Internal workshop for best practice sharing

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1. Aim of the document

The aim of this report is to collect and present the best practices for energy efficiency in schools presented by the partners in the Warsaw internal workshop of Otober 10th, 2018.

Annex 1

3rd meeting
Warsaw / 9th October 2018 to 10th October 2018

NzEB BAT

HEP ESCO / Financial and Legal Department / Goran Hanžek

T1.2.3 NZEB BEST PRACTICES

Interreg CENTRAL EUROPE FEEDSCHOOLS

LIST OF BEST PRACTICES:

1. DUGA RESA: ELEMENTARY SCHOOL IVAN GORAN KOVAČIĆ
2. KLANJEC: ELEMENTARY SCHOOL ANTUN MIHANOVIĆ
3. SOLIN: KINDERGARTEN SALONA
4. KLIS: KINDERGARTEN SVETI ANTE – PRUGOVO
5. DUGO SELO: KINDERGARTEN DUGO SELO (LUKARIŠĆE)
6. RIJEKA: HOME FOR CHILDREN LOVRAN
7. DUGA RESA: HIGH SCHOOL DUGA RESA

T1.2.3 NZEB BEST PRACTICES

1. ELEMENTARY SCHOOL IVAN GORAN KOVAČIĆ (DUGA RESA)

- Total floor area: 2029 m²
- Number of storeys: 3
- Number of classrooms: 12
- Urban context: Not isolated
- Number of pupils: > 200
- Use profile: 2 shifts (06:00 - 21:00) from Monday to Friday

TAKING COOPERATION FORWARD 3

T1.2.3 NZEB BEST PRACTICES

1. ELEMENTARY SCHOOL IVAN GORAN KOVAČIĆ (DUGA RESA)

- Aim of the renovation:
  - lower the buildings energy consumption
  - improve comfort and work conditions for all users of the building
- Implemented energy efficiency measures:
  1. Replacement of the old wooden windows with new highly efficient PVC windows (double IZO glass, Low E, Uw≤1,4 Wm²/K)
  2. Insulation of the facade - thermal insulation, polystyrene d=6 cm (U=0,45 W/m²K)

TAKING COOPERATION FORWARD 4

T1.2.3 NZEB BEST PRACTICES

1. ELEMENTARY SCHOOL IVAN GORAN KOVAČIĆ (DUGA RESA)

- Savings: 250.000 kWh/year
  15.000 €/year

Main entrance - before

Main entrance - after

T1.2.3 NZEB BEST PRACTICES

2. ELEMENTARY SCHOOL ANTUN MIHANOVIĆ (KLANJEC)

- Total floor area: 1800 m²
- Number of storeys: 2
- Number of classrooms: 10
- Urban context: Not isolated
- Number of pupils: 286
- Use profile: 1 shift (08:00 - 14:00) from Monday to Friday

T1.2.3 NZEB BEST PRACTICES

2. ELEMENTARY SCHOOL ANTUN MIHANOVIĆ (KLANJEC)

- Aim of the renovation:
  - lower the buildings energy consumption
  - improve comfort and work conditions for all users of the building
- Implemented energy efficiency measures:
  1. Replacement of the old wooden windows with new highly efficient PVC windows (double IZO glass, Low E, Uw≤1,4 Wm^2/K)
  2. Installation of thermostatic valves (70 pieces)

T1.2.3 NZEB BEST PRACTICES

2. ELEMENTARY SCHOOL ANTUN MIHANOVIĆ (KLANJEC)

- Savings: 70.000 kWh/year
  2.800 €/year

Windows- before

Windows - after

T1.2.3 NZEB BEST PRACTICES

3. KINDERGARTEN SALONA (SOLIN)

- Total floor area: 586,94 m²
- Number of storeys: 2
- Number of classrooms: 10
- Urban context: Isolated
- Number of pupils: 100
- Use profile: 2 shifts (06:00-16:00 h) from Monday to Friday. Approximately 280 working days per year.

T1.2.3 NZEB BEST PRACTICES

3. KINDERGARTEN SALONA (SOLIN)

- Aim of the renovation:
  - lower the buildings energy consumption from 52,70 kWh/m² year (Energy class C) to 10,54 kWh/m² year (Energy class A)
  - improve comfort and work conditions for all users of the building

- Implemented energy efficiency measures:
  1. Renovation of building envelope. Insulation of the facade - thermal insulation,mineral wool d=12cm (λ<=0,035 W/mK) and insulation of the roof, mineral wool d=20cm (λ<=0,037 W/mK)

T1.2.3 NZEB BEST PRACTICES

3. KINDERGARTEN SALONA (SOLIN)

- Savings: 24.800 kWh/year
  3.200 €/year

South facade - before

South facade - after

T1.2.3 NZEB BEST PRACTICES

4. KINDERGARTEN SVETI ANTE – PRUGOVO (KLIS)

- Total floor area: 219,77 m^2
- Number of storeys: 2
- Number of classrooms: 3
- Urban context: Isolated
- Number of pupils: 26
- Use profile: 2 shifts (06:00-16:00 h) from Monday to Friday. Approximately 280 working days per year.

