

DELIVERABLE D.T4.4.1

Energy management plans for selected public schools	Version 1 03/2022
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D.T4.4.1: Energy management plans for selected public schools

Activity A.T4.4 Transfer experiences and lessons learned into 9 action plans for PAs

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Energy Management Plan for public schools in Bassa Romagna

Developed for:

- 1st grade secondary school “A. Oriani” (Municipality of Alfonsine)
- 1st grade secondary school “San Francesco d’Assisi” (Municipality of Bagnara di Romagna)
- 1st grade secondary school “F. Foresti” (Municipality of Conselice)
- 1st grade secondary school “A. Stoppani” (Municipality of Conselice - Lavezzola)
- 1st grade secondary school “S. D’Acquisto” (Municipality of Massa Lombarda)
- 1st grade secondary school “G. Pascoli” (Municipality of Sant’Agata sul Santerno)



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1. Introduction

This document is part of the deliverable D.T4.4.1 and provides an analysis of school buildings piloted by TARGET-CE as well as the activities of TARGET-CE with ICT tools applied, lessons and lessons learned, in the form of an energy management plan in this buildings. Based on the activities carried out earlier in the TARGET-CE project phase and the knowledge of the buildings, the study presents an action model based on the experiences and practices of the pilot action D.T4.2.4 “Optimizing energy consumption in UCBB, Italy (PA4) with TARGET-CE capitalized solutions”. This energy management plan should be an example of an effective energy management plan, as a result of integration of energy efficient practices from TARGET-CE project into the “business as usual” conduct of the organization, is based on a regular assessment of energy performance, and requires the implementation of procedures and measures to reduce energy waste and increase efficiency.

2. Vision

The following factors need to be considered and included within the development of an energy management plan:

- inclusion of maximum of possible solutions in buildings which should be matched to the:
 - needs of building managers, teachers and pupils (based on stakeholder analysis prepared with e.g. questionnaires, direct interview);
 - state of the art of the buildings, especially possibilities to improve energy efficiency and installation of ICT tools;
 - future plans envisaged by building owner
- adjustment of tools to the expectations of building managers, teachers and pupils, state of the art of buildings, its functional attributes and to keep it in line with other energy efficiency projects overseen by building owners;
- organisation of educational activities for pupils with proper execution of lessons and trainings with them;
- assessment of roles for schools employees and pupils for better energy performance in buildings;
- assessment of other energy related activities to increase energy efficiency;
- envisaged activities enlisted in further part of document should bring following results:
 - security and safety enhancement with use of the conditions which are needed to keep pupils healthy and rested;
 - indoor air quality improvement;
 - thermal comfort;
 - visual comfort;
 - acoustic comfort



3. Commitment

As a TARGET-CE Project Partner, PP4 Union of Bassa Romagna Municipalities, we are committed to develop actions included in Pilot Action “Implementation of capitalized pilot action solutions in 25 pilot buildings in Bassa Romagna” included in D.T4.2.4, which will bring results in changing the behavior of students by organization of training activities, reducing electricity and heat consumption, and thus reducing CO₂ emissions.

Other actions presented and proposed in the document should be implemented by schools with the help of an appointed **energy coordinator**. The **Energy coordinator** also should be responsible for sustainability of performed actions in TARGET-CE project.

Due to envisaged actions in energy management plans to implement successful energy efficiency actions should be established working group consisting of:

- Union of Bassa Romagna Municipalities project coordinator and staff responsible for implementation of actions or **energy coordinator** appointed by school management
- School representatives/management
- Teachers
- External experts
- Contractors and Suppliers

Schools as independent unit should be responsible for providing to their employees and students solutions to reduce energy usage, provide thermal and visual comfort to improve their abilities to learn and perform on daily basis. The commitment from schools will benefit also employees and students by better managing facility’s resources, so it can bring savings for other (non-energy related) improvements.

4. Energy Management Plan objectives

Main goals of actions proposed in the energy management plan are consistent to goals of pilot action “Implementation of capitalized pilot action solutions in 25 pilot buildings in Bassa Romagna” developed in TARGET-CE project.

Energy management plan is to ensure that buildings are managed/operated the most economically in matter of energy consumption. Actions proposed and developed in energy management plans need to bring reduction in energy usage and also have positive impact on producing more environmental initiatives.

Crucial goals of energy management plan are to:

- promote and implement energy efficiency solutions and tools for school buildings
- improve energy efficiency
- move towards sustainability of the renewable solutions
- managing efficient energy usage
- encourage energy saving by school employees and students
- assess the possibilities to use innovative technologies, tools and implement them in areas where it’s efficient and useful



- cooperate with external experts and governmental agencies on energy programs and renovation/thermo-modernization of buildings

5. Methodology and scope of Energy Management Plan

5.1. Introduction

Energy Management plan methodology was based on activities incorporated in public school buildings during Pilot Actions and its preparatory station within TARGET-CE project.

Energy Management Plan is developed to reach its goals and change a way of energy management in schools, especially with use of electricity and heat.

Methodology of developing was based on guidelines for energy guardians smart-school management plan upstreamed during TARGET-CE activities.

5.2. Mapping units

For needs of Energy Management Plan for public schools in Bassa Romagna, the most important thing is to establish the list of units as they stand, do not have sustainable energy objectives or energy management plans. In addition, as a result of ongoing activities in the building, they often have excessive consumption of electricity and heat due to the lack of implemented solutions improving energy efficiency and energy management (including ICT tools, which are crucial for the TARGET-CE project).

In this manner, at the beginning of energy efficiency activities the Union of Bassa Romagna Municipalities (UCBR) based on his own data and carried out an analysis of the possibilities and needs of measures to improve energy efficiency in its region with the use of ICT tools and EE solutions. As a result of these activities, 6 buildings were collected for the purpose of carrying out the pilot action. These buildings are:

No.	Name of building	Building address
1.	1 st grade secondary school "A. Oriani"	Via A. Murri, 6 - Alfonsine (RA)
2.	1 st grade secondary school "San Francesco d'Assisi"	Via Matteotti 14, Bagnara di Romagna (RA)
3.	1 st grade secondary school "F. Foresti"	Via Cavallotti - Via Selice, Conselice (RA)
4.	1 st grade secondary school "A. Stoppani"	Via Italia 27, Conselice - Fraz. Lavezzola (RA)
5.	1 st grade secondary school "S. D'Acquisto"	Via Roma 17, Massa Lombarda (RA)
6.	1 st grade secondary school "G. Pascoli"	Via Roma 6, Sant'Agata sul Santerno (RA)



Selected school's representatives will confirm and commit to assemble a team of qualified personnel to develop and sustain actions foreseen in TARGET-CE Pilot Action "Implementation of capitalized pilot action solutions in 25 pilot buildings in Bassa Romagna" and other actions overseen in Energy Management Plan.

