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RE	Restricted to a group specified by the consortium (including the Commission Services)	
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Table of Contents

Quality of the Consortium, EU dimension and social cohesion

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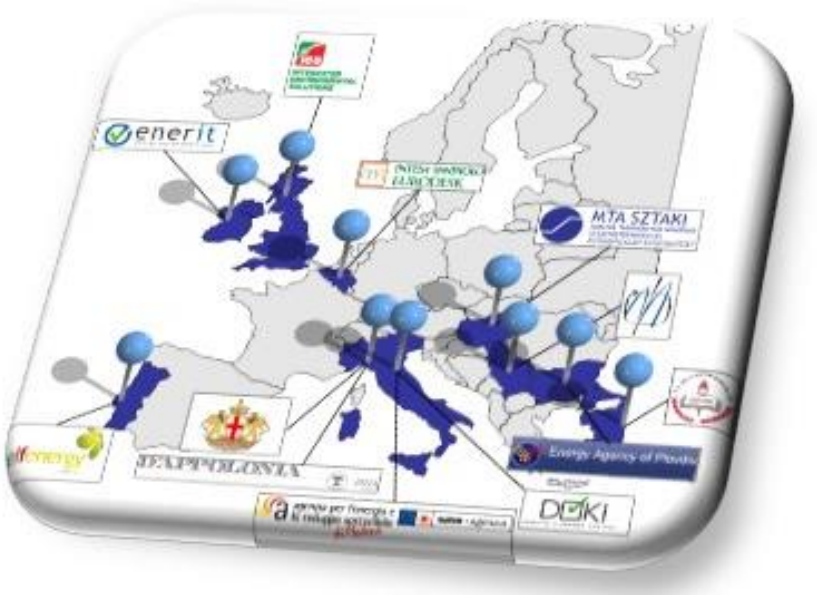

The VERYSchool project has involved a cross section of people and organisations with expertise in the field of technology integration, energy management, public awareness and private end-users.
Industries, R&D and SME offered qualified solutions on energy management and building control, promoted innovation and penetration of technologies and concepts.
The two Regional Energy Agencies (AESS and EAP) established a link with local communities and took energy performances updated with current legal requirements.
The Public Authorities (Municipality of Genoa and Ankara National Education Directorate) offered vision, leadership and help to shape policy development.
The ESCO (EPRO) and the Bank consultant (ISPE) developed the financial aspects for understanding how schools currently finance their energy efficiency improvements, while they outlined how the financing options can change according to the model adopted.

The VERYSchool Family

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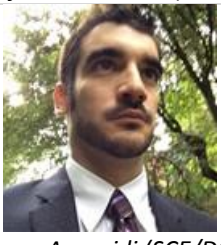
 *Paolo Onesti (SCE/DOKI)*	 *Ormes Corradini (SCE/DOKI)*	 *Lorenzo Argenidi (SCE/DOKI)*	 *Andrea Sacchetti (SCE/DOKI)*

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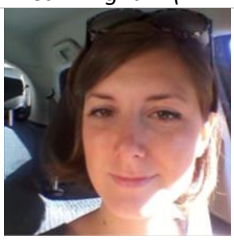
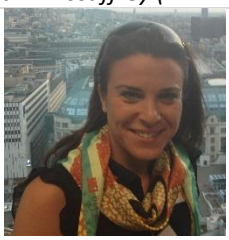
 *Antonio De Ferrari (DAPP)*	 *Federico Di Gennaro (DAPP)*	 *Serena Pagliula (DAPP)*	 *Margherita Scotto (DAPP)*
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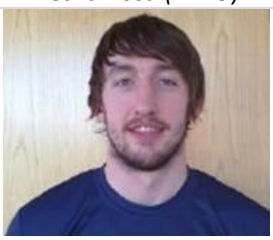
 *Rogério da Ponte (EPRO)*	 *Catherine Conaghan (IES)*	 *Ruth Kerrigan (IES)*	 *Eoin Nolan (IES)*
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Executive Summary

The **VERYSchool** project has addressed the core theme of the *Energy Management*, and it has deployed a methodology and tools for school decision makers and managers, technicians and ICTs professionals, teachers and students, to collectively address the issue of ICTs based solution for energy efficiency in school environment.

A consistent **Action Plan** has been adopted to implement ICTs based solution for energy efficiency in four School Pilots (e.g. smart energy meters, thermostatic valves on the radiators, LED lighting, presence sensor, lux meters, dimming devices), and to full demonstrate the effectiveness of a systematic energy management performed through VSNavigator working in real conditions. During a one year experimental campaign, different people from each school organization were involved (e.g. the Municipalities owner of the schools, school managers and technicians, teachers and students) to get confidence with VSNavigator and to provide feedback for improving the usability.

The **energy saving assessment** of the ICTs based solutions for energy efficiency implemented in the School Pilots was performed with the *eeMeasure software* (the tool provided by the EC to validate the results of EC-CIP projects). The survey and main conclusions are shown in the table below.

ICTs-based solution for energy efficiency	Energy Saving
Installing radiator control valve on each heat emitter with hydronic heating.	*Around 30% for heating consumption.*
Measuring thermal consumption by heat meter in whole school, considering Pilot area and adjacent space where radiator control valves have been installed only in the Pilot area and the other radiators have no local heat output control but only central.	*Up to 10% for heating consumption.*
LED lighting with dimming against traditional lamps	*In the range from 60% to 90% for electricity consumption.*
Dimming versus ON/OFF lighting control (achieved with the same LED electrical power and rooms in "very closed" living conditions and configurations).	*Potential energy saving of 16% to 40% is envisaged for electricity consumption.*
LED lighting without dimming against traditional lamps.	*Nearly 50% for electricity consumption.*
Automatic control of traditional lamps against manual ON/OFF.	*Around 25% for electricity consumption.*

These energy saving results, have also introduced the financial saving capacity and carbon emission reduction quantified in the table below.

Results	Unit	LESA	GENOA	PLOVDIV	LISBON	SCHOOL STOCK
Financial saving	[€/year]	1,126	1,285	564	26	3,001
CO2 reduction	[kgCO2/year]	2,639	3,033	397	95	6,164

Therefore, assuming that the four schools belongs to the same district, the VERYSchool project demonstrated a **financial saving capacity of. 3.001 [€/year]**. The **CO2 reduction** is of **6.164 [kgCO2/year]**.

These energy saving results are the principal outcome of the VERYSchool project and they prove the effectiveness of the Energy Management Program versus the rigorous **compliance to the ISO 50001** standard.

The *Energy Action Navigator*, **VSNavigator**, was at the centre of the **VERYSchool** project development. **VSNavigator** is a *High-Level Management* software platform usable as *web-tool* with a simple and intuitive user interface, and a centralized database.
VSNavigator integrates with other (external) mature technologies, already in the market.

1. *Building Energy Management System* (BEMS), installed in Pilot areas of four European schools, provides monitoring and (local) automatic control system of the energy systems as well comfort in the indoor spaces. Communication between the VSNavigator and the BEMS is one way, to collect measured energy consumption data, devices status and comfort conditions. VSNavigator is not a control system and it does not generate automatic control actions. VSNavigator suggests possible

optimization scenarios and allows the estimation of the benefits that would be gained.

2. *Software for Energy Action Management*, to drive and link all actors of the school value chain under the guidelines and practices of the *ISO 50001 international standard*.
3. *Software for building performance assessment*, to estimate a priori the benefits that could be achieved by a change of current system settings, and at the same time informing decision-makers about potential results.

VSNavigator is primarily a **decision-support system**, with performances superior to any commercial SCADA. It incorporates all the needed functionalities to manage current and future energy management actions, at both the levels of single building or district school network.

The decision process is realized through a **Catalogue of Optimization Scenarios** as principal component of the software platform. The selection of suitable *Optimization Scenarios* is unique for each building since it is built upon the (real) measured data, the information gathered through the energy bills, the building data, organization's rules (system settings configurations).

A standard **IPMVP** methodology customized for school environments, with examples on how to calculate energy savings and assess indoor comfort has been deployed as project result. This methodology provides a *reasonable understanding* of the energy savings and comfort level in school environments using experimental data of limited time and limited number of rooms, both for lighting and for thermal consumptions.

Lessons learnt from demonstration and validation activities, selection of suitable Optimization Scenarios, performances assessed versus acceptable payback periods (energy and cost savings), international best practises of school building renovations, are the project contribution for showing ***Green School Building Design*** and, specifically, an attempt to transform the school Pilot as ***Near-Zero Energy Building***.

An **on-line survey** was carried out to strengthen the Public Awareness Campaign among school people and organizations. The collected information and the statistical analysis, allowed the project to get the following summary and main conclusions.

1. Energy Management in Buildings is considered important by the majority of the respondents' schools and they plan to adopt EE measures in the next three years.
2. Even if the majority of respondents declare to know Energy Standards and certifications, about 70% of them are not equipped with systems to monitor energy consumption, temperature profiles, lighting levels, IAQ management. This could suggest a large untapped market potential for these solutions.
3. The main barriers to be addressed seem to be the lack of awareness and of technical knowledge, as well as the difficulty in raising the needed capital.

In general terms, all the project deliverables that have the nature of public dissemination level can be downloaded from the project website. In addition, the following documents, delivered in format of electronic format, are available to the large audiences as independent publications, and they can be downloaded from the project website:

- e-Book: *A Catalogue of Optimization Scenarios to enhance decision-making in establishing an efficient Energy Management Programme*.
- *On-line survey*: the statistical analysis of the responders.
- *Guide for Financing Energy Smart Schools*.

Moreover, the four consistent databases, with one-year of experimental data, are made available to the public and can be downloaded from the project website.

The overall approach and methodology of the **VERYSchool project**, and the product or services that arise from the use of **VSNavigator**, realize a **modern approach to the Energy Management**.
They are transferrable to the entire European building stock (offices, residential, commercial, industrial, sports facilities, hospitals, heritage, and so on): what would change are simply features that make any building class or typology unique (usage, energy sources, etc.).

Chosen approach for Project Implementation.

Concept, Vision and Objectives

Energy Management of ICTs based solution for energy efficiency is central for setting short, medium and long term energy targets. As research and technologies progress with increasing velocity and 1000s of ICT solutions are on the market,

- Organisations do not have the necessary expertise, time, or resources to digest this rapidly evolving environment, and
- People that must make decisions to meet energy reduction targets are often left behind.

Options are overwhelming, guidelines on how to implement energy conservation measures in a systematic way are not yet full standardised, customisation is needed, needs, timing and business model are still misunderstood.

In this scenario, **Energy Management** becomes a **concern** when decision makers that have the authority to affect energy plans, strategies, programs, and management actions, are often far removed from the problem. Barriers include knowledge on what technologies to select, what energy conservation measures to pursue first, how information are shared among the many layers of hierarchy between the person that authorizes and someone installing high-efficiency ICTs; in simple words **how to create** an **Energy Management Program** that allow to implement the choices in a systematic way ensuring follow-up and continuous upgrade.

Indeed, an adequately addressed **Energy Management** is at the same time an **opportunity**: it is a simple, secure, clean and economical resource, and necessary within the core business.

Moreover, an effective program for installing ICTs based solution for energy efficiency is more urgent as modest are the economic conditions of decision makers.
It is first and foremost a collective interest of any Organization to reduce energy consumptions, and costs, and to drive regeneration policies which remove barriers while stimulate investments. Changing today's energy profiles is a big challenge, facing both decision-making and management processes.

The VERYSchool project contributed to help close the gaps for making effective the energy management of ICTs-based solution with three implementation steps.

1. *Selecting a sector of buildings that is organised and offers high replication potential*.
   The VERYSchool project has engaged the subset of schools in the building domain. Schools interest everyone, they are organised and they provide outreach to our future through the hands of the next generations. **Energy Management in schools is a concern** since almost all the buildings belong to Public Institutions and school managers complain about lack of finance resources to invest on ICT technologies. Conversely, ICTs based solution for energy efficiency in the school stock can be an **opportunity** since it can free up resources - coming from energy and cost savings - to be allocated to core educational activities, while benefitting from less environmental impact and best practises to show to the Community.
   Moreover, school managers and decision makers have no knowledge on key factors to make investments and often find themselves confused on the process to implement.
   The VERYSchool project provided support to overcome the lack of instruments for organising an effective energy management program, and in particular helps on how do:
   - *get started* saving energy in an individual school, or school district,
   - *get effective* with the on-going process (*what do I do next?*),
   - *quickly act* upon to optimize the on-going process,
   - *decisions* made and *actions* performed have been effective,
   - *know a priori* the benefits accruing from better use of resources or from planned investment.
2. *Developing a roadmap on how to bring ICT-based solutions to school and specific to their needs*.
   Reducing the energy consumption of European Schools is a complex task. At the building level, they have unique energy consumption needs. Beyond the building, schools typically fall into a larger network of buildings. The key decision makers may be far away from the actual needs accounted by school managers,

may not be informed, and may lack the time, staff, or expertise to address the problem in an effective way. As a result, beside the need to modernise energy infrastructures, energy reduction in schools requires at least three things:

- school specific ICT technology roadmaps, and
- better operational management of the energy flows within schools, and
- better process to bring energy management to school decision makers at the district (or network of schools) level.

The VERYSchool project addressed this technical challenge by providing a Roadmap to customise the world of energy efficiency to the needs of schools, further implemented as **Navigational System**.
The VERYSchool vision and the "**Energy Navigator approach**" is shown in the figure below.

The schools and the associated stakeholders (e.g. the Client) are placed at the centre. Then, ICT-related energy efficiency clusters have been built around the client to support the achievements of energy targets.

3. *Developing innovative tools and methodologies for managing ICTs based solutions that match the needs of the school domain (buildings and organization)*.
   As a whole, the clusters realizing the Roadmap include technologies, simulation, building operation, renewable energy technologies, energy programs, standards, assessment methods, knowledge creation, and knowledge exploitation. The product deployed by the VERYSchool project, jointly evaluated with the whole set of project results, raised awareness about energy efficiency needs and possibilities in school buildings as well as how energy services can change in school buildings.

Given the concept and vision described above, the objectives and technical challenges pursued in the VERYSchool project are summarized as following:

- Characterize the EU dimension of schools in terms of use patterns, technology provisions, renewable energy and energy consumptions, standard and regulations.
- Integration of commercial technologies such as Energy Action Management and Virtual Environment Simulation software tools, Smart Meters, Building Energy Management System and LED Lighting.
  Security, privacy, inclusiveness, interoperability, replicability, data fusion, have been the driver so that:
  - the project results are transferable to other scenarios of building and engineering environment;
  - a marketable product could be delivered to multivendor providers.
- Development of the *Energy Action Navigator*, a software environment called **VSNavigator** that has been deployed as an innovative tool for the energy efficiency of school buildings. Efficiency in this context is understood as the optimization process of Energy Management during its life cycle: decision-making,

future planning, current management, correction (if necessary) of the operational program in place. Energy Management was established in compliance with the requirements of the ISO 50001.

- Development of *energy optimisation scenarios* specific to the needs of schools (usage, building typologies, energy infrastructure typologies and management methods), and a **Catalogue** as principal component of the VSNavigator software platform.
- Realize a *result-oriented* and *pilot driven* project, with the use of the innovative VSNavigator as the core component. Four schools were chosen at different locations: LESA and GENOA (IT), PLOVDIV (BG) and LISBON (PT). The Schools vary in size, age, typology, location, ownership, and management bodies. They are representative of a large portion of the EU school building stock. In each Pilot area, smart metering, LED lighting, retrofit of heating system, BEMS, local SCADA (intelligent supervisor of energy systems and indoor spaces), simulation tools and communication facilities for data transmission, have been integrated to enable optimal energy decisions and user's interaction, during the demonstration phase.
- Demonstration and Validation of **VSNavigator** at the four school (pilot) locations.
  Demonstration was intended to perform functional tests and short to long term experimental campaigns over one year. Validation was intended as application of a standard methodology based on IPMVP to assess energy savings and indoor comfort profiles, with accurate energy benchmarks and indicators, as well as carbon assessment. The project Action Plan and Energy Management System were also validated against the practice and requirements of ISO 50001.
- Facilitate the *Green Building Design* and promote the concept of *Near-Zero Energy Buildings* for schools, by identifying what should be done, how to do it, and how selection of energy infrastructure can be merged with energy action (operational) frameworks.

Project's objectives have contributed at helping, promoting, guiding, disseminating, learning, raising awareness and improving the culture in school organization on the use of energy and its management. The whole set of objectives target the European industry on ICT-enabled energy efficiency technologies, at the intersection of energy, control, computing, communication, design tools and construction methods, with specific reference to:

- planners in school environment, to elaborate business plans with a systematic and qualified approach,
- designers and architects, towards standard solutions as replication of models and technologies to be adopted in more complex situations,
- energy and facility managers, in public and private school buildings to plan standard technical solutions for achieving cost-effective solutions.

The new technology introduced by **VSNavigator** put at the centre of the process the fundamental understanding how (European) schools actually manage their energy programs, identify possible barriers, promote opportunities and share best practices, even by means of comparative analysis of district schools network.

> It is explicitly stated that **any reference to the school building**, or **school organization**, automatically **extends to the general concept of "building" or "organization"** (of any type).

Energy Action Plan and Management System in the VERYSchool project

A devoted Action Plan was adopted for matching the requirements of demonstrating and validating the VERYSchool project and VSNavigator as well.

With reference to the Catalogue, the following *Optimisation Scenarios*, were implemented.

ELECTRICAL EQUIPMENT

- *OS #13: Implement behavioural rules to save energy (remind turning off unused devices, close windows when HVAC system is on, etc.)*

HEATING

- *OS #21: Install an Outdoor Temperature Compensator for the Heating Unit*
- *OS #22: Install thermostatic valves to radiators*
- *OS #23: Install a zone heat metering system*
- *OS #26: Replace the Heating Unit*

The OSs #21, #22 and #23 required investment costs that were covered within the project budget.