T1.2.3 NZEB BEST PRACTICES

4. KINDERGARTEN SVETI ANTE – PRUGOVO (KLIS)

- Aim of the renovation:
  - Renovation of indoor lighting system
  - improve comfort and work conditions for all users of the building
- Implemented energy efficiency measures:
  1. Replacement of the old fluorescent and incadescent lighting with a new LED Tubes (10 W, 72 pieces)and LED bulbs (10 W,11 pieces)

T1.2.3 NZEB BEST PRACTICES

4. KINDERGARTEN SVETI ANTE – PRUGOVO (KLIS)

- Savings: 4.500 kWh/year
  590 €/year

Indoor lighting- before

Indoor lighting - after

T1.2.3 NZEB BEST PRACTICES

5. KINDERGARTEN DUGO SELO (LUKARIŠĆE)

- Total floor area: 218,34 m²
- Number of storeys: 2
- Number of classrooms: 2
- Urban context: Isolated
- Number of pupils: 60
- Use profile: 2 shifts (06:00-18:00 h) from Monday to Friday. Approximately 250 working days per year.

T1.2.3 NZEB BEST PRACTICES

5. KINDERGARTEN DUGO SELO (LUKARIŠĆE)

- Aim of the renovation:
  - Lower the buildings energy consumption from 155,63 kWh/m² year (Energy class D) to 65,86 kWh/m² year (Energy class B)improve comfort and work conditions for all users of the building
- Implemented energy efficiency measures:
  1. Insulation of the facade - thermal insulation,mineral wool d=14 cm (λ<=0,039 W/mK),
  2. Insulation of the roof, mineral wool d=18 cm (λ<=0,040 W/mK),
  3. Partial replacement of the windows (new PVC windows),

T1.2.3 NZEB BEST PRACTICES

5. KINDERGARTEN DUGO SELO (LUKARIŠĆE)

- Implemented energy efficiency measures:
  4. Replacement of the old gas boiler with a new energy efficient condensing boiler (P=24 kW),
  5. Installation of thermostatic valves (16 pieces)
  6. Installation of solar collectors (A=6,9 m^2) for heating DHW and space heating

T1.2.3 NZEB BEST PRACTICES

5. KINDERGARTEN DUGO SELO (LUKARIŠĆE)

- Savings: 30.140 kWh/year
  1.560 €/year

North-east facade - before

North-east facade - after

T1.2.3 NZEB BEST PRACTICES

6. HOME FOR CHILDREN LOVRAN (RIJEKA)

- Total floor area: 419,54 m²
- Number of storeys: 3
- Number of classrooms: 8
- Urban context: Not Isolated
- Number of pupils: 20
- Use profile: 24h/day from Monday to Sunday. 365 working days per year.

T1.2.3 NZEB BEST PRACTICES

6. HOME FOR CHILDREN LOVRAN (RIJEKA)

- Aim of the renovation:
  - lower the buildings energy consumption from 52,70 kWh/m² year (Energy class C) to 10,54 kWh/m² year (Energy class A)
  - improve comfort and work conditions for all users of the building

T1.2.3 NZEB BEST PRACTICES

6. HOME FOR CHILDREN LOVRAN (RIJEKA)

- Implemented energy efficiency measures:
  1. Replacement of the windows (new PVC windows) - Old windows were replaced with new highly efficient PVC windows (double IZO glass 4/16/4, Low E, Uw≤1,4 Wm^2/K).
  2. Installation of a separate gas meter and reconstruction of the heating system - Implementation included installation of new efficient gas condensing boiler (P=45kW) with separate gas meter. Also new pipeline and radiators with thermostatic valves were installed.
  3. Installation of solar collectors (A=6,9 m^2) for heating DHW (domestic hot water). New water tank (V=300 l) was also installed.

T1.2.3 NZEB BEST PRACTICES

6. HOME FOR CHILDREN LOVRAN (RIJEKA)

- Savings: 52.000 kWh/year
  2.400 €/year

North facade - before

North facade - after

T1.2.3 NZEB BEST PRACTICES

7. HIGH SCHOOL DUGA RESA (DUGA RESA)

- Total floor area: 2.032 m²
- Number of storeys: 3
- Number of classrooms: 22
- Urban context: Not Isolated
- Number of pupils: >100
- Use profile: 1 shift (07:00-15:00 h) from Monday to Friday.

T1.2.3 NZEB BEST PRACTICES

7. HIGH SCHOOL DUGA RESA (DUGA RESA)

- Aim of the renovation:
  - lower the buildings energy consumption
  - improve comfort and work conditions for all users of the building

- Implemented energy efficiency measures:
  1. Replacement of the windows (new PVC windows). Old windows were replaced with new highly efficient PVC windows (double IZO glass 4/16/4, Low E, Uw≤1,4 Wm²/K).
  2. Reconstruction of the oil boiler room (new boiler 560 kW, automatic regulation, new radiators + thermostatic valves)

T1.2.3 NZEB BEST PRACTICES

7. HIGH SCHOOL DUGA RESA (DUGA RESA)

- Savings: 200.000 kWh/year
  13.200 €/year

Main entrance - before

Main entrance - after

T1.2.3 NZEB BEST PRACTICES

Summary on data findings:

- Examples given for best practices represent real implemented projects
- HEP – ESCO has a reference of more than 90 implemented energy efficiency projects
- Results and measurements from implemented projects show:
  - measures on building envelope (thermal insulation, windows replacement…) **produce biggest energy savings** but on the other hand those measures usually have **longest payback period.**
  - measures on building envelope are **crucial for gaining nZEB standard**

T1.2.3 NZEB BEST PRACTICES

Interreg CENTRAL EUROPE FEEDSCHOOLS

Summary on data findings:

- Results and measurements from implemented projects show:
  - measures on heating and cooling system usually have **more favorable payback period.**
  - It is recommended to implement measures on heating and cooling system **after renovation of the building envelope.**
  - Measures on lighting system usually have **shortest pay back period** and easiest and shortest installation
  - Measures with RES (Renewable Energy Sources) are **mandatory for nZEB buildings.** Payback period for these measures can differentiate a lot.
  - Solar collectors for heating DHW usually have shorter payback period than Photovoltaics.