5.3. Mapping needs

In case of above-listed buildings, it was developed a needs analysis based on questionnaire with questions regarding energy efficiency needs and already planned activities in scope of adopting ICT tools and energy management.

Below it can be seen a summary of needs for every school building (developed on basis of TARGET-CE D.T1.1.2):

No.	Name of building	Needs	TARGET-CE tools capitalized
1.	"Oriani" school – Alfonsine	- To realize energy planning and low carbon strategies - To help improving citizens' education and behaviour in energy saving	Energy@School app
2.	"San Francesco d'Assisi" school – Bagnara di Romagna		
3.	"Foresti" school – Conselice		
4.	"Stoppani" school – Conselice Lavezzola		
5.	"D'Acquisto" school – Massa Lombarda		
6.	"Pascoli" school – S. Agata s.s.		

5.4. Methodology of baseline inventory consumption

To establish the baseline energy consumption for EMP, there is need to complete energy data collection for all buildings included in EMP.

A team delegated to the task related to the inventory of heat consumption should provide consistent data about energy consumption and evaluate energy performance of buildings. The baseline inventory should consist in sufficient information on the frequency of consumed energy and which utilities and parts of buildings use it the most.

At the beginning of providing the baseline inventory consumption it's needed to establish factors which will determine how useful will be gathered information:

1. Include all utility sources – in baseline inventory we need to establish what kind of sources are used in the buildings for utilities e.g. electricity, gas, water
2. Establish level of detail in collection of utility sources – use the information about the buildings which shows e.g. number of rooms, submeters, points of water usage
3. Collection of all documents on utilities energy consumption – determine if there are any energy audits/energy certificate which include information about energy usage
4. Document all collected data – for identified sources, collect all information sources e.g. bills, meter readings and prepare the matrix to assemble all information



5. Collect information for all schools – on the basis of the information sources, collect and input all data to the matrix
6. Calculate and evaluate energy indicators, state of the art of buildings, emissions of GHG.

On the basis of collected data within higher included elements, for all selected buildings there is need to establish following information:

- Electricity consumption
- Heat consumption
- Heat sources consumption (e.g. natural gas, coal)
- Domestic Hot Water consumption
- Water consumption

The collected data for energy consumption should be divided on:

1. Systemic energy consumption – the energy for needs of devices which are necessary to operate the school buildings – minimal amount of energy to fulfill fundamental operational needs of building. Typical systemic energy consumption is energy for heating system, domestic hot water system or cooling system.
2. Non-Systemic energy consumption – the energy needed by teachers, school management etc. – the most wasteful energy in schools which should be better managed
3. Un-systemic energy consumption – energy which is linked (not directly) with systemic and non-systemic energy consumption and used during activities in school e.g. lighting.

For needs of overall evaluation of schools/facilities, there also should be performed analysis of the state of the art of buildings, which need to include inventory of:

- Heating system, including: energy source, radiators, piping, insulation and regulation
- Domestic hot water system, including: energy source, piping, insulation and regulation
- External walls, including: surface area, materials with thickness (cross-section of the wall) and heat transfer coefficient
- Roof, including: surface area, materials with thickness (cross-section of roof) and heat transfer coefficient
- Floor, including: surface area, materials with thickness (cross-section of floor) and heat transfer coefficient
- Windows, including: surface area, material, type, quantity and heat transfer coefficient
- Doors, including: surface area, material, type, quantity and heat transfer coefficient
- Lighting system, including: lighting type, number of lighting
- Renewable energy sources installations

On the basis of those information, the energy coordinator will select the additional actions to improve energy efficiency of the buildings, which can be included in the Action Plan implemented within the Energy Management Plan.

The assessment of state of the art should be executed with any necessary tools. Those tools could be e.g. data sheets, assessment checklist or simple database. For needs of Energy Management Plan for Bassa Romagna and other TARGET-CE activities, it was developed a matrix/sheet to complex data collection to establish state of the art of buildings and with help of national norms/benchmarking there



is also possibility to determine which actions could increase energy efficiency. The matrix can be found as an **annex 1** to the EMP.

The assessment will also provide the information thanks to comparison of schools (with similar usable area, construction) with their energy profiles, energy performance of energy sources. Also the matrix can show which data is lacking to precisely analyze the building.

For more precise analysis of buildings, the energy coordinator with team can appoint external expert to fill the gaps in lacking data, analyze energy consumption with current state of the building (insulation, heating system) to develop system for better energy management in building with use of technology, meters and applications or to perform an energy audit for building refurbishment in case the buildings require one.

Energy audit will be a comprehensive review of the school energy systems that will evaluate the baseline energy performance of its systems, thermal resistance of envelopes against their designed performance on best available technology and with better insulation. Through this audit, the difference between the designed performance and baseline performance of the school and facility's systems will determine the potential for energy savings for each building.

5.5. Goals of actions included in EMP

Every school building included in action plan related to energy efficiency improvement should have established a portfolio of energy efficiency goals or goals related to change of children behaviour.

On the basis of baseline inventory and assessment of potential actions (to gain energy savings), for every school building it is obligatory to assess the goals which should be:

- Specific
- Measurable
- Action-Oriented
- Realistic
- Time-sensitive

Goals should be assessed by setting baselines (on the stage of Baseline Inventory Consumption) and identifying the differences in energy consumption between similar facilities or through energy expertise. Those information are to provide which buildings are of priority to implement retrofitting, which should be modernized in the longer term and which are in good condition and do not require renovation measures.

For each school in the next section of EMP will be established short-term and long-term goals for improving energy efficiency and change of behaviour of students, teachers and school staff on the basis of data collected by matrix and included in its foreseen possibilities/actions for energy transformation. Goals are also set by foreseen future actions which are directed for building users.

5.6. Action Plan preparation

For established goals, to properly develop change and decrease of energy consumption in school buildings, there is a need of preparation for Action Plan (AP). Plans need to be well-detailed and ensure a systematic implementation and time frame which will provide energy savings.



The established working group with help of external experts will focus on finding out what are problems in satisfying energy management in buildings and how to upgrade energy management with practical and possible to implement solutions.