The OS #26 refers only to PLOVDIV with costs covered by the school Organization, thus no charged in the project.

LIGHTING

- *OS #27: Increase lighting efficiency*
- *OS #28: Set up occupancy based lighting control*
- *OS #29: Set up dimming lighting control*
- *OS #31: Split the electrical lighting circuits*

All these OSs required investment costs that were covered within the project budget.

SYSTEM SETTING STRATEGIES

- *OS #32: Optimize the thermostat set points during the day by keeping it at minimum allowed level (e.g. 21°C switch to 20°C)*
- *OS #33: Optimize the thermostat set points during unoccupancy of the school (trade-off between keeping at minimum level or switching the system off.)*
- *OS #35: Adjust timers to optimize switching "on" and "off" of the heating system before and after occupancy (Ramp Up)*
- *OS #36: Implement a remote control of radiators (zoning by room), with calendar scheduling option*

RENEWABLES

- *OS #55: Install a Photovoltaic (PV) system*
- *OS #56: Improve the use of the PV system*

The two OSs refers only to LESA with costs covered by the school Organization, thus no charged in the project.

MANAGEMENT-BEHAVIOR

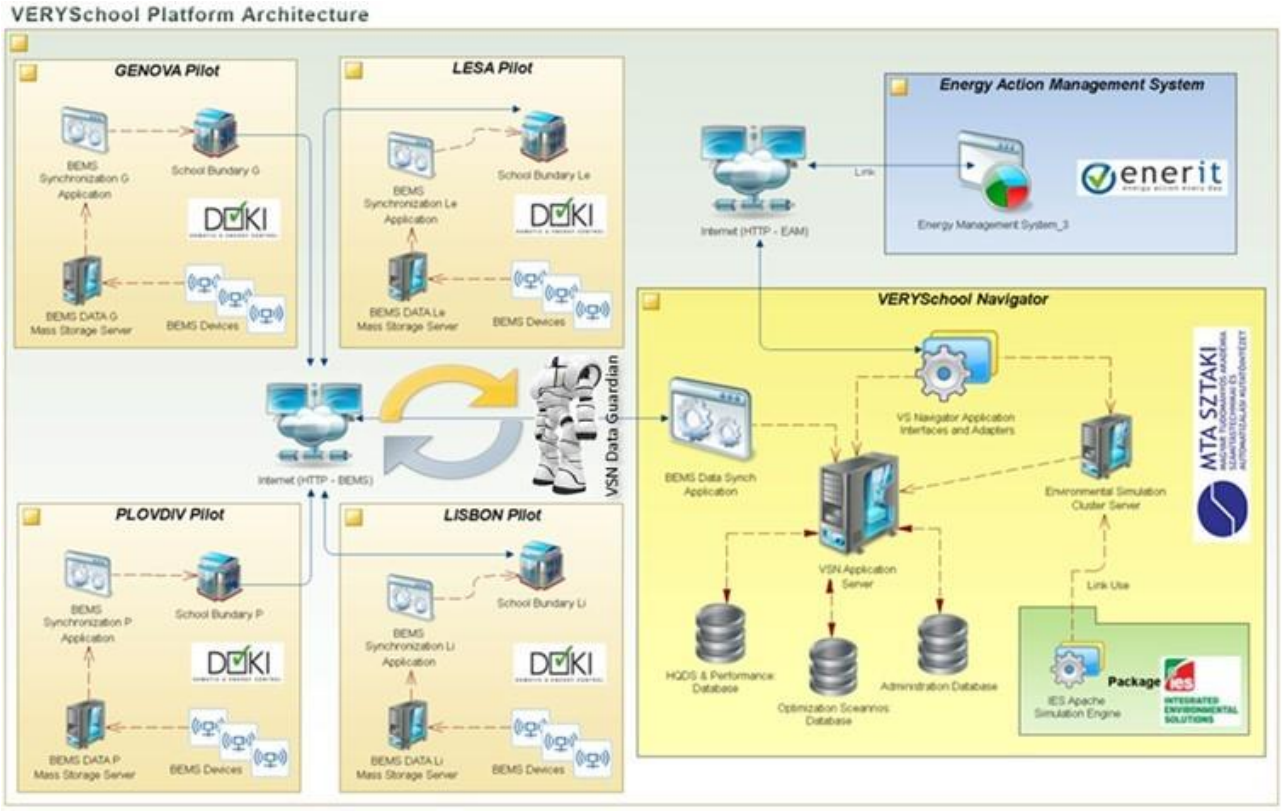
- *OS #64: Carry out lighting analysis*
- *OS #65: Carry out HVAC analysis*
- *OS #66: Carry out analysis of other electrical use and appliances*
- *OS #68: Raise awareness of staff, pupils and school personnel*
- *OS #70: Ensure lights are switched off at breaks and after school*
- *OS #74:Communicate with Staff*
- *OS #75: Communication for Students*
- *OS #76: Monitoring of energy supply contracts including global service contract*

VSNavigator as a Technology Challenges

One of the main objective of the VERYSchool project was to drive behavioural changes in schools through, continuous monitoring of user's behaviour and operative conditions, identification of non-optimized conditions and suggestions for improving the system setting strategies (or organization's rules) through a more effective energy management.

Pursuing this objective, **VSNavigator** is an innovative technology, which offers user specific energy optimisation recommendations based upon real marketable energy saving products. Nevertheless, the platform provides contents for measurement and verification plan.

The VSNavigator architecture is depicted below.

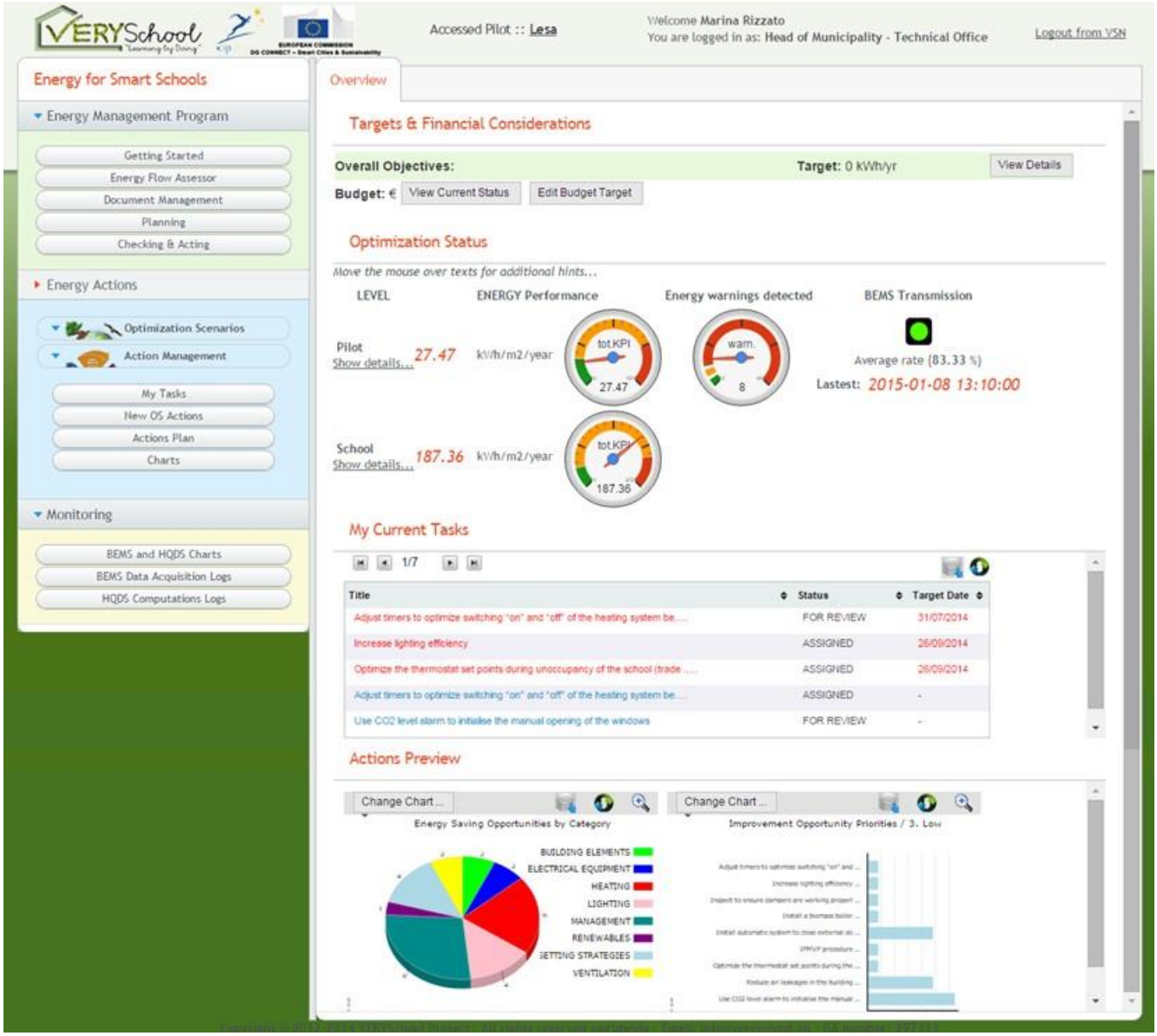


The main technical characteristics of VSNavigator can be mentioned as following:

1. Integration of the most recent technologies in software development (fully web-based).
2. Integration of the most recent technologies for BEMS, Energy Action Management and Environmental Simulations for Energy Optimization.
3. Easily deployable: all the application logics from integrated components is generated and driven on server side.
4. Easily customizable to and by user's requirements.
5. Multi-lingual ready platform.
6. Good-looking GUI.
7. Graphical representation of BEMS data, bill data, energy actions and simulations.

The VSNavigator platform, intended as a product, implements functions so that users can experience from the easy utilization and usability of its functionality. **VSNavigator** links all actors of the school value chain under a common platform dedicated to energy efficiency and provide "*how to*" information, enabling tools, and cutting edge intelligent energy savings strategies through the execution of optimisation scenarios dedicated

specifically to the needs of schools. Figure below depicts the role-based, service-oriented nature of functionalities offered by VSNavigator.



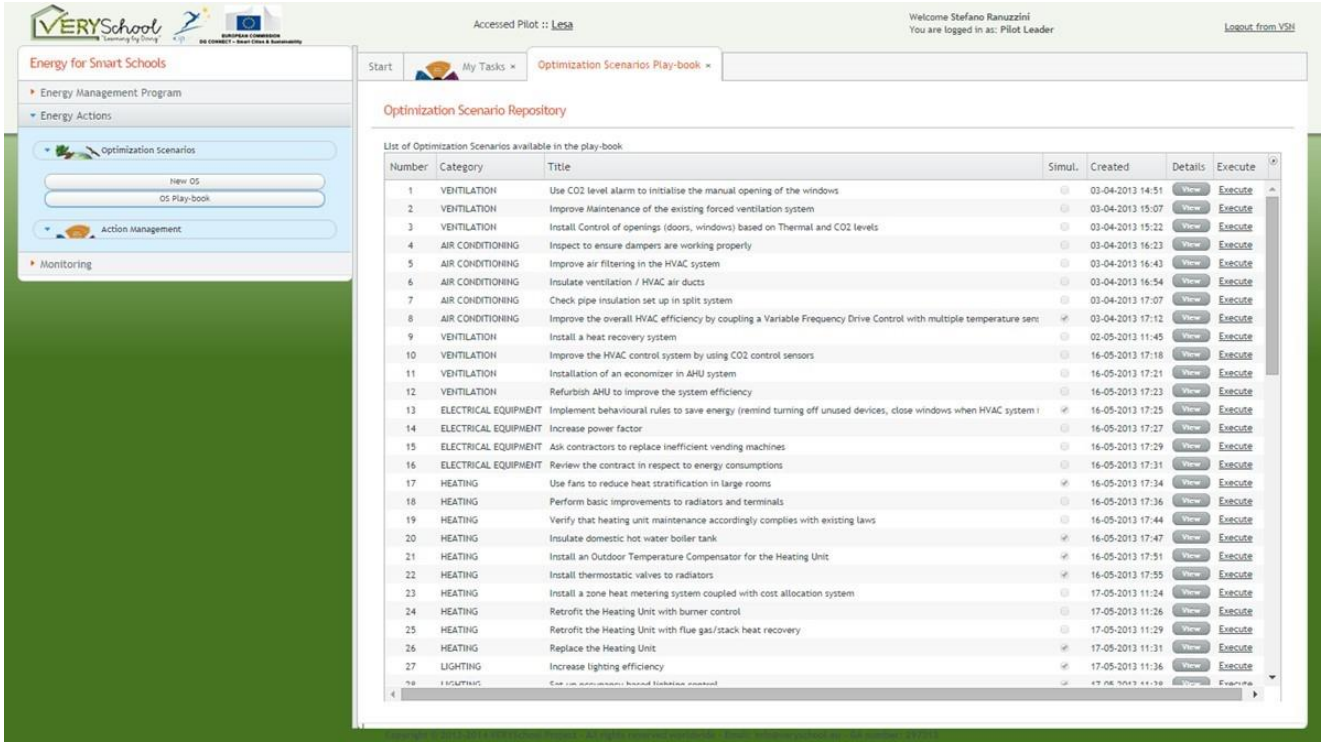
Users have different access levels and roles associated with the various levels (assigned by the administrator and implemented at the login). **Services are provided for all the users**.

Without distinguishing roles and accountability, these services can be mentioned as:

- the energy management system, established in a systematic way and complying with guidelines, practices and requirements of the ISO 50001 standard;
- the automatic simulation of operative conditions (optimization scenarios), that enable to get near realistic energy saving estimations when a change of the current setting is evaluated before the implementation. This is the point where the automation outcome (machine driven) enables the generation and activation of human-oriented actions in the Energy Management System.
- the generate (human) behavioural changes, possible through the evidence of non-optimized energy scenarios, and proposition on how to remove them. The energy indicators and comparison with annual targets and the list of warnings are the most evidence.

Optimization Scenarios

VSNavigator is mainly a **decision support system**, with superior performance to any commercial SCADA. The **decision process** is centred on a ***Catalogue of Optimization Scenarios*** (***OSs***) developed in the project.
This Catalogue is the kernel of the decision-making process within VSNavigator.



The *OSs Catalogue* used in the VSNavigator gives users many suggestions on energy saving opportunities covering a wide range of areas to improve energy management in schools.

- *63 Optimization Scenarios*, divided into 10 technical categories, are ICTs based solution for energy efficiency:
  - Ventilation
  - Air conditioning
  - Electrical equipment
  - Heating
  - Lighting
  - System setting strategies
  - Building elements
  - Layout options
  - Sport facilities
  - Renewables
- *13 Optimization Scenarios* classified as *Action Management and Behaviour*.

Within VSNavigator, the *Catalogue* is an online tool with *Set Rules* as the *heartbeat of the decision-making process* to automatically propose energy saving measures in an intelligent and dynamic way.
Ideally, each *Optimization Scenario* is associated to a specific set-rule.

Considering the suggested *Optimization Scenarios*, the user can decide for a real time implementation or consider some of them for future revision of the Energy Action Plan, by activating an Energy Action in full coherence with the ISO 50001 standard.

Each *Optimization Scenario*:

- includes recommendations on the applicability of the ICT solution,
- describes the implementation steps,
- make reference to standards and regulations,
- mentions the manufacturers of the specific technology,
- highlights the links with other possible *Optimization Scenarios*, and
- anticipates the estimation on capital costs, annual operation & maintenance costs, payback period, and expected energy savings that the scenario will produce.

TITLE

Improve Maintenance of the existing forced ventilation system

NUMBER

2

MAIN OBJECTIVES

Often in schools the existing forced ventilation system is not correctly maintained, and this issue leads to a global inefficiency that can heavily affect energy consumptions.

The aim is to avoid waste of energy due to malfunctioning, weak maintenance and components' wear. Checking that HVAC systems are working as intended will help to prevent them from using energy ineffectively and also lower the risk of breakdown and spiraling costs. In this way, regular maintenance of equipment and controls makes good business sense.

HVAC systems - Image courtesy of www.learnhvac.org

APPLICABILITY

This OS is highly recommended for schools with HVAC system. Several parts/components can be affected by some refurbishment/maintenance activities.

REFERENCES

- *Carbon Trust* www.carbontrust.com
- K-12 School guidebook for facility managers

POTENTIAL IMPACT

HVAC system in schools is a valuable resource and need to be always efficient: energy consumption can increase by up to 30% if regular maintenance is not undertaken.

IMPLEMENTATION STEPS

Step 1: Technology and plants assessment

A deep analysis of HVAC systems, electrical devices and all equipments used in school shall be done by a qualified technician, in order to have a clear picture of systems that need maintenance.

Step 2: Scheduling Maintenance

The school manager, together with technicians, shall provide a scheduled maintenance plan according to plants, equipments and budget. It is important to prioritize actions in order to guarantee not only energy savings, but also school users' comfort.

Some examples of maintenance activities are described in the following points:

Regular maintenance for optimum performance

HVAC components must be kept free of dirt and other obstructions in order to operate efficiently. The overall system should be serviced annually either by a maintenance technician or a professional contractor. Routine maintenance should be regularly undertaken to identify potential problems at early stage.

Maintain boilers

Have boilers serviced regularly by a reputable firm. Gas-fired boilers should be serviced once a year; oil boilers twice a year. A regularly serviced boiler can save as much as 10% on annual heating costs.

Check condensers

Condensers are usually located on the outside of buildings and reject heat that has been removed from inside the building by the cooling system. Ensure condensing and evaporating devices are clean and well maintained. Check condensers are not obstructed, for example by equipment or vegetation.