T1.2.3 NZEB BEST PRACTICES

Interreg CENTRAL EUROPE FEEDSCHOOLS

Summary on data findings:

- Results and measurements from implemented projects show:
  - Measures with heat pumps usually have **significant investement** but can be **very cost effective** if they are selected correctly
  - As a conclusion – practice proves that nZEB standard for existing buildings means big investement and great savings

T1.2.3 NZEB BEST PRACTICES

Interreg CENTRAL EUROPE FEEDSCHOOLS

Significance of these measurse on country level:

- Contribution in achieving national objective for savings regarding Article 7 of EU Directive on the energy performance of buildings
- Reduction of overall energy consumption
- Reduction of CO2 emission

Annex 2

Internal workshop for best practice sharing
Warszawa | 10/10/2018

Best practices in schools - Czech Republic

FeedSchools | Pavel Ruzicka, ENVIROS

NATIONAL REGULATION

Legislation	Content
Act No 406/2000 on Energy Management	Basic requirements that must be followed during construction, re-construction, operation and maintenance of buildings.
Decree No 480/2012 on Energy Audit	Compulsory content of an energy audit and how it shall be elaborated.
Decree No 78/2013 on Energy Performance of Buildings	Elaboration of an energy performance of buildings assessment.
Act No 561/2004 on School Education	Main requirements to be applied at all levels of a school system. However, there are no provisions relevant for buildings.
Act No 128/2000 on Municipalities Act No 129/2000 on Regions	Main financial responsibilities and financial management of municipalities/regions. However the Acts do not set any specific requirements regarding schools.

- No regulation at regional nor local level

TAKING **COOPERATION** FORWARD 2

TYPE OF SCHOOL BUILDINGS

Historical buildings

- Older than 100 years
- Often protected as cultural heritage
- Brick structure, saddleback roof, 2-3 floors
- Usually not insulated, but with new windows and insulated roof

Buildings from 70s and 80s

- Pavilion houses, panel construction, flat roof, 1-2 floors
- Overwhelming majority already insulated and windows changed

SUPPORT FOR ENERGY RENOVATIONS

Past financial programmes

- Operational Programme Environment 2007 – 2013
- State Environmental Fund – national programme
- „Sun to Schools“
- Energy Performance Contracting

Current financial programmes

- Operational Programme Environment 2014 – 2020
- Programme EFEKT
- Energy Performance Contracting

SUPPORT FOR ENERGY RENOVATIONS

Non-financial mechanisms

- Database of Products and Technologies
  - Under New Green Savings Programme (NGS)
  - Technical characteristics of products and materials
- ENVIMAT
  - Interactive catalogue of building materials and structures
  - Assessment and comparison of environmental impacts

SCHOOL RENOVATIONS
BEST PRACTICE EXAMPLES

- 9 examples in the database
  - Pavilion buildings from 70s/80s
  - Old buildings from 20s/30s
  - Examples of buildings from 50s/60s

- Insulation of building envelop + new windows
- Thermostatic radiator valves
- Energy source remained unchanged

SCHOOL RENOVATIONS
BEST PRACTICE EXAMPLES

ZS Litvinovska, Prague

- Three interconnected buildings (classrooms, kitchen, canteen, after-school childcare, gym)
- Constructed in the 1970s, additional classroom storey in 2003
- Reconstruction in 2014 (wall insulation, flat roof insulation, windows replacement)

Savings:

- Heat savings = about 414 MWh/per year
- Financial savings = 25 thous. EUR/per year

SCHOOL RENOVATIONS
BEST PRACTICE EXAMPLES

ZS 1. maje, Dobrany

- Two interconnected buildings (classrooms, gym)
- Constructed in 1928 – 1930
- Reconstruction in 2014 (wall insulation, roof insulation, windows replacement)

Savings:

- Heat savings = about 489 MWh/per year
- Financial savings = 7 thous. EUR/per year

SCHOOL RENOVATIONS
BEST PRACTICE EXAMPLES

ZS Trebizskeho, Kralupy nad Vltavou

- Three interconnected buildings (assembly hall, offices, afterschool child care; classrooms, canteen, kitchen; gym)
- Constructed in the 1950s.
- Reconstruction in 2011 (wall insulation, roof insulation, windows replacement, heating of a cellar)

Savings:

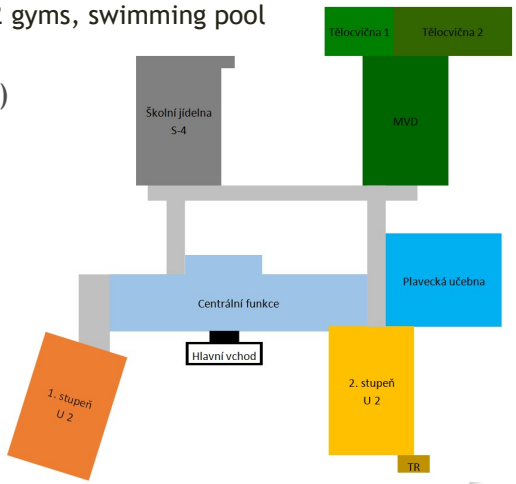
- Heat savings = about 316 MWh/per year
- Financial savings = 15 thous. EUR/per year

SELECTED SCHOOLS

City	Schools
Louny	ZŠ Prokopa Holého
Jablonec nad Nisou	ZŠ Rýnovice
Ostrava	ZŠ a MŠ V. Košaře ZŠ gen. Škarvady ZŠ gen. Píky ZŠ Dvorského ZŠ Pěší ZŠ Chrjukinova ZŠ Aleše Hrdličky

EXAMPLE
ZŠ PROKOPA HOLÉHO, LOUNY

- 7 interconnected pavilions
  - Classrooms, kitchen and canteen, afterschool childcare (incl. Ceramic workshop), 2 gyms, swimming pool
  - 1-3 floors
- 800 pupils (27 classrooms)



EXAMPLE
ZŠ PROKOPA HOLÉHO, LOUNY

- Central heating system + Individual Room Control system
- Forced ventilation system in 2 pavilions (canteen, swimming pool)
- Old type of lighting
- All pavilions already insulated (12-16 cm EPS), and windows changed (double glazed)

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EXAMPLE
ZŠ PROKOPA HOLÉHO, LOUNY

Identified measures	
No-cost measures	• Application of energy management principles (e.g. ventilation, lighting) • Awareness raising
Low-cost measures	• Energy efficient electric appliances • Use of waste heat from filter washing process in the swimming pool
Investment measures	Heating of water in the swimming pool by a heat pump / solar panels Heating of sanitary water by heat pump / solar panels LED lighting Substitution of central heating by gas boiler Installation of PV panels Additional insulation of the roof

Thank you for your attention

Annex 3

3th Meeting
Warsaw 10th October 2018

Best Practices

FEEDSCHOOLS - ENEA - Maria-Anna Segreto, Giovanni Margareci and Alessandra Gugliandolo

PRIMARY SCHOOL (Marinella di Bruino, TO - ITALY)

Interreg CENTRAL EUROPE FEEDSCHOOLS

Information about city

Bruino (Bruin in Piedmontese) is an Italian municipality of 8586 inhabitants in pronince of Turin in Piedmont. Located about 20 kilometers west of the capital, it stands on the right bank of the Sangone torrent, near the homonymous valley.

Climate and Temperature data

Below the climate zone assigned by the 412/93 Decree.

Degrees Day	2834
Climate zone (according to italian law)	E
Altitude	320 m
Surface	5,57 km^2
Inhabitans	8586
Coordinates	45°01'N7°28E
Density	1.541,47 inh/Km^2

TAKING COOPERATION FORWARD 2

PRIMARY SCHOOL (Marinella di Bruino, TO - ITALY)

INFORMATION ABOUT HEATING AND COOLING OPERATIONAL PERIOD

The operational period of the Italian heating system is defined by a national law. The Italian Decree 412/93, it divides Italy into 6 different climatic zones ranging from A (the hottest) to F (the coldest) depending on the degrees day.

Each climatic zone is divided in range of Degrees Day (DD): the degrees day of a location is the unit of measurement that estimates the energy requirements to maintain a comfortable internal climate in buildings. It represents the sum, extended to each day of a conventional annual heating period, of the average daily temperature you need to reach 20°C. Higher is the DD value, cooler is the zone.

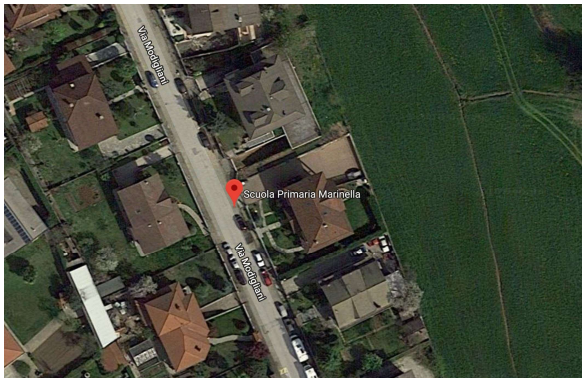
Climatic Zone	Degrees-Day	Period	Number of hours
A	Municipality DD ≤ 600	1° december - 15 march	6 hours for day
B	600 < Municipality DD≤ 900	1° december - 31 march	8 hours for day
C	900 < Municipality DD GG ≤ 1.400	15 november - 31 march	10 hours for day
D	1.400 < Municipality DD ≤ 2.100	1° november - 15 april	12 hours for day
E	2.100 < Municipality DD ≤ 3.000	15 october - 15 april	14 hours for day
F	Municipality DD > 3.000	All the year if necessary	No limit

PRIMARY SCHOOL (Marinella di Bruino, TO - ITALY)

MARINELLA DI BRUINO SCHOOL GENERAL INFORMATION

The "Marinella Primary School" of Bruino (Turin) was built in the first half of the '70s. The building is spread over two floors and it is served by a central heating system, placed on the groundfloor. The building is used both during the day for school activities and during evening time for additional activities such as dance classes and other sports activities.