To define the actions/steps to fulfill expectations and reach goals of Action Plan, obligatory is to prepare technical documentation/assessment with feasibility study. The technical assessment should be based on energy audits.

Every action/step in Energy Management Plan should have:

- title
- description
- roles
- duration
- measures taken
- estimated cost, energy savings and CO₂ reduction

Actions/steps overseen should also be divided on “essential” and “desirable”. Every action should include different kinds of working group and is needed to be monitored on each step.

Technical assessment should provide foundation for preparing a roadmap to implement the steps necessary to improve energy efficiency and upgrade buildings included in action.

Preparatory stage of AP should consist of:

- establishment of energy targets/goals for each buildings based on baseline inventory consumption
- set the time frame of actions, including preparation of specific action/upgrade, trainings, appointing meetings, working group, milestones and reached goals
- development of monitoring system to track the progress of actions/activities and allow to measure the energy consumption
- determine final roles of work group members – include all school staff to implement action plan in the area that they are the most capable e.g. financial experts in schools should be responsible for budget planning
- identification of needed and used resources – working group on preparatory stage need to identify what conditions need to be met and what should be provided to successfully implement action plan e.g. human resources, expenditures, suppliers, service providers, external experts and consultants

Action plan should be diverse and involve soft and technical activities from communication, dissemination and educational activities to use energy efficiency and RES measures like thermal modernization or installation of photovoltaic panels if necessary.

6. Action Plan scope and implementation

6.1. Scope of Action Plan

Action Plan implemented as a part of Energy Management Plan and TARGET-CE project will include actions which are needed to sustain executed ICT tools from TARGET-CE project and other actions which will provide direct (technical activities) and indirect (soft activities e.g. trainings with children, stickers to remind about energy savings) reduction of energy consumption.



At the beginning of preparation of action plan, to the proper identification of scope, in line with mapping needs, UCBR selected buildings in which were developed actions through cooperation within TARGET-CE project. In those buildings were implemented tools capitalized in TARGET-CE project and other tools overseen in Pilot Action.

No.	Name of building	TARGET-CE tools capitalized	Other capitalized tools
1.	“Oriani” school – Alfonsine	Energy@School app BOSTEE-CE OnePlace	n.d.
2.	“San Francesco d’Assisi” school – Bagnara di Romagna		
3.	“Foresti” school – Conselice		
4.	“Stoppani” school – Conselice Lavezzola		
5.	“D’Acquisto” school – Massa Lombarda		
6.	“Pascoli” school – S. Agata s.s.		

For sufficient implementation of action plans, capitalized tools were adjusted by UCBR and at the moment of execution Pilot Action within TARGET-CE project tools were ready to use by **energy coordinators** or school management and teachers. The results of TARGET-CE tools can be seen below, with description of capitalized tools in TARGET-CE project.

TARGET-CE Pilot Action results

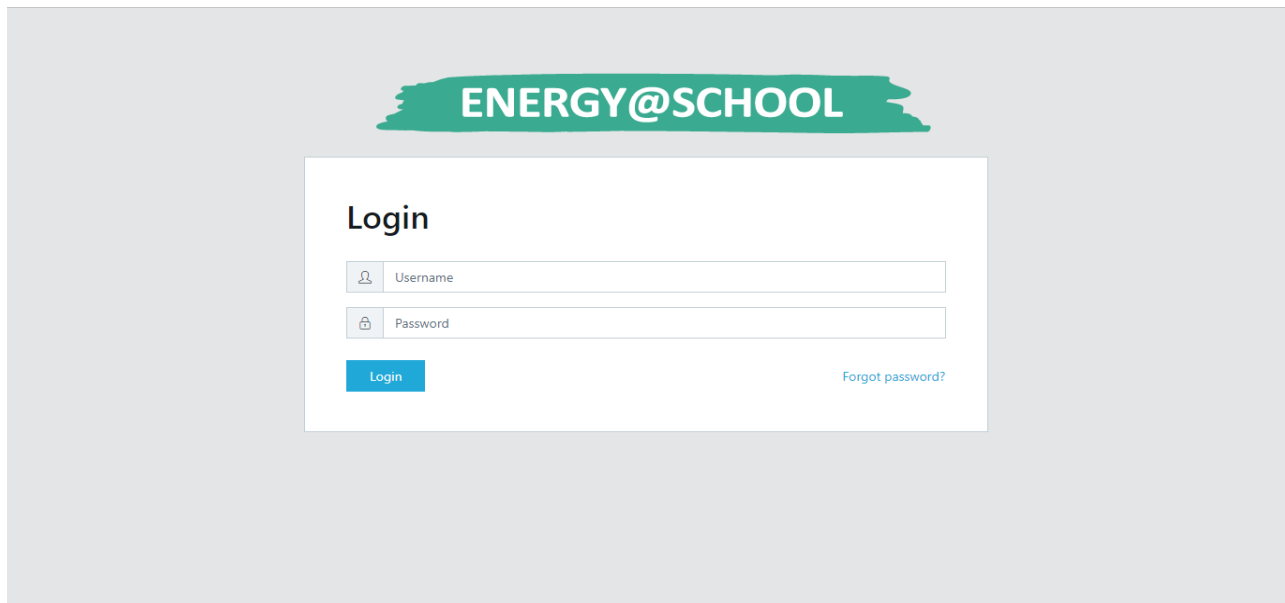
To involve schools in the measurement of their own energy consumption, and thus to raise awareness in the new generations of students, the Energy@School project was capitalized in many Municipalities of the Union. To quantify in numbers the pilot action undertaken by the Union, more than half of its Municipalities (5 out of 9) was involved in the experience of Energy@School, with 1 school per Municipality (2 schools in the case of the Municipality of Conselice) and a total of 15 classes, 323 pupils and 5 reference teachers. With respect to what originally planned, because of the COVID-19 crisis that seriously affected everyday life in schools, most of the Energy@School training activities translated in online format and concentrated in fewer pilot schools.

To capitalize the Energy@School app, first of all the app itself was updated to a new TARGET-CE version. At the same time, specific equipment was installed in school buildings (sensors, smart meters, lamps and valves) to set up Energy Labs for training activities. At the core of Energy@School project, such training activities pursued an educational aim and followed the guidelines of the Energy Guardians Smart-School Management Plan (EGSSMP). The training content explained and related, in an attractive and interactive way, many aspects of EE – from UNO Sustainable Development Goals, to EE possibilities in everyday lifestyle. Activities could then take place between February and March 2022. To conclude, pilot schools participated in an online plenary meeting on March 11th, where all the classes reported their experience and presented original works on lessons learnt within the project.