Check air conditioning and comfort cooling plant

Ensure cooling plant is regularly maintained to avoid operating at reduced levels of efficiency. Replace insulation on refrigerant pipework as poor condition will affect the temperature of the refrigerant flowing through the system and thus consume more energy in maintaining the required temperature. Pay specific attention to pipework located outside a building. Check for refrigerant charge and leakage. If your refrigeration plant contains more than 3 kg of refrigerant then the F-Gas regulations state that you must have a schedule of regular inspection for gas leaks.

Clean fans, filters and air ducts to improve efficiency by up to 60%

There is no point in having an efficiently running system if the conditioned air gets stopped by a solid wall before reaching the work space. Blockages in HVAC systems are common and increase running costs, so make sure that the filters are regularly checked. Consider fitting pressure gauges to indicate when replacement of filters is required.

REFERENCE SUPPLIERS

No suppliers needed

RELATED OS

-

LINK TO SET RULES

Some scenarios require dynamic simulations for predicting the associated potential energy savings and some do not. To estimate the energy impact and the potential return on investment for those scenarios requiring simulation, VSNavigator links to building calibrated model developed with the IES <Virtual Environment> suite.

The *OSs* that may require simulations have been grouped into two categories:

a. *operational scenarios*, and
b. *design scenarios*.

The operational scenarios are, for example, the scenarios dealing with "system setting strategies" to explore the potential energy impact of different configurations based on the simulation results. The operational scenarios are executed based on user-driven inputs; therefore, there is no pre-defined input profile.

The **e-Book** "***A Catalogue of Optimization Scenarios to enhance decision-making in establishing an efficient energy management programme"*** is delivered as project result. This publication is made for public dissemination, with the **e-Book** downloadable from the project website and from websites of some Consortium Partners.

Maturity of the technical Solution

The VERYSchool project adopted mature technologies (hardware and software) provided by Consortium Partners: BEMS, LED lighting and smart metering by SCE/DOKI, simulation software suite by IES and energy management platform by Enerit.

Willing to extend the "maturity" concept also to **VSNavigator**, intended as a web-application and resulting in the orchestration of mature hardware and software technology, it is appropriate to highlight that the technologies used to develop the VSNavigator platform are also mature in its field of application (programming languages, database, protocols, and so forth). VSNavigator has been deployed into a highly customizable, innovative environment. Its minimum software requirements include a web application server and servlet container, a relational database management system, a Java virtual machine and a relatively modern web-browser.

The core element of VSNavigator functionality is a pure Java-based web application, whose main client-server components and their relative interfaces have been orchestrated as follow:

- **Server side**: the communication between the external BEMS and VSNavigator is undertaken by a dedicated layer, responsible not only for handling connections but also for validating and interpreting the semantics between the application logics and the communication protocols.
- **Client side**: the client-side function of VSNavigator is a rich Internet application-based graphical user interface (GUI), which embodies similar characteristics to desktop software and is delivered by way of a browser and extensive use of JavaScript. The GUI provides the user with a friendly interface to easily access all of the platform's functionalities.

Being the maturity of the proposed technologies, there have been no hardware development in the project but only hardware integration and software development for energy management and optimisation scenarios customised for school in a sustainable and profitable way.

Degree of innovation

VSNavigator is a product for energy efficiency in school buildings technologically new. This innovative tool provides a quality improvement of existing solutions for Energy Management, since it introduces a repeatable integration of techniques and technologies, via integration with Monitoring & Targeting techniques (M&T), utility billing system, (semi-) automated billing entry, (semi-)automated reading entry.

Using VSNavigator, Energy Management becomes a systematic methodology that complies with all the requirements of the ISO 50001 international standard. The PDCA cycle (Plan-Do-Check-Act) governs the activities within the Organization, suiting with current management, correction of the on-going operational program, decision-making and future planning.
The innovative and high technological level ensured by VSNavigator versus market product and actual compliance with ISO 50001 state-of-the-art solutions is depicted in the table below.

ISO 50001 functions	VERYSchool EAN (Navigator)	M&T Techniques	BMS	Corporate Carbon and Energy reporting
Direct energy meter/sensors connections	Yes	Yes	Yes	
Reports - energy	Yes	Yes	Yes	Yes
Reports - actions	Yes			
Significant Energy Users (SEU)	Yes			
Energy Saving Opportunities (ESO)	Yes			
Planning	Yes			
Action Management	Yes			
Control of Systems/Devices	Yes		Yes	
Management of People	Yes			
Management review	Yes			
Document management	Yes			
Audit management	Yes			
Corrective Actions	Yes			
Integration with other systems	Yes			

The innovation in VSNavigator lead to a product that is superior to alternative solutions, while creating higher quality services.

Pilot Challenges

VERYSchool was a pilot driven project. Four School Pilots, geographically scattered in Europe, were selected: LESA and Genoa (Italy), Plovdiv (Bulgaria) and Lisbon (Portugal).

These Pilots vary in size, age, typology, activities, ownership, and management bodies.

They are complementary and representative of a large portion of the school building stock; thus providing the basis for a wide replication potential.

Target outcome was to demonstrate the functionality of VSNavigator in real conditions, and to validate the performances under different climates, school usage, people habits, energy infrastructures and type of management. The replication concept was at the centre of these activities.

Energy audits occurred early in the project to provide inputs for the development and to establish a basis for evaluating the final energy achievements of the project.

The Pilot schools were prepared to implement the renovation actions (e.g. smart meters, thermostatic valves on each radiator, LED lighting and dimming) and further to install the BEMS. The Pilots were fully operational in the second half of the project and they ran until the end of the project (continuing also beyond). The integration of the project technologies helped to develop the specific Optimization Scenarios, while the experimental campaign performed over one year of continued ICT-focused activities allowed to collect a congruent dataset of measured data that have been used for:

- developing the IPMVP methodology customized for schools,
- closing the development feedback loop,
- supporting the dissemination (webpage, brochure, press releases, presentations, papers) and exploitation activities (replication plan), and last but not least were used as showcase.

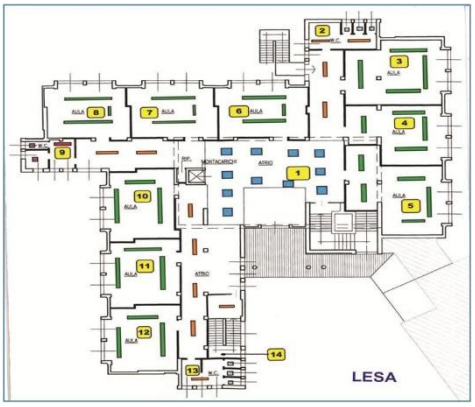
The end users were the owners of the schools and the equipment and systems deployed at the pilot sites will remain their permanently. Maintenance was assured during the life of the project, but the owners are responsible for maintenance and repair after the project.

The four Pilot Schools

Pilot #1: LESA

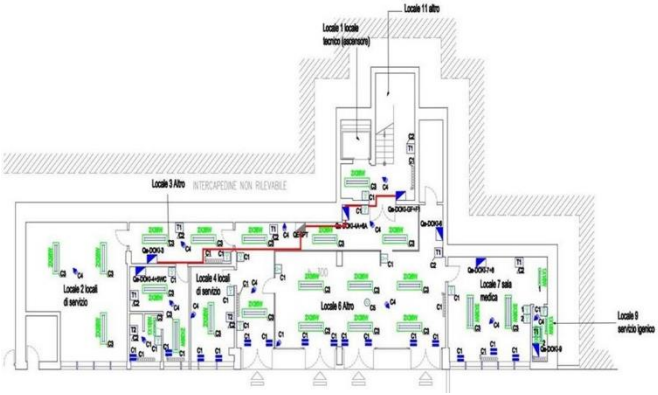
The town of LESA is located in the Lago Maggiore region, North-West of Italy. The Elementary and Middle-grade school is a single building built in 1974 with total area of 3,056 m^2 and heating volume of about 11,160 m^3. It is a two story building that during the school year hosts about 220 people (both staff and students).
The building is a typical construction of the 70s. The Municipality, who is the owner of the school, underwent an important restructuring plan to realize energy savings by substituting the heat generators, installing PV solar panels and adding insulation material specifically under the roof top.

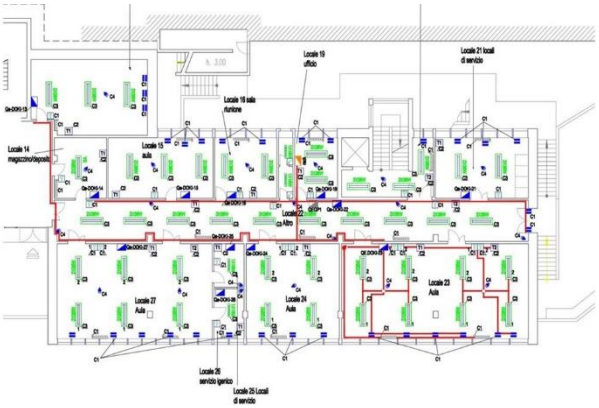
Pilot area is the first floor, and has net indoor area of 939 m^2. Pilot area hosts approximately 102 people and consists of 9 Classrooms, 3 Bathrooms, Service Rooms, Entrance, Lobby and Corridors.
The LESA Pilot has been considered as a "laboratory" for the project, where the basic of the DOKI BEMS customized for schools have been first implemented and checked.
The lessons learnt in terms of physical and interfacing solutions adopted at LESA have been further customized for the other three Pilots, standing that from the functional and use point of views affecting VSNavigator, the BEMS performances are identical for all Pilots.



Pilot #2: GENOA

Genoa (Voltri) School is a recent complex school, located in the West district of Genoa city and built in 1985. It includes three basic school levels: nursery, primary and junior high school; during the school year it hosts an average of 446 people. The complex is accessible from an internal road with some lay-byes and car park areas. The school has a video room, a library, a computer lab, a drawing room, a lot of class rooms, a big cafeteria, a kitchen, a big and well equipped gymnasium and a medical room.
It is a two building complex: both the buildings consist of three floors plus the ground floor, for a total volume of about 24,000 m^3.
The Building proposed for the VERYSchool project has total area of about 3,030 m^2. **Pilot** area is the first floor and part of the second floor, with a net indoor area of 737 m^2. **Pilot** consist of classrooms, laboratories, offices, library, lobbies, corridors and WC-s. Pilot area hosts approximately 88 people.





Pilot #3: PLOVDIV

Professional School for Electrotechnics and Electronics (PSEE) is an elite government high school with local significance for the education of young people. Its professional training is consistent with the requirements of high education standards. Future technicians in electrotechnical Industry, information technology and electronics are prepared in this school. PSEE is a two buildings complex located in West district of Plovdiv, built in 1962 and renovated in 1985. Moreover, the School was refurbished partially, with the change of windows in 2008 (still ongoing action) and the improvement of the heating system in 2012.

First buildings has total built area of 1,400 m^2, the second one has 1,100 m^2. There is a third building bridging the two buildings that has 400 m^2 built area. The total built area is 2,900 m^2, total floor area is 8,646 m^2, heating volume is 26,388 m^2. PSEE outdoor area is 17,656 m^2. During the school year PSEE hosts an average of 939 people.

The Pilot area proposed for the VERYSchool project is part of the 3rd floor, with a net indoor area of about 1000 m^2. **Pilot** consist of classrooms, laboratories, library, corridors and stairs and WC-s. Pilot area hosts approximately 210 people.

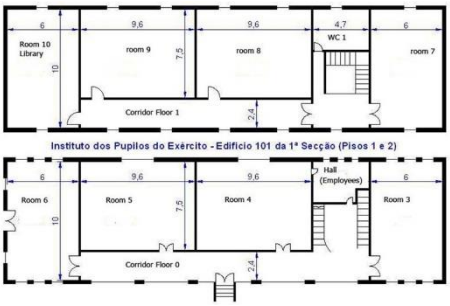
Pilot #4: LISBON

IPE, Instituto Pupilos do Exército in Lisbon, is a military educational establishment for the basic education (2nd and 3rd cycles) and Secondary Education (Vocational Education), that is developed along with of a physical activity/sports and cultural practices.

The school complex is constituted by several separate buildings distributed on a large surface. Most of the buildings were built since several years.

The building selected as a Pilot for the VERYSchool project was built in 1900, has gross indoor area of 950 m^2, 3 floors and 10.34 m total height, with pitched roof, without attic and cellar. Structural material of the building is brickwork; building mass is heavy. North-east and north-west facades have open position, the remaining two are obscured. During the school year the building hosts an average of 91 students and 7 employees.

This pilot building was refurbished before the DOKI BEMS installation. The new Pilot area was developed on two floors; the ground floor where 3 classrooms, teacher's room, employees room and a corridor are located; while in the 1st floor find place 3 Classrooms, a bathroom, one corridor and a Computer Room.



Building Energy Management System

The following table includes the type and number of monitoring and control devices installed in each Pilot.

	Type	LESA	GENOA	PLOVDIV	LISBON
1	Room Units	13	20	18	16
2	Energy Units	3	3	3	2

The DOKI system uses its communication protocols in several ways, according to the size of the network and the expected network response time. LESA and PLOVDIV Pilot schools have wired networks and communication protocols based on TCP/IP. LISBON has a full wireless protocol. GENOA has a mix of wired and wireless communication.

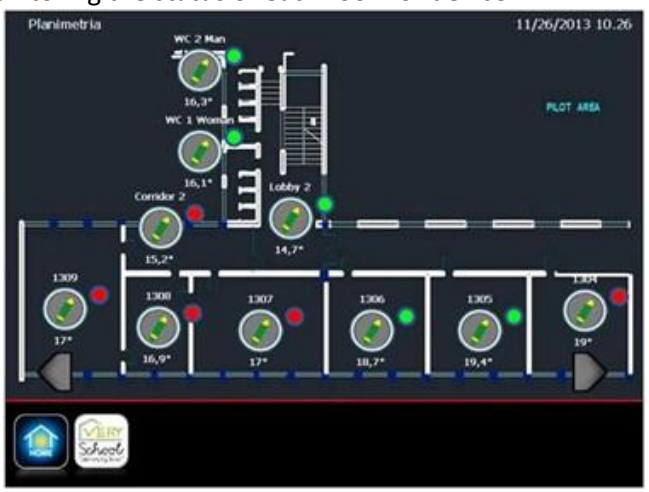
The main features of BEMS working in Pilots are summarized below.

- *Electrical meters*: each BEMS measures active and reactive power, active and reactive electricity consumptions, both for School and Pilot area.
  Moreover the electrical current and voltage on the three phases are measured for matching the needs of the calibrated models delivered to each pilot.
  In the LESA pilot, one meter is for measuring the electric energy generated by the PV plant.
- *Thermal meters*: PLOVDIV measures the School heating consumption; GENOA measures the Pilot heating consumption.
  LESA has no meters because it was impossible to install the device in the boiler house; LISBON has no meters because there isn't thermal energy generation.
- *LED lighting*: each Pilot has specific LED installations, with and without dimming control.
- *Indoor air temperature*: each Pilot room has one sensor. BEMS provides the dynamic set-point values to establish the room thermal comfort.
- *External air temperature*: each Pilot has one sensor.
- *Occupancy*: each Pilot room has at least one presence sensor (larger rooms have more than one).
- *Brightness levels*: each Pilot has specific room installations and configurations to fit with the dimming control. BEMS provides also the dynamic set-point values establishing the room visual comfort.
- *Window contact*: each room has contact sensors to detect the status OPEN/CLOSE of the windows. All windows in the room are connected in series, so that only the room status of the windows is collected.
- *ON/OFF thermostatic valves*: each radiator has one valve. For each of them the variable "status", "minutes ON" and "hours ON" are measured.
  The room heating control is performed considering each room as "group of radiators".
- *Lighting circuits*: each room could have more than one electrical circuit. For each of them the variable "status", "minutes ON" and "hours ON" are measured.
- *BEMS control status*: each room has one selector to switch the functionality as *automatic*, *manual*, *stand-by*. Some large rooms have more than one selector to perform the "zone" control.

Table below provides a summary of the BEMS equipment installed in each Pilot.

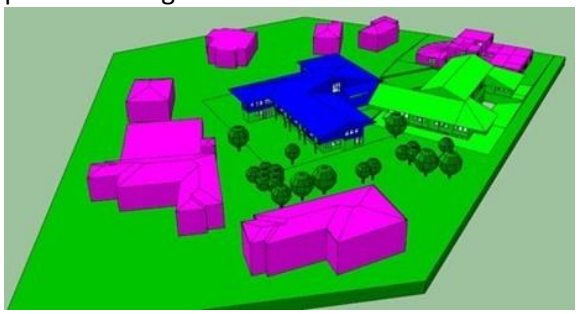
Pilot	Indoor rooms	Variables				Sensors / Hardware							
		Digital	Analogue	SW	**Total**	Temp	Presence	Lux.	Valves	Lighting Circuits	groups radiators	Electrical Meter	Thermal meter
LESA	14	83	235	1.037	**1.355**	14	17	3	25	32	13	3	0
PLOVDIV	18	99	293	1.281	**1.673**	19	21	12	46	24	21	3	1
GENOA	18	85	231	1.122	**1.438**	18	21	1	23	25	17	3	1
LISBON	12	42	125	667	**834**	13	12	2	0	12	0	2	0

BEMS provides a *Touch Screen Display* for local user interfaces and remote internet (web) access, to cover the need of controlling the plant at the site, as well as for monitoring the status of each room or device.