Type of school	Primary school (6-10 years old)
Number of pupils/classrooms	19 (total 93)
Number of other people that work in it	91
Use profile	Morning and afternoon (Monday-Friday) only morning on Saturday.
Urban context	Downtown
Classrooms	5
Rooms	offices
	gym
	laboratories
	hygienic services
	Multiporpose room



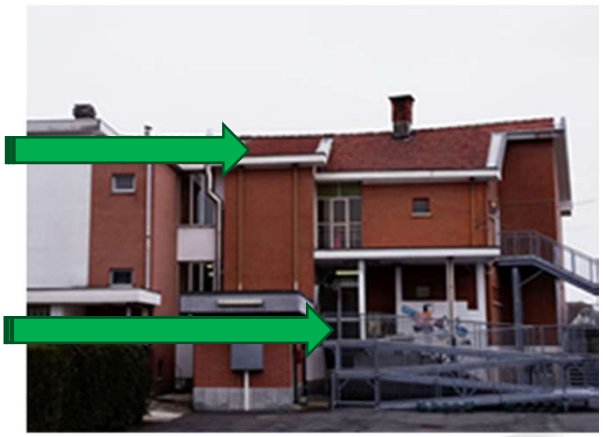
Height for each storey	000 m
Heated Volume	00000 m^3
Dispersing surface	00000 m^2
Shape ratio	000000 m^{-1}
Total floor surface	000000 m^2

PRIMARY SCHOOL (Marinella di Bruino, TO - ITALY)

GENERAL DESCRIPTION ABOUT ENERGY ISSUES

The main source of heat dispersion was due to poor **insulation of the roof**. Thanks to the insulation of the roof it was possible to achieve environmental comfort (20°C), with an important saving of primary energy. It were used double panels of high-density glass wool to obtain the mandatory minimum requirements.

The existing wooden windows with simple glass were replaced with PVC thermal break **windows** equipped with low emissivity glass. The final U value for windows is less than 1.3 W / m^2K



PRIMARY SCHOOL (Marinella di Bruino, TO - ITALY)

SHORT DESCRIPTION OF THE RENOVATION AND ITS PURPOSE

The most important aim of the project was to reduce primary energy consumption and polluting emissions. The building needed an important refurbishment focused mainly on energy efficiency.

Another improvement action was made on the envelope: it was installed an **external walls insulation** with 14 cm panels of graphite EPS; the intervention reduces thermal bridges and improves the summer thermal comfort performance with significant energy advantages even in winter.

PRIMARY SCHOOL (Marinella di Bruino, TO - ITALY)

NZEB
NEARLY ZERO ENERGY BUILDINGS

ENERGY CONSERVATION AND RENEWABLE ENERGY MEASURES

Efficient energy supply: Replacement of a methane boiler with an **air-water heat pump**; installation of programmable **thermostatic valves**; installation of a **remote management system.**

Renewables: installation of a **photovoltaic system** grid-connected (250 Wp modules)

SAVINGS: Energy classification **nZEB** according to Piedmont Region standards.

THANK YOU FOR YOUR ATTENTION

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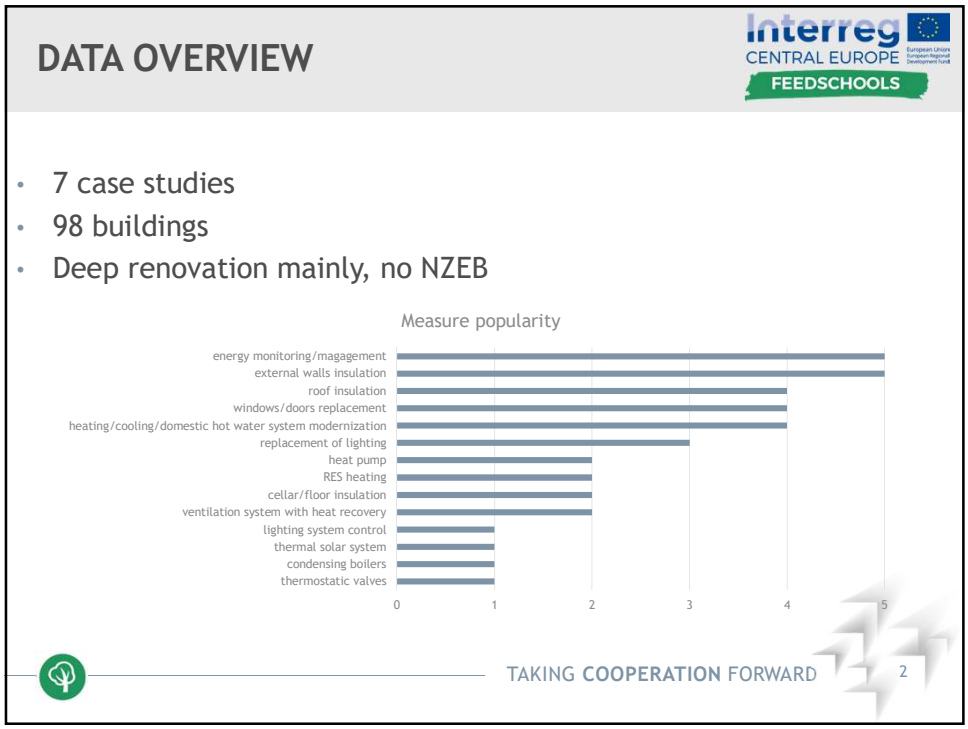
Annex 4