It is hard to exactly state the economic magnitude of the pilot action in the current period, biased by energy crisis. However, it is sure that acting on the consciousness and everyday habits of people – students first – may result in a long-term improvement of energy performance of the buildings attended.



Capitalized in Pilot Action buildings TARGET-CE tools



ENERGY@SCHOOL user02

Dashboard **HOME** Home / InsertTemperature

Daily Report

INSERT DATA

scuola02

02-class1

02-class2

VISUALIZE DATA

Insert Temperature Measurement

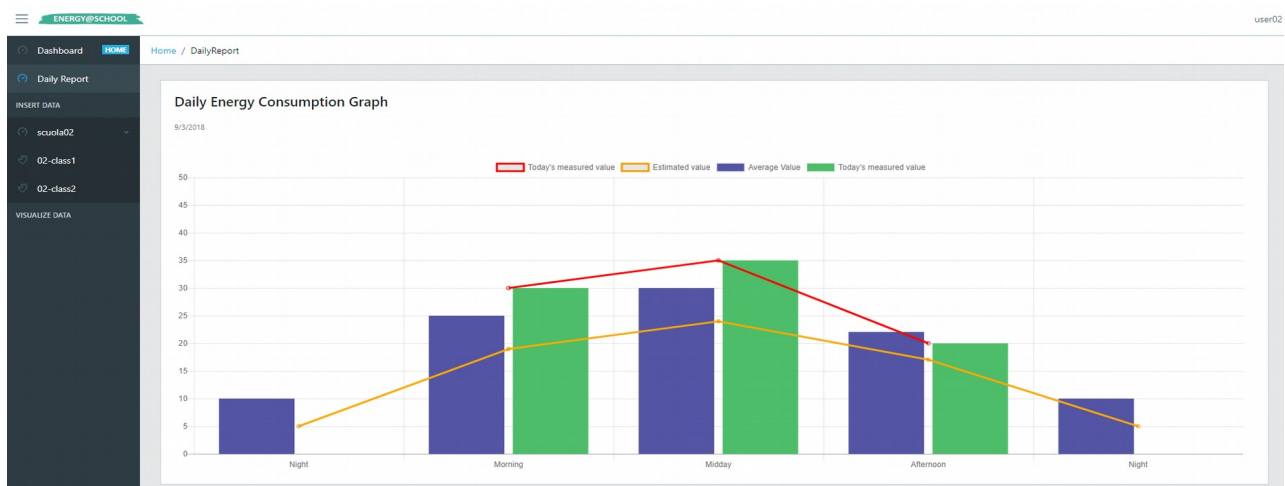
Date:

Morning 10:00	Presence <input type="checkbox"/>	Temperature* <input type="text"/>
Midday 12:00	Presence <input checked="" type="checkbox"/>	Temperature* <input type="text"/>
Afternoon 15:00	Presence <input type="checkbox"/>	Temperature* <input type="text" value="3"/>

Last Measures

Date Time	Presence	Temperature
12/01 Morning	Yes	15
13/01 Morning	No	20
12/01 Midday	Yes	22
12/01 Afternoon	No	18

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The Energy@School app was central in the training activities realized with students, since the measurement and monitoring tasks connected to behavioural change relied on the app itself and on the equipment installed in the Energy Labs. The app was thus updated and fixed in order to match the technical needs of a bigger audience, composed by many schools of the territory.

The use of the Energy@School app was fundamental for students to measure and monitor energy consumption in their Energy Labs, in turn to understand problems and opportunities of school buildings' energy management. The app was indeed spread on large scale, namely to be used by all the students involved in TARGET-CE project among the Union's Municipalities – more than 300 pupils.

As a part of Energy Management Plan, the crucial thing is to maintain the continuity of the work of the tools used, it will be required to introduce sustainability actions that will result in their further use and the possibility of further benefits and lessons for new students, users and teachers of schools.

In this part schools will commit to execute those actions which will sustain the tools installed in their facilities and will disseminate them to new pupils and teachers.

In addition to the activities carried out under the TARGET-CE project and their sustainability, schools will also implement other activities leading to the reduction of energy consumption under the action plan by:

- introducing activities for individual groups, indicating their duties and elements that should be taken care of while using and staying in school facilities
- identification of energy renovation possibilities on the basis of collected data during the state of the art analysis which could result in high energy savings

6.2. Implementation of Action Plan

For successful implementation of AP, there is need for all important and decisive actors to be involved in action. In case of school buildings as a part of implementation work group (as listed before) will be involved:

- Union of Bassa Romagna Municipalities project coordinator and staff responsible for implementation of actions or **energy coordinator** appointed by school management
- School representatives/management
- Teachers
- External experts
- Contractors and Suppliers

The first element for sufficient implementation of Action Plan is the preparation of detailed Baseline Inventory Consumption. Baseline Inventory Consumption should be executed accordingly to point 5.4 of Energy Management Plan.

During implementation of TARGET-CE, for school buildings included in Pilot Action, it was executed a state of the art analysis which can provide information needed to execute Baseline Inventory Consumption and establish SMART goals.

Below table lists the results of state of the art analysis which provides information on:

- heat consumption;
- electricity consumption;



- energy class of school building.

6.1.

6.2.1. Baseline inventory results

For every given building chosen to be included in Energy Management Plan, there were collected energy data at least on heat consumption, electricity consumption and energy class. In data collection also were included information about walls, roofs and windows joinery. The table below shows the essential information on energy data collected in baseline inventory, which full results are showed in **annex**.

Building	Heat source	Heat consumption [GJ/year]	Electricity consumption [kWh/year]	Renewable Energy Source [YES/NO]	Emission of CO ₂ [tonnes of CO ₂ /year]
“Oriani” school – Alfonsine	Gas boiler	44,51	105,28	NO	n.d.
“San Francesco d’Assisi” school – Bagnara di Romagna	Heat pump (electric)	n.d.	27,28	YES	n.d.
“Foresti” school – Conselice	Gas condensing boiler	468,58	26,92	YES	59,79 (school) 117,43 (gym)
“Stoppani” school – Conselice Lavezzola	Gas boiler	1538,80	32,31	NO	n.d.
“D’Acquisto” school – Massa Lombarda	Gas boiler	1234,37	34,52	NO	81,75 (old school) 63,46 (new school + gym)
“Pascoli” school – S. Agata s.s.	Gas boiler	n.d.	n.d.	YES	n.d.