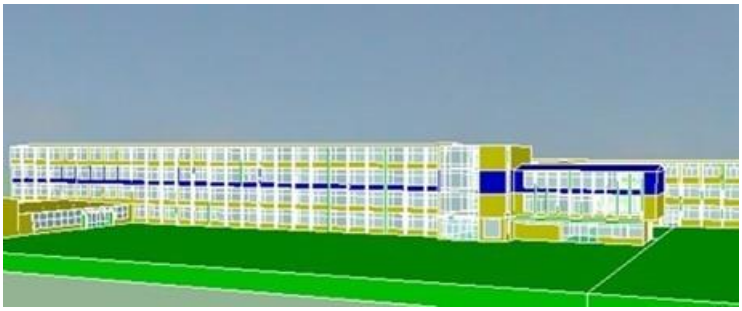
The pilot calibrated models

To assess the impact of managing the ICTs-based solutions implemented in the VERYSchool project (in general terms the VERYSchool *Optimization Scenarios*), a software based building simulation model has been developed for each Pilot School with an evidence-based calibration methodology for whole building energy patterns using the IES Virtual Environmental Software.



Model for school in LESA

Model for school in GENOA



Model for school in LISBON

Model for school in PLOVDIV

Pilot experimental campaign: monitoring and Field tests

At the time when VERYSchool project was conceptualized, the project was designed to assess the final energy performance, introduced by adopting VSNavigator as a standard ICT tool to make the *Energy Management System* more efficient compared to the conditions assessed at the start of the project through an initial energy audit carried out in each pilot school.
To make the outputs of the energy performance validation very reliable, VSNavigator and the ICTs solution implemented in the VERYSchool project have been validated using data collected from the one-year experimental campaign.

Across the Pilot demonstration activities, the flexible and reconfigurable BEMS allowed to implement different "*school scenarios*" in the "*real time execution*", and the creation of *baseline* (*pre-retrofit*, before VSNavigator working in the Pilot) and *reference* (*post-retrofit*, with VSNavigator working in the Pilot) conditions. Thus, comparison of *pre* versus *post* retrofit actions were possible for assessing the performances effectiveness of VSNavigator, in terms of energy savings, indoor comfort, carbon emission and compliance with the ISO 50001 requirements.

The permanent measurements (experimental campaign) in the Pilot schools started on the 1st November 2013, and run until the 31st October 2014. One full heating season was covered and four experimental tests were performed, each one consisting of a two week baseline period and two consecutive weeks of reference period, setting the BEMS with different configurations.

- With BEMS OFF for a period of 15 days, the Pilot *pre-retrofit* conditions (**baseline** period, e.g. before VSNavigator installed in the Pilot) were created, and consequently.
- With BEMS ON for the next 15 days, and different "*school scenarios*" in the "*real time execution*", the Pilot *post-retrofit* were created (**reference**, e.g. VSNavigator working in the Pilot) for the target of the validation.

The four testing periods extended from December 2013 to March 2014, thus covering the whole winter season and provided experimental data with homogeneous conditions for baseline (*pre*) and reference (*post*) periods.

Data were collected over the four testing periods, according to the timetable shown in the table below.

Period	Baseline (pre-retrofit)	Reference (post-retrofit)
I	05.12.2013. - 15.12.2013.	16.12.2013. - 12.01.2014.
II	13.01.2014. - 26.01.2014.	27.01.2014. - 09.02.2014.
III	10.02.2014. - 23.02.2014.	24.02.2014. - 09.03.2014.
IV	10.03.2014. - 24.03.2014.	25.03.2014. - 15.04.2014.

Rules for heating consumptions in the *baseline periods were established* defining a calendar for operating the central heating energy generation systems and high set points for the indoor temperature in each room, so that the BEMS never performed the automatic control. Indeed, the appropriate operative conditions and thermal comfort levels were defined for each one of the reference periods.

The following table shows the results of the numerical analysis performed on data collected from each pilot, from 1st November 2013 to 31st October 2014, with the quantitative indicators of sensor coverage.

School	NTotal	NSensor	Mean	Median	Standard deviation
LESA	29552595	334	84.2%	88.9%	18.0%
GENOA	27899339	323	82.2%	88.6%	19.4%
PLOVDIV	36603966	411	84.7%	93.0%	22.9%
LISBON	11995782	172	66.3%	71.0%	19.2%

The percentage is calculated considering the total "*365 days * 12 values per hour * 24 hours per day*" = 54036 expected data points for each variable. That the median is so much greater than the mean, shows that the mean is being reduced by a small number of low values.

Type of data

Experimental data have been the initial source of information to assess the pilot energy performances. The pilot BEMS performed monitoring and local storage of measured values with a frequency of seconds, and it transmit the measured data to VSNavigator every five minutes, as current values at each time.

A quality indicator is associated to each data at each specific time interval, calculated on the specific number of data points received every 5 minutes (from BEMS):

QI [%] = [(Number of data received)/(Number of data expected)].

The Data Fusion application developed within VSNavigator process of experimental data (measurement) to produce **HQDS** (*High Quality Data Set*):

- *quarterly* (15 minutes),
- *hourly* (60 minutes) and
- *daily* averaged (24 hours) data.

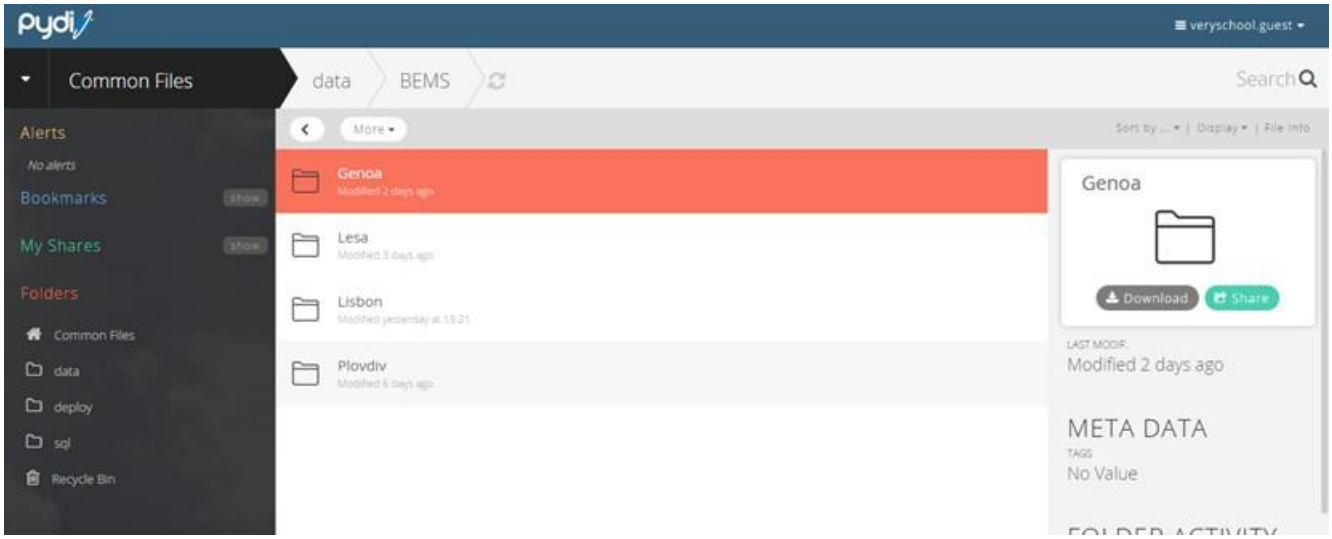
HDQS refers not only the measured data but provides calculated values, such as thermal and lighting energy consumption for each room of the Pilot, even detailed for type of source, such as traditional lamps, LED with and without dimming control. Among the set of calculated values, *counters of events* are also considered to understand the current people behaviour and the rules of the existing action plan. Typically, events such as "*BEMS operated in manual mode*", "*Windows opened and Heating ON*", "*Light ON without presence in the room*", "*Indoor temperature higher than the set-point and Heating ON*" are some of representative calculations.

Both Experimental data and the HQDS can be exported in csv format using a function implemented in the GUI of VSNavigator; this allows post-data elaboration.

The consistent amount of experimental data collected and the database, as well as of the generated High Quality Data Set, is made for public download to the benefit of the scientific Community.
The link for downloading is provided through the project website (www.veryschool.eu), while the facility has been arranged on the SZTAKI's servers using the following URL:

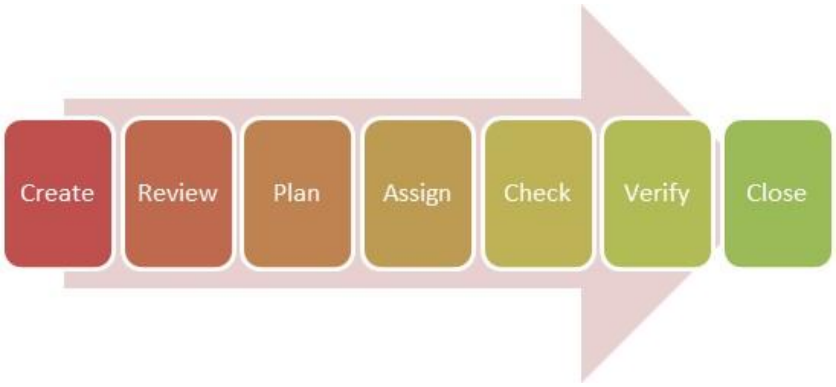
https://igor.xen.emi.sztaki.hu/VERYSchool, and access is through:

- username: *veryschool.guest*, and password: *veryschool*.



ISO 50001 customized for School Organizations

Action planning is a core concept in the ISO 50001 energy management system standard. The general scheme required to successfully implement an improvement opportunity through to an action has been customized for school organizations, following the order in which actions have been successfully and efficiently created, reviewed, assigned, verified and closed.
The customization of ISO 50001 for school for a systematic energy management action workflow (figure below), was established using **VSNavigator**, and specifically the action management component of the Enerit ISO 50001 software.



Pilot's activities and action management have characterized the experimental campaign performed across the four pilots, during one year of field tests with **VSNavigator**. The effectiveness of the project Action Plans and guidance on how to implement an efficient Energy Management System under the rigorous compliance of the ISO 50001 standard has been evaluated through the modern approach focused on VSNavigator.

Addressing the compliance to the ISO 50001 practices, a combination of approaches were selected for the overall assessment of VSNavigator in regards *how*:

- *how these requirements are covered in VSNavigator*, and
- *how Users have considered these requirements, through actions created in VSNavigator*.

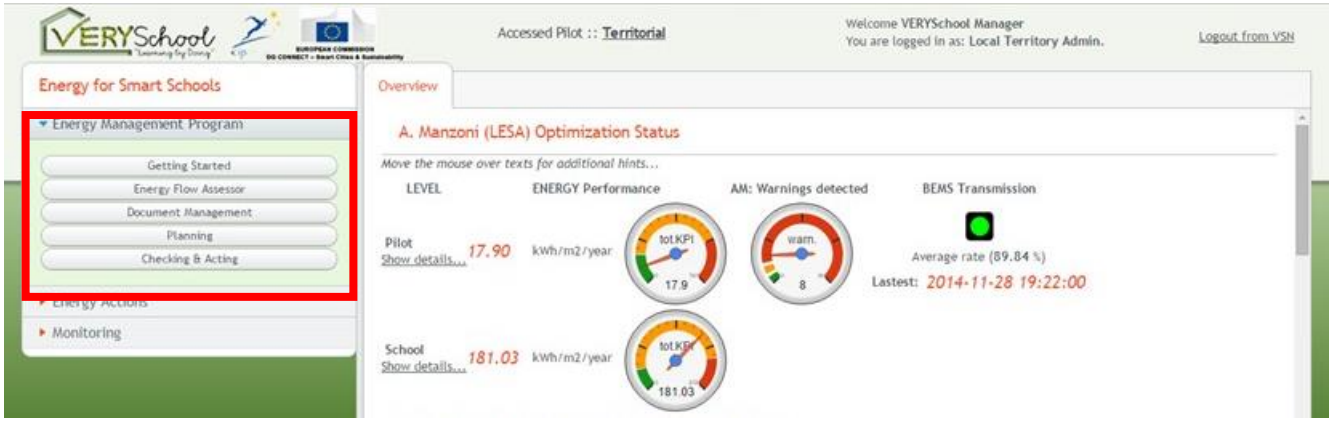
The overall evaluation comes from three main categories of assessment defined as follows:

a. *functional coherence of the system in terms of action management process*;
b. *adherence to the ISO 50001 standard way-of-working*;
c. *user acceptance*.

The validation approach considered how the pilot schools were organised and who needs to be included in this validation process (i.e. who are the actors in implementing effective action management and the overall energy management system). An important requirement established in the VERYSchool project was the assumption that those responsible for the assessment were independent of those responsible for developing and implementing it. In fact, within VERYSchool the pilot teams have been organizationally separate from the system developers. The advantage of independent evaluation is that the results command greater confidence amongst potential clients and are more likely to include an adequate assessment of the widest impacts.

Action Management has been the core activity in implementing an effective Energy Management System in the VERYSchool project. In parallel, *action management* took care of ensuring continuity on the collection of experimental data and high quality data sets, analysing energy behaviour and energy indicators, comparing energy performances among pilots, creating actions and assigning responsibilities, applying guidelines and reporting lessons learned.

Action Management is driven in the *main page* of VSNavigator by the menus *Getting Started*, *Energy Flow Assessor*, *Document Management*, *Planning* and *Checking & Acting.*



Getting Started

The *Getting Started* section explains the steps for implementing a systematic Energy Management with the aim of identifying improvement opportunities and to give a methodology for establishing energy objectives, energy targets and energy management action plans.
The *Getting Started* is an online guide, consisting of pre-configured *implementation tasks* that guides the users to answer questions such as: "*How do I get started?*.

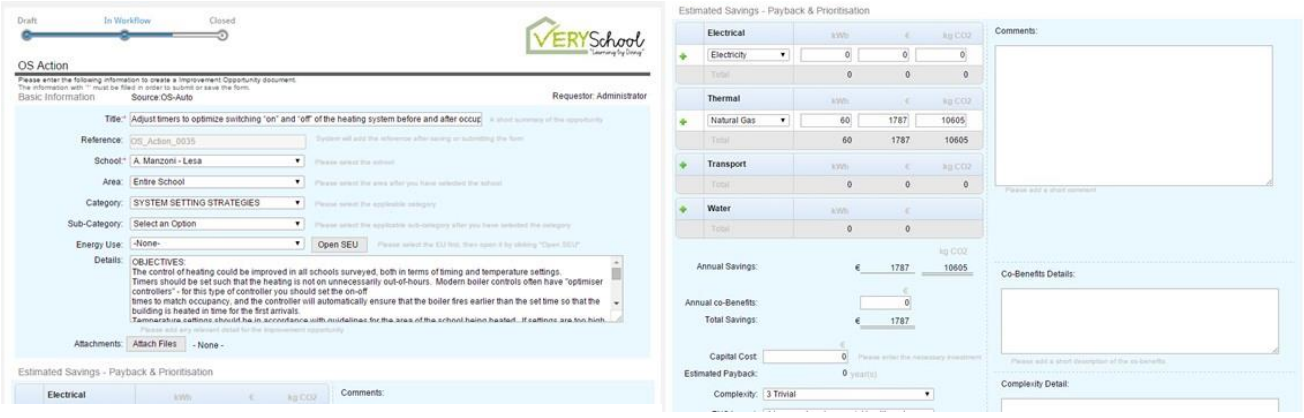
These tasks deal with *Commitment* (ISO 50001, sec. 4.4.1), *Planning*, *Implementation*, *Checking* (ISO 50001, sec 4.6) and *Acting* (ISO 50001, sec 4.7); the user has to complete them to progressively establish the EnMS.

The *implementation task* provides details on how to approach and carry out the particular task. Each task is assigned to a relevant and competent person and it lives until the task is closed.

Action Management

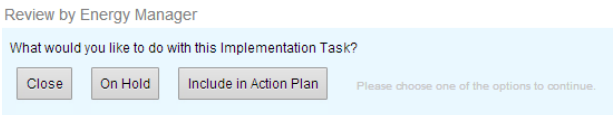
According to the ISO 50001 way-of-working, Action Management within the VSNavigator includes how to:

Create a detailed description of the improvement opportunity , requested by the user, as well as the impact factors (savings, capital cost, etc.) to help in the decision making process of what to do with this opportunity.



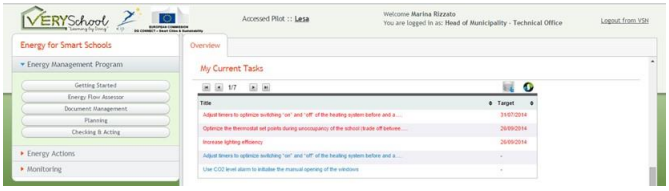
Review: the Energy Manager user decides what to do with the opportunity (e.g. Close, On hold, Include in Action Plan).

Plan. If the option *Include in Action Plan* is chosen, the improvement opportunity then becomes an *Energy Action*.

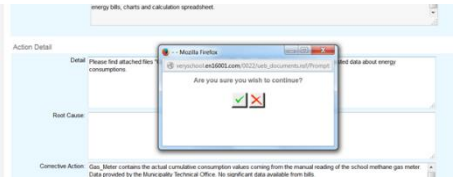


Assign. Once all information is provided, the action to implement the task can be assigned. A reminder is automatically sent to the assignee by means of an email message.

Act. Now, for the assignee, the action appears in the *My Current Tasks* section, together with the other tasks assigned (to him/her), to be performed as part of the EnMS.



The assignee provides details and can upload files for supporting the actions. When the work is finished users are informed about the completion of the assigned task. Therefore, the action disappears from *My Current Tasks* section for that user.