Interreg
CENTRAL EUROPE
FEEDSCHOOLS
TAKING
COOPERATION
FORWARD
3rd Partner Meeting
Warsaw, 10-10-2018
WP T1.1.3 Best practices - Poland
PRO-A | Katarzyna Korczak, Max Kochański


DATA OVERVIEW
Interreg
CENTRAL EUROPE
FEEDSCHOOLS
7 case studies
98 buildings
Deep renovation mainly, no NZEB
Measure popularity
energy monitoring/magagement
external walls insulation
roof insulation
windows/doors replacement
heating/cooling/domestic hot water system modernization
replacement of lighting
heat pump
RES heating
cellar/floor insulation
ventilation system with heat recovery
lighting system control
thermal solar system
condensing boilers
thermostatic valves
0
1
2
3
4
5
TAKING COOPERATION FORWARD
2

PL1 MARIANOWO: BOARDING HOUSE

KEY FACTS:

- - 94.4% Energy consumption decrease
- Final Energy consumption: 10.3 kWh/m²a
- Thermal insulation (walls, roof, windows)
- BEMS
- Heat pump

ENERGY CONSERVATION AND RENEWABLE ENERGY MEASURES	
Energy Conservation	external walls insulation, ground floor insulation, roof insultaion, windows and door replacement, installation of a mechnical ventilation system with heat recovery from exhaust air and pre-heating of supply air;
Efficient energy supply	replacement of old coal boilers with a heat pump
Renewables	heat pump, 199 kW (heating capacity)
Advanced control and monitoring	installation of a new BEMS, used to collect, archive and present data from sensors and measuring devices, as well to control actuators and to alarm about failures

TAKING COOPERATION FORWARD 3

PL2 RADZIONKOW: 5 SCHOOLS MODERNISED IN A PPP PROJECT

KEY FACTS:

- First PPP project in Poland
- 10-year contract with Siemens (2010-2020)
- Goal: -54% of heat costs and -39% of lighting

	ENERGY CONSERVATION AND RENEWABLE ENERGY MEASURES
Energy Conservation	- insulation of external walls - 11,200 m², - insulation of flat roofs - 5,500 m² - replacement of windows - 2.851 m² (762 pieces), - replacement of doors - 66 m² (18 items), - modernization of lighting - replacement of 1,179 luminaires, - replacement of 2 heating substations
Efficient energy supply	- replacement of 3 gas boilers - new condensing boilers with a system allowingto regulate the indoor temperature - heating system eachange and automation system installation
Renewables	no
Advanced control and monitoring	All buildings have been equipped with a BEMS, connected to the Siemens' center of monitoring and analysis of energy and media (Advantage Operational Center - AOC). The center is located in Warsaw and the municipality managers have remote access to it.

TAKING COOPERATION FORWARD 4

PL3 SOSNOWIEC: 87 SCHOOLS (PPP)

KEY FACTS:

- Big PPP contract (87 schools)
- No major renovation
- Focus on control systems

ENERGY CONSERVATION AND RENEWABLE ENERGY MEASURES	
Energy Conservation	Replacement of luminaires - replacement of existing lighting with fluorescent luminaires with electronic ballasts in 38 buildings
Efficient energy supply	1. Installation of remote control appliances on heat substations 2. Installation of thermostatic valves 3. Application of pump mixing nodes in group heat substations 4. Installation of a system allowing to set individual temperature in rooms, with different schedules.
Renewables	no
Advanced control and monitoring	1. Installation of an energy monitoring and remote control system - allows for detailed registration of energy parameters and remote control of the operation of heating installations, detection of failures and irregularities in operation. 2. Active energy management - continuous control of energy consumption and optimization.

TAKING COOPERATION FORWARD 5

PL4 WARSAW: COMPLEX OF SCHOOLS NO. 23

KEY FACTS:

- 30% heat savings
- Heat substation renovation
- Motivation:
- 1) technical reasons - insufficient functionality (limited possibility of control and regulation or even lack of it), the need to reduce the space occupied, etc.
- 2) economic reasons - reduction of heat losses and losses of heat carrier (heating water), reduction of the number of people employed to maintenance the system

TAKING COOPERATION FORWARD 6

PL5 MARIANOWO: TECHNICAL SCHOOL

KEY FACTS:

- - 94.9% energy consumption decrease
- Final Energy consumption: 12.1 kWh/m²a
- Thermal insulation (walls, roof, windows)
- BEMS
- Heat pump

ENERGY CONSERVATION AND RENEWABLE ENERGY MEASURES	
Energy Conservation	external walls insulation, ground floor insulation, roof insultaion, windows and door replacement, installation of a mechnical ventilation system with heat recovery from exhaust air and pre-heating of supply air;
Efficient energy supply	replacement of old coal boilers with a heat pump
Renewables	heat pump, 158 kW (heating capacity)
Advanced control and monitoring	installation of a new BEMS, used to collect, archive and present data from sensors and measuring devices, as well to control actuators and to alarm about failures

