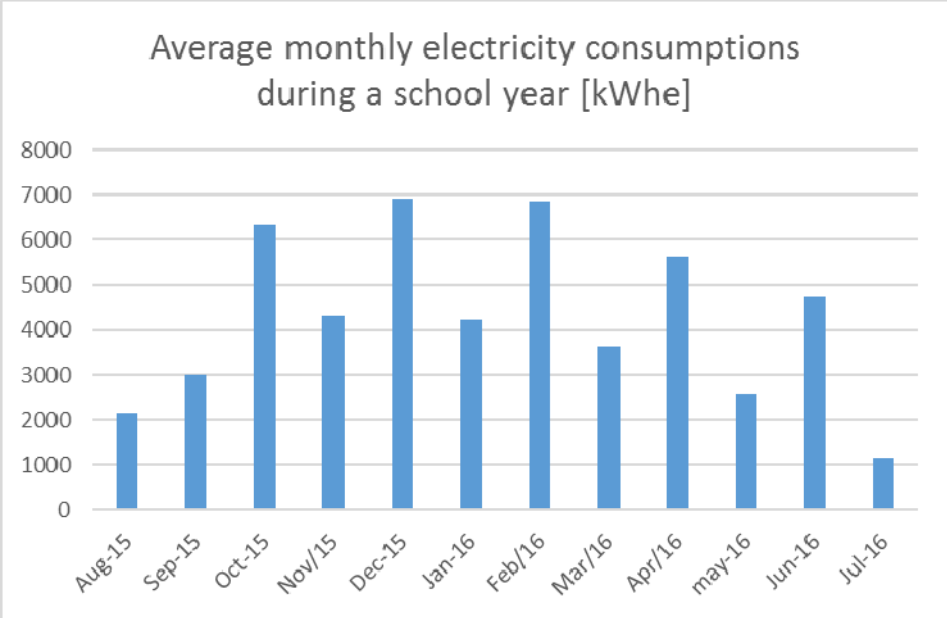
Picture 96 - Division of the School areas for intended use [%]

BUILDING ENVELOPE

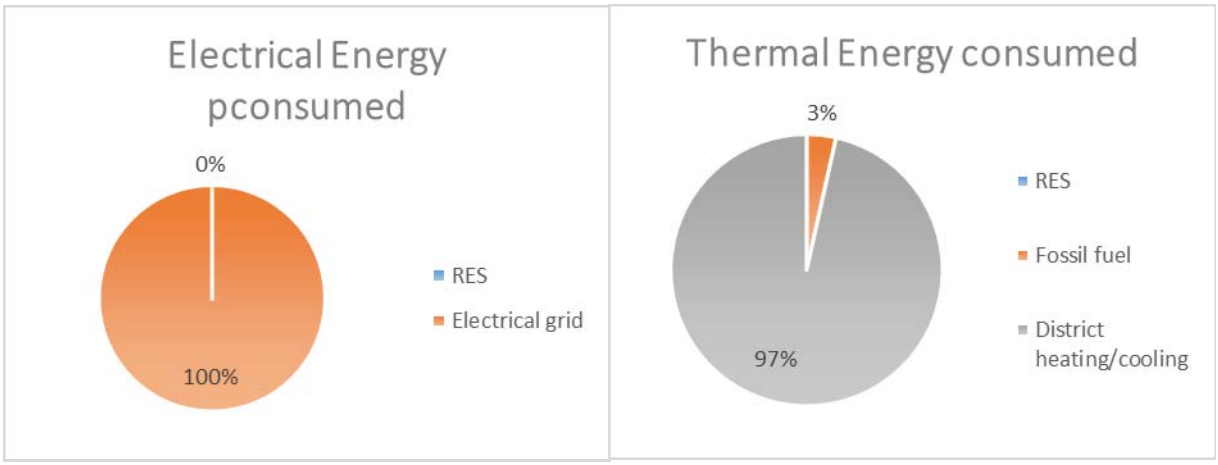
Year of construction	1990-2000
Type of structure	Prefab modules
External wall insulation	No insulation

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 97 - Average monthly electricity consumptions during a school year [kWhe]



Picture 98 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	51625	0,15	6,44	13,14	55,93	277,56	51625	22364	10
Natural gas	Sm3	2856	0,01	0,36	0,73	3,09	15,35	27416	571	2
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	757935	2,23	94,51	192,87	821,16	4074,92	0	272857	72
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	84	0,00	0,01	0,02	0,09	0,45		295791	84

Table 27 – Energy performance indicators

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
✓	**Retrofit external walls with insulation**	**100**	**€/m2**	**4147,0**	**m2**	**414700**	**€**	**-16%**	**Energy need for space heating reduction [%]**
✓	**Retrofit roof with insulation**	**200**	**€/m2**	**3923,0**	**m2**	**784600**	**€**		
✓	**Replace windows**	**450**	**€/m2**	**1603,0**	**m2**	**721350**	**€**		
	Install solar shading systems	150	€/m2	1603,0	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**111**	**valves***	**7753**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**837,0**	**lamps**	**20925**	**€**	**-55%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-43%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**8020,0**	**m2**	**200500**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 28 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

***Most relevant energy consumption reduction*

Energy need for space heating - envelope

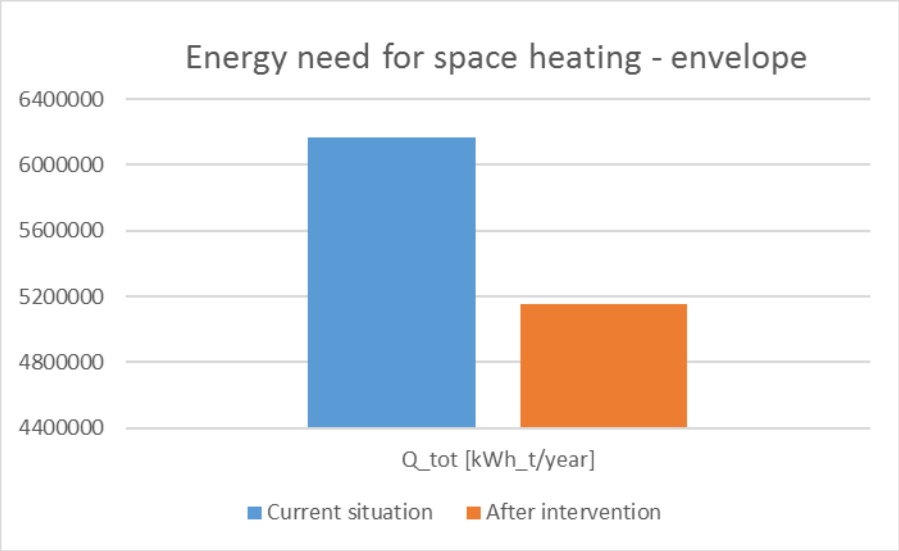
	Q_tot[kWh_t/year]
Current situation	6164834,643
After intervention	5152100,309
Energy need for space heating reduction [%]	**-16%**

Lamp replacement with LED

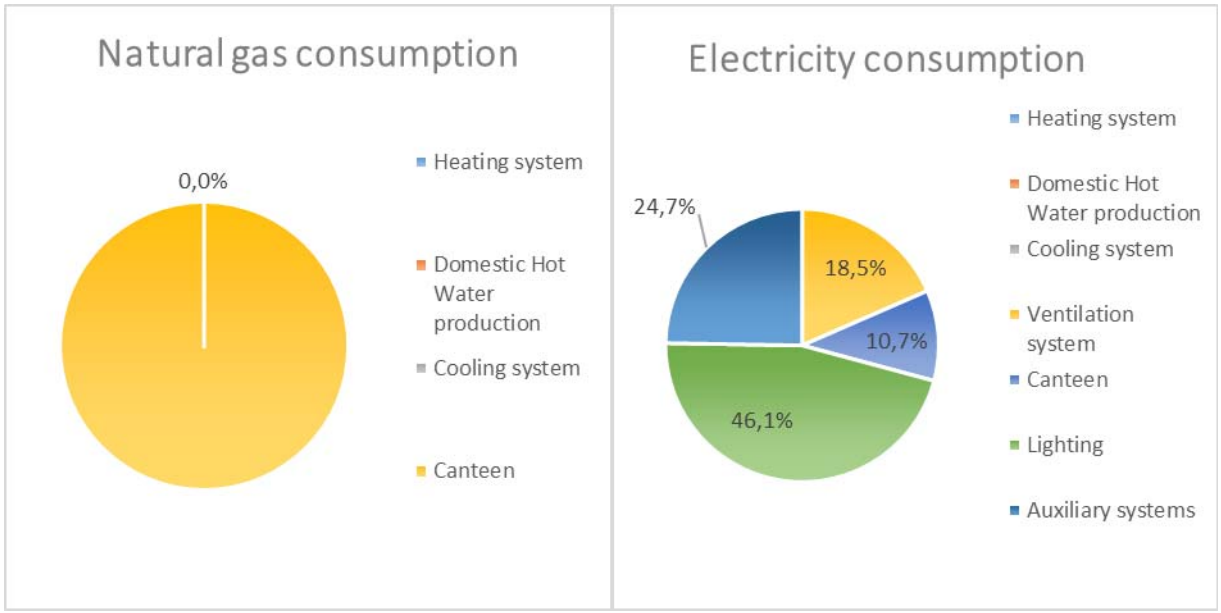
	Q [kWh_t/year]
Current situation	62099,138
After intervention	27893,025
Energy consumption reduction [%]	**-55%**

Electrical energy reduction with PV system

	Q [kWh_el/year]
Current situation	51625,35833
Energy produced by RES	22000
After intervention	29625,35833
Eletrical energy reduction [%]	**-43%**



Picture 99 - Energy need for space heating before and after (predicted) the intervention - envelope [kWh_t/year]



Picture 100 - Pie Graph of Electrical and Natural gas consumptions subdivision [%] for each final intended use

4.15. Primary school "Szkoła Podstawowa nr 65"- Swimming pool

GENERALITIES

School type	Primary
Student age range	6-13

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

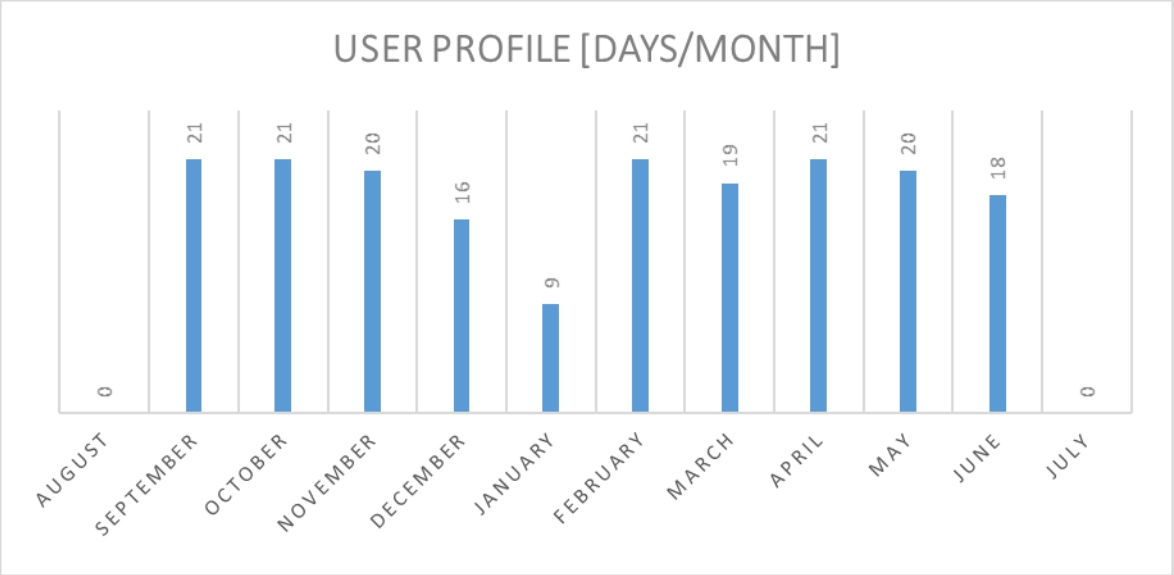
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

Total floor heated area [m²]	2460
Volume [m³]	97416
S/V	0,06

OCCUPATION AND USE OF THE BUILDING

Number of students	1500
Total days of use	186
Daily hours of use	15



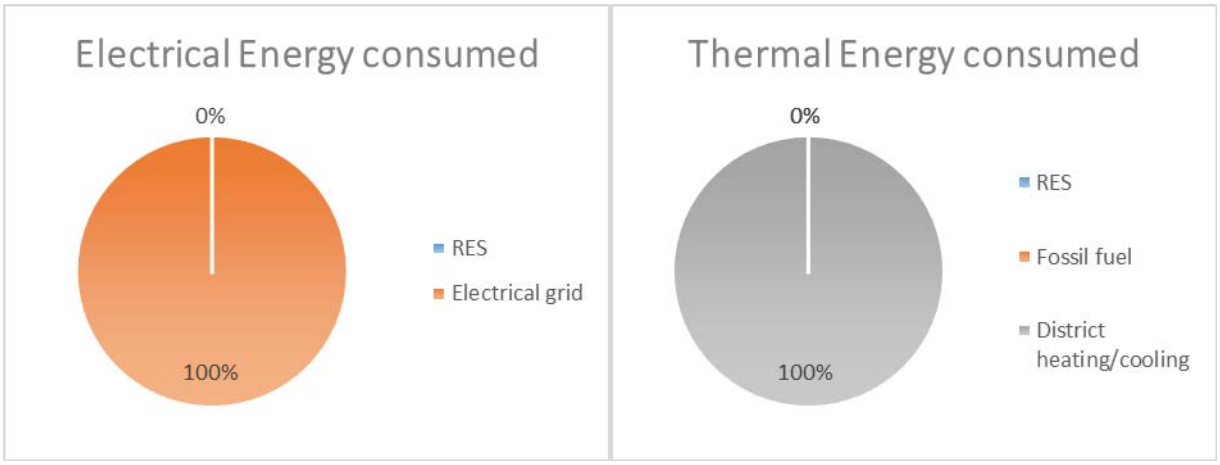
Picture 101 - Graphic representation of the user profile during school period [working days/month]

BUILDING ENVELOPE

Year of construction	2000-2010
Type of structure	
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 102 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	241520	2,48	98,18	/	161,01	1298,50	241520	104627	45
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	671176	6,89	272,84		447,45	3608,47	0	241623	64
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	109	0,00	0,04		0,07	0,59		346250	109

Table 29 – Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	1529,3	m2	0	€		
	Retrofit roof with insulation	200	€/m2	2100,0	m2	0	€		
	Replace windows	450	€/m2	823,5	m2	0	€		
✓	**Install solar shading systems**	**150**	**€/m2**	**823,5**	**m2**	**123522**	**€**	**-5÷10%**	**cooling consumptions**
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**180**	**valves***	**12600**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
	Replace lights with LED	25	€/lamp	0,0	lamps	0	€		
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-9%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**2460,0**	**m2**	**61500**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

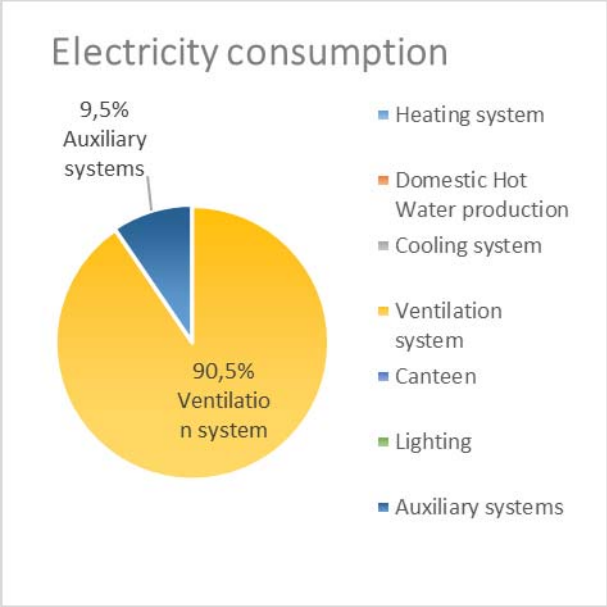
***= estimated values**

*Table 30 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

***Most relevant energy consumption reduction*

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	241520,3958
Energy produced by RES	22000
After intervention	219520,3958
Eletrical energy reduction [%]	**-9%**