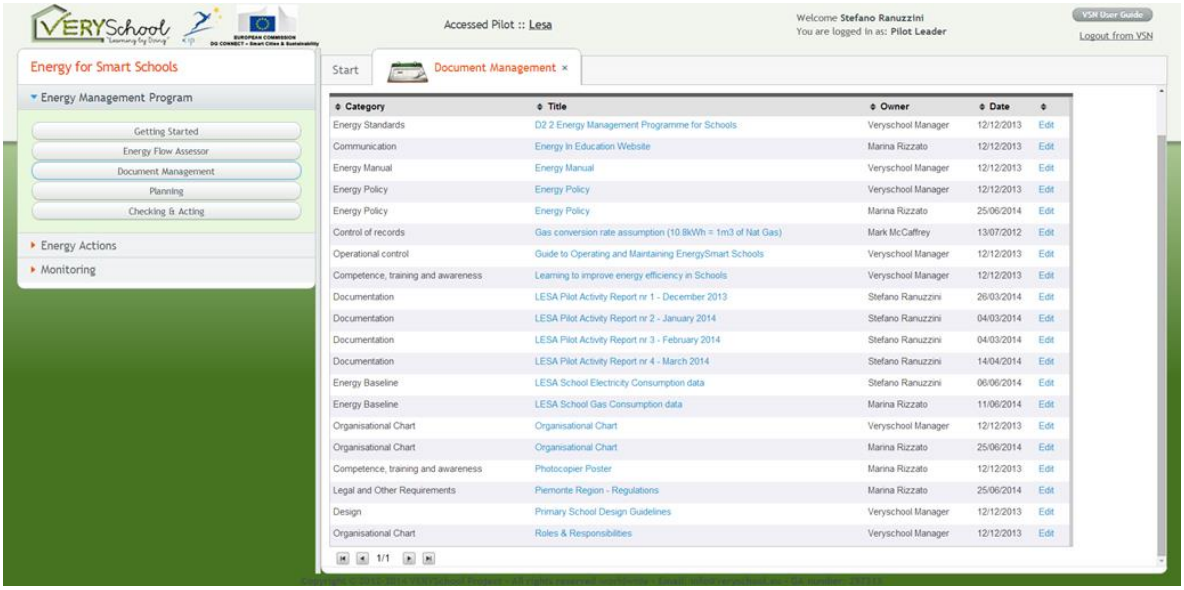


Verify. The energy manager user receives an email that informs about the completion of the action by the assignee and can review and verify if the action was carried out as originally expected.

Close. If the energy manager is satisfied with the actions carried out, the task is closed, and the assignee informed that the actions have been reviewed and closed by the Energy Manager.

Document Management

According to ISO 50001, *Document Management* is part of an efficient EnMS to share data and information between the users. In **VSNavigator**, this requirement is covered by the "*Document Management"* sections



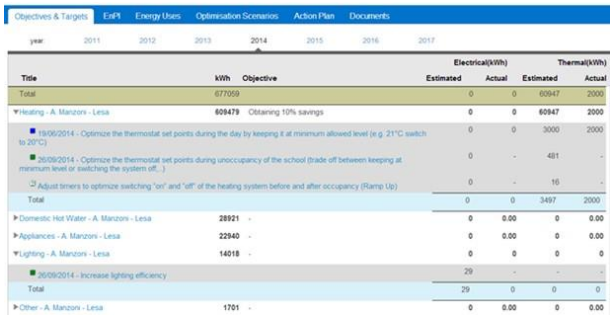
A practical step-by-step workflow has been customised for the creation and management if any EnMS related documents until the final approval. The document management system meets all the ISO 50001 and other management system document control requirements.

Planning

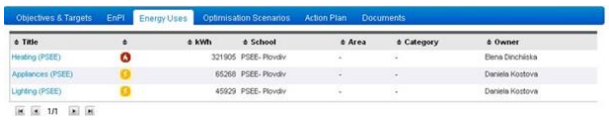
Planning is another core functionality ensured by VSNavigator to accomplish the ISO 50001 requirements (ISO 50001 4.4.1). Planning (along with the Energy Flow Assessor) concentrates on understanding how much energy is consumed in the school, and

- what type (e.g. oil, gas, electricity) and where the energy is used (e.g. lighting, heating),
- what actions we can be identified to reduce the energy use (e.g. replace incandescent bulbs with LEDs),
- when they should be carried out and by whom.

Objectives & Targets are defined and tracked from information entered on energy uses and improvement opportunities and actions. For every energy use, it is possible to review the overall targets in terms of what was initially estimated and the actual results. Users can also see all the specific actions undertaken and planned towards achieving the energy saving targets.



Energy Use views show more detailed data of the SEUs. The starting point to assess the overall energy distribution for different purposes is the energy audit carried out for the 4 pilots at the start of the VERYSchool project.



Optimisation Scenario, automatically suggested by VSNavigator or created from the OS Playbook, that have not been reviewed can be managed in this section.

The Action Plan views contain all the information about planned actions sorted by different specific Action Management variables (Status, Energy Uses, Assigned Person, Category, School, All Open, and All Closed).

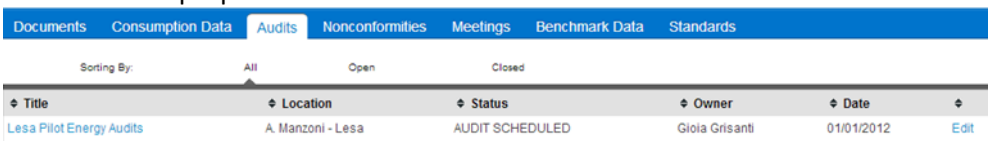
Checking and Acting

According to ISO 50001 requirements, *Checking and Acting* ensures the correct and continuous improvement of the EnMS. The **Optimization Status** section on the main VSNavigator, the **Monitoring** section on the main menu, the **Consumption Data** and the **Benchmark Data** within the Checking and Acting area all contribute to effective control and monitoring of the energy performance for the schools and district managers. The Checking and Acting section provides monitoring, measurement and analysis the performance of the overall energy management system through audit management, meetings and identification of non-conformities and carrying out corrective and preventive actions to improve the overall EnMS.

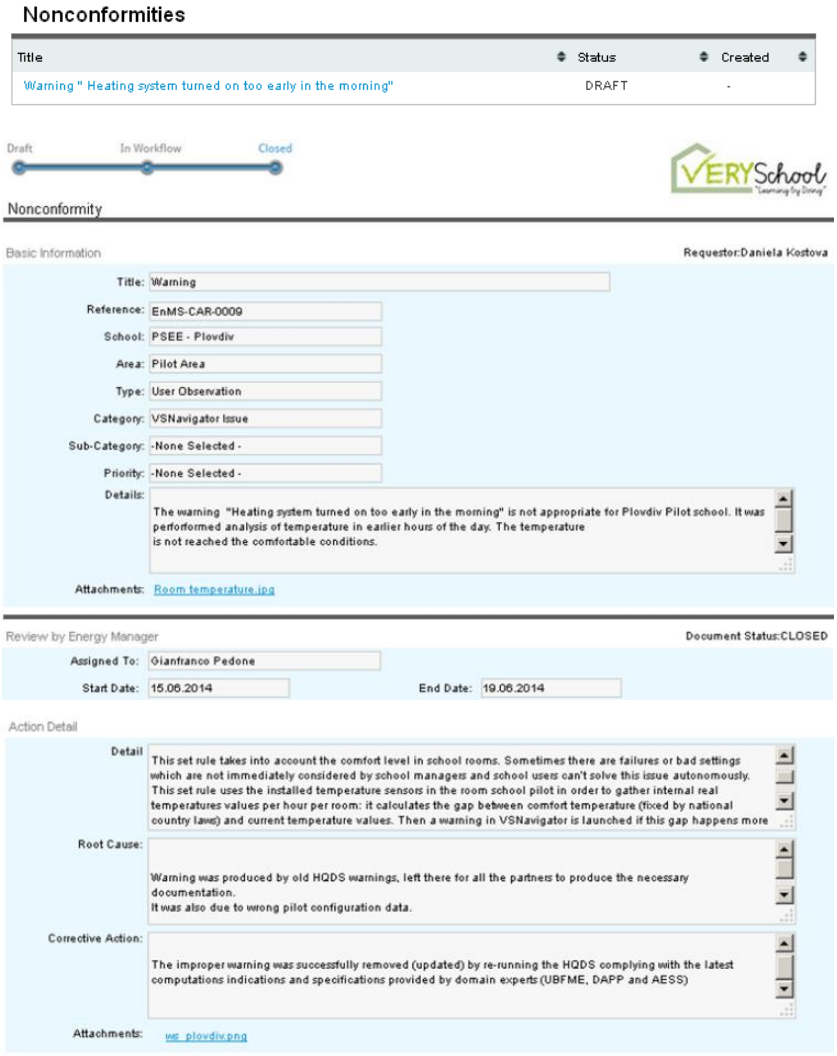
Consumption Data can be entered by the users for different energy sources including units, costs, location and metering/bill identifiers. The consumption data of heating and electricity are taken from the bills, and provided by the School administration.

Date	Type	Unit	Cost	Location	Sub-Location	Meter
01/12/2013	Natural Gas	106750	9053	A. Manzoni - Lesa		Main Natural Gas
01/12/2013	Electricity	5367	1342	A. Manzoni - Lesa	Entire School	Main Electricity
01/11/2013	Natural Gas	69760	5916	A. Manzoni - Lesa		Main Natural Gas
01/11/2013	Electricity	4513	1128	A. Manzoni - Lesa	Entire School	Main Electricity
01/10/2013	Natural Gas	46030	3903	A. Manzoni - Lesa		Main Natural Gas
01/10/2013	Electricity	4174	1044	A. Manzoni - Lesa	Entire School	Main Electricity

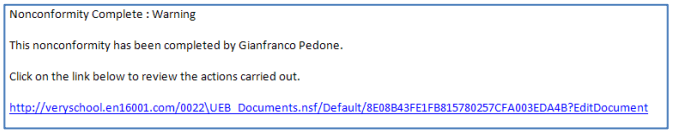
Audits of the EnMS can be scheduled and managed through the audits view. Audits of the EnMS and effectiveness of the energy management programme are a formal requirement of ISO 50001. EnMS audits are beyond the scope of the VERYSchool project but the Energy Audits performed in each pilot school were uploaded for demonstration purposes.



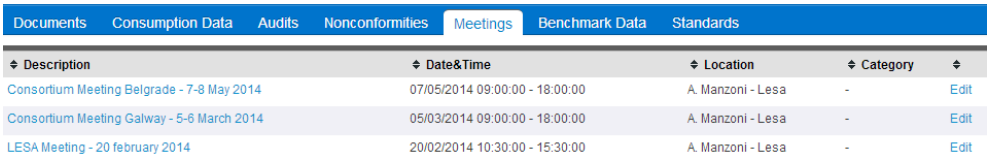
Nonconformities are typically problems with the EnMS that must be fixed or recommendations for improvement**.** Users can create nonconformities from an audit or directly in the VSNavigator. Within the VERYSchool project, they were used as a feedback loop for optimizing the performance of VSNavigator. They have their own customised workflow which is similar to that of the improvement opportunities described above. The following is an example of workflow.



Automatic emails are generated informing relevant users at different steps in the workflow.



Meetings can be created and schedule and all the meeting organized within the organization are available here.

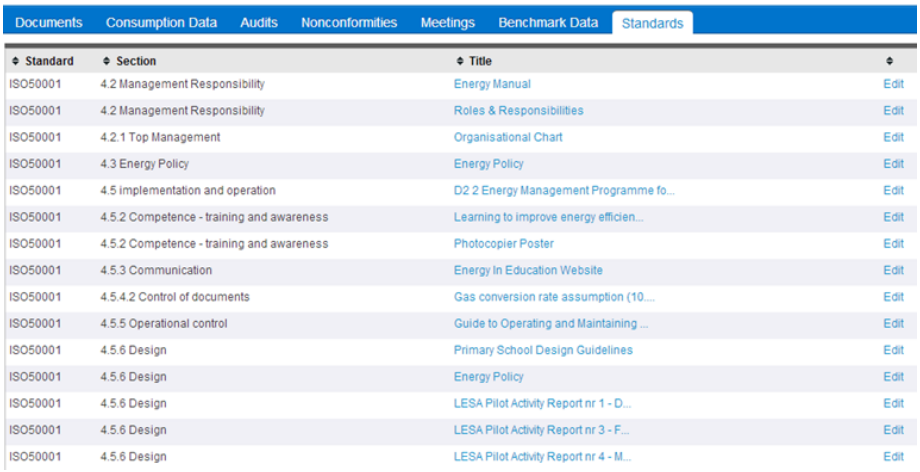


Description	Date&Time	Location	Category	
Consortium Meeting Belgrade - 7-8 May 2014	07/05/2014 09:00:00 - 18:00:00	A. Manzoni - Lesa	-	Edit
Consortium Meeting Galway - 5-6 March 2014	05/03/2014 09:00:00 - 18:00:00	A. Manzoni - Lesa	-	Edit
LESA Meeting - 20 february 2014	20/02/2014 10:30:00 - 15:30:00	A. Manzoni - Lesa	-	Edit

By clicking on any of them, it is possible to view all details about that meeting: basic information about the scheduling, the agenda, attendees and minutes.

Benchmark Data is used for benchmarking cost and consumptions. For example, in a school environment the typical benchmark data includes total occupants - *Staff + Students* and *m^2 of School Total Area* which can be entered by the users.

Standards which documents refer to and the related section can viewed and sorted to allows the user to see where there maybe gaps in documentation to fulfil the ISO 50001 standard requirements.



Standard	Section	Title	
ISO50001	4.2 Management Responsibility	Energy Manual	Edit
ISO50001	4.2 Management Responsibility	Roles & Responsibilities	Edit
ISO50001	4.2.1 Top Management	Organisational Chart	Edit
ISO50001	4.3 Energy Policy	Energy Policy	Edit
ISO50001	4.5 implementation and operation	D2 2 Energy Management Programme fo...	Edit
ISO50001	4.5.2 Competence - training and awareness	Learning to improve energy efficien...	Edit
ISO50001	4.5.2 Competence - training and awareness	Photocopier Poster	Edit
ISO50001	4.5.3 Communication	Energy In Education Website	Edit
ISO50001	4.5.4.2 Control of documents	Gas conversion rate assumption (10....	Edit
ISO50001	4.5.5 Operational control	Guide to Operating and Maintaining ...	Edit
ISO50001	4.5.6 Design	Primary School Design Guidelines	Edit
ISO50001	4.5.6 Design	Energy Policy	Edit
ISO50001	4.5.6 Design	LESA Pilot Activity Report nr 1 - D...	Edit
ISO50001	4.5.6 Design	LESA Pilot Activity Report nr 3 - F...	Edit
ISO50001	4.5.6 Design	LESA Pilot Activity Report nr 4 - M...	Edit

The overview above shows how the VSNavigator successfully implements Action Management in a school environment and how it also helps school managers to meet all the requirements of a strong overall ISO 50001 energy management system.

VSNavigator as Energy and Environmental Challenge

Energy Saving Assessment

The **energy assessment** and validation of the **VERYSchool project** in general, and in particular of the ICTs-based solutions implemented in the project and of **VSNavigator** as ICT tool working in the four pilots, has been mainly performed through *eeMeasure* as independent method.

eeMeasure is a software tool based on a simplified procedure for estimating energy savings reached by applying some *Optimisation Scenario*s. This software has been especially developed for energy efficiency measurements applicable to ICT in buildings (in the scope of the project SMART 2011/0072) and it implements a methodology based on the IPMVP. The inputs for the *eeMeasure* are mainly measured values, but in the case that there are no reliable experimental data, calculated values can be used, too.

Six different case studies were performed to assess the performances of the implemented ICTs-based solutions and of the Action Plan established in the VERYSchool project. Some of them consider all the four pilot schools, others part of them. The total number of implemented projects was 13.

The survey and main conclusions of the obtained results with eeMeasure performing on the VERYSchool measured data are shown in the table below.

Case study	Description	Pilot school	LESA	GENOA	PLOVDIV	LISBON
1	Heating pilot (calculated)	saving [%]	**33.1**	**28.5**	**13.4**	-
		statistical significance	**significant**	**significant**	**significant**	
2	Heating measured (school or part of school)	saving [%]	-	**9.5**	**8.5**	-
		statistical significance		**significant**	not significant	
3	LED dimming vs Traditional	saving [%]	**73.3**	**89.9**	**63.6**	**85.4**
		statistical significance	**significant**	**significant**	**significant**	**significant**
4	LED dimming vs LED NO dimming	saving [%]	**40.9**		-	**17.2**
		statistical significance	**significant**			not significant
5	LED NO dimming vs Traditional	saving [%]	**48.5**		-	-
		statistical significance	**significant**			
6	Automatic control vs Manual ON/OFF traditional light	saving [%]	-	-	**24.6**	-
		statistical significance			**significant**	

The main conclusions coming from the survey of the eeMeasure assessment method are that all the 13 performed projects show possible energy saving, but only 11 of them are estimated as significant, while two of them are assessed not significant, although positive. Lessons learnt for the results of the **eeMeasure projects** performed for one year period or one to four functional tests, are in the following summarized.

ICTs-based solution for energy efficiency	Energy Saving
Installing radiator control valve on each heat emitter with hydronic heating.	*Around 30% for heating consumption.*
Measuring thermal consumption by heat meter in whole school, considering Pilot area and adjacent space where radiator control valves have been installed only in the Pilot area and the other radiators have no local heat output control but only central.	*Up to 10% for heating consumption.*
LED lighting with dimming against traditional lamps	*In the range from 60% to 90% for electricity consumption.*
Dimming versus ON/OFF lighting control (achieved with the same LED electrical power and rooms in "very closed" living conditions and configurations).	*Potential energy saving of 16% to 40% is envisaged for electricity consumption.*
LED lighting without dimming against traditional lamps.	*Nearly 50% for electricity consumption.*

Automatic control of traditional lamps against manual ON/OFF.	*Around 25% for electricity consumption.*

Based on the survey and main conclusions of the six case studies, nine projects with significant results and enough length of baseline and reference periods were selected for publishing in the eeMeasure portal to the benefit of the Scientific Community.