TAKING **COOPERATION** FORWARD 7

PL6 WARSAW: KINDERGARTEN NO. 181

KEY FACTS:

- Thermal insulation
- Heat substation renovation
- Lighting replacement
- Motivation: money savings

ENERGY CONSERVATION AND RENEWABLE ENERGY MEASURES	
Energy Conservation	- Insulation of external walls with a 12 cm layer of polystyrene (λ<0.036 W/mK) - 486.62 m² of walls - Insulation of the flat roof with 16 cm layer of mineral wool (λ< 0.040 W mK) - 383.27 m² - exchange of 167 luminaires, total adjusted power - 14.27 kW - exchange of 150 luminaires, total adjusted power - 13.66 kW
Efficient energy supply	Replacement of the heat substation
Renewables	none
Advanced control and monitoring	Installation of the heat management system

TAKING **COOPERATION** FORWARD 8

PL7 WARSAW: JOHN III SOBIESKI PRIMARY SCHOOL NO. 3017 AND KINDERGARTEN NO. 349

KEY FACTS:

- Thermal insulation
- heat recovery from ventilation system
- modernization of the heating and domestinc hot waster installation,
- Solar collectors
- BEMS

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Annex 5

Warsaw, Poland
October 10th, 2018

D.T. 1.2.3. Best practices

FEEDSCHOOLS/ LEASP

BEST PRACTICES – PRIMARY SCHOOL IVANJKOVCI (WITH KINDERGARTEN)

Interreg CENTRAL EUROPE FEEDSCHOOLS

Building type and size:

- 2.424 m^2 (floor area)
- 6 (classrooms) + 3 (playrooms)
- 2 (storeys)
- use – morning and afternoon, gym in weekends

Renovation and its purpose:

- Aim - lover net energy consumptions from 138,11 kWh/m^2 to 85,47 kWh/m^2 year and to reduce heat loss.
- Renovation had been done in summer holiday

BEST PRACTICES - PRIMARY SCHOOL IVANJKOVCI (WITH KINDERGARTEN)

Interreg CENTRAL EUROPE FEEDSCHOOLS

Energy conservation and renewable energy measures:

- Thermal isolation of facade, roof isolation
- Windows and doors replacement
- Installation of thermostatic valves at the radiators
- Installation of biomass boiler
- Energy accounting - monitored use of energy, energy products and their costs

Savings:

- Annual saving: 127.593 kWh
- Total cost reduction: 14.795 EUR

BEST PRACTICES - PRIMARY SCHOOL ANICE ČERNEJEVE(MAKOLE)

Interreg CENTRAL EUROPE FEEDSCHOOLS

Building type and size:

- 1.981 m^2 (floor area)
- 9 (classrooms)
- 2 (storeys) + basement
- use - morning and afternoon, gym in weekends

Renovation and its purpose:

- Aim - lover net energy consumptions from 150,7 kWh/m^2 to 88,2 kWh/m^2
- Renovation had been done in summer holiday

BEST PRACTICES - PRIMARY SCHOOL ANICE ČERNEJEVE(MAKOLE)

Energy conservation and renewable energy measures:

- Thermal isolation of facade, roof isolation,
- Windows and doors replacement
- Installation of thermostatic valves at the radiators
- Installation of heat pump (air/water) - for sanitary water
- Energy accounting - monitored use of energy, energy products and their costs.

Savings:

- Annual saving: 122,48 kWh
- Total cost reduction: 9.193 EUR

BEST PRACTICES - PRIMARY SCHOOL MARKOVCI

Building type and size:

- 3.264 m^2 (floor area)
- 15 (classrooms)
- 2 (storeys)
- use - morning and afternoon, gym in weekends

Renovation and its purpose:

- Aim - lover net energy consumptions from 168,8 kWh/m^2 to 97,1 kWh/m^2
- Renovation had been done in summer holiday

BEST PRACTICES - PRIMARY SCHOOL MARKOVCI

Energy conservation and renewable energy measures:

- Thermal isolation of facade,
- roof and floor isolation,
- Windows and doors replacement
- Installation of thermostatic valves at the radiators
- Installation of biomass boiler
- Energy accounting - monitored use of energy, energy products and their costs.

Savings:

- Annual saving: 307,24,48 kWh
- Total cost reduction: 16.311,60 EUR

BEST PRACTICES - PRIMARY SCHOOL OLGA MEGLIČ

Building type and size:

- 2.182 m^2 (floor area)
- 28 (classrooms)
- 3 (storeys) + basement
- use - morning and afternoon, gym in weekends

Renovation and its purpose:

- Aim - lover net energy consumptions from 102,8 kWh/m^2 to 30,8 kWh/m^2 and reducing heat lose
- Renovation had been done in summer holiday

BEST PRACTICES - PRIMARY SCHOOL OLGA MEGLIČ

Energy conservation and renewable energy measures:

- Thermal isolation of facade,
- Roof isolation,
- Windows and doors replacement
- Installation of thermostatic valves at the radiators
- Energy accounting - monitored use of energy, energy products and their costs.