Picture 103 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use

4.16. Secondary school "Zespół Szkół Samochodowych" Technical School, Vocational Schools Team

Picture 104 – Secondary school "Zespół Szkół Samochodowych" Technical School, Vocational Schools Team

GENERALITIES

School type	Secondary
Student age range	16-19

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

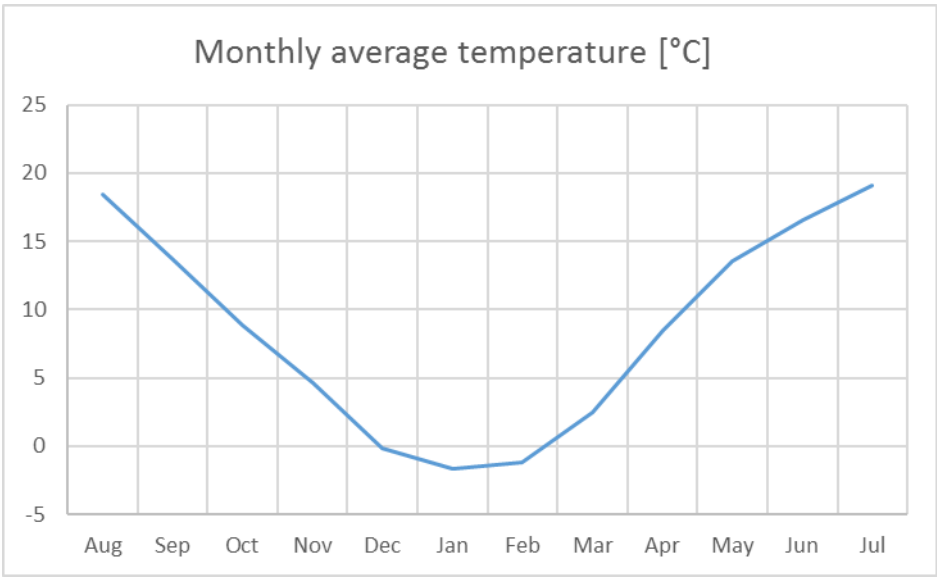
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

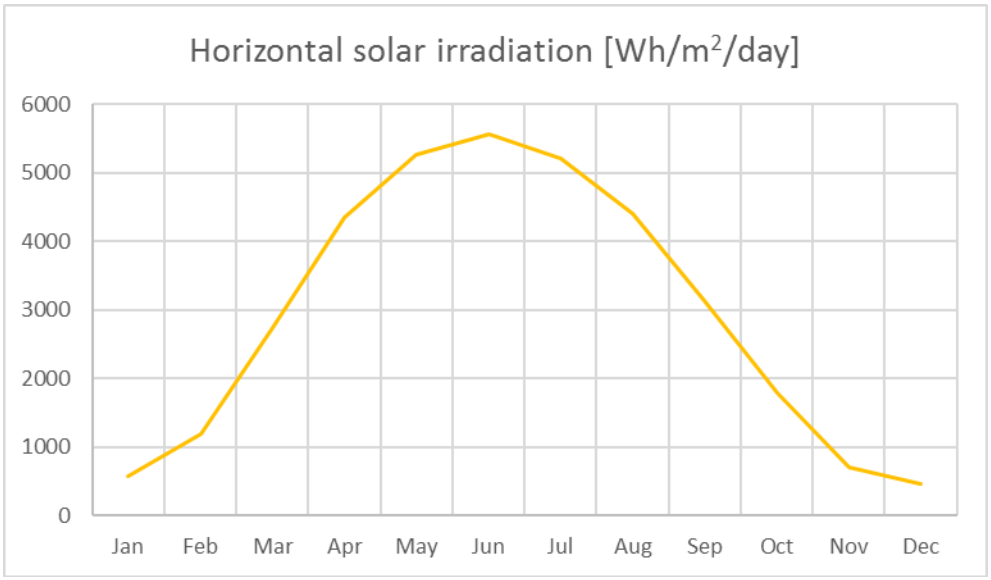
Total floor heated area [m²]	4440
Volume [m³]	56832
S/V	0,11

OCCUPATION AND USE OF THE BUILDING

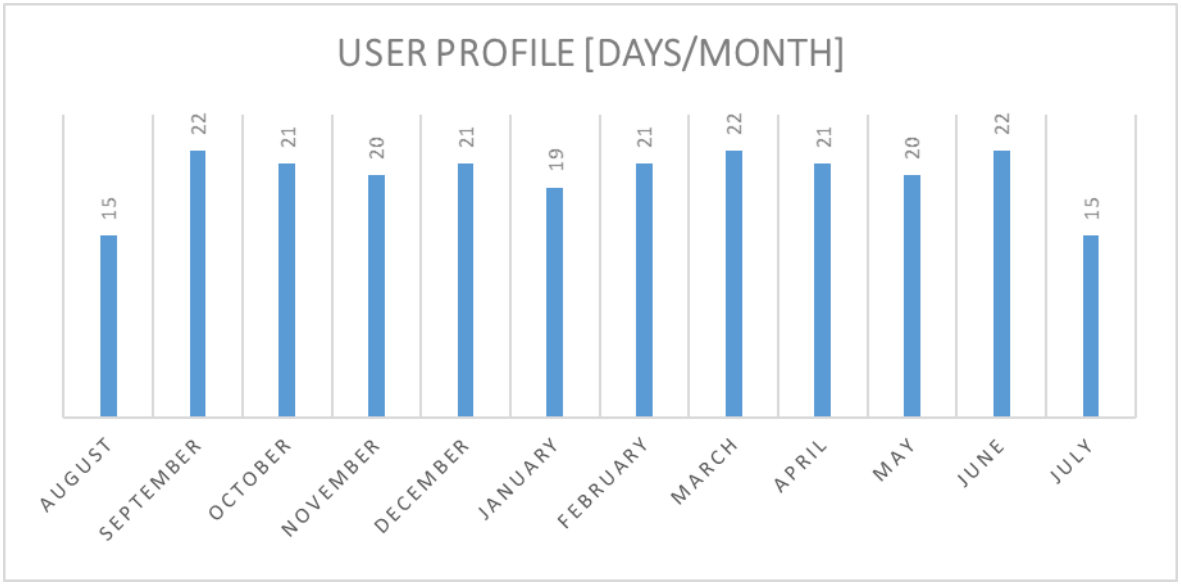
Number of students	623
Total days of use	239
Daily hours of use	16
Total area allocated to classrooms [%]	26



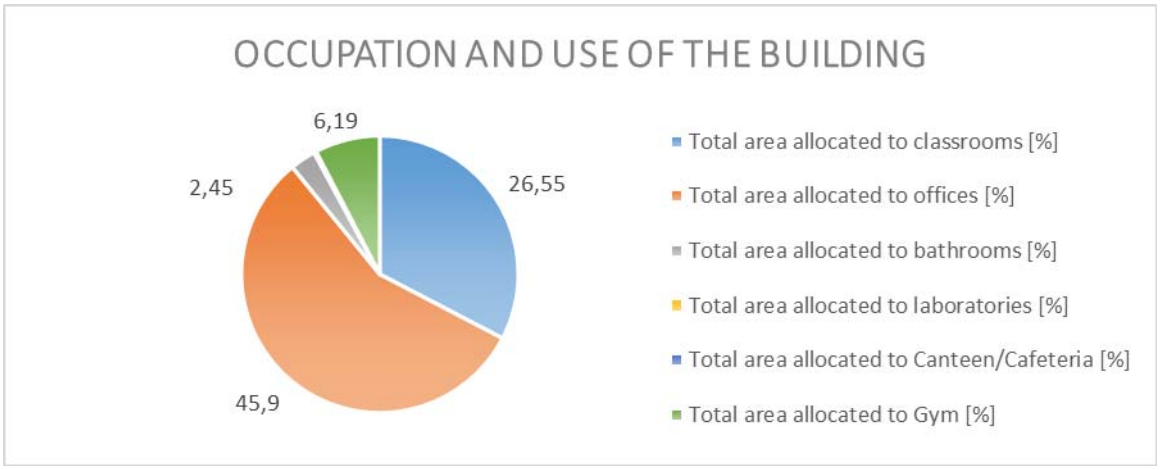
Picture 105 - Average monthly electricity consumptions during a school year [kWhe]



Picture 106 - Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 107 - Graphic representation of the user profile during school period [working days/month]



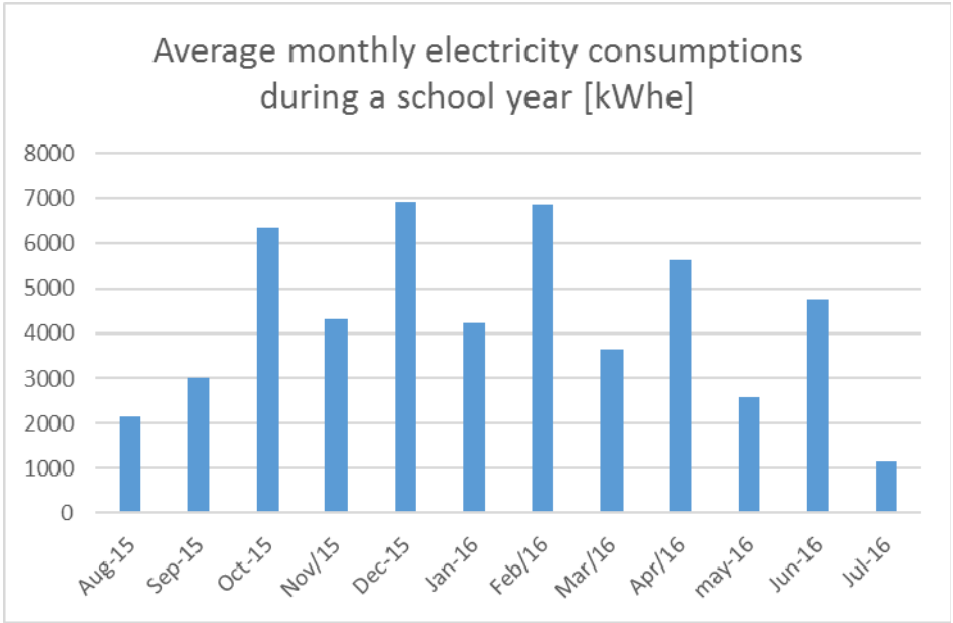
Picture 108 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

BUILDING ENVELOPE

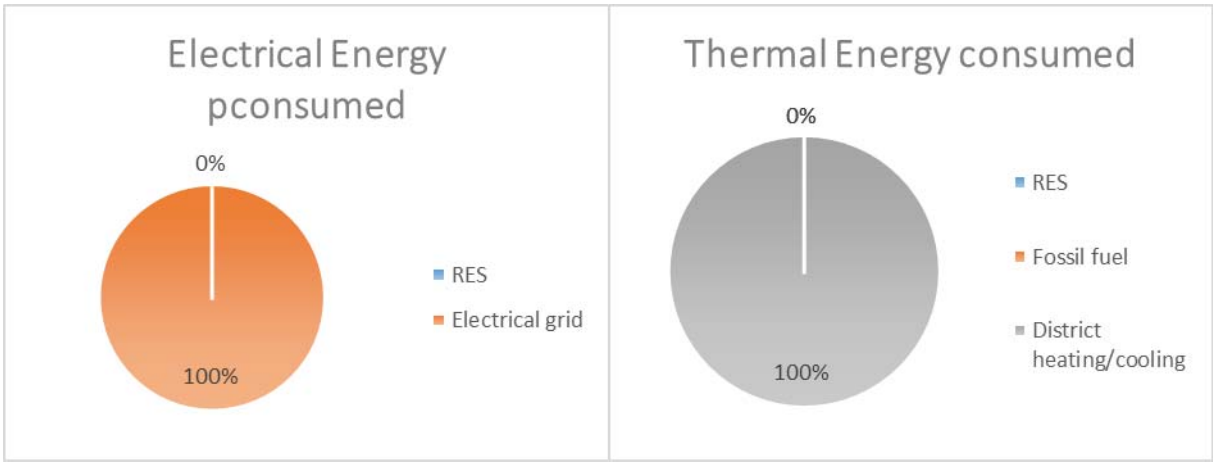
Year of construction	>2010
Type of structure	Prefab modules
External wall insulation	No insulation

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 109 - Average monthly electricity consumptions during a school year [kWhe]



Picture 110 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	**118432**	**2,08**	**26,67**	**100,47**	**190,10**	**495,53**	**118432**	**51305**	**22**
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	**522824**	**9,20**	**117,75**	**443,51**	**839,20**	**2187,55**	**0**	**188217**	**50**
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	**72**	**0,00**	**0,02**	**0,06**	**0,12**	**0,30**		**239522**	**72**

Table 31 – Energy performance indicators

Priorities of interventions, standard costs per intervention and energy reduction estimations

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
✓	**Retrofit external walls with insulation**	**100**	**€/m2**	**1261,8**	**m2**	**126180**	**€**	**-5%**	**Energy need for space heating reduction [%]**
	Retrofit roof with insulation	200	€/m2	2101,8	m2	0	€		
	Replace windows	450	€/m2	859,4	m2	0	€		
	Install solar shading systems	150	€/m2	859,4	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**75**	**valves***	**5233**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**437,0**	**lamps**	**10925**	**€**	**-55%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-19%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
✓	**Replace electrical boilers with heat pumps**	**1500**	**€/kW**	**0,0**	**kW**	**0**	**€**	**up to -50÷70%**	**electrical energy consumptions for DHW production**
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**4440,0**	**m2**	**111000**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 32 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

***Most relevant energy consumption reduction*

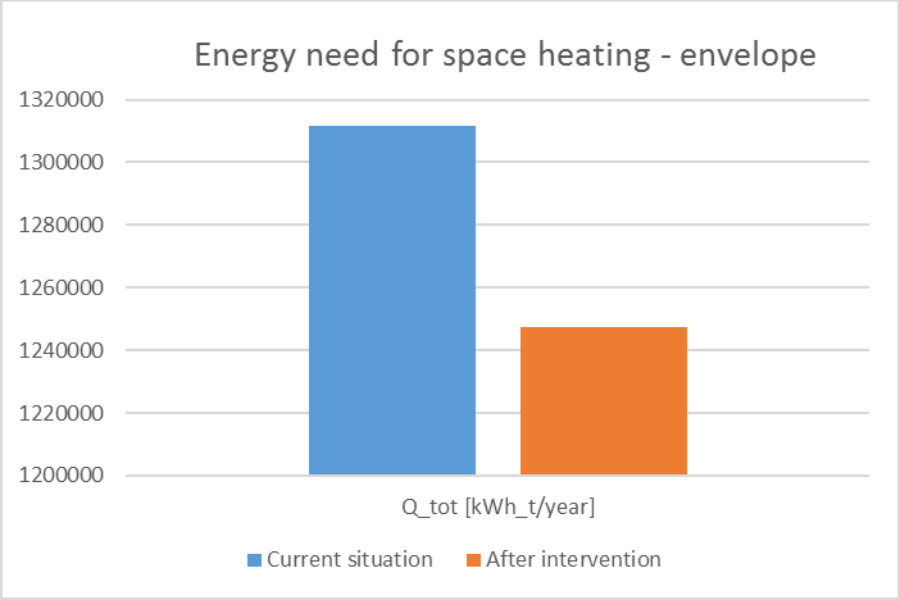
Energy need for space heating - envelop	Q_tot[kWh_t/year]
Current situation	1311497,121
After intervention	1247367,985
Energy need for space heating reduction [%]	**-5%**