6.2.2. Goals

On the basis of Baseline Inventory Results short-term and long-term goals were assessed for every building in line with point 5.5. of this document.

No.	Name of building	Short-term goals	Long-term goals
1.	“Oriani” school – Alfonsine	Realization of training activities with TARGET-CE tools for behaviour change	Reduction of electricity, gas and water consumption by 10%
2.	“San Francesco d’Assisi” school – Bagnara di Romagna	Immediate actions undertaken by	Execution of thermal modernization for the reduction



3.	“Foresti” school – Conselice		school users, such as reduction of water and electricity usage	of heat consumption by 30%
4.	“Stoppani” school – Conselice Lavezzola			
5.	“D’Acquisto” school – Massa Lombarda			
6.	“Pascoli” school – S. Agata s.s.			

6.2.3. Defined actions

To reach the set goals in Energy Management Plan, for each building were set actions which will provide results in reducing energy consumption. Within the Action Plan will be developed similar soft actions and overseen in future different technical actions for every building.

Particularly, the actions foreseen were divided in eight different categories.

Category of action:

- lighting
- space heating
- space cooling
- water heating
- office equipment
- cooking
- ventilation
- miscellaneous

For those 8 categories were set actions which are about avoiding the wasting of energy, use energy efficiently and use energy efficiency measures and renewable energy sources.

Tables below present all foreseen actions which will reduce energy usage in buildings in each category:

Action title	Category	Description of action	Duration [start and end time]	Technical measures taken (If needed in action)	Description of behaviour change	Estimated cost [EUR]	Estimated energy savings [%]	CO2 reduction [%]
Turn the lights on...or off!	LIGHTING	Soft actions: training activities, with the use of Energy@Sc	n.d.	LED light bulbs and efficient lighting installed where suitable.	Students, as well as their teachers and school staff, will gain knowledge and thus	No cost for soft actions Low cost for technical measures	Up to 20%	Unknown



		hool app and Energy Labs, on efficient electricity consumption		Smart meter installed in the school's electric panel. Other sensors, such as movement / occupancy and daylight sensors, installed to automatically guide lighting.	higher awareness on the environmental and economic impact of electricity waste. In turn, they will act more carefully towards electricity usage, e.g. by turning lights off more frequently and turning them on just if needed.			
Wrap up warm!	SPACE HEATING	Soft actions: training activities, with the use of Energy@School app and Energy Labs, on optimal thermal consumption in winter	n.d.	Thermostatic valves and other tools (ceiling fans in winter mode, door seals, automatic door closers) installed where suitable. Smart meter installed in the school's electric panel. School's thermostat set appropriately and constantly adjusted to match heating needs (18-20°C in winter). Better coating and double-glass windows may be	Students, as well as their teachers and school staff, will gain knowledge and thus higher awareness on the environmental and economic impact of inefficient heating and overheating. In turn, they will act more carefully, e.g. by heating only occupied rooms and dressing for the weather.	No cost for soft actions Low cost for technical measures Significant cost for investments in the school building – substitution of glazing and coating	Up to 10% per degree less	Unknown



				installed in the school building.				
Be cool...but not too much!	SPACE COOLING	Soft actions: training activities, with the use of Energy@School app and Energy Labs, on optimal thermal consumption in summer	n.d.	<p>Thermostatic valves and other tools (ceiling fans, door seals, automatic door closers) installed where suitable.</p> <p>Smart meter installed in the school's electric panel.</p> <p>School's thermostat set appropriately and constantly adjusted to match heating needs (24-27°C in summer).</p> <p>Better coating and double-glass windows may be installed in the school building.</p>	<p>Students, as well as their teachers and school staff, will gain knowledge and thus higher awareness on the environmental and economic impact of inefficient cooling and overcooling.</p> <p>In turn, they will act more carefully, e.g. by cooling only occupied rooms and dressing for the weather.</p>	<p>No cost for soft actions</p> <p>Low cost for technical measures</p> <p>Significant cost for investments in the school building – substitution of glazing and coating</p>	Up to 10% per degree more	Unknown
Save (hot) water!	WATER HEATING	Soft actions: training activities, with the use of Energy@School app and Energy Labs, on better management of hot water	n.d.	<p>Timer on the hot water unit for automatic turn-off installed.</p> <p>Hot water temperature maintained between 38-42°C.</p> <p>Natural gas system or electric</p>	<p>Students, as well as their teachers and school staff, will gain knowledge and thus higher awareness on the environmental and economic impact of wasting hot water.</p> <p>In turn, they</p>	<p>No cost for soft actions</p> <p>From low to significant cost for technical measures</p>	Unknown	Unknown



				instantaneous hot water heater may be installed.	will act more carefully, e.g. by preferably using cold water when possible.			
Don't forget your PC!	OFFICE EQUIPMENT	Soft actions: training activities, with the use of Energy@School app and Energy Labs, on efficient use of ICT equipment	n.d.	No technical measures needed.	Students, as well as their teachers and school staff, will gain knowledge and thus higher awareness on the environmental and economic impact of electricity consumption linked to ICT equipment. In turn, they will act more carefully, e.g. by not leaving computers and devices in stand-by mode with monitors on.	No cost	Unknown	Unknown
Cook delicious...and sustainable!	COOKING	Soft actions: training activities, with the use of Energy@School app and Energy Labs, on efficient management of the school kitchen	n.d.	No technical measures needed.	Students, as well as their teachers and school staff, will gain knowledge and thus higher awareness on the environmental and economic impact of electricity and gas consumption in the school's kitchen. In turn, they will act more carefully, e.g.: - by	No cost	Unknown	Unknown



					positioning refrigerators and freezers away from heat sources - by checking their seals and doors - by defrosting them regularly - by fully exploiting them - by switching off grills, fryers and ovens after use - by using energy-efficient programs in dishwashers			
Take a breathe !	VENTILATION	Soft actions: training activities, with the use of Energy@School app and Energy Labs, on efficient ventilation	n.d.	Ceiling fans, door seals and automatic door closers installed where suitable.	Students, as well as their teachers and school staff, will gain knowledge and thus higher awareness on the environmental and economic impact of a good ventilation. In turn, they will act more carefully, e.g. by avoiding unnecessary opening and closing of doors and windows.	No cost for soft actions Low cost for technical measures	Unknown	Unknown
Think renewable!	MISCELLANEOUS	Soft actions: training activities, with the use of Energy@School app and Energy Labs, on	n.d.	Photovoltaic systems to produce heat and electricity, as well as solar systems to produce hot sanitary	Students, as well as their teachers and school staff, will gain knowledge and thus higher awareness on the	Significant costs for the installation of photovoltaic and solar systems	Unknown	Unknown



		renewable energy sources		water, may be installed.	environmental and economic impact of renewable energy.			
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6.2.4. Procedures and good practices for energy reduction