Savings:

- Annual saving: 158,30 kWh
- Total cost reduction: 15.737,60 EUR

BEST PRACTICES - PRIMARY SCHOOL KOG (WITH KINDERGARTEN)

Building type and size:

- 1.587 m^2 (floor area)
- 4 (classrooms) + 2 (playrooms)
- 2 (storeys) + ground floor
- use - morning and afternoon, gym in weekends

Renovation and its purpose:

- Aim - lover net energy consumptions from 77,03 kWh/m^2 to 60,67 kWh/m^2 and reducing heat lose
- Renovation had been done in summer holiday (almost all)

BEST PRACTICES - PRIMARY SCHOOL KOG (WITH KINDERGARTEN)

Energy conservation and renewable energy measures:

- Thermal isolation of facade,
- Roof isolation,
- Windows replacement
- Installation of thermostatic valves at the radiators
- Installation of heat pumps
- Energy accounting - monitored use of energy, energy products and their costs.

Savings:

- Annual saving: 25,96 kWh
- Total cost reduction: 5.650 EUR

BEST PRACTICES - PRIMARY SCHOOL MIKLAVŽ PRI ORMOŽU

Building type and size:

- 2078,1 m^2 (floor area)
- 11 (classrooms)
- 2 (storeys) + basement
- use - morning and afternoon, gym in weekends

Renovation and its purpose:

- Aim - lover net energy consumptions from 91,15 kWh/m^2 to 51,2 kWh/m^2 and reducing heat lose
- Renovation had been done in summer holiday (almost all)

BEST PRACTICES - PRIMARY SCHOOL MIKLAVŽ PRI ORMOŽU

Energy conservation and renewable energy measures:

- Thermal isolation of facade
- Roof isolation
- Windows and doors replacement
- Installation of thermostatic valves at the radiators
- Installation of heat pumps
- Energy accounting - monitored use of energy, energy products and their costs

Savings:

- Annual saving: 69,103 kWh
- Total cost reduction: 11.596 EUR

BEST PRACTICES - PRIMARY SCHOOL BREG

Building type and size:

- 2.784 m^2 (floor area)
- 20 (classrooms)
- 3 (storeys)
- use - morning and afternoon, gym in weekends

Renovation and its purpose:

- Aim - lover net energy consumptions from 125 kWh/m^2 to 97,3 kWh/m^2
- Renovation had been done in summer holiday

BEST PRACTICES – PRIMARY SCHOOL BREG

Energy conservation and renewable energy measures:

- Thermal isolation of facade
- Roof isolation
- Windows and doors replacement
- Energy accounting - monitored use of energy, energy products and their costs

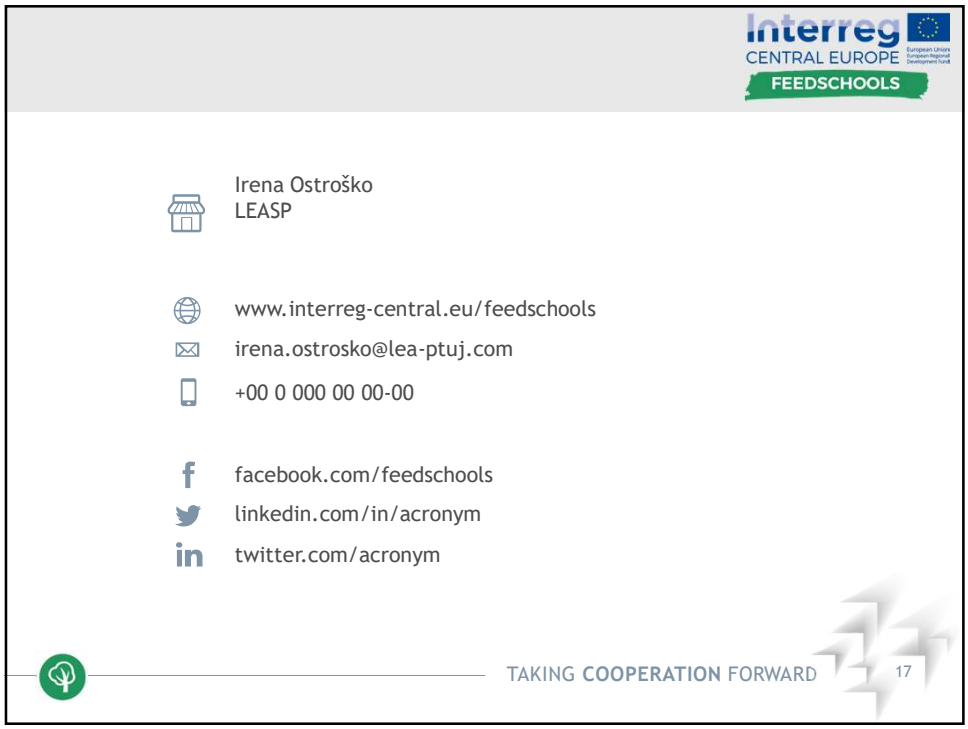
Savings:

- Annual saving: 89,87 kWh
- Total cost reduction: 4.584,40 EUR

SUMMARY ON DATA FINDINGS

- Less pollution of the environment
- Less CO2 emissions due to the replacement of energy products
- Lower energy consumption

- Significance on country level – calculation are made based on Renewable energy action plan 2010-2020; If we want to achieve the objectives of the Action Plan Slovenia support energy rehabilitation of existing buildings (public sector).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