Lamp replacement with LED

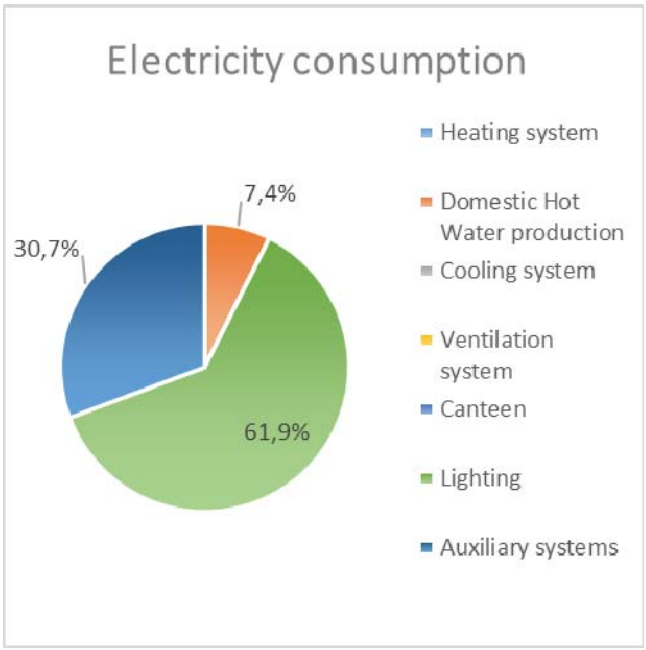
	Q [kWh_t/year]
Current situation	46322,144
After intervention	20853,8
Energy consumption reduction [%]	**-55%**

Electrical energy reduction with PV system

	Q [kWh_el/year]
Current situation	118432,4867
Energy produced by RES	22000
After intervention	96432,48667
Eletrical energy reduction [%]	**-19%**



Picture 111 - Energy need for space heating before and after (predicted) the intervention - envelope [kWh_t/year]



Picture 112 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use

4.17. Primary and Secondary school “Zespół Szkół nr 25”

Picture 113 – Primary and Secondary school “Zespół Szkół nr 25”

GENERALITIES

School type	Primary and Secondary
Student age range	6-16

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

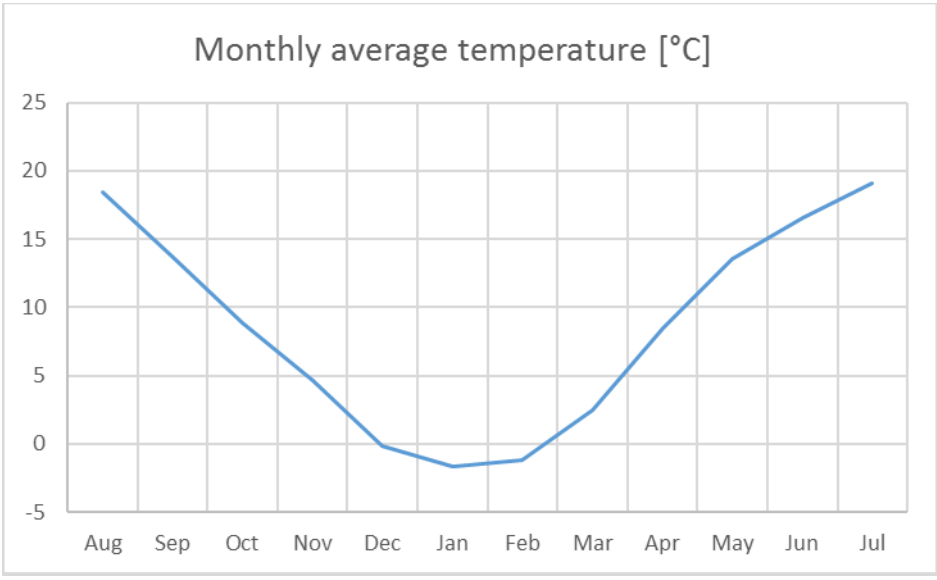
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

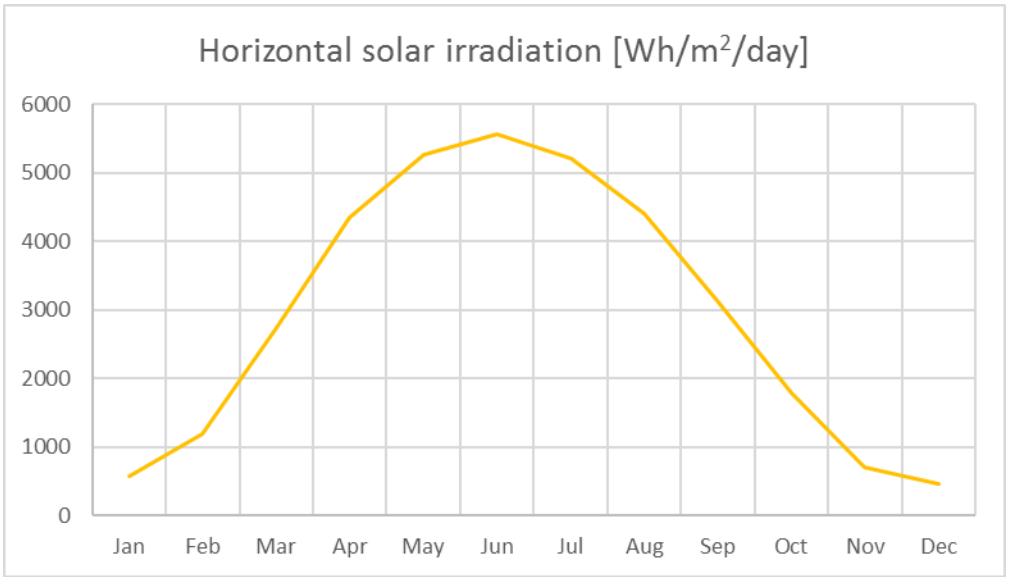
Total floor heated area [m²]	14166
Volume [m³]	186987
S/V	0,02

OCCUPATION AND USE OF THE BUILDING

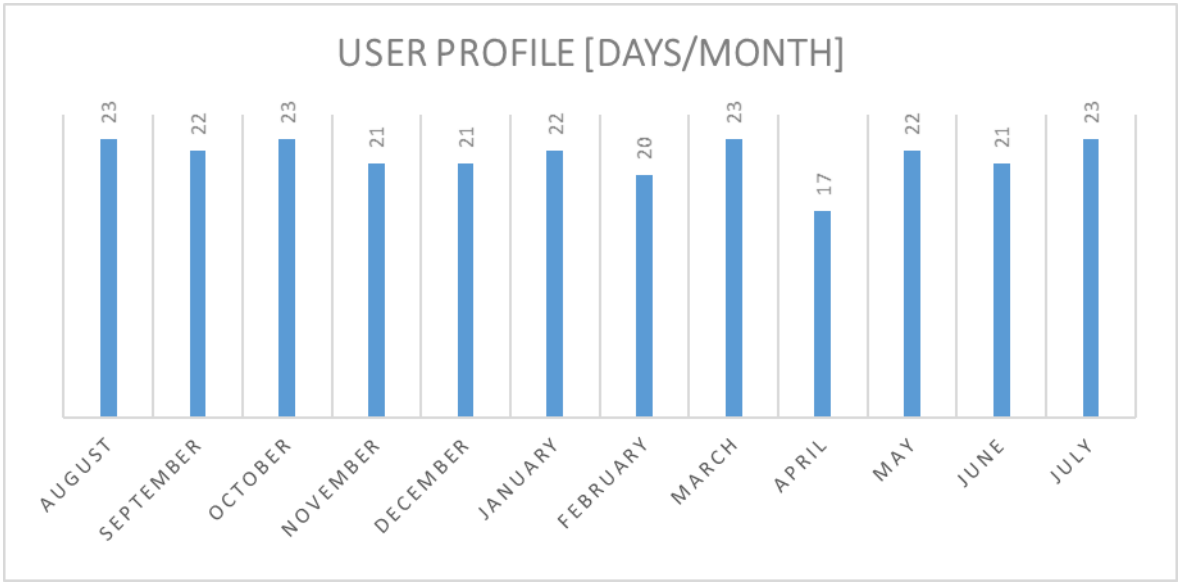
Number of students	417
Total days of use	258
Daily hours of use	15
Total area allocated to classrooms [%]	29



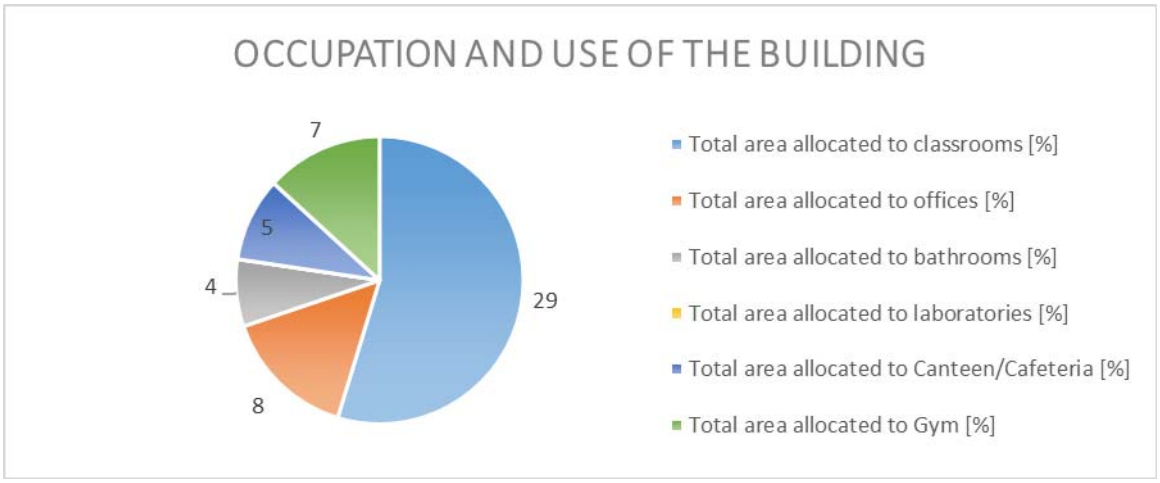
Picture 114 - Average monthly electricity consumptions during a school year [kWhe]



Picture 115 - Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 116 - Graphic representation of the user profile during school period [working days/month]



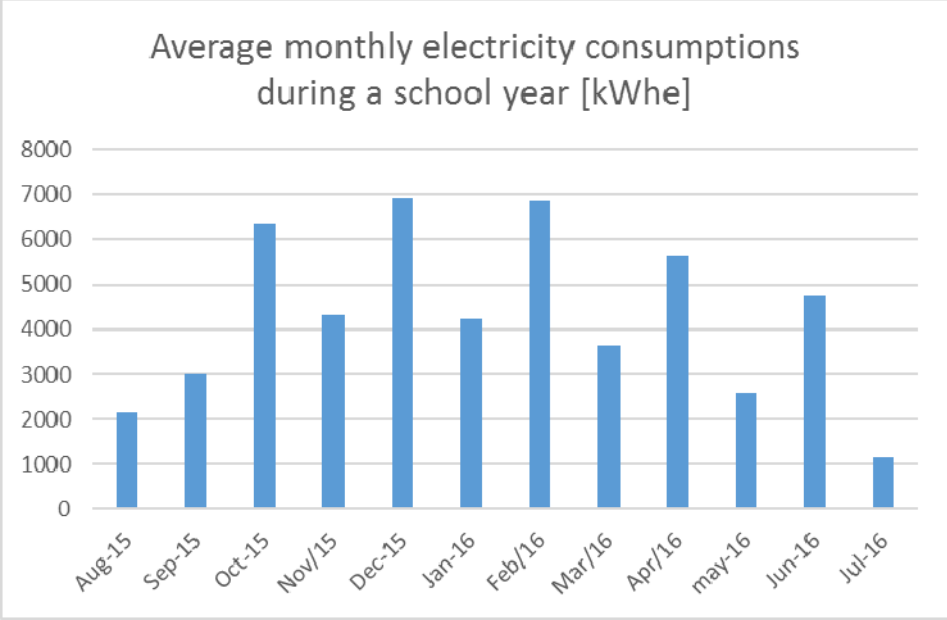
Picture 117 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

BUILDING ENVELOPE

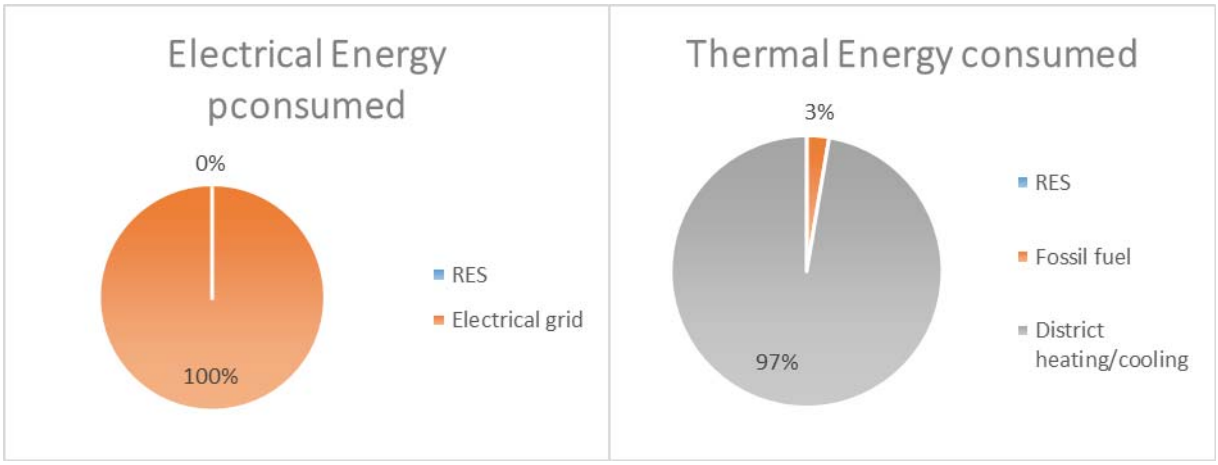
Year of construction	1960-1970
Type of structure	Prefab modules
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 118 - Average monthly electricity consumptions during a school year [kWhe]



Picture 119 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/Fuel/ Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	39857	0,21	2,81	9,70	95,58	154,48	39857	17266	7
Natural gas	Sm3	797	0,00	0,06	0,19	1,91	3,09	7648	159	1
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	278639	1,49	19,67	67,83	668,20	1080,00	0	100310	27
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	35	0,00	0,00	0,01	0,08	0,13		117735	35

Table 33 – Energy performance indicators

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit esternal walls with insulation	100	€/m2	1011,7	m2	0	€		
	Retrofit roof with insulation	200	€/m2	699,5	m2	0	€		
	Replace windows	450	€/m2	305,3	m2	0	€		
	Install solar shading systems	150	€/m2	305,3	m2	0	€		
	Reaplace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**50**	**valves***	**3503**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**309,0**	**lamps**	**7725**	**€**	**-55%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-55%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**14165,7**	**m2**	**354143**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 34 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

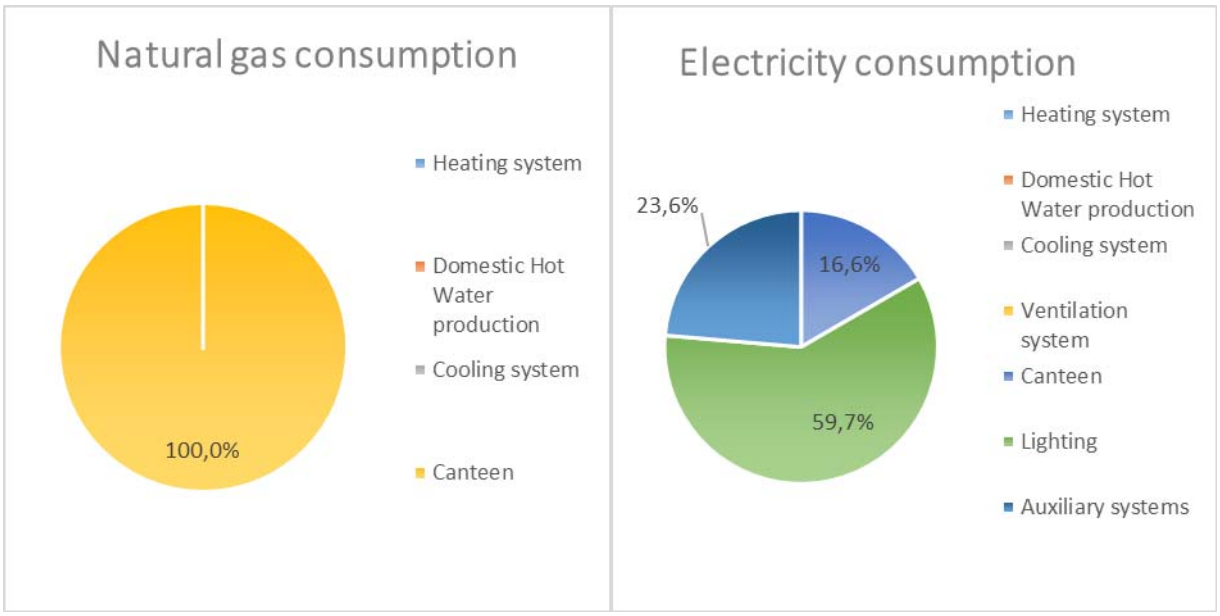
***Most relevant energy consumption reduction*