All those actions listed above are to reach the goals set in document. For each category, there are guidelines for activities to be carried out in schools by the responsible persons or contractors entrusted with this responsibility. The activities provided for in the table above should fit into what is included in the content-related part below, and the individual roles and responsibilities will be divided between the students and the teacher in the further part of the study. These guidelines do not describe the new technical solutions used, but the proposed method of operation of the devices. These guidelines also indicate what alternative solutions can be used in the event that those provided for in the table are not available.

LIGHTING

Lighting is one of schools' largest areas of energy use. Installing energy efficient lighting is a simple action for schools to reduce their energy consumption. A detailed energy audit, described in 5.6. (Action Plan Preparation) developed by energy expert, will identify if lighting upgrades are suitable to be replaced with LED or energy-efficient fluorescent tube lighting. By installing movement and daylight sensors you can significantly reduce energy use. Occupancy sensors automatically turn off lights in a space after it has been unoccupied for a period of time. Furthermore, making good use of daylight in a classroom can reduce the energy consumption up to 20%.

Recommended lighting levels are generally 240-500 lux – as suggested in **UNI EN 12464-1**. Lighting should be higher than 300 lux in spaces such as workshops with detailed bench or machine work, laboratories and music, reading and computer rooms, and lower than 300 lux in corridors and stairways, assembly halls, audio-visual rooms, and social areas. Installing dimmer switches provides flexibility and reduces the power draw, especially in rooms with good natural daylight.

SPACE HEATING AND COOLING

One of the main action is to set the school's thermostat at 18-20°C in winter and 24-27°C in summer in order to avoid the overheat and overcool. Temperature needs can vary during the day, so check that the system operating hours match with the times when heating is most needed. Review the setting every month to ensure they are correct. Adjust timers so that the building reaches optimum temperature just as people arrive and begins to cool down as people leave. This is best done by gradually altering setting over a number of days and checking the response of the building occupant. For example, if the school is occupied for different periods over the week, it could be useful to install seven-day timers to allow the system to operate only when the building is occupied. This action should be developed action plan.

Ensure thermostats are not influenced by draughts, sunlight, heaters or ICT equipment. Take into account that every degree warmer or cooler can increase your energy consumption by up to 10%. On such basis:



1. Ceiling fans can be an alternative to air conditioning. They are much cheaper to install and maintain. Reversible ceiling fans can be set to winter-mode, allowing warm air collected near the ceiling to be pushed back down to ground level, and thus keeping the air temperature in the room more even while requiring less energy to heat the space.
2. Door seals are an effective way to reduce heating and cooling costs, as well as to improve the thermal comfort of classrooms and office areas by reducing drafts. Door seal should be a priority for older buildings that have large gaps under doors.
3. Different types of glass and coating will have an impact on the light of the room and its insulation. Opt for double or triple glazing as a minimum requirement for all new windows for comfort and energy saving. This is especially important for north-facing or exposed windows.
4. Doors that are left open cause a significant loss of heat in winter and cool in summer, thus wasting the energy used to heat / cool the air. Automatic door closers are a great way of reducing this loss from classrooms and office areas.
5. Schools can reduce their heating and cooling energy consumption by implementing “dress for the weather” policies.
6. Installation of heat pumps in rooms that increase comfort in both winter and summer can be a solution. Heating and cooling are available and they are regulated within limits. Heat pumps are highly efficient, producing an average of 3kWh of thermic energy by the consumption of 1 kWh of electric energy. This will increase the electrical load, but decrease two third of total energy consumption.



WATER HEATING

If your school uses a significant amount of hot water from an electric hot water unit, it may be worthwhile upgrading to a natural gas system; however, if the hot water consumption is not high, it may be beneficial to install energy-efficient electric instantaneous hot water heaters.

Install a power point timer on your boiling hot water unit to automatically turn the unit off when hot water is not in use; this will ensure it is not running 24 hour a day, seven days a week, thus preventing it from continuing to use electricity or natural gas to maintain the water at temperature. Maintain the temperature of boiling hot water at 38-42°C, not higher, for preventing the waste of energy.

OFFICE EQUIPMENT

The increased use of electrical equipment and ICT in schools is having an effect on electricity consumption. Computers, devices and office equipment can amount for a third of a school's total energy consumption.

The electricity usage of office equipment could be lowered by use of the energy efficient devices. For every new equipment the school management should directly look for this with good energy class, not lower than C.

COOKING

When it comes to cooking and preparing meals, especially in schools with canteens, you should use appliances with high energy efficiency for food storage and preparation, e.g. refrigerators, ovens, electric or gas cookers. In this documentation, it is recommended to select a non-energy-consuming device as often as possible.

In addition, an important factor in working in the kitchen is also a large amount of heat generated in this room, which leads to a very high air temperature and overheating of it. Therefore, the canteens and kitchen rooms should also be modernized in terms of ventilation. Heat recovery ventilation can cause excess heat to be reused. In addition, you should also take care of adequate air exchange to provide proper conditions for work and stay of students in the canteen rooms. Therefore, ventilation with heat recovery should be used more and more often, ensuring the stability of air exchange.

VENTILATION

As said above, there is need to include modern solutions allowing for the optimal use of exhaust and supply air in rooms with excessive heat generation or where a large number of users stay. Therefore, as part of the pilot actions, it should be foreseen to improve ventilation systems that will enable meeting air exchange standards in buildings. Of course, along with the modernization of the ventilation system, additional improvements should be made to seal the external partitions of buildings.

MISCELLANEOUS

In addition to the above-mentioned possibilities in individual categories, it is necessary to remember to include the integration of renewable energy sources in buildings as part of the envisaged tasks, which will generate, depending on the type, heat or electricity.

Installing renewable energy generation is a cost-effective strategy to reduce the school's energy consumption and costs.



Photovoltaic can be a strategic approach, since it generates power to cover the heat pump consumption, as well as the lighting during the day or the consumption of the electrical equipment. The accumulation in batteries of the electric energy produced in excess during the day could be strategic too, to cover the electric consumption during the night.