According to the eeMeasure results, the following table shows the calculated annual CO_2 reduction and financial savings.

ICT solution: Installing radiator control valve on each heat emitter with hydronic heating.			**LESA**	**GENOA**	**PLOVDIV**	**LISBON**
Projects related to Case study: 1	Financial saving	[€/y]	890	1,138	555	
	Specific financial saving	[€/m^{2}y]	*1.01*	*1.59*	*0.55*	
	CO_2 reduction	[kgCO_2/y]	2,126	2,719	347	
	Specific CO_2 reduction	[kgCO_2/m^{2}y]	*2.42*	*3.80*	*0.35*	

ICT solution: LED dimming vs Traditional Lamps			**LESA**	**GENOA**	**PLOVDIV**	**LISBON**
Projects related to Case study: 3	Financial saving	[€/y]	165	147	9	26
	Specific financial saving	[€/m^{2}y]	*1.56*	*1.60*	*0.13*	*0.18*
	CO_2 reduction	[kgCO_2/y]	359	314	50	95
	Specific CO_2 reduction	[kgCO_2/m^{2}y]	*3.39*	*3.42*	*0.73*	*0.66*

ICT solution: dimming vs ON/OFF control (LED lighting)			**LESA**	**GENOA**	**PLOVDIV**	**LISBON**
Projects related to Case study: 4	Financial saving	[€/y]	19			
	Specific financial saving	[€/m^{2}y]	*0.35*			
	CO_2 reduction	[kgCO_2/y]	42			
	Specific CO_2 reduction	[kgCO_2/m^{2}y]	*0.77*			

ICT solution: LED lighting vs tradition lamps (ON/OFF control)			**LESA**	**GENOA**	**PLOVDIV**	**LISBON**
Projects related to Case study: 5	Financial saving	[€/y]	52			
	Specific financial saving	[€/m^{2}y]	*1.07*			
	CO_2 reduction	[kgCO_2/y]	112			
	Specific CO_2 reduction	[kgCO_2/m^{2}y]	*2.30*			

The same results, presented in an aggregated manner (table below), can be quantified as following.

Results	Unit	LESA	GENOA	PLOVDIV	LISBON	SCHOOL STOCK
Financial saving	[€/year]	1,126	1,285	564	26	3,001
CO2 reduction	[kgCO2/year]	2,639	3,033	397	95	6,164

Therefore, assuming that the four schools belongs to the same district, the VERYSchool project demonstrated a **financial saving capacity of. 3.001 [€/year]**. The **CO2 reduction** is of **6.164 [kgCO2/year]**.

The obtained results are also the consequence of the effective *Action Plan* and *Energy Management System* established in the project in accordance within the practices of the ISO 50001 standard.

IPMVP customized for school environments

IPVMP (*International Performance Measurement and Verification Protocol*) is a reference methodology to support performance-based contracts. It describes in 13 steps the standard procedures that, when implemented, allow building owners, decision makers, managers, ESCO, and Investors on energy efficiency

projects (e.g. banks) to quantify the performance of energy conservation measures and related energy saving to evaluate the cost impact and financial options.
Taking as reference the general steps, the **IPMVP was customized for school buildings** (e.g. the VERYSchool methodology) to provide a *reasonable understanding* on how to calculate energy savings and assess indoor comfort in school environments.

Option C (*measurements at sub-facility level*) and Option D (*simulation of the whole building*) were adopted for the VERYSchool project, with the key aspects summarized as below.

- Use of experimental dataset of limited time (both for *baseline* and *post-retrofit* periods) and limited number of rooms, both for lighting and for thermal consumptions.
- Consider as renovation actions those implemented in the project, that have been:
  - the installation of thermostatic valves on the radiator, in each room of the Pilot area, to perform the ON/OFF control (set-point) of the indoor temperature;
  - the installation of LED lighting in some rooms, and some LED with dimmers, to perform the ON/OFF (set-point) and dimming lighting control in these rooms.
- Consider the "*school optimization scenarios*" performed in "*real time execution*", with reference to:
  - *operational Optimized Scenarios*,
    - zoning programming,
    - thermostatic setpoint,
  - *design Optimization scenarios*:
    - LED light,
    - control presence on lights and
    - dimming on lights.

The energy consumption, e.g. the independent variable, were measured and computed in the same way for the four pilots: the existing metering system, the BEMS sensors and some additional external measurement (like the weather conditions) were used to calculate the related savings.

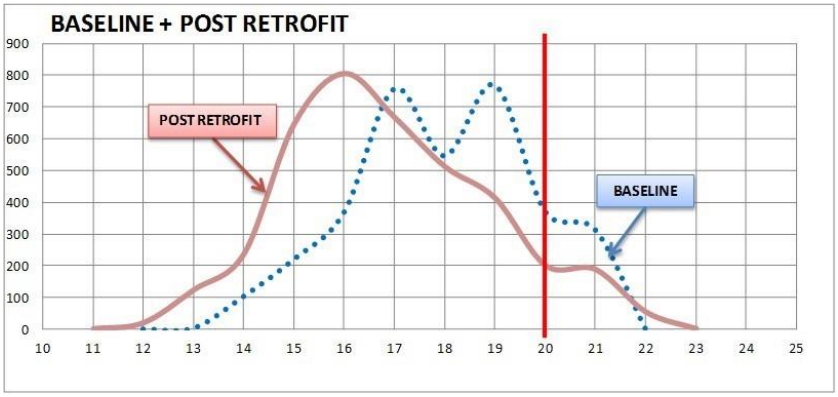
In order to simplify and take the process within the available time in the project, but without losing the objective to establish a common methodology, the calculation of the heating energy savings has been performed for a limited number of rooms for each pilot (three or four rooms per pilot). The **analyzed rooms** have been selected as **representative of specific conditions** such as sun exposition, orientation and number of external walls and their energy saving results have been extended to other rooms with similar characteristics. Therefore, **clusters of room** with similar characteristics (three or four clusters for each pilot, see table below) have been created, and **characterized with the same value of heating energy saving**.

The thermal energy savings calculated with IPMVP are summarized in the tables below.

HEATING					
PILOT		**LESA**	**GENOA**	**PLOVDIV**	**LISBON**
Heating Energy Saving	*[%]*	*28,89*	*35,59*	*32,28*	-

LISBON is not considered because there is no hydronic heating and then no thermal consumptions.

Evaluation of **thermal comfort** has been also performed taking into account the same baseline and reference periods of energy savings. To assess it, a graphical variance analysis was used. The graphical analysis shows the capability of the system to stay around the set point.



Regarding lighting consumption, **two different classrooms**, with homogenous features were compared in parallel, although it was difficult to find **two identical rooms** (same window, same orientation, similar schedules). In general, for each Pilot school, two assessment were performed.

a. *LED lighting with dimming versus LED lighting without dimming*, to assess the effectiveness of the dimming control versus the automatic ON/OFF.

b. *Automatic versus manual control*, in classrooms with traditional lighting.

The electricity savings for lighting calculated with IPMVP are summarized in the tables below.

LIGHTING					
PILOT		**LESA**	**GENOA**	**PLOVDIV**	**LISBON**
LED lamps with dimming control vs. no dimming	*[%]*	*81,44*	-	-	-
Automatic vs. Manual control	*[%]*	-	-	*20,36*	*7,82*

Green Design and attempt to Near-Zero Energy Building for the Pilot Schools

As use studies of Green Design an attempt was done to demonstrate through simulation assessment how the pilot school can move towards the Near-Zero Energy Building performances. Based on this, a number of suitable *optimization scenarios* (from the OSs Catalogue) were selected and simulated on the calibrated building model's to obtain their individual percentage savings. The results were used to determine savings in relation to energy consumption (electrical and thermal), generation (renewables) and associated energy costs.

The ICTs-based solutions that were considered to reach the NZEB targets are listed below.

OS No.	Category	ICTs-based solutions for NZEB scenario
3	Ventilation	Install control of openings based on thermal and CO2 level
26	Heating	Replace conventional boiler with condensing boiler 95% efficiency
27	Lighting	Increase lighting efficiency through LED lighting
28		Set-up occupancy based light control
29		Install dimming lighting system
32	System Setting Strategies	Optimize the thermostat set points during the day by keeping it at minimum allowed level
33		Optimize the thermostat set points during not occupancy of the school, keeping at minimum level or switching the system off.
53	Renewables	Install solar thermal plant
55		Installing PV panel. All PV panels with a nominal efficiency of 0.19
64	Management	Carry out lighting analysis

The selected ICTs-based solutions were merged with some renovation actions of the building envelope.

OS No.	Category	Renovation of the building envelope for NZEB scenario
37	Building Element	Install automatic system to close external doors
40		Install Triple glazed PVC windows with most performing U-values
45		Insulation of External Walls and Roofs with most performing U-values

The most effective scenarios were then identified and *simulated as a whole* to determine the overall percentage saving effect on the school building. The energy/economical results for attempting to NZEB performances at school building level are summarised in the next table.

	Unit	LESA	GENOA	PLOVDIV	LISBON
Baseline	[MWh]	524.7	218.8	442,7	23.6
Annual Energy saving compared to baseline	[MWh]	431	161	285	29
Annual Energy Saving	**[%]**	**82.14**	**73.63**	**64.44**	**113.5**
Total Cost of Investment	[€]	743,387	327,005	483,367	33,247
Annual Cost Savings	**[€]**	**57,210**	**33,752**	**26,229**	**4,055**
Simple Payback	**[years]**	**12.99**	**9.69**	**18.43**	**8.2**

Socio-economic impacts

Schools interest everyone since they are an important value for the Community: they are where much of our time is spent, they give rise to knowledge, they help get our most important resource (pupils and teachers) to be actively involved in energy efficiency initiatives, providing outreach to our future through the hands of the next generation, they create awareness, they tax our resources, they are organised on territorial levels, they contribute to global warming, they produce a huge impact on their occupants and on the environment.

There are about 110 million people in the **EU-27**, about 22% of the total population, enrolled in educational activities, and more than 482,292 school buildings with a public expenditure on education equivalent to 5.1% of GDP (compared with 7.2 % for healthcare) [1]. As a comparison, in the **USA**, more than 20% of America's population goes to school every day, with more than 55 million students and more than 5 million faculty, staff and administrators, spending about 6 hours a day in a school building [2]. Over $35 billion is the annual expenditure on school construction, representing one of the largest construction sector of the economy.

The overall European school building stock can be depicted as following.

a. Schools mostly depend on Public Administrations (Ministries, Directorates or Municipalities).
b. The majority of students attend public schools.
c. Schools are rather ancient and buildings are operated to simply meet codes. As averaged conditions, they have poor HVAC and lighting systems and they require expensive maintenance efforts.
d. The annual teaching time differs from primary to secondary levels, with a different distribution during the curricula years. Teaching time is spread over five days a week (except in Italy, six days), with a annual volume ranging from 850 to 1050 of hours.
e. Schools have considerable autonomy in the use of public funds, but decisions are often subject to approval by higher authority or must be taken within specific guidelines.

As general requirement, schools of the future need to:

a. optimize the flow of funds from the municipal budgets to the schools,
b. receive incentives for a better resources management,
c. mobilize more funds for creating space of sustainable savings at the school level.

The lack of understanding on energy management as a need is recognized as a barrier to develop energy efficient management, to implement organizational measures, to improve motivation, to create awareness and to assign responsibilities to personnel.

The results and critical analysis of a public survey

One of the main objectives of the VERYSchool project was to encourage Schools' stakeholders to adopt a positive behavioral change in energy management. To achieve this objective it was important to know the Schools' attitudes and the constraints facing the change of current behavior.

Thus, a specific **on line survey** was launched, throughout a questionnaire implemented in the project website. This initiative created the foundations to directly share the modern concept the VERYSchool project is introducing through VSNavigator as efficient and powerful tool of a new generation of ICTs for Energy Efficiency and for the implementation of the ISO 50001.

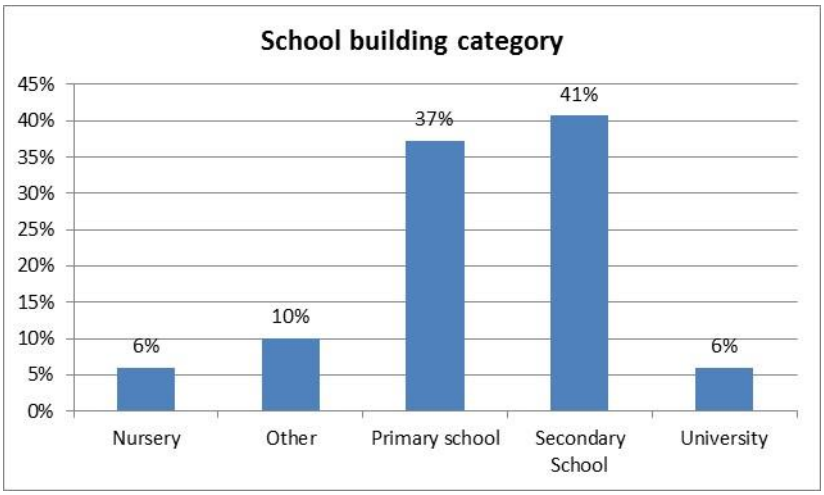
The questionnaire template has designed around three main blocks of questions:

a. opinions about energy efficiency management,
b. implementation of EnMS in the school,
c. management and economic aspects.

[1] EURYDICE / EUROSTAT - "*Le cifre chiave dell'istruzione in Europa*" ISSN 1725-2814.
[2] The Vision: Green School within a Generation, The U.S. Green Building Council (USGBC), 2007

Responder's answers from different Countries have been used for understanding barriers and opportunities and to gain an insight on how EU schools managers evaluate energy management systems and their intent for future actions. At the end of the project, **1.669 responders** have been participated. The geographical distribution of the responders and the type (percentage) of responding school are shown below.

Type of Schools	Share
Public	93%
Private	7%
Country	**Responses**
Belgium	12
Bulgaria	33
Hungary	9
Ireland	8
Italy	80
Portugal	28
Serbia	243
Turkey	1.171
UK	7
Other	78
TOTAL responses	**1.669**



The other Countries participating to the survey were: Belarus (2), Bosnia and Herzegovina (30), France (1), Malta (1), Romania (6), Spain (1), Montenegro (16), Croatia (1).

The main figures in the respondents' schools are in the following summarized.

- Energy Management in school buildings: about 44% consider it as a *necessity*; 23% a *concern*; 21% an *opportunity* and 12% *core business*.
- Main barriers for implementing Energy Efficiency measures: *lack of funds* is considered as the main obstacle (33%); *lack of interest/awareness* for such measure (26%); *lack of technical knowledge* (18%), and *technical difficulties* (13%); *bills not so high* (67%) and *other* (3%).
- Role of ICT applied to Energy Efficiency: about 49% consider it *extremely important* and 47% *important*; *marginal* for the 3% and *not relevant* for 1%.
- Awareness of standards for Energy Management in school Buildings: about 46% declares to know the European standards for Energy management in buildings, but only 19% of them have already implemented an EnMS in their school based on the above mentioned standards. About 57% knows the EBPD and the Energy Certificate requirements.
- Main drivers to implement an Energy Management Program: *cost reduction* (18%); followed by *possibility to keep in the schools money saved through the EnMS* (14%) and *transition towards a low carbon environment* (14%); *prestige of the school* (13%); *legal requirements* (11%); *National/European recommendations* (9%); *improve Performance assessment of the school and related staff* (8%).
- Main expectations in terms of potential energy savings: about 36% believe that *energy savings should be in the range 20-30%*; 32% expect *saving in the range 10-20%*; 19% saving *over 30%* and 12% believing that saving should be *below the 10%*.
- Responsible for Energy Management: 47% have a person dealing with this role. In the large majority of cases (63%) an employee is appointed for that; 23% use outsourcing services and 14% ESCOs.
- Benchmarks to energy consumption: 47% of Schools apply a benchmark to energy consumption.
- Systems for monitoring/analysing energy consumption: 70% schools are not equipped with a system to monitor and analyse energy consumption. Almost 24% is equipped with a BEMS.
- Temperature profiles systems: The majority of the schools (69%) is not equipped with such systems.
- Lighting monitoring systems: The majority of the schools (74%) is not equipped with such systems.
- IAQ monitoring systems: the large majority of the schools (79%) is not equipped with such systems.

- Use of Renewable Energy: almost 28% of them declare to make use of Renewable Energy Sources.
- Energy Audits: 55% schools have performed energy audits in the last 3 years.
- Energy efficiency certificates: only 35% obtained an energy efficiency certificate, among the respondents who declared of having already performed energy audits in the last three years.
- Energy Efficiency measures implemented: even if the majority of schools have not conducted energy audits in the last 3 years, the 55% of them declare of having implemented measures related to energy efficiency in the same period of time.

To protect the privacy of the responders the whole database is not for public use. Indeed, a devoted publication is available and downloadable from the project website (www.veryschool.eu) the statistical analysis and the results of the on-line survey to make aware the Community of the common behaviour.

Wider Societal Implications

Evaluating the impact and legacy of a project at the moment of completion is challenging because it involves assumptions about the future. There are however some clear indications that demonstrate very clearly that the work carried out in VERYSchool could have a positive legacy.

With a new vision, innovative but mature ICTs-based solution for energy efficiency have been merged with Organization's rules and user's behaviour to be a whole and sole process driving the Energy Management System through the advanced ICT solution provided by VSNavigator.