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	33313,695
After intervention	14931,375
Energy consumption reduction [%]	**-55%**

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	39857
Energy produced by RES	22000
After intervention	17857
Eletrical energy reduction [%]	**-55%**



Picture 120 - Pie Graph of Electrical and Natural gas consumptions subdivision [%] for each final intended use

4.18. Primary and Secondary school "Zespół Szkół nr 7"

GENERALITIES

School type	Primary and Secondary
Student age range	5-19

GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

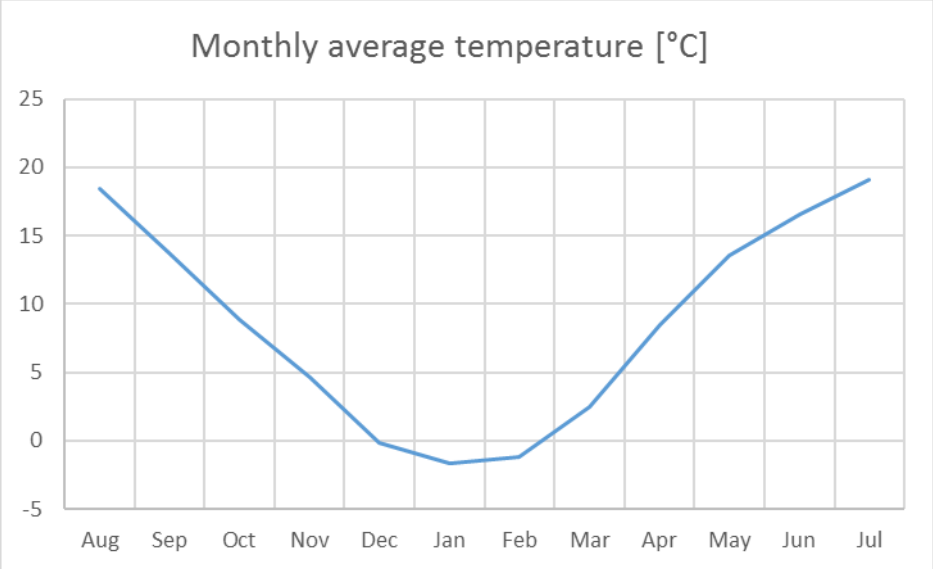
Country	Poland
City	Bydgoszcz

BUILDING GEOMETRY

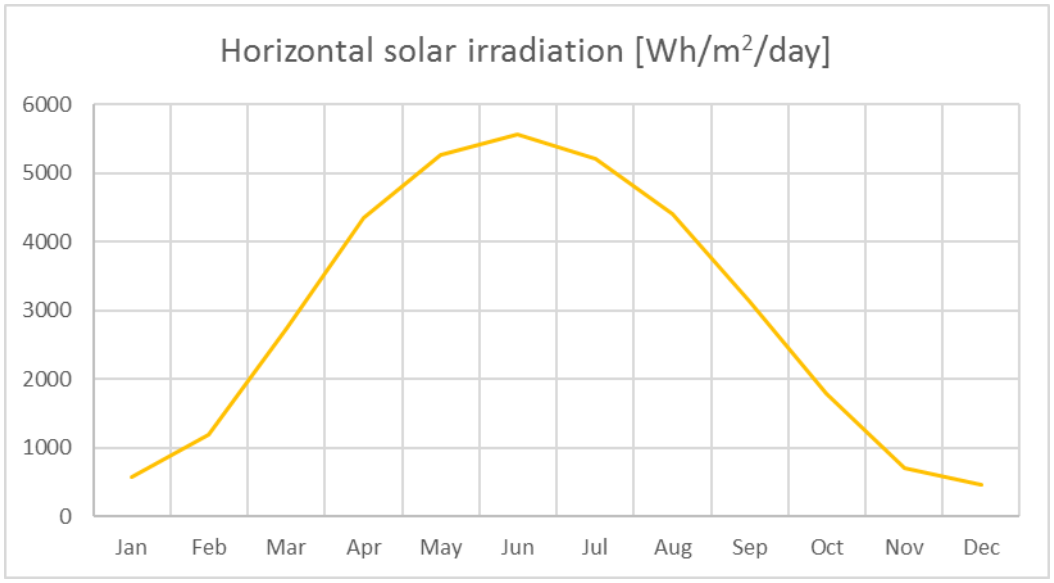
Total floor heated area [m²]	3706
Volume [m³]	35355
S/V	0,14

OCCUPATION AND USE OF THE BUILDING

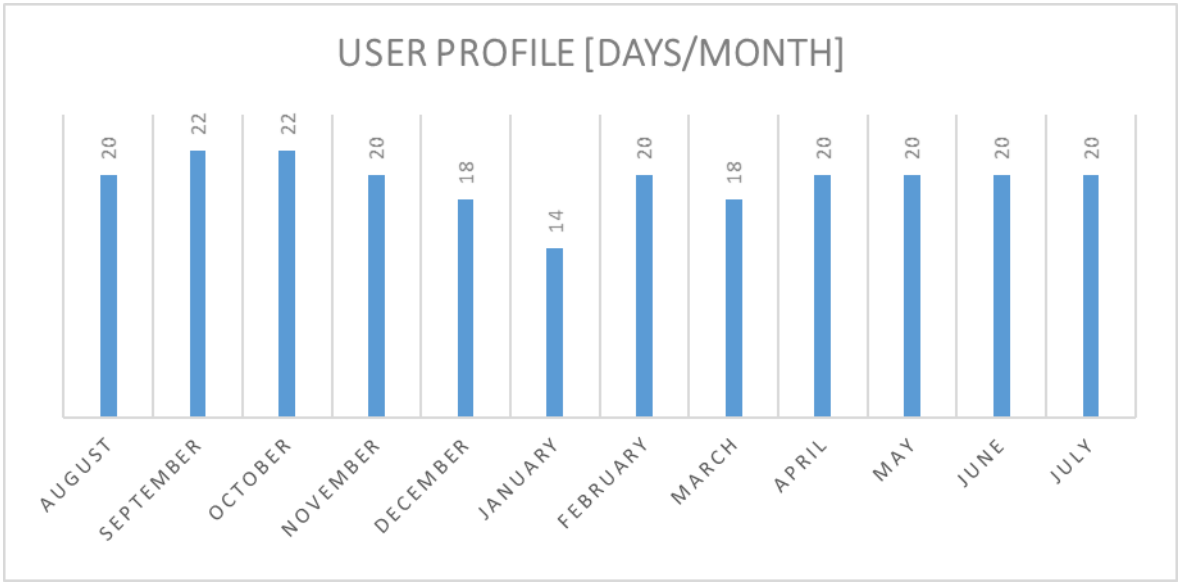
Number of students	477
Total days of use	234
Daily hours of use	16
Total area allocated to classrooms [%]	28



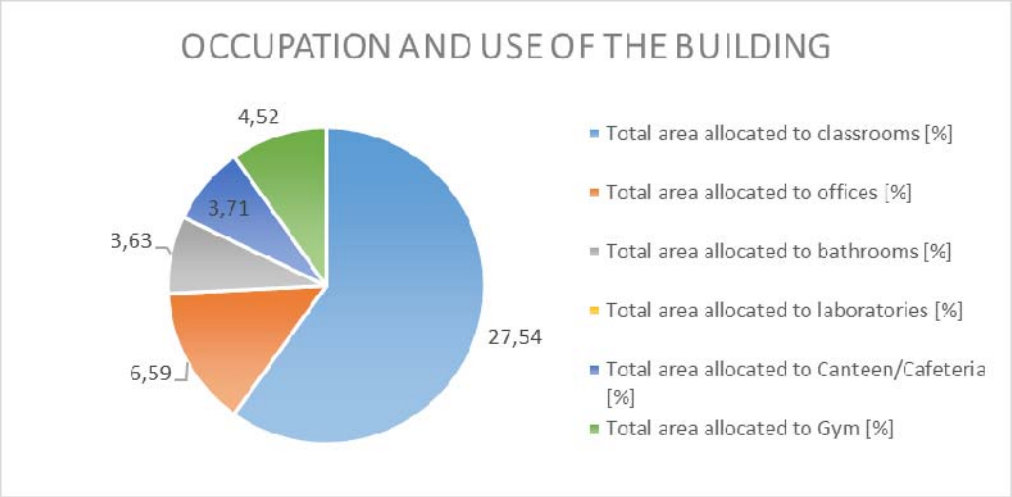
Picture 121 - Average monthly electricity consumptions during a school year [kWhe]



Picture 122 - Graphic representation of the Horizontal solar irradiation [Wh/m²/day] per Months. This value is the monthly/yearly average of the sum of the solar radiation energy that hits one square meter in a horizontal plane in one day.



Picture 123 - Graphic representation of the user profile during school period [working days/month]



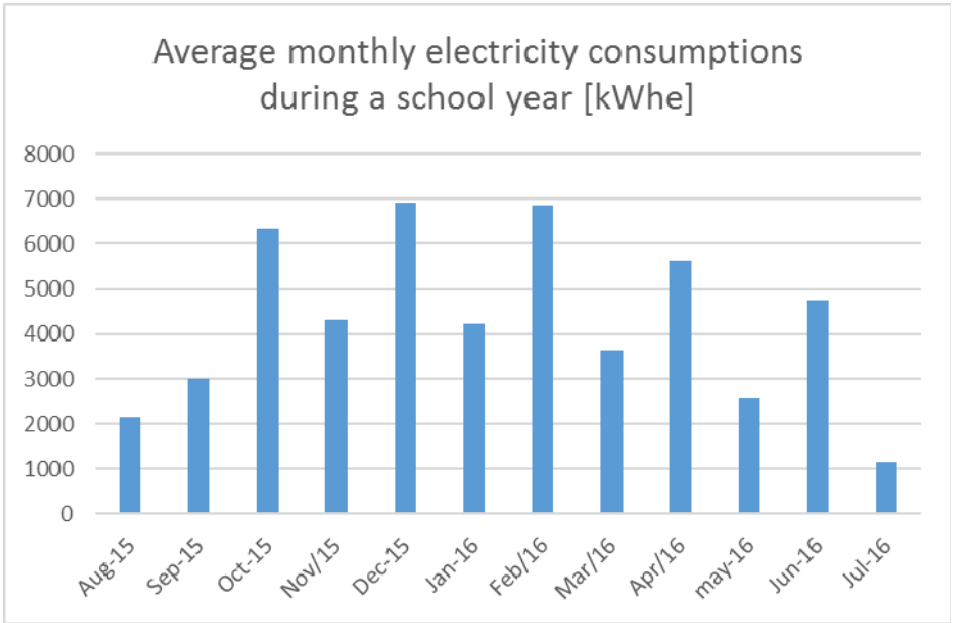
Picture 124 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

BUILDING ENVELOPE

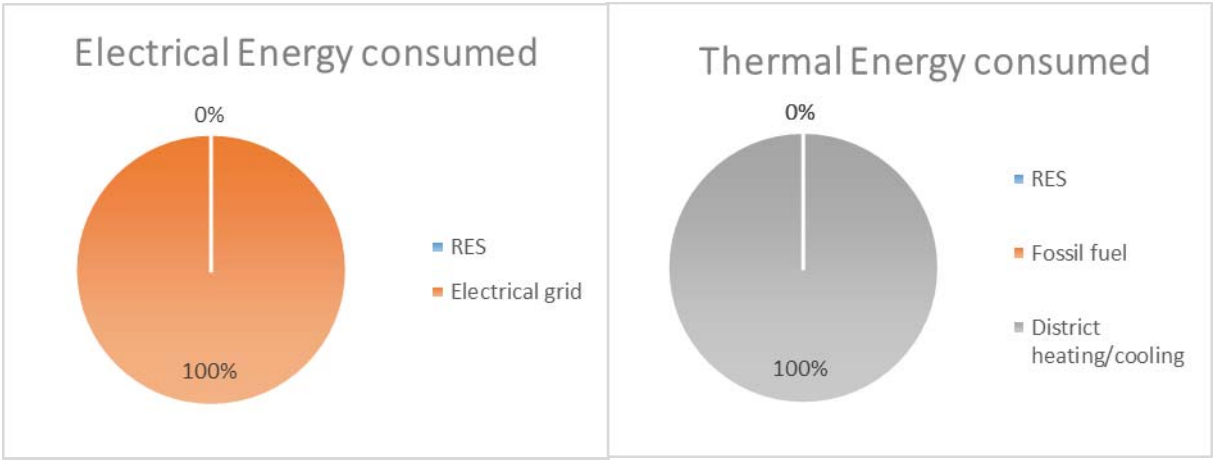
Year of construction	1960-1970
Type of structure	Prefab modules
External wall insulation	High [>10 cm]

HVAC AND RES SYSTEMS

Heat generation system	District heating
RES systems	



Picture 125 - Average monthly electricity consumptions during a school year [kWhe]



Picture 126 - Pie Graph of Electrical and Thermal energy consumptions, related to the different energy carriers/fuels or systems [%] in use into the school

		Total consumption per year	Consumption per volume	Consumption per heated area	Consumption per classrooms area	Consumption per number of students	Consumption per number of days	Total energy consumption per year	kg CO2 equivalent per year	Tonnes of oil equivalent per year
Energy carrier/ Fuel/Power source	u.m.	u.m.	u.m./m^3	u.m./m^2	u.m./m^2	u.m./student	u.m./day	kWh	kg CO_2 equiv	tep
Electricity	kWh_{el}	172790	4,89	46,62	169,30	362,24	738,42	172790	74852	32
Natural gas	Sm3	0						0		0
Fuel oil/Diesel	t	0						0		0
GPL	t	0						0		0
Biomass	t	0						0		0
District heating	kWh_t	380250	10,76	102,60	372,56	797,17	1625,00	0	136890	36
District cooling	kWh_f	0						0		0
Photovoltaics	kWh_{el}	0						0		
Solar thermal collectors	kWh_t	0						0		
Geothermal	kWh_t	0						0		
Other - energy produced	0	0								
Tonnes of oil equivalent	tep	69	0,00	0,02	0,07	0,14	0,29		211742	69

Table 35 – Energy performance indicators

		Unit cost of intervention				Cost of intervention		Energy reduction [%] **	
	Retrofit external walls with insulation	100	€/m2	2029,5	m2	0	€		
	Retrofit roof with insulation	200	€/m2	2099,0	m2	0	€		
	Replace windows	450	€/m2	447,3	m2	0	€		
	Install solar shading systems	150	€/m2	447,3	m2	0	€		
	Replace heat generator with a more efficient one	160	€/kW	0,0	kW	0	€		
✓	**Install thermostatic valves**	**70**	**€/valve**	**57**	**valves***	**4007**	**€**	**-2÷5%**	**thermal energy reduction for heating system**
✓	**Replace lights with LED**	**25**	**€/lamp**	**561,0**	**lamps**	**14025**	**€**	**-47%**	**light consumptions**
✓	**Install Energy Saving Switchs and Presence Sensors**	**250**	**€/point**	**50**	**points***	**12500**	**€**	**-2÷20%**	**light consumptions**
✓	**Install smart metering**	**5000**	**€**			**5000**	**€**	**-2÷10%**	**overall consumptions**
✓	**Install a photovoltaic system**	**1600**	**€/kWp**	**20,0**	**kWp***	**32000**	**€**	**-13%**	**Eletrical energy reduction [%]**
✓	**Install a solar thermal system**	**600**	**€/m2**	**4,0**	**m2***	**2400**	**€**	**up to 50%**	**thermal energy consumptions for DHW production**
	Replace electrical boilers with heat pumps	1500	€/kW	0,0	kW	0	€		
✓	**Install building automation system (automatic centralized control of a building's heating, ventilation and air conditioning, lighting…)**	**25**	**€/m2**	**3706,0**	**m2**	**92650**	**€**	**up to 15%**	**overall consumptions [depending on technology installed]**
✓	**Change end-user behaviour: control devices stand-by (monitors, PCs, laboratory equipment, lights, etc.)**	**0**	**€**			**0**	**€**	**-2÷5%**	**electricity consumptions**