Solar heating of sanitary hot water as well as of pools is one option too, and the technology is increasingly cost-effective to reduce the amount of the natural gas consumption.

6.2.5. Roles and responsibilities in building energy management and action plans

For proper implementation of behaviour change actions and energy actions, every user should act in line with the provisions of this document, especially to not excessively use energy. For every group of building users were developed roles and responsibility for energy conservation.

6.2.5.1. School management roles and responsibilities

The following activities during the implementation of the action plan and the energy management plan are the responsibility of the school management:

- Appoint an Energy Coordinator as a lead representative for your school's Energy Team.
- Establish an Energy Team for your school comprised of students, teachers, and maintenance and administrative employees.
- Use this Energy Management Plan to reduce and conserve energy at your schools/facilities.
- Cooperate with the Energy Team in their assessment and help them implement the necessary energy conservation measures
- Implement a lighting procedure for your school. Keep lights off when an office or area is unused;
- Ensure that personal microwaves and mini refrigerators are not in classrooms and auxiliary offices/rooms if the school has a designated room with a larger refrigerator and microwave that are available for teachers and staff/employees to use. Exceptions to this procedure may be considered on a case by case situation.
- Enable power management features on computers, copiers, scanners, printers, etc.
- Do not adjust thermostats beyond the Temperature Settings Procedure. If heating and cooling is not operating properly, contact the Facilities Department.
- Report faulty thermostats and other equipment that may be malfunctioning to the Facilities Department.
- Wear warmer clothes in cold weather and encourage students to do the same.
- Wear cooler clothes in hot weather and encourage students to do the same.
- Combine classes when practical, especially when using A/C or heating equipment.
- Involve students in monitoring energy consumption.
- Do not use assembly areas, such as the auditorium or gymnasium, for small groups that can comfortably meet in smaller areas.
- Schedule the use of office area and other areas wisely to reduce energy consumption
- Use the fewest number of rooms necessary for summer and night programs. Schedule teachers into one room for preparation periods, and place support staff in fewer rooms, if possible.
- Schedule classes to maximize the utilization of classroom space in the buildings.



- Reduce the movements of students and staff in and out of buildings.
- When repainting buildings, use light, reflective colors.
- Establish a resource center for energy education in your school.
- Solicit feedback from students and staff /employees on energy conservation.
- Inform the public, parents and other groups about your school's energy conservation efforts

6.2.5.2. Teachers roles and responsibilities

The main role of teachers will be teaching energy savings skills that students can use at school and at home. Teachers will give students the opportunity to participate by being on the working group. Since there are more students than staff, involving students creates more energy savers. Staff/employees will be more likely to save energy if reminded by students. In order to foster enthusiasm and involvement in energy savings activities, teachers will:

- Give students a challenge to let them know they can make a difference in energy costs.
- Provide opportunities for recognition and sponsor awareness contests that are available through energy conservation programs.
- Involve students in monitoring energy usage so that they will reduce energy consumption.
- Use civic activities and ideas provided through the working group.
- Turn off lights when leaving a room.
- Turn off all computers in classrooms. If possible, use power strips for your computers and peripherals.
- Enable power management features on computers, copiers, scanners, printers, etc.
- Unplug all battery charging devices or power adapters when equipment is fully charged or disconnected from the adaptor.
- Turn off all other smaller appliances if possible.
- Do not block classroom air supply and return grills with furniture or displays.
- Keep classroom doors and windows shut when heat or air conditioning is on.
- Close all windows and doors when leaving the classroom at the end of the day and turn off all equipment and lights.
- Do not cover or block thermostats.
- If heating and cooling is not operating properly, contact the Facilities Department.
- Report faulty thermostats and other equipment that may be malfunctioning to the Facilities Department.
- Wear warmer clothes in cold weather and encourage students to do the same.
- Wear cooler clothes in hot weather and encourage students to do the same.
- Combine classes when practical, especially when using A/C or heating equipment.
- Cooperate with the working group in their assessment and help them implement the necessary energy conservation measures.



6.2.5.3. Maintenance and other school staff role and responsibilities

The following activities during the implementation of the action plan and the energy management plan are the responsibility of the school maintenance and staff:

- Check for proper thermostat settings and functions.
- Check for overheated and over cooled areas.
- Turn off power ventilators and exhaust systems when not needed.
- Isolate unoccupied spaces from heating and cooling systems.
- Turn off lights when leaving a room.
- Disconnect all unused electrical equipment.
- Follow procedure for turnoffs during weekends and vacations.
- Check all building insulation, caulking and weather-stripping. Repair caulking and weather-stripping as necessary.
- Inspect heating and air conditioning equipment periodically.
- Replace worn seals, fittings, traps, etc., check ducts for leakage.
- Check the hydraulic system pipes that pass through uninsulated areas.
- Keep refrigerator compressors and condensers clean.
- Inspect drinking fountains for proper operation and leaks.
- Check all plumbing for leaks.
- Reduce hot water heater temperatures to 48-52°C except in food preparation areas.
- Secure all attic and roof hatches.
- Replace ceiling tiles when dislodged, broken or missing.
- Keep door closer in good working condition.
- Repair damaged windows and doors immediately.
- Inspect and clean water coolers.
- Cooperate with the working group in their assessment and help them implement the necessary energy conservation measures.

6.2.5.4. Students role and responsibilities

Students are the most important target group of energy management plan because of the behaviour change that can it bring especially in long-term perspective. Especially important part is to incorporate active young people to the working groups and try to influence them to change their sight on energy efficiency relevance in today's world. Encouragement of students to conserve the energy in schools will be key part of good energy management in school buildings. The responsibilities of students will be:

- Turn off lights when leaving a room.
- Turn off all computers in classrooms when not in use. If possible, use power strips for your computers and peripherals.
- Enable power management features on computers, copiers, scanners, printers, etc..
- Unplug all battery charging devices or power adapters when equipment is fully charged or disconnected from the adapter.
- Keep classroom doors and windows shut when heat or air conditioning is on.
- Wear warmer clothes in cold weather.
- Wear cooler clothes in hot weather.



- Cooperate with the working group in their assessment and help them implement the necessary energy conservation measures.

6.2.6. Communication

In order to optimally implement the solutions presented in the energy management system, it is necessary to create appropriate communication channels between all members of the working group and the recipients of the activities implemented in the action plan, i.e. students, employees, parents, etc.