VERYSchool has demonstrated under real operational conditions that can contribute directly to reduce energy consumptions in European schools and help EU to move towards near-zero energy targets. Supporting this outcome, the project validation has demonstrated that a substantive energy saving can be achieved in annual consumption, while carbon emission reduction and a financial saving capacity have been envisaged.

Because the Consortium involved public authorities, energy agencies, ESCO, system integrators and technology providers, at the appropriate level (national, regional or local), and the project provided evidence of the timely usability of VSNavigator working in pilots, the consistent methodology adopted for communicating and promoting objectives, outcomes and results, allowed to link with various stakeholders and users alike to collectively address the issue of energy management in schools.

Target Groups

VERYSchool linked individual people who will benefit from new services and products and groups that showed interested in expanding their skills for educational or professional purposes. Within the value chain of stakeholders who act to ensure the more efficient Energy Management programme, the following categories have been reached at European, National and Regional levels.

- **Public administrators** and **Policy makers**, who overview cost savings, reward efforts to best energy classes, broadcast best energy management practices. This kind of stakeholder also includes the *Smart City Community* and promote solutions for achieving significant energy savings at city level.
- **Operational**, **Energy** and **Facility Managers**, who take energy decisions to get the energy management process started or to make the current operational scenario more effective.
- **Technicians**, who have the day-by-day responsibility to maintain and operate the buildings.
- **ESCO** and **Financial Institutions**, who are interested in promoting concepts of green economy where energy savings pay for investments.
- **ICT's** and **Scientific Professionals**, who develop and present best practises and new technologies, while producing awareness on efficient scenarios and habits;
- **Practitioners**, who want to learn about best practices on energy efficiency.

New applied knowledge

The **VERYSchool** project was not technology specific. It promoted human behavioural changes in schools; however, content has been developed to get the best performance out of the technologies. This content was used to create awareness, to share knowledge and to improve the use of ICTs-based solution for energy efficiency within a school environment.

VSNavigator functionalities are of fundamental importance for any school stakeholder, because they provide a coherent platform for services in the efficient use of energy and future investments in schools. Among its performances, **VSNavigator** provides operational guidance for achieving the key objectives on how to:

- help managers committed to reducing energy costs in many buildings;
- get an energy know-how in the company at a lower cost;
- achieve energy and cost savings in short term;
- reduce energy consumption, year after year.

This, in a context where energy audits are deficient and the School Energy Plan (annual or multi-year) is difficult to create, investments for the modernization of energy and/or building structures are difficult to estimate, and established targets on savings are difficult to verify.

Two aspects of the concept and objectives are worth highlighted in VERYSchool: they are the ICTs solution for energy management and the Energy Resource Cluster. The former find a summary in VSNavigator with its integrated technologies, e.g. smart efficient (LED) lighting, smart metering, BEMS, action management and simulation software. The latter is the attempt made for transforming the existing pilot schools into Near-Zero Energy Building, using techniques of Green Design that consider the Catalogue of Optimization Scenarios.

A review carried out in the VERYSchool project of best practices highlighted that there are many excellent examples of energy management programme for schools. However, the majority are focused mainly at individual school level. Where school districts are discussed, the user is usually referred to more broader and general energy management programme.

An initial review carried out at the start of the VERYSchool project showed that the ISO 50001 energy management standard was found to provide an excellent framework for systematic energy management in the school context and this has been validated in the VERYSchool project. The Energy Planning process (which is the engine of an ISO 50001 EnMS and includes the identification, prioritization and planning of improvement opportunities), is significantly aided by the development of the Catalogue of Optimisation Scenario within the VSNavigator and provides a significant head start for schools to quickly and effectively start to make energy savings.

Because of the unique integration of smart metering technologies with the optimisation scenarios and set-rules, through to real actions, the VSNavigator platform can enable school managers to achieve a higher level of energy management system maturity quicker (and therefore make more energy savings) than many organisations that have already achieved ISO 50001.

Education and Awareness

The **Public Education** and **Awareness Campaign** adopted a multi-channel delivery approach to involve all the business sector and stakeholders, and the following key goals.

- *Disclose information* on the objectives of the project (i.e. newsletter, brochure, interviews, publication on journals and magazines) to promote knowledge integration in developing cooperation amongst people and programmes.
- *Engage stakeholders* (i.e. mail shots, project workshops and participation at events organized by others), building a qualifying network of actors involved in energy management decisions and energy savings actions in schools (i.e. city councils, public managers, energy managers, technicians, maintenance workers, global service, financial stakeholders, students and teachers).

- *Promote the project results* (i.e. newsletter, international events, interviews, project workshops) to convince decision makers and users to the topic of ICTs for energy efficiency.
- *Meet the media* and disclose information on the objectives of the project (i.e. newspapers, journals and magazines) with specialized technical publications.
- *Promote the communication tools* available (the on-line questionnaire, a forum on the project website and links on selected Social Networks) for achieving information and receive feedback to be considered as inputs for possible improvements.
- *Facilitate the access* of the broad Community to VSNavigator, login as *e-Learning User* virtually associated to the Organization of one Pilot School, to get confidence and verify the powerful performance of the platform.
- *Support school decision makers in planning and financing* energy efficiency investments.
- *Promote the customisation and use* of ISO 50001 and IPMVP for schools;
- *Excite current and future generations* about energy and sustainability.

These goals have been also reached through two project videos deployed as project results and available on:

Project Website	EN/IT Version: http://www.veryschool.eu/
EC Digital Agenda for Europe website	EN Version: http://ec.europa.eu/digital-agenda/en/news/veryschool-project
Twitter: @EU_ICT4Cities	EN Version: https://twitter.com/EU_ICT4Cities/status/449582832877195264
YouTube	EN Version: https://www.youtube.com/watch?v=ZiXv744kpEE
	IT Version: http://www.youtube.com/watch?v=QMPzII_yG6I
Facebook	EN/IT Version: https://www.facebook.com/veryschool?ref=hl

International and National Co-operation

Information and cooperation with other EU projects has been established in particular to define and adopt a common methodology for measuring energy gains via ICT solutions.

A Community exists in "**BUILD-Up**", the European portal for energy efficiency in buildings, with the project coordinator (AESS) taking the role of *facilitator of the "School for the Future"*.

VERYSchool co-operated with the EDISON Project, both part of the ICT PSP work program 2011, with EDISON promoting an innovative solution focusing on lighting efficiency.

VERYSchool co-operated with the EC ZEMedS project (Zero Energy MEDiterranean Schools), which is a 3 years project co-funded by the European Commission within the Intelligent Energy Europe Programme (IEE). There is a closed link between the VERYSchool and the ZEMedS for achieving NZEB and "Green Design" objectives.

VERYSchool provided support to **CIRCE foundation** that **was commissioned by the DG CONNECT to perform a study** entitled "*Reducing energy consumption in building with ICT-Analysis of data from EU pilot projects-SMART 2013/0073*". The VERYSchool Pilot in Genoa was selected as one of the 10 relevant pilots to get an in-depth analysis of the projects. The result was a "*Pilot Card*" published at http://ict4ee-analysis.eu/.

VERYSchool linked with ELENA, the European Local Energy Assistance facility that aims to support cities and regions implementing viable investment projects in the areas of energy efficiency, renewable energy and sustainability. This link was facilitated since project coordinator (AESS) undersigned the ELENA agreement with the European Investment Bank and created a Supporting Unit for the supply of technical assistance.

VERYSchool linked with Climate-KIC, which is the EU's main climate innovation initiative and the Europe's largest public-private innovation partnership focused on mitigating and adapting to climate change. Climate-KIC is one of the Knowledge and Innovation Communities (KICs) created in 2010 by the European Institute of Innovation and Technology (EIT), the EU body tasked with creating sustainable European growth while dealing with educational and global challenges of our time.

VERYSchool has been presented as part of the ***Guide for Replication for ICT-enabled energy efficiency services***, and published online under the SPACES web-site.

Candidated by GENOA, **VERYSchool received the first Green Digital Charter (GDC) Award**. The Award highlights Cities that are working towards the respective GDC commitment in their effort to deliver on the EU climate objectives using digital technologies that increase energy efficiency, facilitate emissions reductions and forestall climate change. The GDC award assigned to VERYSchool recognized the performance indicators of the project, the Innovation of the project and compliance with the Use of the GDC reporting tools.

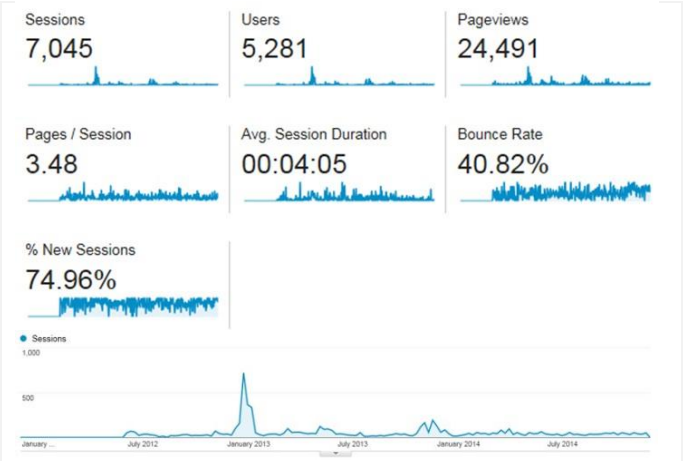
The GDC Award Ceremony took place during the NiCE roadshow (Eurocities 2013), held in Amsterdam on 14 and 15 November 2013.

Finally, as a platform to engage stakeholders and to link them with and capture their interest towards the project, a "Networking" menu has been implemented in the project website. At the end of the project a Community of 21 members (e.g. European Organizations representing different business and decision-making areas) joined as "followers" the project development and shared the results.

The project website

The project website, available at www.veryschool.eu, has been constantly maintained and updated with project news and events, as well as other items relating to energy efficiency, with the aim to raise the profile and to increase visitor numbers.
All the project deliverables that are public by nature are available under the *download* page. The home page has changed and dynamically updated with particular relevance given to the project VIDEO, enhancement of the on-line survey and promotion of the VSNavigator demo version.
Tools have been implemented to make data available for a critical analysis of the use and visits.

The general result of this critical analysis is summarized in the figure below.

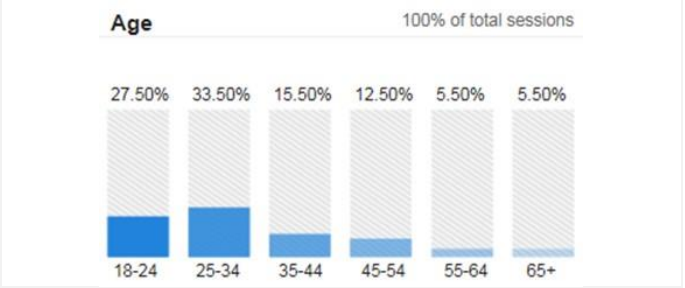


Country	Acquisition		
	Sessions	% New Sessions	New Users
	7,045 % of Total: 100.00% (7,045)	75.03% Site Avg: 74.96% (0.09%)	5,286 % of Total: 100.09% (5,281)
1. Italy	2,138 (30.35%)	68.19%	1,458 (27.58%)
2. Turkey	1,732 (24.58%)	78.87%	1,366 (25.84%)
3. Serbia	596 (8.46%)	72.82%	434 (8.21%)
4. Portugal	410 (5.82%)	87.56%	359 (6.79%)
5. Spain	227 (3.22%)	58.59%	133 (2.52%)
6. United Kingdom	204 (2.90%)	74.02%	151 (2.86%)
7. Ireland	149 (2.11%)	61.07%	91 (1.72%)
8. Brazil	148 (2.10%)	99.32%	147 (2.78%)
9. Germany	137 (1.94%)	80.29%	110 (2.08%)
10. Bulgaria	134 (1.90%)	51.49%	69 (1.31%)

In addition to demographic and geographic data, these tools allowed to:

- measure the impact of users accessing the site,
- detect different types of users,
- analyse traffic and optimise dissemination,
- identify the best strategies for effective communications according to the target audience.

User Type	Acquisition		
	Sessions	% New Sessions	New Users
	7,045 % of Total: 100.00% (7,045)	75.03% Site Avg: 74.96% (0.09%)	5,286 % of Total: 100.09% (5,281)
1. New Visitor	5,286 (75.03%)	100.00%	5,286 (100.00%)
2. Returning Visitor	1,759 (24.97%)	0.00%	0 (0.00%)



Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit
	24,491 % of Total: 100.00% (24,491)	18,226 % of Total: 100.00% (18,226)	00:01:39 Site Avg: 00:01:39 (0.00%)	7,045 % of Total: 100.00% (7,045)	40.82% Site Avg: 40.82% (0.00%)	28.77% Site Avg: 28.77% (0.00%)
1. /	6,442 (26.30%)	4,961 (27.22%)	00:01:06	4,269 (60.60%)	36.12%	42.56%
2. /survey.php	3,215 (13.13%)	2,666 (14.63%)	00:07:18	1,311 (18.61%)	45.69%	41.28%
3. /schools.php	1,991 (8.13%)	1,357 (7.45%)	00:00:31	309 (4.39%)	61.81%	21.95%
4. /index.php	1,730 (7.06%)	1,079 (5.92%)	00:00:52	173 (2.46%)	34.68%	19.08%
5. /programme.php	1,719 (7.02%)	1,109 (6.08%)	00:00:59	152 (2.16%)	39.47%	18.50%
6. /download.php	1,269 (5.18%)	850 (4.66%)	00:00:20	54 (0.77%)	9.26%	6.46%
7. /partners.php	1,248 (5.10%)	997 (5.47%)	00:01:21	168 (2.38%)	67.26%	33.01%
8. /news.php	865 (3.53%)	512 (2.81%)	00:00:35	53 (0.75%)	32.08%	12.14%
9. /networking.php	586 (2.39%)	465 (2.55%)	00:00:56	50 (0.71%)	54.00%	21.16%
10. /downloadlist.php?id=3	459 (1.87%)	381 (2.09%)	00:02:14	13 (0.18%)	61.54%	28.76%

Device Category	Acquisition			Behaviour		
	Sessions	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	7,045 % of Total: 100.00% (7,045)	75.03% Site Avg: 74.96% (0.09%)	5,286 % of Total: 100.09% (5,281)	40.82% Site Avg: 40.82% (0.00%)	3.48 Site Avg: 3.48 (0.00%)	00:04:05 Site Avg: 00:04:05 (0.00%)
1. desktop	6,747 (95.77%)	75.07%	5,065 (95.82%)	40.28%	3.51	00:04:10
2. mobile	165 (2.34%)	71.52%	118 (2.23%)	58.79%	2.25	00:01:50
3. tablet	133 (1.89%)	77.44%	103 (1.95%)	45.86%	3.33	00:02:34

Market and Commercialization

VSNavigator has been developed with the contribution of European funds as CIP-ICT-PSP project, but it is also the result of a research and innovation action. Thus, the VSNavigator software is not released as a product ready for the market.
The Consortium was aware to be not able to create any "*spin-off company*" or "*joint-venture*" after the end of the project. Thus, to make the business plan realistic and successful, the Consortium set up an exploitation strategy that considers the "*sell of the rights*" of the VSNavigator software to Customers who wish to buy them, giving them the extra option to integrate the technologies of the industrial partners (IES, SCE/DOKI and Enerit).

The ***long term viability*** is addressed because VSNavigator is a solution that provides value for energy management, being on the same time friendly, manageable and low to no maintenance.
The *value added solution* and the *implementation at large* are ensured by following the VSNavigator systematic approach, which:

- helps decision makers to fund parts of the energy management program through energy savings,
- allows decision makers to control the velocity of the program (e.g. timing of investments),
- changes the organizational culture through the implementation of an energy savings program.

Moreover, enlarging the ***long term viability*** concept, VSNavigator is a product that generates services and that can be implemented by parties acting alone or in consortium, upon agreements that provide the basis for joint value creation.

The ***wider deployment and use***, fitting with the objectives of the business model, is based on the assumption that VSNavigator is a:

- customised solution that addresses the unique needs of and the entire value chain of schools (e.g. city councils, public managers, energy managers, technicians, maintenance workers, global service, students and teachers);
- replicable solution because any reference to the school building, or school organization, automatically extends to the general concept of "building" or "organization".
- competitive product with integrated award winning, leading, and cutting edge technologies.

According to the established business model, the Consortium is already prepared, organised, and has a network, especially among ESCOs, professionals and ICTs organisations to exploit the product in its reference market.

Business Model: Clear and realistic commercialization plan

VSNavigator is a software platform classifiable as "*High-Level Management*", usable as "*web-tool*" with a friendly and intuitive user interface. VSNavigator **is not a control system** and it doesn't issue automatic control signals. VSNavigator is a **decision support system**, with superior performance to any commercial SCADA. VSNavigator **suggests possible actions for optimization**, and it allows to estimate the achievable benefits.

The **VERYSchool Valuable Action Plan (VAP)**, established as business model, targets distinct customer's groups and includes value proposition, market size, strategy and implementation, pricing, intellectual property rights and life-cycle system aspects, paying attention to the future deployment at commercial level of VSNavigator successfully put in the market.

Value proposition and Competitive advantage

It is Consortium's convincement that the VSNavigator software allows creation of new kind of business in the market segment of Energy Management, along: decision phases, future planning, current management, correction of the on-going operational program. All these steps performed in compliance with the requirements of the ISO 50001 standard.
ESCOs, schools and other buildings, facility companies and utilities, BEMS technology providers can deploy a centralized service with the prospect of increasing their services portfolio.

The main value proposition for each target segment can be assumed as in the table below.