***= estimated values**

*Table 36 - Priorities of interventions, standard costs per intervention and energy consumptions reductions. Items with * are referred to estimated values*

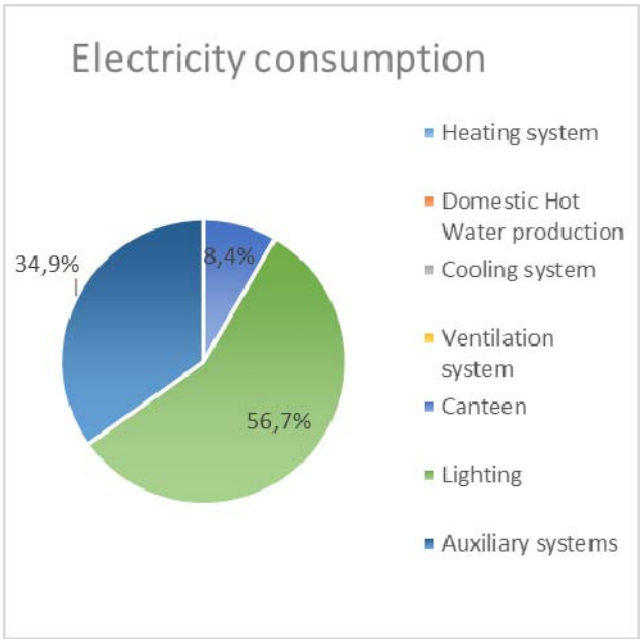
***Most relevant energy consumption reduction*

Lamp replacement with LED

	Q[kWh_t/year]
Current situation	50241,73029
After intervention	26470,10357
Energy consumption reduction [%]	**-47%**

Electrical energy reduction with PV system

	Q[kWh_el/year]
Current situation	172789,57
Energy produced by RES	22000
After intervention	150789,57
Eletrical energy reduction [%]	**-13%**



Picture 127 - Pie Graph of Electrical consumptions subdivision [%] for each final intended use

5. Inventory: all data set

5.1. Secondary school "Zespół Szkół nr 12 im. Jana III Sobieskiego, General Education Schools Team" (Junior High School and High School)

DataSet1: information about geographical location, building geometry and typical use of the school building.

1.1 GENERALITIES

Name of the School	Zespół Szkół nr 12 im. Jana III Sobieskiego - school building
School type *More than one answer*	Primary x Secondary Other:
Student age range	13-21

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country	Austria Croatia Germany Italy x Poland Slovenia Hungary
City	x Bydgoszcz Celie Karlovac Klagenfurt Lugo Stuttgart Szolnok Újszilvás Other (Add name):
Latitude [DD.dd°]	53.12°
Longitude [DD.dd°]	17.96°
Height above mean sea level [m]	68

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,2	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m²/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	4
Average floor-to-floor height [m]	3,29
Total floor heated area [m²]	3685
Basement area [m²]	777,26+403,49 (main building connected with addicional building)
Roof area [m²]	991,16+425,65(main building connected with addicional building)

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m²]	1305		379		1305		363	
Window-to-wall ratio [%]	33%		28%		26%		12%	

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	491	
Number of teachers and personnel (estimation)	68	
Total area allocated to classrooms [%]	10	
Total area allocated to offices [%]	6	
Total area allocated to bathrooms [%]	3	
Total area allocated to laboratories [%]	30	
Total area allocated to Canteen/Caleteria [%]	1	
Total area allocated to Gym [%]	7	

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	21
September	24
October	26
November	24
December	22
January	24
February	24
March	26
April	26
May	25
June	25
July	23
Total	290

Daily use [hh:mm-hh:mm) - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	08:00-14:00	08:00-15:00
Lectures time	07:10-17:05	07:10-17:05	07:10-17:05	07:10-17:05	07:10-16:15	08:00-14:00	08:00-15:00

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems.

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	Feb/16	Mar/16	Apr/16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]			2524		1421		4993	5433			2601		6037	23009
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		1583	2917	35667	39361	40611	67861	49472	45500	24111	7667	3583	3222	321556
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	feb-15	mar-15	apr-15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]			2590		2044		5312		5430		5432		2742	23550
b. Natural gas [Sm3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		3556	3972	21500	41083	57889	53667	48861	39778	28194	8667	4083	2611	313861
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]			967		4.123		1.698		4.231		5.113		3.506	19.638
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		1389	9944	22389	43556	48667	68056	46028	35667	20667	11528	3611	3306	314806
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
		1950-1960	
	x	1960-1970	
		1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
		>2010	
b. Type of structure		Load bearing masonry wall	
	x	Reinforced concrete structure	
		Steel frame structure	
		Wood framed	
		Prefab modules	
		Other:	

External walls			
a. Type		Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
		Prefab wall (concrete)	
	x	Other: (add U value)	reinforced concrete
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Roofs			
a. Type		Wooden roof	
		Mixed structure of hollow brick and concrete	
	x	Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
	x	Basement on under-ground cavity	
		Other:	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	

Windows		
a. Frame		Wood
	x	PVC
		Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
	x	Double pane glass
		Triple pane glass
		Other:
c. Condition	x	Good/New
		Medium
		Bad/Old
d. Solar shading		External curtain
	x	Internal curtain
	x	Blinds
		Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?	x	Yes
		No
b. Combined heating+domestic hot water?		Yes
		No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		
h. Emission system		Floor/ceiling radiant panels
		Radiators
		Fan coils
i. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]							
k. T set-point during closing hours							
l. Winter period [dd.mm-dd.mm]							
m. Starting external temperature the							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	08:00-14:00	08:00-15:00

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit	2006	
f. N of users	491	
g. N of showers	7	
h. Average daily use of the gym [h/day]		

Cooling system			
a. Cooling system?	x	Yes	
		No	
b. District cooling?		Yes	
	x	No	
c. Cooling generation system		Heat pump	
		Trigeneration	
	x	Other:	3 classrooms have it's own device
d. Energy carrier/Fuel	x	Electricity	
		Natural gas/Fuel oil/Diesel/GPL	
		Geothermal	
		Solar thermal collectors	
e. Cooling generation system		Centralised	
		One for each room	
f. Type of Heat Pump (external unit)		Air/air	
		Air/water	
		Water/air	
		Water/water	
		Brine/air (if geothermal)	

		Brine/water (if geothermal)
g. Total installed electrical power [kW]		
h. Year of installation/retrofit		
i. Emission system		Radiant ceiling
		Fan coils
j. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves
k. Percentage of the floor space cooled above the total floor heated area [%]		

Ventilation		
a. Controlled mechanical ventilation unit?		Yes
	x	No
b. Type of ventilation		Mechanical ventilation without heat recovery system
		Mechanical ventilation with heat recovery system (HRS)
c. (If HRS is present) Year of installation		
d. Percentage of the floor space ventilated above the total floor heated area [%]		

3.3 LIGHTING AND AUXILIARY SYSTEMS

Lighting					
		Room	Room	Gym	External
a. Type	Traditional incandescent light				
	Halogen light bulbs				
	Fluorescent tubes	x(287)	x (106)		
	Compact fluorescent light (CFL)	x (62)	x (2)		
	LED			x 5	
b. Control	Always ON				
	Manual	x	x	x	
	Manual on and automatic off				
	Automatic				
c. Number of lights		349	113	60	

Canteen		
a. N of hot meals per day		
b. Energy carrier/fuel/power source used to cook		Electricity
		Natural gas
		GPL

Equipment and machineries			
	[number]	**Typical power [W]**	**Average daily hours**
a. PCs	**121**		**6**
b. Projectors/Light boards	**14+2**		**4**
c. Printers/copiers	**34**		**2**
d. Vending machines	**1**		**2**

e. Coolers (in canteen, cafeteria)	4	350	24
f. Elevators			
g. Laboratories	*(Brief description of equipment installed with power, time of use…)*		
	There are four specialist laboratories in which are located sets of electrical		
h. Other			

3.4 ON SITE RENEWABLE ENERGY SOURCES (RES) INSTALLED

PV systems		
a. PV cells		Yes
	x	No
b. Cells typology		Silicon mono-crystalline
		Silicon poly-crystalline
		Silicon amorphous
c. Power installed [kW]		
d. Year of installation		
e. PV cells area [m^2]		
f. Slope [°]		
g. Orientation [N,NE,E,SE,S,SW,W,NW]		

Solar thermal collectors		
a. Solar thermal system		Yes
	x	No
b. Power installed [kW]		
c. Collector area [m^2]		
d. Year of installation		
e. Slope [°]		
f. Orientation [N,NE,E,SE,S,SW,W,NW]		
g. Hot water storage [L]		

Other RES	
a. Type	
b. Power	
c. Year of installation	

5.2. Secondary school "Zespół Szkół Budowlanych im. J. Gagarina ul. Jana Pestalozziego 18. Technical School, Vocational Schools Team"

DataSet1: information about geographical location, building geometry and typical use of the school building.

1.1 GENERALITIES

Name of the School	Zespół Szkół	
School type *More than one answer*		Primary
	x	Secondary
		Other:
Student age range	16-20	

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country		Austria
		Croatia
		Germany
		Italy
	x	Poland
		Slovenia
		Hungary
City	x	Bydgoszcz
		Celle
		Karlovac
		Klagenfurt
		Lugo
		Stuttgart
		Szolnok
		Ujszilvás
		Other (Add name):
Latitude [DD.dd°]	53.12°	
Longitude [DD.dd°]	18.03°	
Height above mean sea level [m]	42	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,2	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m^2/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	4
Average floor-to-floor height [m]	3,2
Total floor heated area [m^2]	5747
Basement area [m^2]	2622
Roof area [m^2]	3253

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m^2]	1231	0	1089	0	1221	0	1089	0
Window-to-wall ratio [%]	24	0	31	0	20	0	41	0

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	416
Number of teachers and personnel (estimation)	84
Total area allocated to classrooms [%]	27
Total area allocated to offices [%]	12
Total area allocated to bathrooms [%]	2
Total area allocated to laboratories [%]	0
Total area allocated to Canteen/Cafeteria [%]	0,5
Total area allocated to Gym [%]	5

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	31
September	30
October	31
November	30
December	31
January	31
February	28
March	31
April	30
May	31
June	30
July	31
Total	365

Daily use [hh:mm-hh:mm] - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	0:00-24:00	0:00-24:00	0:00-24:00	0:00-24:00	0:00-24:00	0:00-24:00	0:00-24:00
Lectures time	7:00-18:30	7:00-18:30	7:00-18:30	7:00-18:30	7:00-18:30	8:00-13:00	

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems.

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	feb-16	mar-16	apr-16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]														71784
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		8806	9694	91111	109889	92167	151250	107583	99750	76556	22000	5917	5583	780306
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	feb-15	mar-15	apr-15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]														75373
b. Natural gas [Sm3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		3694	4417	73444	106556	131111	134500	114972	81194	61500	26722	8389	8389	754889
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]														73112
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		5000	22972	78417	109806	102778	149528	101833	89389	67500	22111	4000	3389	756722
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
		1950-1960	
	x	1960-1970	
		1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
		>2010	
b. Type of structure	x	Load bearing masonry wall	
		Reinforced concrete structure	
		Steel frame structure	
		Wood framed	
		Prefab modules	
		Other:	

External walls			
a. Type	x	Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
		Prefab wall (concrete)	
		Other: (add U value)	
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	
c. Main external coloring		Light	
		Medium	
	x	Dark	

Roofs			
a. Type		Wooden roof	
		Mixed structure of hollow brick and concrete	
	x	Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	
c. Main external coloring		Light	
		Medium	
	x	Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
	x	Other: (add U value)	Basement on under-ground cavity
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	

Windows		
a. Frame		Wood
	x	PVC
		Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
	x	Double pane glass
		Triple pane glass
		Other: (add U_{window} value)
c. Condition		Good/New
		Medium
	x	Bad/Old
d. Solar shading		External curtain
	x	Internal curtain
	x	Blinds
	x	Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?	x	Yes
		No
b. Combined heating+domestic hot water?	x	Yes
		No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		
h. Emission system		Floor/ceiling radiant panels
		Radiators
		Fan coils
i. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]							
k. T set-point during closing hours							
l. Winter period [dd.mm-dd.mm]							
m. Starting external temperature the heating turns ON (Suggested value: 12°C) [°C]							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	07:00-22:00	07:00-22:00	07:00-22:00	07:00-22:00	07:00-22:00	08:00-22:00	

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit	1963	
f. N of users	420	
g. N of showers	4	
h. Average daily use of the gym [h/day]		

Cooling system		
a. Cooling system?		Yes
	x	No
b. District cooling?		Yes
	x	No
c. Cooling generation system		Heat pump
		Trigeneration
		Other:
d. Energy carrier/Fuel		Electricity
		Natural gas/Fuel oil/Diesel/GPL
		Geothermal
		Solar thermal collectors
e. Cooling generation system		Centralised
		One for each room
f. Type of Heat Pump (external unit)		Air/air
		Air/water
		Water/air
		Water/water

		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Total installed electrical power [kW]		
h. Year of installation/retrofit		
i. Emission system		Radiant ceiling
		Fan coils
j. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves
k. Percentage of the floor space cooled above the total floor heated area [%]		

Ventilation		
a. Controlled mechanical ventilation unit?		Yes
	x	No
b. Type of ventilation		Mechanical ventilation without heat recovery system
		Mechanical ventilation with heat recovery system (HRS)
c. (If HRS is present) Year of installation		
d. Percentage of the floor space ventilated above the total floor heated area [%]		

3.3 LIGHTING AND AUXILIARY SYSTEMS

Lighting					
		Rooms (classroom, offices, laboratories)	**Common spaces (corridors, atrium, canteen)**	**Gym**	**External**
a. Type	Traditional incandescent light	x (15)	x (7)		
	Halogen light bulbs			x (24)	
	Fluorescent tubes	x (292)	x (86)		
	Compact fluorescent light (CFL)				
	LED				x (10)
b. Control	Always ON				
	Manual	x	x	x	
	Manual on and automatic off				
	Automatic				x
c. Number of lights		307	93	24	10

Canteen		
a. N of hot meals per day		
b. Energy carrier/fuel/power source used to cook		Electricity
		Natural gas
		GPL

Equipment and machineries			
	[number]	Typical power [W]	Average daily hours of use [h/day]
a. PCs	110	500	5
b. Projectors/Light boards	23	200	2
c. Printers/copiers	25	300	2
d. Vending machines	2	1800	2
e. Coolers (in canteen, cafeteria)	2	250	24
f. Elevators	0		
g. Laboratories	*(Brief description of equipment installed with power, time of use…)*		
h. Other	1	2000	2

3.4 ON SITE RENEWABLE ENERGY SOURCES (RES) INSTALLED

PV systems		
a. PV cells		Yes
	x	No
b. Cells typology		Silicon mono-crystalline
		Silicon poly-crystalline
		Silicon amorphous
c. Power installed [kW]		
d. Year of installation		
e. PV cells area [m^2]		
f. Slope [°]		
g. Orientation [N,NE,E,SE,S,SW,W,NW]		

Solar thermal collectors		
a. Solar thermal system		Yes
	x	No
b. Power installed [kW]		
c. Collector area [m^2]		
d. Year of installation		
e. Slope [°]		
f. Orientation [N,NE,E,SE,S,SW,W,NW]		
g. Hot water storage [L]		

Other RES	
a. Type	
b. Power	
c. Year of installation	

5.3. Primary school "Zespół Szkół Ogólnokształcących nr 4, General Education Schools Team" – Main school building

DataSet1: information about geographical location, building geometry and typical use of the school building.