Therefore, the communication should provide information about actions e.g. trainings, lessons, new rules for children and all interested parties. Those communication channels can be:

- social media channels
- school's website
- phone communicators
- specially developed school app
- posters
- school press

6.2.7. Raising awareness

Everyone has a role in energy management. Effective programs make staff/employees aware of energy performance goals and initiatives, as well as their responsibility in carrying out these programs.

The energy coordinator will develop communication strategies and materials for raising awareness of energy consumption, goals and impacts that will be tailored to the needs of the intended audience. Staff/employees and students may be unaware of how their everyday actions and activities at home and work affect utility consumption and impact the environment. By increasing the overall awareness, it will be an effective way to gain greater support for energy initiatives.

The energy coordinator will increase general energy awareness through:

- New staff/employee orientation programs – provide basic information on organizational and individual energy consumption to new staff/employees.
- Earth Day – coordinate events to educate and promote energy conservation at home and school.
- Internet site – publish information on energy consumption, environmental impacts, and energy-saving options geared towards a general audience on school's web site.
- Email distribution – send an energy tip with email distribution for reducing and conserving utilities.
- Poster campaigns – develop attractive and informative posters for break rooms, bulletin boards, etc, that discuss energy consumption.

Besides general energy awareness, the working group's members will make staff/employees and students aware about the operations of their schools/facilities and its impact on the school and environment. With the increased awareness of school and facility energy consumption, it will help build support for energy management programs.

Like general awareness efforts, facility-oriented energy awareness can take many forms. The energy coordinators should increase facility energy awareness through:



- Summary statistics – use general school and facility energy facts and figures, such as overall energy costs, costs to operate equipment, and environmental information related to energy consumption.
- Sources of energy – most people do not know how the energy they use is generated. Providing information on the sources of energy consumption at their school and facility along with the associated pollution (greenhouse gases) that results from its use could increase awareness of the environmental aspects of energy consumption.
- Energy consumption of equipment – provide information on the energy performance of equipment or processes that staff/employees regularly use as part of their jobs. For example, most staff/employees probably do not know how much energy their computer uses during the day and how much that costs the organization when it is on, but not in use.
- Scorecards – develop charts and graphics that illustrate energy performance for schools/facilities and compare it to the national standards.

6.2.8. Capacity building

The Energy experts will build the capacity of the staff/employees through training, access to information, and transfer of successful practices, procedures, and technologies.

Investing in training and systems to share successful procedures and practices will help to ensure the success of energy action plans by building the overall school capacity. Many organizations have found that informed staff/employees are more likely to contribute ideas, operate equipment properly, and follow procedures, helping to guarantee that capital investments in energy improvements will realize their potential.

Training

The working group will use training to help staff/employees understand the importance of energy performance so that it provides the necessary information to make informed decisions. The training will also provide an excellent opportunity for gathering staff/employee feedback and evaluations. The type and nature of training will vary by school and facility and its specific energy action plan.

Training programs will consist of:

- Operational and procedural training — provides instruction on new operating methods or procedures designed to reduce energy consumption. Such training is typically targeted towards specific audiences, such as facility managers, operations, and maintenance staff.
- Administrative training — Includes reporting, monitoring, data collection, and other administrative efforts that support energy management.
- Specialized training — Gives specific instructions on using and maintaining equipment or tools to ensure more efficient operation.



7. Monitoring of Action Plan

The measures and actions taken during action plan should be monitored and tracked by data collection on energy consumption in building. Towards to this, the working group will establish the tracking system and develop it as a part of action plan to track and monitor progress in repetitive time (intervals) and quantification.

Monitoring system can be a simple system which will identify what activities are at the moment pending and show which targets are fulfilled, milestones and actions reached.

To prepare the monitoring system, the working group will undertake the actions towards the successful tracking and monitoring the progress. Chosen member of working group to monitor should:

- Perform regular updates of current and comprehensive information (at least monthly updates);
- Conduct periodic reviews and report which goals and milestones are reached at the moment and show what are the problems and barriers in successful action development;
- Identify necessary corrective actions with monitoring system highlighted in periodic reviews to correct the action and reach its milestones.

8. Action plan evaluation

The working group will evaluate the progress through formal review of both utility consumption data (heat, electricity, water) and activities carried out as part of the energy action plan and comparison to established goals.

Evaluation results and information gathered during the formal review process will be used to create new energy action plans, identify additional best practices, and set new energy performance goals.

Developed actions should be review with the full report on action plan implemented and executed in schools.

During the reviewing of energy action plan it's important to understand the factors affecting the results as well as the additional benefits of the improved energy performance. This review will address the effectiveness of each school and facility's energy action plan. It will determine where activities and projects were successful, document best practices to share throughout the schools, determine where goals were not met.

Review of action plan should include:

- feedback – get the feedback and ideas on the plan, implementation team;
- awareness affection – assessment of staff/employees behaviour change on the energy issues;
- identification of critical elements/factors – assess what should be contributed to reach missing targets;
- quantification of benefits not foreseen in action, but identified during action plan development;
- creation of insight for new energy related actions;
- commitment of resources;
- success stories and financial results



9. Risk management

During implementation and monitoring of energy action plan, there will be conducted actions to lower possibility of decrease of action impact. Through the monitoring and overviewing the actions, there will be reported the activities/factors which can in wrong way affect the implementation of the action.

At the moment of implementation of the action, the working group will list the actions which can be problematic and unsure to finalize and list the resources which at the moment schools are lacking of e.g. staff, energy knowledge, metering devices. After identification of “red flags”, the working group will find the suitable solution and adjust current solutions

10. Dissemination of undertaken actions

Dissemination of actions and possible ways to present it to the stakeholders were presented in chapter 6.2.7. Raising awareness. Of course dissemination of actions could be done on higher level and use of channels e.g. TV, press to showcase the results of action for wider group of people not directly involved or impacted by the action plan.

11. Conclusion

To have an Energy Management Plan is the very first step for a public school to move towards energy efficiency and sustainability. Major changes in energy behaviour and attitude of students, teachers and school staff – in turn, in energy consumption and performance of the building they attend – may happen by putting in place a series of simple, soft actions combined with cost-effective technical measures. Nowadays, school buildings still present drawbacks to be faced in the field of energy. Indeed, this offers the opportunity to take action for greener schools. To start, the above document provides suggestions and guidelines for every kind of school and it represents a ready-to-use tool to reach EE goals in the near future.