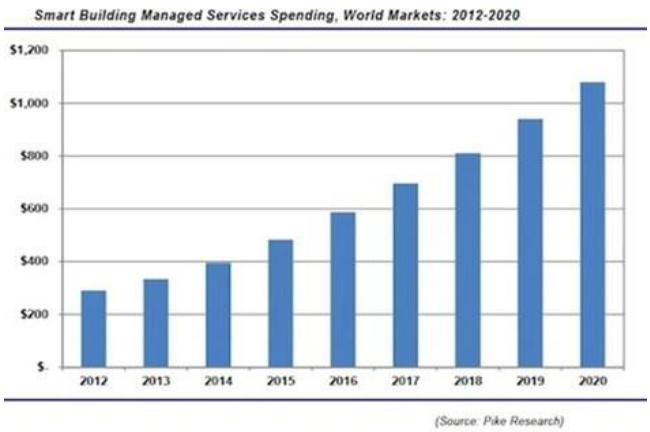
ESCOs *They promote business models based on the concepts that energy savings pays for investment.*	**Schools and Other Buildings** *Public Administration, Executive and Energy Managers, are driven in making effective their Energy Action Plan.*
- Additional services: reduce energy costs and improve energy efficiency of the buildings without initial investment from their customers. - The revenues for the ESCO and for the customers came from the savings of the project.	- Assistance in selecting the profitable and environmentally sustainable solutions and guidance in making decisions on cost effectiveness. - Reduce energy costs year by year with a systematic improvement of the EnMS.
Facility Companies *They coordinate the Operational Program: space, infrastructure, people & organization.*	**Utility** *They offer a wide range of services/products: energy, environmental, waste and infrastructures.*
- Choice of high efficiency solutions. - Additional service included in a building maintenance contract without additional costs.	- Additional service to energy supply. - Extra service to capture new clients while being a differentiating factor among other utilities.
BMS technology providers *These Companies, at least the big ones that covers the world market, are expanding their range of services including even the "energy performance contract".*	
- Additional service to their technological supply. These companies can take advantage of VSNavigator to overcome the limits of the existing SCADA.	

Market size

Industrial EnMS are evolving quickly.

According to the study "*Energy Manager Today Staff, April 17, 2013*" [3], worldwide market spending on EnMS and services, including initial services, software installation and operation and ongoing services, was of $11.3 billion in 2013 and it is estimated that it will grow up to $22.4 billion in 2020.
That amounts to a compound annual growth rate of 10.3 percent.

Another report, *Managed Smart Building Services* [4], released in September 2012 by Pike Research, found that the worldwide spending on automated, or smart building, EnMS- which include data acquisition and analytics, as well as building maintenance contracts – was of $291 million in 2012 and it will grow to $1.1 billion by 2020, that's four times more in size.



[3] http://www.energymanagertoday.com/energy-management-market-to-almost-double-by-2020-091048/,
[4] http://www.energymanagertoday.com/smart-building-energy-management-to-top-1bn-by-2020-084421/

The large equipment manufacturers have long dominated this market, taking benefits of their global presence, extensive domain expertise and established infrastructure to support long-term engagements. Moreover, other smaller niche companies are also participating in the EnMS market with unique product and service offerings; the most evident is **Enerit, a VERYSchool Partner**, but these companies generally require partnering relationships and more established energy management service providers and technology vendors in order to access the market.

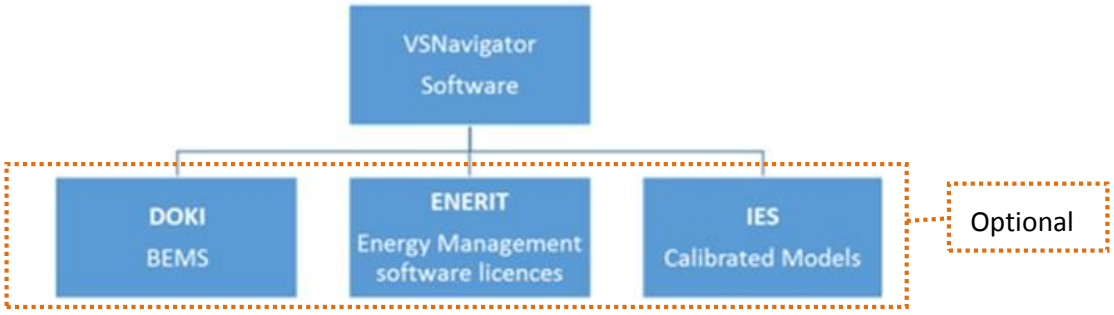
Many of the potential EnMS customers are at a stage where they roughly understand the benefits of implementing these systems, but they do not follow the technological evolution, and are often not interested. The *status quo* is that their businesses do not provide a holistic and complete picture of their overall performance and they prefer to utilize more basic technology and applications.
This is doubtless due to resource constraints as well as the early stage of understanding energy consumption and energy efficiency within their Organizations.

Within this scenario, the **target segment** for **VSNavigator** is specifically defined:

Sectors	Geographic Area
- ESCOs companies; Schools and School Boards or Districts; Facility companies, Utilities and BEMS technology providers. - Any Building or Energy Infrastructure aiming at implementing a systematic Energy Management Programme and ISO 50001 certification.	- Consortium Countries. - Commercial chain of some Consortium Members in Europe and Worldwide.

Market strategy and replication

The project market and replication strategy is focused on the "sell" of the rights of VSNavigator software, granting the use of the software to the benefit of potential customers.
Figure below depicts the block diagram of the "Energy Navigator" software as a whole.



The strategy for selling the VSNavigator software have the extra option for the customers to integrate the modules provided by the industrial partners (IES, SCE/DOKI and ENERIT), giving the opportunity to each industrial partners to enlarge their own business. The same business opportunity is extended to SZTAKI if the customer requires other assistance that involves changes in the software.

Pricing strategy has been a critical decision within the VERYSchool Consortium that is difficult to estimate the cost of the investment made to obtain the VSNavigator software and to charge the added value of the know-how, particularly due the fact that the software was developed in a research and innovation project context.

Nevertheless, the reference cost of the VSNavigator software has been estimated as the total human resources spent by the Partners in the "development" tasks, and the average monthly rate in the project of each related Beneficiary. Thus, a total of **129 person-months** has been calculated (it is about 27% of the resources allocated in the VERYSchool project) and it give a total investment cost of **€703,219**.

All partners of the VERYSchool Consortium will drive the sales strategy, according to an agreed revenue sharing. The percentage distribution foresees three Groups, as shown in the table below.

	Percentage distribution per group	Percentage distribution per Partner
Partner who sells	30%	30%
Help-Desk Technical Support *SZTAKI*	10%	10%
First Group: *AESS, SZTAKI, DAPP*	18%	6%
Second Group: *DOKI, ENERIT, IES*	15%	5%
Third Group: *EAP, CDG, EPRO, UBFME, AMEM*	27%	5,4%
Total	**100%**	

The tactic of this revenue sharing schema aims to increase the Consortium partners' motivation and satisfaction to make their best efforts to sell the product. In this way, not only the industrial partners (Enerit, SCE/DOKI, IES) and SZTAKI are stimulated in making private business, but all the Consortium beneficiaries promoting the selling of the VSNavigator can earn the relative fees.

Since the VSNavigator software is, from the point of view of end-users, a web-application integrating external technologies belonging to the industrial partners, to guarantee the "*user requested functionality*" the price of each optional module is also included in the business plan. However, this is a negotiation between the potential customer and the industrial partner, thus all further negotiation and private agreement will be made and conduct directly by each involved industrial partner.

All the Consortium Partners will sign a commercial agreement, as approval of the Terms & Conditions that regulates the collective IPRs.
Consortium Members, driven by this commercial agreement, have already started to promote the selling of the software. The two expression of interest already received from two European stakeholders provides evidence that the agreed exploitation strategy, is effective and will be fruitful after the end of the project.

Guidelines for replication and Performance guarantees

The VSNavigator is purely a software platform and is not hardware dependent. The Consortium as a whole guarantee that the delivered VSNavigator software will have all the technical characteristics and functions, as deployed at the end of the project.
Given that the future buyers, becoming the owner, will have full permission to use and replicate the VSNavigator software in several types of buildings and applications, the Consortium does not guarantee the performance, for obvious reasons, if the buyers make adaptations and changes to the software.

The Consortium guarantees for one year after the project completion that the final version of the VSNavigator software, deployed at the end of the project will be:

1. runnable , with the run-time version to be used for demonstration purposes.
2. downloadable using a link that will be provided to the Customer at the signature of the contract.
   The following sources are also available for download:
   - the complete application, e.g. the run-time and source codes in the different (programming) languages (JAVA, Javascript, pl/SQL, HTML, CSS, OS scripts and so forth);
   - the High Quality Data Set source codes;
   - the user and installation manuals;

For the extra option modules belonging to the industrial partners,

- SCE/DOKI equipment are guaranteed on yearly base maintenance contracts. Assistance is provided by a free remote online (web-)service and in case of request/need of onsite activity, only travel and subsistence will be requested.
- The IES module are guaranteed under a specifically developed "*Terms and Conditions*" and "*licensing*" documents, based on IES'S standard T&C's and software licences.

- The Enerit SAM product are guaranteed under a specifically developed "*Master Subscription Agreement*", based on Enerit's standard Master Subscription Agreement, which is used for Enerit's existing SaaS product portfolio.

Financing Energy Smart Schools

Energy efficiency is a key factor to achieve progresses towards a low carbon and more sustainable economy, and to contribute to social equity by reducing energy prices to final customers and increasing energy availability. Every **school has the potential to become a high performance school** - defined as a school facility that improves the student learning environment and achieves the maximum level of energy performance possible, saving energy, resources and money. By making a commitment to high performance schools, many school districts are discovering that **smart energy choices** can have lasting benefits for their students, their communities, and the environment.

Even if the short-term savings and long-term economic benefits of energy efficiency improvements are obvious, up-front capital for high performance school projects is often hard to find and must be balanced against competing capital needs. While there are innovative financing approaches that lower up-front costs to the school, these mechanisms are not close to the knowledge of all involved Energy Decision Makers and School Administrators also facing challenges in getting the access to the financing tools and information they need to **invest in the energy efficiency projects or improvements.** Also facing steep budget cuts and rising energy costs, many school are grappling with how to finance urgently needed, but capital intensive, energy efficiency upgrades on campus.

Thus, the **Guide for Financing Energy Smart Schools** summarizes existing suitable methods of financing smart schools, showing that achieving success is a matter of understanding the opportunity, making the commitment, and creatively tapping into the financing available and looks ahead to innovative, while supporting the **Decision Makers in Schools to identify the best available financing options**.

Mainly, the financing methods presented were related to **external financing**, **capital as a service** and **green investment funds**, as shown in the table:

Financing Option	Threshold value	Summary of actions and strategic implications
Bank financing	Not defined	- Partnership with banks
Crowd funding	Until 20.000€	- Partnerships with Platform - Visibility to the community - Ability to identify investors within the community
Green Investment Funds Green Revolving Funds	From 100.000€	- Partnership with Investment Funds
Capital as a service	Not defined	- Ability to contractually the partnership model and share-savings

Lessons Learnt

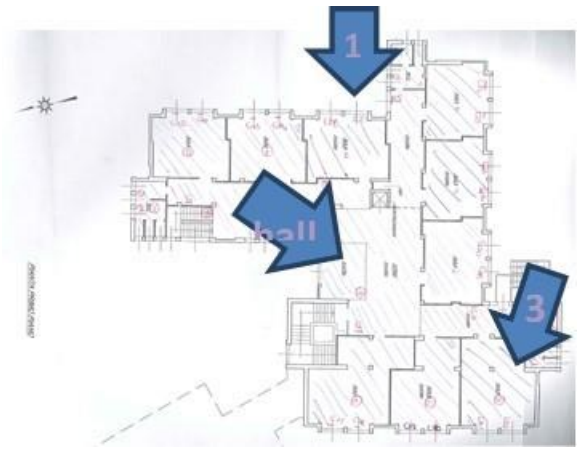
The development of the VERYSchool project, the demonstration and the validation activity performed in the four pilots, has been a challenging but very rewarding activity. Interviews with school managers, public administrators and technology providers, experimental data acquisition and cleaning, data analysis and results validation, allowed to learn a lot about the needs of the School environment and the Team to be ready to reuse this experience during the commercial exploitation of the VSNavigator.

Four main key learnings can be drawn from this experience:

- **Accuracy of pilot selection**: the implementation of the BEMS related scenario in the four pilots was dictated by the project available budget and energy infrastructures initial constraints.

  In a future commercial installation scenarios like (1) zoning programming, (2) thermostatic setpoint, (3) LED light (4) control presence on lights and (5) dimming on lights must be installed only in a selected number of rooms in which the advantage of those scenarios are potentially good.

  In the school environment, in particular, the zone programming scenario can be extremely beneficial for example in gyms, theatres, common areas, room for pupils morning reception while it seems rather useless for classrooms which are continuously used.



- **Initial audit and continuous users contact**: in VERYSchool the implementation of the different BEMS settings was made in strict collaboration with the local users.
  The local school calendar was confirmed during the initial audit and a local Reference was identified. In all pilots the Team had a clear idea of the user needs, especially in terms of setpoint programming per room.
  Moreover, the initial audits were extremely useful to identify alternative improvements that could be done quickly and "for free". For example:
  - fully heated radiators in unused rooms
  - heating losses due to weakened passive elements like broken windows
  - behavioral losses like loss of personnel controls after the school closure.

- **Utilization of VSNavigator monitoring functions for BEMS fine tuning**: the validation Team used extensively the VSNavigator to evaluate the initial impact of the BEMS settings on the local comfort and the energy savings.
  This aspect is probably the most important one: during commercial exploitation it will be critical to follow how the system reacts to a different setpoint, especially when comfort can be affected. Monitoring (for example) how fast a room heats up when the morning setpoint was adjusted is critical for the school environment, especially for nurseries and primary schools around 8am.

- **A combination of good communication** with the local reference Users and objective evaluation through the VSNavigator remote monitoring function can lead to outstanding results and customer satisfaction.

As summary of the **statistical analysis performed on the online survey**, the following main conclusions can be reported as lessons learnt to depict the current European School Building stock.

1. Energy Management in Buildings is considered important by the majority of the respondents' schools, and they plan to adopt EE measures in the next three years.
2. Even if the majority of respondents declare to know Energy Standards and certifications, about 70% of them are not equipped with systems to monitor energy consumption, temperature profiles, lighting levels, IAQ management. This could suggest a large untapped market potential for these solutions.
3. The main barriers to be addressed seem to be the lack of awareness and of technical knowledge, as well as the difficulty in raising the needed capital.

Conclusions

VSNavigator has been developed with the contribution of European funds as CIP-ICT-PSP project, but it is also the result of a research and innovation action. Thus, the VSNavigator software is not released as a product ready for the market.
VSNavigator is a specific technology and a replicable model. Any reference to the school building, or school organization, automatically extends to the general concept of "building" or "organization".

The Consortium pursues the goal to give value to the efforts and the expenditures made with public money to strengthen the competitiveness and Innovation of the European Industry. Thus, to make the business plan realistic and successful, the Consortium set up an exploitation strategy that considers the "*sell of the rights*" of the VSNavigator software to Organizations who wish to buy.

As a whole, the project has achieved excellent results.

VSNavigator functionalities, and energy performance resulting from the VERYSchool project methodology have been demonstrated and validated in four European school pilots.
A demo version of VSNavigator is available from the project website for any **e-Learning user** and to support the commercial activities that the Consortium purses by selling to Customers the rights of the software.

The Catalogue of the Optimization Scenarios, which support the decision-making process of VSNavigator has been published as **e-Book** and it is free downloadable from the project website.

The entire Energy Management Programme established in each pilot school has been validated in compliance with the ISO 50001 during one year of experimental activities.

The energy performances assessment, and the achieved energy savings in the project, was performed with the eeMeasure software, that is provided by the European Commission as a tool to calculate energy savings with a standard methodology.

A methodology for the application of IPMVP in school buildings has been developed, with examples on how to calculate energy savings and comfort conditions.

The energy and environmental assessment were performed using the Building Energy Index (BEI), the Climate Energy Index (CEI) and the Carbon Assessor (CA), all belonging to the market product IES <Virtual Environment>.

Using the Optimization Scenarios appropriate to each pilot school, a Green Design has been performed as best practices to show how the selected pilot schools can be transformed into Near-Zero Energy Building.

Concepts, methods and results were continuously disseminated, and published on the project website, to enhance the culture around the themes of energy efficiency and energy management. As a platform to engage stakeholders and to link them with and capture their interest towards the project, a "Networking" menu has been implemented in the project website, while the project is visible in Facebook and LinkedIn Social Network.

VERYSchool project has been recognized for the high level of innovation that have introduced, and in 2013 received an Award as best European project within the Green Digital Charter, with ceremony held in Amsterdam during the EUROCITIES conference.

Project Publications

All the project deliverables that are public by nature are available for download from the project website.

A demo version of VSNavigator is available from the project website for any **e-Learning user** and to support the commercial activities that the Consortium purses by selling to Customers the rights of the software.

The **Catalogue of the Optimization Scenarios**, which support the decision-making process of VSNavigator has been published as **e-Book** and it is free downloadable from the project website.

The consistent dataset comprising both the experimental data collected and the HQDS data are made for public download to the benefit of the scientific Community; the link is established through the project website.

The results of the statistical analysis related to the on-line survey that involved about **1.669 responders**, are made as free publication to provide information and create awareness on the actual level of knowledge for implementing an Energy Management System in European.

A Guide *Financing Energy Smart Schools* has been produced for publication; it can be downloaded from the project website.

Two videos has been produced and they are available on the project website and on the net. The former was produced at the early stage of the project to illustrate the concept and the objectives; the latter was produced at the end of the project to communicate the achieved project results.