1.1 GENERALITIES

Name of the School	Zespół Szkół	
School type *More than one answer*		Primary
	x	Secondary
		Other:
Student age range	13-19	

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country		Austria
		Croatia
		Germany
		Italy
	x	Poland
		Slovenia
		Hungary
City	x	Bydgoszcz
		Celie
		Karlovac
		Klagenfurt
		Lugo
		Stuttgart
		Szolnok
		Ujszilvás
		Other (Add name):
Latitude [DD.dd°]	53.12°	
Longitude [DD.dd°]	17.97°	
Height above mean sea level [m]	66	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,4	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m^2/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	4
Average floor-to-floor height [m]	3,25
Total floor heated area [m^2]	3646,4
Basement area [m^2]	1744,3
Roof area [m^2]	2034,9

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m^2]	840	0	480	132	840	0	480	212
Window-to-wall ratio [%]	41	0	19	45	42	0	18	12

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	467
Number of teachers and personnel (estimation)	57
Total area allocated to classrooms [%]	37
Total area allocated to offices [%]	6
Total area allocated to bathrooms [%]	4
Total area allocated to laboratories [%]	0
Total area allocated to Canteen/Cafeteria [%]	2
Total area allocated to Gym [%]	8

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	0
September	22
October	21
November	19
December	16
January	21
February	7
March	15
April	21
May	15
June	18
July	0
Total	175

Daily use [hh:mm-hh:mm] - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	6:00-22:00	6:00-22:00	6:00-22:00	6:00-22:00	6:00-22:00		
Lectures time	7:10-15:05	7:10-15:05	7:10-15:05	7:10-15:05	7:10-15:05		

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	feb-16	mar-16	apr-16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]			3705		10249		10095		8568		7735		4330	44682
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		6472	52750	32833	45334	45889	74888	53334	50695	27139	11722	8445	8083	417584
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	feb-15	mar-15	apr-15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]			4615		10884		10818		10967		6110		6247	49641
b. Natural gas [Sm3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		6667	6111	24111	45639	56333	65083	54250	43445	32972	12666	5861	4944	358082
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]			6347		12495		11623		8526		9740		7785	56516
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		5333	13917	28834	48861	56416	71334	52111	38917	24167	16778	7611	6888	371167
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
		1950-1960	
	x	1960-1970	
		1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
		>2010	
b. Type of structure		Load bearing masonry wall	
		Reinforced concrete structure	
		Steel frame structure	
		Wood framed	
	x	Prefab modules	
		Other:	

External walls			
a. Type		Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
	x	Prefab wall (concrete)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Roofs			
a. Type		Wooden roof	
		Mixed structure of hollow brick and concrete	
	x	Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
	x	Other: (add U value)	Basement on-under ground cavity
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	

Windows		
a. Frame		Wood
	x	PVC
		Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
	x	Double pane glass
		Triple pane glass
		Other: (add U_{window} value)
c. Condition	x	Good/New
		Medium
		Bad/Old
d. Solar shading		External curtain
	x	Internal curtain
	x	Blinds
	x	Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?	x	Yes
		No
b. Combined heating+domestic hot water?		Yes
		No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		2006
h. Emission system		Floor/ceiling radiant panels
		Radiators
		Fan coils
i. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]							
k. T set-point during closing hours							
l. Winter period [dd.mm-dd.mm]							
m. Starting external temperature the heating turns ON (Suggested value: 12°C) [°C]							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	6:00-22:00	6:00-22:00	6:00-22:00	6:00-22:00	6:00-22:00		

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit	2006	
f. N of users	467	
g. N of showers	6	
h. Average daily use of the gym [h/day]		

Cooling system		
a. Cooling system?		Yes
	x	No
b. District cooling?		Yes
	x	No
c. Cooling generation system		Heat pump
		Trigeneration
		Other:
d. Energy carrier/Fuel		Electricity
		Natural gas/Fuel oil/Diesel/GPL
		Geothermal
		Solar thermal collectors
e. Cooling generation system		Centralised
		One for each room
f. Type of Heat Pump (external unit)		Air/air
		Air/water
		Water/air
		Water/water

		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Total installed electrical power [kW]		
h. Year of installation/retrofit		
i. Emission system		Radiant ceiling
		Fan coils
j. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves
k. Percentage of the floor space cooled above the total floor heated area [%]		

Ventilation		
a. Controlled mechanical ventilation unit?		Yes
	x	No
b. Type of ventilation		Mechanical ventilation without heat recovery system
		Mechanical ventilation with heat recovery system (HRS)
c. (If HRS is present) Year of installation		
d. Percentage of the floor space ventilated above the total floor heated area [%]		

3.3 LIGHTING AND AUXILIARY SYSTEMS

Lighting					
		Rooms (classroom, offices, laboratories)	**Common spaces (corridors, atrium, canteen)**	**Gym**	**External**
a. Type	Traditional incandescent light				
	Halogen light bulbs			x	x
	Fluorescent tubes	x	x		
	Compact fluorescent light (CFL)				
	LED				
b. Control	Always ON				
	Manual	x	x	x	
	Manual on and automatic off				x
	Automatic				
c. Number of lights		455	165	38	10

Canteen		
a. N of hot meals per day		
b. Energy carrier/fuel/power source used to cook		Electricity
		Natural gas
		GPL

Equipment and machineries			
	[number]	Typical power [W]	Average daily hours of use [h/day]
a. PCs	47	500	6
b. Projectors/Light boards	19	200	6
c. Printers/copiers	20	300	2
d. Vending machines	1	1800	2
e. Coolers (in canteen, cafeteria)	1	250	24
f. Elevators	0		
g. Laboratories	*(Brief description of equipment installed with power, time of use…)*		
h. Other - washing maschine	1	2000	2

3.4 ON SITE RENEWABLE ENERGY SOURCES (RES) INSTALLED

PV systems		
a. PV cells		Yes
	x	No
b. Cells typology		Silicon mono-crystalline
		Silicon poly-crystalline
		Silicon amorphous
c. Power installed [kW]		
d. Year of installation		
e. PV cells area [m^2]		
f. Slope [°]		
g. Orientation [N,NE,E,SE,S,SW,W,NW]		

Solar thermal collectors		
a. Solar thermal system		Yes
	x	No
b. Power installed [kW]		
c. Collector area [m^2]		
d. Year of installation		
e. Slope [°]		
f. Orientation [N,NE,E,SE,S,SW,W,NW]		
g. Hot water storage [L]		

Other RES	
a. Type	
b. Power	
c. Year of installation	

5.4. Primary and Secondary school "Zespół Szkół Ogólnokształcących nr 4, General Education Schools Team" – Swimming pool

DataSet1: information about geographical location, building geometry and typical use of the school building

1.1 GENERALITIES

Name of the School		Zespół Szkół
School type *More than one answer*	x	Primary
	x	Secondary
		Other:
Student age range		7-19

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country		Austria
		Croatia
		Germany
		Italy
	x	Poland
		Slovenia
		Hungary
City	x	Bydgoszcz
		Celie
		Karlovac
		Klagenfurt
		Lugo
		Stuttgart
		Szolnok
		Ujszilvas
		Other (Add name):
Latitude [DD.dd°]		53.12°
Longitude [DD.dd°]		17.97°
Height above mean sea level [m]		68

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,6	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m²/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	3
Average floor-to-floor height [m]	11,6
Total floor heated area [m²]	2024
Basement area [m²]	1404
Roof area [m²]	1834

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m²]	655,4		324,8		655,4		232	
Window-to-wall ratio [%]	32		42		46		48	

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	390 and commercial services average 454
Number of teachers and personnel (estimation)	28
Total area allocated to classrooms [%]	
Total area allocated to offices [%]	4,89
Total area allocated to bathrooms [%]	7,06
Total area allocated to laboratories [%]	
Total area allocated to Canteen/Cafeteria [%]	
Total area allocated to Gym [%]	

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	10
September	30
October	31
November	28
December	27
January	29
February	29
March	28
April	30
May	28
June	30
July	31
Total	331

Daily use [hh:mm-hh:mm] - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	07.00-22.00	07.00-22.00	07.00-22.00	07.00-22.00	07.00-22.00	08.00-22.00	08.00-22.00
Lectures time	07.00-15.15	07.00-15.15	07.00-15.15	07.00-15.15	07.00-15.15	0	0

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	feb-16	mar-16	apr-16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]		45202	45202	48506	47706	52121	55589	51672	53470	50703	49545	48239	36000	583955
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		31111	60556	96111	105000	93889	140833	130556	120000	96944	86389	59444	56389	1077222
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	feb-15	mar-15	apr-15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]					48660	53163	56701	52705	54539	51717	50536	49204	36720	453946
b. Natural gas [Sm3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		0	0	0	70556	91944	97500	91389	116944	105556	63056	71389	60833	769167
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]														
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		0	0	0	0	0	0	0	0	0	0	0	0	0
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
		1950-1960	
		1960-1970	
		1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
	x	>2010	
b. Type of structure		Load bearing masonry wall	
		Reinforced concrete structure	
	x	Steel frame structure	
		Wood framed	
		Prefab modules	
		Other:	

External walls			
a. Type		Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
		Prefab wall (concrete)	
		Other: (add U value)	brick mensory
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring	x	Light	
		Medium	
		Dark	

Roofs			
a. Type		Wooden roof	
		Mixed structure of hollow brick and concrete	
	x	Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
	x	Other: (add U value)	Basement on-under ground cavity
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	

Windows		
a. Frame		Wood
		PVC
	x	Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
		Double pane glass
	x	Triple pane glass
		Other: (add U_{window} value)
c. Condition	x	Good/New
		Medium
		Bad/Old
d. Solar shading	x	External curtain
		Internal curtain
	x	Blinds
		Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?		Yes
	x	No
b. Combined heating+domestic hot water?		Yes
	x	No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		2015
h. Emission system	x	Floor/ceiling radiant panels
	x	Radiators
	x	Fan coils
i. Control system *More than one answer*		Not present
	x	On/off
	x	External climate probe
	x	Zone thermostat
	x	Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]	26						
k. T set-point during closing hours	26						
l. Winter period [dd.mm-dd.mm]	11.12-19.02						
m. Starting external temperature the heating turns ON (Suggested value: 12°C) [°C]							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	24/day	24/day	24/day	24/day	24/day	24/day	24/day

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit	2015	
f. N of users	0	
g. N of showers	31	
h. Average daily use of the gym [h/day]		

Cooling system		
a. Cooling system?		Yes
	x	No
b. District cooling?		Yes
	x	No
c. Cooling generation system		Heat pump
		Trigeneration
		Other:
d. Energy carrier/Fuel		Electricity
		Natural gas/Fuel oil/Diesel/GPL
		Geothermal
		Solar thermal collectors
e. Cooling generation system		Centralised
		One for each room
f. Type of Heat Pump (external unit)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)

		Brine/water (if geothermal)
g. Total installed electrical power [kW]		
h. Year of installation/retrofit		
i. Emission system		Radiant ceiling
		Fan coils
j. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves
k. Percentage of the floor space cooled above the total floor heated area [%]		

Ventilation		
a. Controlled mechanical ventilation unit?	x	Yes
		No
b. Type of ventilation		Mechanical ventilation without heat recovery system
	x	Mechanical ventilation with heat recovery system (HRS)
c. (If HRS is present) Year of installation	2015	
d. Percentage of the floor space ventilated above the total floor heated area [%]		

3.3 LIGHTING AND AUXILIARY SYSTEMS

Lighting					
		Rooms (classroom, offices, laboratories)	**Common spaces (corridors, atrium, canteen)**	**Gym**	**External**
a. Type	Traditional incandescent light				
	Halogen light bulbs				
	Fluorescent tubes	x			
	Compact fluorescent light (CFL)				
	LED	x	x	x	
b. Control	Always ON				
	Manual	x		x	
	Manual on and automatic off		x		
	Automatic				
c. Number of lights		32	36		

Canteen		
a. N of hot meals per day		
b. Energy carrier/fuel/power source used to cook		Electricity
		Natural gas
		GPL

Equipment and machineries

	[number]	Typical power [W]	Average daily hours of use [h/day]
a. PCs			
b. Projectors/Light boards			
c. Printers/copiers			
d. Vending machines	2	360	4
e. Coolers (in canteen, cafeteria)	1	117 kWh/y	24
f. Elevators	2	7	16
g. Laboratories	*(Brief description of equipment installed with power, time of use…)*		
h. Other			

3.4 ON SITE RENEWABLE ENERGY SOURCES (RES) INSTALLED

PV systems		
a. PV cells		Yes
	x	No
b. Cells typology		Silicon mono-crystalline
		Silicon poly-crystalline
		Silicon amorphous
c. Power installed [kW]		
d. Year of installation		
e. PV cells area [m^2]		
f. Slope [°]		
g. Orientation [N,NE,E,SE,S,SW,W,NW]		

Solar thermal collectors		
a. Solar thermal system		Yes
	x	No
b. Power installed [kW]		
c. Collector area [m^2]		
d. Year of installation		
e. Slope [°]		
f. Orientation [N,NE,E,SE,S,SW,W,NW]		
g. Hot water storage [L]		

Other RES	
a. Type	
b. Power	
c. Year of installation	

5.5. Primary and Secondary school "Zespół Szkół nr 10" - Main building

DataSet1: information about geographical location, building geometry and typical use of the school building

1.1 GENERALITIES

Name of the School	Zespół Szkół nr 10 -	
School type *More than one answer*	x	Primary
	x	Secondary
		Other:
Student age range	6-15	

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country		Austria
		Croatia
		Germany
		Italy
	x	Poland
		Slovenia
		Hungary
City	x	Bydgoszcz
		Celie
		Karlovac
		Klagenfurt
		Lugo
		Stuttgart
		Szolnok
		Ujszilvàs
		Other (Add name):
Latitude [DD.dd°]	53.12°	
Longitude [DD.dd°]	18.02°	
Height above mean sea level [m]	38	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,7	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m^2/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	4
Average floor-to-floor height [m]	3,3
Total floor heated area [m^2]	3093,54
Basement area [m^2]	1102
Roof area [m^2]	1107

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m^2]	957	0	166	0	883	0	151	0
Window-to-wall ratio [%]	23	0	2	0	31	0	27	0

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	809
Number of teachers and personnel (estimation)	117
Total area allocated to classrooms [%]	48
Total area allocated to offices [%]	5
Total area allocated to bathrooms [%]	4
Total area allocated to laboratories [%]	0
Total area allocated to Canteen/Cafeteria [%]	6
Total area allocated to Gym [%]	0

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	22
September	22
October	20
November	20
December	22
January	21
February	11
March	23
April	19
May	20
June	21
July	21
Total	242

Daily use [hh:mm-hh:mm] - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	06:00-22:30	06:00-22:30	06:00-22:30	06:00-22:30	06:00-23:00	08:00-15:00	08:00-15:00
Lectures time	07:00-16:45	07:00-16:45	07:00-16:45	07:00-16:45	07:00-15:05		

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	feb-16	mar-16	apr-16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]														79818
b. Natural gas [Sm^3]			672		349		434		340		275		99	2169
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		1111	2500	20389	33111	33306	55000	37194	35389	17611	9083	4917	2389	252000
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	Feb/15	Mar/15	Apr/15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]														83809
b. Natural gas [Sm3]			530		366		456		357		289		104	2102
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		278	3611	14222	30556	49278	48139	41750	27528	20417	7194	3000	889	246861
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]														82970
b. Natural gas [Sm^3]			557		385		478		375		303		109	2207
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		1389	2778	26389	51389	55000	72778	50833	44722	17222	14722	3611	278	341111
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
		1950-1960	
		1960-1970	
	x	1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
		>2010	
b. Type of structure		Load bearing masonry wall	
		Reinforced concrete structure	
		Steel frame structure	
		Wood framed	
	x	Prefab modules	
		Other:	

External walls			
a. Type		Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
	x	Prefab wall (concrete)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring		Light	
		Medium	
	x	Dark	

Roofs			
a. Type		Wooden roof	
		Mixed structure of hollow brick and concrete	
	x	Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	
c. Main external coloring		Light	
		Medium	
	x	Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
		Other: (add U value)	Basement on-under ground cavity
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	

Windows		
a. Frame		Wood
	x	PVC
		Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
	x	Double pane glass
		Triple pane glass
		Other: (add U_{window} value)
c. Condition	x	Good/New
		Medium
		Bad/Old
d. Solar shading		External curtain
		Internal curtain
		Blinds
	x	Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?		Yes
	x	No
b. Combined heating+domestic hot water?		Yes
	x	No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		2012
h. Emission system		Floor/ceiling radiant panels
		Radiators
		Fan coils
i. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]	20						
k. T set-point during closing hours	20						
l. Winter period [dd.mm-dd.mm]	11.12-19.02						
m. Starting external temperature the heating turns ON (Suggested value: 12°C) [°C]							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	06:00-22:30	06:00-23:00	06:00-23:30	06:00-22:30	06:00-23:00	08:00-16:00	08:00-16:00

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit	2012	
f. N of users	809	
g. N of showers	14	
h. Average daily use of the gym [h/day]		

Cooling system		
a. Cooling system?	x	Yes
		No
b. District cooling?		Yes
	x	No
c. Cooling generation system		Heat pump
		Trigeneration
		Other:
d. Energy carrier/Fuel		Electricity
		Natural gas/Fuel oil/Diesel/GPL
		Geothermal
		Solar thermal collectors
e. Cooling generation system		Centralised
	x	One for each room
f. Type of Heat Pump (external unit)		Air/air
		Air/water
		Water/air
		Water/water

		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Total installed electrical power [kW]		
h. Year of installation/retrofit		
i. Emission system		Radiant ceiling
		Fan coils
j. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves
k. Percentage of the floor space cooled above the total floor heated area [%]		

Ventilation		
a. Controlled mechanical ventilation unit?		Yes
	x	No
b. Type of ventilation		Mechanical ventilation without heat recovery system
		Mechanical ventilation with heat recovery system (HRS)
c. (If HRS is present) Year of installation		
d. Percentage of the floor space ventilated above the total floor heated area [%]		

3.3 LIGHTING AND AUXILIARY SYSTEMS

Lighting					
		Rooms (classroom, offices, laboratories)	**Common spaces (corridors, atrium, canteen)**	**Gym**	**External**
a. Type	Traditional incandescent light	x (4)	x (18)		
	Halogen light bulbs				
	Fluorescent tubes	x (283)	x (150)		x
	Compact fluorescent light (CFL)				
	LED				
b. Control	Always ON				
	Manual	x	x		
	Manual on and automatic off				
	Automatic				x
c. Number of lights		287	168		8

Canteen		
a. N of hot meals per day	570	
b. Energy carrier/fuel/power source used to cook	x	Electricity
	x	Natural gas
		GPL

Equipment and machineries			
	[number]	Typical power [W]	Average daily hours of use [h/day]
a. PCs	52	575	8
b. Projectors/Light boards	41	250	8
c. Printers/copiers	18	550	8
d. Vending machines	0		
e. Coolers (in canteen, cafeteria)	5	160	24
f. Elevators	0		
g. Laboratories	*(Brief description of equipment installed with power, time of use…)*		
h. Other			

3.4 ON SITE RENEWABLE ENERGY SOURCES (RES) INSTALLED

PV systems		
a. PV cells		Yes
	x	No
b. Cells typology		Silicon mono-crystalline
		Silicon poly-crystalline
		Silicon amorphous
c. Power installed [kW]		
d. Year of installation		
e. PV cells area [m^2]		
f. Slope [°]		
g. Orientation [N,NE,E,SE,S,SW,W,NW]		

Solar thermal collectors		
a. Solar thermal system		Yes
	x	No
b. Power installed [kW]		
c. Collector area [m^2]		
d. Year of installation		
e. Slope [°]		
f. Orientation [N,NE,E,SE,S,SW,W,NW]		
g. Hot water storage [L]		

Other RES	
a. Type	
b. Power	
c. Year of installation	

5.6. Primary and Secondary school "Zespół Szkół nr 10" - Ggym

DataSet1: information about geographical location, building geometry and typical use of the school building

1.1 GENERALITIES

Name of the School	Zespół Szkół nr 10 - gym	
School type *More than one answer*	x	Primary
	x	Secondary
		Other:
Student age range	6-15	

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country		Austria
		Croatia
		Germany
		Italy
	x	Poland
		Slovenia
		Hungary
City	x	Bydgoszcz
		Celie
		Karlovac
		Klagenfurt
		Lugo
		Stuttgart
		Szolnok
		Ujszilvás
		Other (Add name):
Latitude [DD.dd°]	53.12°	
Longitude [DD.dd°]	18.02°	
Height above mean sea level [m]	37	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,8	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m^2/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	4
Average floor-to-floor height [m]	8
Total floor heated area [m^2]	2578
Basement area [m^2]	2154
Roof area [m^2]	2310

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m^2]	504	0	568	0	600	0	488	0
Window-to-wall ratio [%]	23	0	15	0	17	0	13	0

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	809
Number of teachers and personnel (estimation)	117
Total area allocated to classrooms [%]	0
Total area allocated to offices [%]	1
Total area allocated to bathrooms [%]	3
Total area allocated to laboratories [%]	0
Total area allocated to Canteen/Cafeteria [%]	1
Total area allocated to Gym [%]	72

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	6
September	22
October	22
November	20
December	21
January	19
February	21
March	22
April	21
May	20
June	22
July	0
Total	216

Daily use [hh:mm-hh:mm] - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	06:00-22:30	06:00-23:00	06:00-23:30	06:00-22:30	06:00-23:00	08:00-12:00	09:00-12:00
Lectures time	07:00-16:45	07:00-15:55	07:00-16:45	07:00-16:45	07:00-15:55	08:00-12:00	

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	feb-16	mar-16	apr-16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]		7004	9518	14050	15831	16571	15873	19030	16608	15773	16512	17242	4981	168992
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		2722	5583	16194	26306	28417	54889	41889	35167	15750	3889	1111	889	232806
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	feb-15	mar-15	apr-15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]		0	0	0	0	0	0	0	0	0	0	0	0	0
b. Natural gas [Sm3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		0	0	0	28611	41111	41111	30278	22889	13806	6306	5000	3778	192889
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]		0	0	0	0	0	0	0	0	0	0	0	0	0
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		0	0	0	0	0	0	0	0	0	0	0	0	0
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
		1950-1960	
		1960-1970	
		1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
	x	>2010	
b. Type of structure		Load bearing masonry wall	
		Reinforced concrete structure	
		Steel frame structure	
		Wood framed	
	x	Prefab modules	
		Other:	

External walls			
a. Type		Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
	x	Prefab wall (concrete)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring	x	Light	
		Medium	
		Dark	

Roofs			
a. Type		Wooden roof	
		Mixed structure of hollow brick and concrete	
	x	Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring	x	Light	
		Medium	
		Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
		Other: (add U value)	Basement on-under ground cavity
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	

Windows		
a. Frame		Wood
	x	PVC
		Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
	x	Double pane glass
		Triple pane glass
		Other: (add U_{window} value)
c. Condition	x	Good/New
		Medium
		Bad/Old
d. Solar shading		External curtain
	x	Internal curtain
	x	Blinds
	x	Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?	x	Yes
		No
b. Combined heating+domestic hot water?		Yes
		No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		2014
h. Emission system		Floor/ceiling radiant panels
		Radiators
		Fan coils
i. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]	20						
k. T set-point during closing hours	20						
l. Winter period [dd.mm-dd.mm]	11.12-19.02						
m. Starting external temperature the heating turns ON (Suggested value: 12°C) [°C]							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	06:00-22:30	06:00-23:00	06:00-23:30	06:00-22:30	06:00-23:00	08:00-12:00	09:00-12:00

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit	2014	
f. N of users	809	
g. N of showers	14	
h. Average daily use of the gym [h/day]	12	

Cooling system		
a. Cooling system?		Yes
		No
b. District cooling?		Yes
		No
c. Cooling generation system		Heat pump
		Trigeneration
		Other:
d. Energy carrier/Fuel		Electricity
		Natural gas/Fuel oil/Diesel/GPL
		Geothermal
		Solar thermal collectors
e. Cooling generation system		Centralised
		One for each room
f. Type of Heat Pump (external unit)		Air/air
		Air/water
		Water/air
		Water/water

		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Total installed electrical power [kW]		
h. Year of installation/retrofit		
i. Emission system		Radiant ceiling
		Fan coils
j. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves
k. Percentage of the floor space cooled above the total floor heated area [%]		

Ventilation		
a. Controlled mechanical ventilation unit?		Yes
	x	No
b. Type of ventilation		Mechanical ventilation without heat recovery system
		Mechanical ventilation with heat recovery system (HRS)
c. (If HRS is present) Year of installation		
d. Percentage of the floor space ventilated above the total floor heated area [%]		

3.3 LIGHTING AND AUXILIARY SYSTEMS

Lighting					
		Rooms (classroom, offices, laboratories)	**Common spaces (corridors, atrium, canteen)**	**Gym**	**External**
a. Type	Traditional incandescent light				
	Halogen light bulbs			x	
	Fluorescent tubes				
	Compact fluorescent light (CFL)				
	LED				
b. Control	Always ON			x	
	Manual				
	Manual on and automatic off				
	Automatic				
c. Number of lights				53	

Canteen		
a. N of hot meals per day		
b. Energy carrier/fuel/power source used to cook		Electricity
		Natural gas
		GPL

Equipment and machineries			
	[number]	Typical power [W]	Average daily hours of use [h/day]
a. PCs			
b. Projectors/Light boards			
c. Printers/copiers			
d. Vending machines			
e. Coolers (in canteen, cafeteria)	2	110	24
f. Elevators			
g. Laboratories	*(Brief description of equipment installed with power, time of use…)*		
h. Other			

3.4 ON SITE RENEWABLE ENERGY SOURCES (RES) INSTALLED

PV systems		
a. PV cells		Yes
	x	No
b. Cells typology		Silicon mono-crystalline
		Silicon poly-crystalline
		Silicon amorphous
c. Power installed [kW]		
d. Year of installation		
e. PV cells area [m^2]		
f. Slope [°]		
g. Orientation [N,NE,E,SE,S,SW,W,NW]		

Solar thermal collectors		
a. Solar thermal system		Yes
	x	No
b. Power installed [kW]		
c. Collector area [m^2]		
d. Year of installation		
e. Slope [°]		
f. Orientation [N,NE,E,SE,S,SW,W,NW]		
g. Hot water storage [L]		

Other RES	
a. Type	
b. Power	
c. Year of installation	

5.7. Secondary school "Zespół Szkół Mechanicznych nr 2, Technical School, Vocational Schools Team" – Main school building

DataSet1: information about geographical location, building geometry and typical use of the school building

1.1 GENERALITIES

Name of the School	ZS Mechanicznych nr 2 -	
School type *More than one answer*		Primary
	x	Secondary
		Other:
Student age range	16-50	

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country		Austria
		Croatia
		Germany
		Italy
	x	Poland
		Slovenia
		Hungary
City	x	Bydgoszcz
		Celle
		Karlovac
		Klagenfurt
		Lugo
		Stuttgart
		Szolnok
		Ujszilvás
		Other (Add name):
Latitude [DD.dd°]	53.13°	
Longitude [DD.dd°]	17.96°	
Height above mean sea level [m]	69	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,9	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m^2/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	4
Average floor-to-floor height [m]	3,3
Total floor heated area [m^2]	3674,45
Basement area [m^2]	763,74
Roof area [m^2]	1212,59

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m^2]	332,83	0	997,92	0	332,83	0	997,92	0
Window-to-wall ratio [%]	21,78	0	34,45	0	22,18	0	36,61	0

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	549
Number of teachers and personnel (estimation)	100
Total area allocated to classrooms [%]	41,31
Total area allocated to offices [%]	10,76
Total area allocated to bathrooms [%]	4,83
Total area allocated to laboratories [%]	0
Total area allocated to Canteen/Cafeteria [%]	0,34
Total area allocated to Gym [%]	12,05

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	0
September	22
October	21
November	20
December	21
January	19
February	21
March	22
April	21
May	20
June	22
July	0
Total	209

Daily use [hh:mm-hh:mm] - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	07:00-16:00	07:00-16:00
Lectures time	07:00-16:00	07:00-16:00	07:00-16:00	07:00-16:00	07:00-21:00	07:00-16:00	07:00-16:00

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	feb-16	mar-16	apr-16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]														57630
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		4.088	2.053	50.579	74.051	74.014	119.160	90.754	79.321	46.479	11.796	3.421	6.176	561.893
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	feb-15	mar-15	apr-15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]														58783
b. Natural gas [Sm3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		3.468	2.998	40.239	74.961	81.167	107.155	86.848	69.599	53.133	19.508	810	1.296	541.183
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]														58195
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		4.607	19.674	51.614	89.946	89.870	101.674	78.350	73.671	43.940	4.350	2.452	4.847	564.995
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
		1950-1960	
		1960-1970	
	x	1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
		>2010	
b. Type of structure		Load bearing masonry wall	
		Reinforced concrete structure	
		Steel frame structure	
		Wood framed	
	x	Prefab modules	
		Other:	

External walls			
a. Type		Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
	x	Prefab wall (concrete)	
		Other: (add U value)	
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Roofs			
a. Type		Wooden roof	
		Mixed structure of hollow brick and concrete	
	x	Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
		Other: (add U value)	Basement on-under ground cavity
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	

Windows		
a. Frame		Wood
	x	PVC
		Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
	x	Double pane glass
		Triple pane glass
		Other: (add U_{window} value)
c. Condition	x	Good/New
		Medium
		Bad/Old
d. Solar shading		External curtain
	x	Internal curtain
	x	Blinds
		Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?	x	Yes
		No
b. Combined heating+domestic hot water?		Yes
		No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		
h. Emission system		Floor/ceiling radiant panels
		Radiators
		Fan coils
i. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]							
k. T set-point during closing hours							
l. Winter period [dd.mm-dd.mm]							
m. Starting external temperature the heating turns ON (Suggested value: 12°C) [°C]							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	06:00-16:00	07:00-16:00

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit	2015	
f. N of users	450	
g. N of showers	6	
h. Average daily use of the gym [h/day]		

Cooling system		
a. Cooling system?		Yes
	x	No
b. District cooling?		Yes
	x	No
c. Cooling generation system		Heat pump
		Trigeneration
		Other:
d. Energy carrier/Fuel		Electricity
		Natural gas/Fuel oil/Diesel/GPL
		Geothermal
		Solar thermal collectors
e. Cooling generation system		Centralised
		One for each room
f. Type of Heat Pump (external unit)		Air/air
		Air/water
		Water/air
		Water/water

		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Total installed electrical power [kW]		
h. Year of installation/retrofit		
i. Emission system		Radiant ceiling
		Fan coils
j. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves
k. Percentage of the floor space cooled above the total floor heated area [%]		

Ventilation		
a. Controlled mechanical ventilation unit?		Yes
	x	No
b. Type of ventilation		Mechanical ventilation without heat recovery system
		Mechanical ventilation with heat recovery system (HRS)
c. (If HRS is present) Year of installation		
d. Percentage of the floor space ventilated above the total floor heated area [%]		

3.3 LIGHTING AND AUXILIARY SYSTEMS

Lighting					
		Rooms (classroom, offices, laboratories)	**Common spaces (corridors, atrium, canteen)**	**Gym**	**External**
a. Type	Traditional incandescent light		x		
	Halogen light bulbs				x
	Fluorescent tubes	x	x	x	
	Compact fluorescent light (CFL)	x			
	LED	x	x	x	
b. Control	Always ON				
	Manual	x	x	x	
	Manual on and automatic off				x
	Automatic				
c. Number of lights		201	187	87	5

Canteen		
a. N of hot meals per day		
b. Energy carrier/fuel/power source used to cook		Electricity
		Natural gas
		GPL

Equipment and machineries			
	[number]	Typical power [W]	Average daily hours of use [h/day]
a. PCs	100	230	5
b. Projectors/Light boards	24	200	2
c. Printers/copiers	18	500	2
d. Vending machines	0		
e. Coolers (in canteen, cafeteria)	4	230	24
f. Elevators	0		
g. Laboratories	*(Brief description of equipment installed with power, time of use…)*		
h. Other - washing maschines	2	230	2

3.4 ON SITE RENEWABLE ENERGY SOURCES (RES) INSTALLED

PV systems		
a. PV cells		Yes
	x	No
b. Cells typology		Silicon mono-crystalline
		Silicon poly-crystalline
		Silicon amorphous
c. Power installed [kW]		
d. Year of installation		
e. PV cells area [m^2]		
f. Slope [°]		
g. Orientation [N,NE,E,SE,S,SW,W,NW]		

Solar thermal collectors		
a. Solar thermal system		Yes
	x	No
b. Power installed [kW]		
c. Collector area [m^2]		
d. Year of installation		
e. Slope [°]		
f. Orientation [N,NE,E,SE,S,SW,W,NW]		
g. Hot water storage [L]		

Other RES	
a. Type	
b. Power	
c. Year of installation	

5.8. Secondary school "Zespół Szkół Mechanicznych nr 2, Technical School, Vocational Schools Team" - Practical education centre

DataSet1: information about geographical location, building geometry and typical use of the school building

1.1 GENERALITIES

Name of the School	ZS Mechanicznych nr 2 -	
School type *More than one answer*		Primary
	x	Secondary
		Other:
Student age range	16-50	

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country		Austria
		Croatia
		Germany
		Italy
	x	Poland
		Slovenia
		Hungary
City	x	Bydgoszcz
		Celie
		Karlovac
		Klagenfurt
		Lugo
		Stuttgart
		Szolnok
		Ujszilvas
		Other (Add name):
Latitude [DD.dd°]	53.12°	
Longitude [DD.dd°]	17.96°	
Height above mean sea level [m]	69	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,1	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m²/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	2
Average floor-to-floor height [m]	9
Total floor heated area [m²]	4480,87
Basement area [m²]	3593,75
Roof area [m²]	3593,75

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m²]	195,4		541,6		670,2		414	
Window-to-wall ratio [%]	50,5		26,8		34,5		14,8	

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	549
Number of teachers and personnel (estimation)	100
Total area allocated to classrooms [%]	2,26
Total area allocated to offices [%]	3,87
Total area allocated to bathrooms [%]	2,41
Total area allocated to laboratories [%]	50,8
Total area allocated to Canteen/Cafeteria [%]	2,18
Total area allocated to Gym [%]	

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	0
September	22
October	21
November	20
December	21
January	19
February	21
March	22
April	21
May	20
June	22
July	0
Total	209

Daily use [hh:mm-hh:mm] - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	07:00-16:00	07:00-16:00
Lectures time	07:00-16:00	07:00-16:00	07:00-16:00	07:00-16:00	07:00-21:00	07:00-16:00	07:00-16:00

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	feb-16	mar-16	apr-16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]			4729,78		6560,74		6145,12		5270,2		5434,86		1825,82	29967
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		2.453	2.464	8.710	11.238	12.146	25.659	15.656	15.366	9.688	5.233	4.025	7.206	119.843
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source* *specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	feb-15	mar-15	apr-15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]			3598,3		6919		7654		8487,9		4131		2327	33117
b. Natural gas [Sm3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		6.936	4.437	7.728	13.284	12.139	15.976	13.250	13.620	9.859	8.600	1.013	1.426	108.266
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source* *specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]			8111		13724	11184	7777		9895		7194		2777	60661
b. Natural gas [Sm^3]														
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		3.686	2.222	9.805	12.824	15.185	16.177	12.357	11.770	7.940	4.893	3.678	3.525	104.063
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source* *specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
		1950-1960	
	x	1960-1970	
		1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
		>2010	
b. Type of structure		Load bearing masonry wall	
	v	Reinforced concrete structure	
		Steel frame structure	
		Wood framed	
		Prefab modules	
		Other:	

External walls			
a. Type		Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
	x	Prefab wall (concrete)	
		Other: (add U value)	
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	
c. Main external coloring		Light	
		Medium	
	x	Dark	

Roofs			
a. Type		Wooden roof	
		Mixed structure of hollow brick and concrete	
	x	Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
		Other: (add U value)	basement on-under ground cavity
b. Insulation	x	No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
		High [>10 cm]	

Windows		
a. Frame		Wood
	x	PVC
		Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
	x	Double pane glass
		Triple pane glass
		Other: (add U_{window} value)
c. Condition	x	Good/New
		Medium
		Bad/Old
d. Solar shading		External curtain
	x	Internal curtain
	x	Blinds
	x	Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?	x	Yes
		No
b. Combined heating+domestic hot water?		Yes
		No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		
h. Emission system		Floor/ceiling radiant panels
		Radiators
		Fan coils
i. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]							
k. T set-point during closing hours							
l. Winter period [dd.mm-dd.mm]							
m. Starting external temperature the heating turns ON (Suggested value: 12°C) [°C]							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	06:00-22:00	07:00-16:00	07:00-16:00

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit		
f. N of users		450
g. N of showers		6
h. Average daily use of the gym [h/day]		

Cooling system		
a. Cooling system?		Yes
		No
b. District cooling?		Yes
		No
c. Cooling generation system		Heat pump
		Trigeneration
		Other:
d. Energy carrier/Fuel		Electricity
		Natural gas/Fuel oil/Diesel/GPL
		Geothermal
		Solar thermal collectors
e. Cooling generation system		Centralised
		One for each room
f. Type of Heat Pump (external unit)		Air/air
		Air/water
		Water/air

f. Type of Heat Pump (external unit)		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Total installed electrical power [kW]		
h. Year of installation/retrofit		
i. Emission system		Radiant ceiling
		Fan coils
j. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves
k. Percentage of the floor space cooled above the total floor heated area [%]		

Ventilation		
a. Controlled mechanical ventilation unit?		Yes
	x	No
b. Type of ventilation		Mechanical ventilation without heat recovery system
		Mechanical ventilation with heat recovery system (HRS)
c. (If HRS is present) Year of installation		
d. Percentage of the floor space ventilated above the total floor heated area [%]		

3.3 LIGHTING AND AUXILIARY SYSTEMS

Lighting					
		Rooms (classroom, offices, laboratories)	Common spaces (corridors, atrium, canteen)	Gym	External
a. Type	Traditional incandescent light		x		
	Halogen light bulbs				
	Fluorescent tubes	x	x		
	Compact fluorescent light (CFL)	x			
	LED				
b. Control	Always ON				
	Manual	x	x		
	Manual on and automatic off				
	Automatic				
c. Number of lights		326	73		

Canteen		
a. N of hot meals per day		
b. Energy carrier/fuel/power source used to cook	x	Electricity
	x	Natural gas
		GPL

Equipment and machineries			
	[number]	Typical power [W]	Average daily hours of use [h/day]
a. PCs			
b. Projectors/Light boards			
c. Printers/copiers			
d. Vending machines	1	230	2
e. Coolers (in canteen, cafeteria)	1	230	24
f. Elevators			
g. Laboratories	*(Brief description of equipment installed with power, time of use…)* *Workshops - metalworking, welding station, equipment for electrical measurements. Workshops sewing - sewing machines, irons, dishes, computer lab - the worksities of students and teacher with desktop computers with monitors, printers. Use - during class student, qualification courses, practical*		
h. Other - wasching machines	1	230	2

3.4 ON SITE RENEWABLE ENERGY SOURCES (RES) INSTALLED

PV systems		
a. PV cells		Yes
	x	No
b. Cells typology		Silicon mono-crystalline
		Silicon poly-crystalline
		Silicon amorphous
c. Power installed [kW]		
d. Year of installation		
e. PV cells area [m^2]		
f. Slope [°]		
g. Orientation [N,NE,E,SE,S,SW,W,NW]		

Solar thermal collectors		
a. Solar thermal system		Yes
	x	No
b. Power installed [kW]		
c. Collector area [m^2]		
d. Year of installation		
e. Slope [°]		
f. Orientation [N,NE,E,SE,S,SW,W,NW]		
g. Hot water storage [L]		

Other RES	
a. Type	
b. Power	
c. Year of installation	

5.9. Primary school "Szkoła Podstawowa nr 10"

DataSet1: information about geographical location, building geometry and typical use of the school building

1.1 GENERALITIES

Name of the School		Szkoła Podstawowa nr
School type *More than one answer*	x	Primary
		Secondary
		Other:
Student age range		6-13

1.2 GEOGRAPHICAL LOCATION AND WEATHER CONDITIONS

Country		Austria
		Croatia
		Germany
		Italy
	x	Poland
		Slovenia
		Hungary
City	x	Bydgoszcz
		Celie
		Karlovac
		Klagenfurt
		Lugo
		Stuttgart
		Szolnok
		Ujszilvás
		Other (Add name):
Latitude [DD.dd°]		53.13°
Longitude [DD.dd°]		17.99°
Height above mean sea level [m]		42

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily average temperature [°C]	-1,7	-1,1	2,5	8,5	13,6	16,6	19,1	18,4	13,7	8,9	4,6	-0,2
Horizontal solar irradiation [Wh/m^2/day]	576	1190	2740	4360	5260	5570	5210	4410	3130	1780	702	455

1.3 BUILDING GEOMETRY

Number of floor levels	4
Average floor-to-floor height [m]	3,19
Total floor heated area [m^2]	2799
Basement area [m^2]	729,25
Roof area [m^2]	1164,6

Orientation	N	NE	E	SE	S	SW	W	NW
Exterior wall area [m^2]		942,24		597,4		942,24		597,4
Window-to-wall ratio [%]		19,9		8,5		12,7		9,6

1.4 OCCUPATION AND USE OF THE BUILDING

Number of students	329
Number of teachers and personnel (estimation)	53
Total area allocated to classrooms [%]	36,4
Total area allocated to offices [%]	7,15
Total area allocated to bathrooms [%]	3,58
Total area allocated to laboratories [%]	
Total area allocated to Canteen/Cafeteria [%]	4,64
Total area allocated to Gym [%]	5,65

DAYS OF USE (Weekends and Vacations excluded) SCHOOL YEAR 2015-2016	
Month	Number of days (estimation)
August	0
September	22
October	22
November	18
December	14
January	13
February	21
March	18
April	20
May	18
June	18
July	0
Total	184

Daily use [hh:mm-hh:mm] - SCHOOL YEAR 2015-2016							
	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Opening hours	06:30-20:00	06:30-20:00	06:30-20:00	06:30-20:00	06:30-20:00		
Lectures time	08:00-14:30	08:00-14:30	08:00-14:30	08:00-14:30	08:00-14:30		

DataSet2: information about energy consumption, related to different energy carriers/fuels or systems

SCHOOL YEAR 2015-2016

Energy carrier/Fuel/Power source		Aug-15	Sep-15	Oct-15	Nov/15	Dec-15	Jan-16	feb-16	mar-16	apr-16	may-16	Jun-16	Jul-16	TOT
a. Electricity [kWh$_e$]		1352	2949	3558	3696	3204	2657	3508	3275	3260	3026	2757	1090	34331
b. Natural gas [Sm^3]														476
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		1.528	1.917	19.722	28.861	24.667	47.611	33.861	31.278	15.111	4.694	2.111	1.306	212.667
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2014-2015

Energy carrier/Fuel/Power source		Aug-14	Sep-14	Oct-14	Nov/14	Dec-14	Jan-15	feb-15	mar-15	apr-15	may-15	Jun-15	Jul-15	TOT
a. Electricity [kWhe]		1186	2819	3507	3589	3095	3472	2459	3259	2965	2986	2669	1413	33420
b. Natural gas [Sm3]														501
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWht]		1.389	2.444	15.528	32.194	43.056	33.417	33.111	26.028	18.167	6.694	2.306	1.444	215.778
g. District cooling [kWht]														
h. Photovoltaics [kWhe]	Produced													
	Consumed													
i. Solar thermal collectors [kWht]	Produced													
	Consumed													
j. Geothermal energy [kWht]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

SCHOOL YEAR 2013-2014

Energy carrier/Fuel/Power source		Aug-13	Sep-13	Oct-13	Nov/13	Dec-13	Jan-14	feb-14	mar-14	apr-14	may-14	Jun-14	Jul-14	TOT
a. Electricity [kWh$_e$]								3830	4143	3429	3408	3103	1752	19665
b. Natural gas [Sm^3]														536
c. Fuel oil/Diesel [kg]														
d. GPL [kg]														
e. Biomass [kg]														
f. District heating [kWh$_t$]		0	278	11.944	38.056	35.556	45.556	35.556	28.611	14.167	8.611	1.944	1.944	222.222
g. District cooling [kWh$_t$]														
h. Photovoltaics [kWh$_e$]	Produced													
	Consumed													
i. Solar thermal collectors [kWh$_t$]	Produced													
	Consumed													
j. Geothermal energy [kWh$_t$]	Produced													
	Consumed													
k. Other carrier/fuel/power source*														
*specify the measuring unit														

DataSet3: information about building envelope characteristics, heating and cooling systems, lighting and auxiliary systems.

Building structure			
a. Year of construction		<1940	
		1940-1950	
	x	1950-1960	
		1960-1970	
		1970-1980	
		1980-1990	
		1990-2000	
		2000-2010	
		>2010	
b. Type of structure	x	Load bearing masonry wall	
		Reinforced concrete structure	
		Steel frame structure	
		Wood framed	
		Prefab modules	
		Other:	

External walls			
a. Type	x	Traditional fired-clay brick masonry	
		Cavity wall	
		Concrete hollow blocks	
		Fired-clay hollow blocks	
		Prefab wall (sandwich)	
		Prefab wall (concrete)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring	x	Light	
		Medium	
		Dark	

Roofs			
a. Type	x	Wooden roof	
		Mixed structure of hollow brick and concrete	
		Concrete flat roof (accessible plane)	
		Other: (add U value)	
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	
c. Main external coloring		Light	
	x	Medium	
		Dark	

Basement			
a. Type		Basement on crawl space/Floor on ground	
		Hollow-core concrete floor on pilotis	
		Other: (add U value)	Basement on-under ground cavity
b. Insulation		No insulation	
		Low [2-5 cm]	
		Medium [5-10 cm]	
	x	High [>10 cm]	

Windows		
a. Frame		Wood
	x	PVC
		Aluminium
		Steel
b. Glass		Single pane glass
		Laminated glass
	x	Double pane glass
		Triple pane glass
		Other: (add U_{window} value)
c. Condition	x	Good/New
		Medium
		Bad/Old
d. Solar shading		External curtain
	x	Internal curtain
	x	Blinds
	x	Shutters

3.2 HVAC – HEATING, VENTILATING AND AIR CONDITIONING

Heating system		
a. District heating?	x	Yes
		No
b. Combined heating+domestic hot water?		Yes
		No
c. Heat generation system *More than one answer*		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Electrical heating
		Biomass boiler
		Cogeneration
d. Energy carrier/Fuel *More than one answer*		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
e. Total installed thermal* power [kW]		
f. Type of Heat Pump (if Heat pump is selected)		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
g. Year of installation/retrofit		
h. Emission system		Floor/ceiling radiant panels
		Radiators
		Fan coils
i. Control system *More than one answer*		Not present
		On/off
		External climate probe
		Zone thermostat
		Thermostatic Valves

j. T set-point ON (Suggested value: 20°C) [°C]							
k. T set-point during closing hours							
l. Winter period [dd.mm-dd.mm]							
m. Starting external temperature the heating turns ON (Suggested value: 12°C) [°C]							
n. Time of use [hh:mm-hh:mm]	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	06:30-20:00	06:30-20:00	06:30-20:00	06:30-20:00	06:30-20:00		

Domestic Hot Water		
a. Heat generation system *More than one answer*		Electrical boiler
		Natural gas boiler
		Oil/GPL boiler
		Heat pump
		Ground coupled heat pump (geothermal)
		Solar thermal collectors
		Biomass boiler
		Cogeneration
b. Energy carrier/Fuel		Electricity
		Natural gas
		Fuel oil/Diesel/GPL
		Biomass
		Solar thermal power
		Geothermal power
c. Installed power [kW]		
(if Heat pump is selected) d. Type of Heat Pump		Air/air
		Air/water
		Water/air
		Water/water
		Brine/air (if geothermal)
		Brine/water (if geothermal)
e. Year of installation/retrofit	2012	
f. N of users	337	
g. N of showers	2	
h. Average daily use of the gym [h/day]		

Cooling system		
a. Cooling system?		Yes
		x
b. District cooling?		Yes
		No
c. Cooling generation system		Heat pump
		Trigeneration
		Other:
d. Energy carrier/Fuel		Electricity
		Natural gas/Fuel oil/Diesel/GPL
		Geothermal
		Solar thermal collectors
e. Cooling generation system		Centralised
		One for each room
f. Type of Heat Pump (external unit)		Air/air
		Air/water
		Water/air
		Water/water