TEESCHOOLS

Transferring Energy Efficiency in Mediterranean Schools

PRIORITY AXIS: Fostering Low-carbon strategies and energy efficiency in specific MED territories: cities, islands and remote areas

OBJECTIVE: 2.1 To raise capacity for better management of energy in public buildings at transnational level

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EXECUTIVE SUMMARY

One of the great challenges in energy and the fight against climate change is to increase energy efficiency in all the stages, from generation to final consumption. A clear example of beneficial of energy efficiency is in renovations activities. For this reason, the EU focuses efforts in sectors such as buildings where there is greater scope for energy saving.

In this sense, TEESCHOOLS works to raise capacity for better management of energy in public school buildings and the Green Paper is a significant document of this project and a basic element for the capitalization of its results. The pages of the Green Paper include approaches, methods and contains ideas on energy performance of building to stimulate a debate at European level on Energy Efficiency in Mediterranean Schools.

During the project, different methodologies has been used in order to achieve the objectives such as regional conference, phone assisted interview partner daily work experience or world cafè methodology.

The analysis of methods and plans included in national and local legislation lets know how these territories are working in energy performance of buildings and the concept Nearly Zero Energy Building (nZEB) in partners countries of TEESCHOOLS project.

Results of audits in analysed schools show that most of them need the implementation of renovation activities to improve the energy performance of buildings. The actual conditions of school building in partner countries mainly differ depending on their localization and the construction year, being more efficient energetically the most recent ones when incorporating new materials and systems and being in accordance with the current energy efficiency regulations.

The analysis carried out in the early phases of the TEESCHOOLS project has allowed us to identify which are the weak points in the renovation of system and energy management in school buildings. In this sense, lack of funds and the difficulty of accessing to funds together with the complex legislative system from a financial point of view, lack of qualified personnel from technical point of view, lack of awareness of the educational community from changing behaviour point of view and not clear competences in energy management from organizational point of view are problems that affect most of schools in partner countries.

In turn, financial mechanisms have been detected that are already in operation in the partner countries or have been identified as solutions that could help in the renovation of energy systems in schools. Among the financial models it`s found underlining own funding, credit financing, ESCO model, PPP model and subsides or incentives.

This Green paper document incorporates several recommendations regarding financing, technical, changing behaviour or organizational issues. Among the different proposals are to establish a clear and simplified financing processes, specific programs for EE in schools, promote information actions / training events to raise energy efficiency awareness or increase the skills of actors in the educational community.

This document includes important solutions that can facilitate the management of energy in school buildings, however it reveals that there are still limitations and a long way to achieve the objectives stablish by the EU in this area.

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INTRODUCTION

Energy consumption increased by several circumstances in the last years, from generation to final consumption. It becomes necessary intensify efforts to deliver energy savings in the short term.

Renovation of existing buildings can reduce the EU's total energy consumption and lower CO2 emissions in a relevant way. For this reason, EU measures focus on building sector where the potential for savings is greatest and it can play a key role in the clean energy transition.

TEESCHOOLS project focuses attention on schools providing solutions to Local Authorities to carry out activities of energy renovation in schools building.

This green paper document incorporates approach and methods from different actors in order to sharing views, systems and opinions to improve the performance energy in this kind of buildings.

TEESCHOLS Project

TEESCHOOLS project is part of the MED programme, within the priority of the Fostering low-carbon strategies and energy efficiency in Mediterranean territories and within the objective to raise capacity for better management of energy in public buildings at transnational level.

TEESCHOOLS project aims at providing new solutions to Local Authorities both in technical and financial terms to implement Nearly Zero Energy Building (NZEB) renovation activities in Mediterranean Schools.

A pre-audit tool to simplify the energy audits, a carbon footprint calculator based on the building life cycle information, an innovative database of BAT for renovation of school buildings, tailored financing models and highly qualified trainings complete an innovative and integrated set of tools user- friendly but scientifically sound. These tools have been tested in all partner countries and have been adapted and harmonized with the objective to be used in local, regional and national energy plans.

An expert transnational working team have supported the pilots and blended learning models help enhancing capacity in public sector. The transnational and multidisciplinary expertise of the partnership is a fundamental asset to consolidate the knowledge of local energy managers.

WHY OPERATE ON SCHOOLS

Throughout the Recast Energy Performance of Buildings Directive (EPBD) it is requested that "the public sector in each Member State should lead the way in the field of energy performance of buildings" and "buildings occupied by public authorities and buildings frequently visited by the public should set an example". Among the most promising public building types to act as lighthouse projects are school buildings. They are visited by people belonging to different age groups such as pupils, teachers and parents. Classes can offer pupils first-hand experience of visible improvements to the building envelope and the technical services systems, they can learn how to support energy savings by responsible user behavior. Furthermore, pupils can actively participate in the renovation process and transfer what they have learned to their parents.

In this sense, students have demonstrated in the "Fridays global Climate strikes" organized in several cities of the world along 2019 that they are the most important activist to lead actions against the climate change and to make an intergenerational transmission of this commitment.

Moreover, members of the educational community such as students, teachers, fathers and mothers are an important sector of the society with the capacity to influence political, social and economic issues.

THE CURRENT EE EU POLICY FRAMEWORK

The EU is committed to developing a sustainable, competitive, secure and decarbonised energy system by 2050. To achieve that goal, EU countries and investors need measures that aim to reach the long-term greenhouse gas emission goal and that decarbonise the building stock, which is responsible for approximately 36 % of all CO2 emissions in the Union, by 2050.

At EU level, the legislation that regulates this matter are mainly the Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency and the Directive 2010/31/EU or the European Parliament and of the Council of 19 May 2010 on the energy performance of building.

To achieve the objectives, it is necessary to review the legislation on energy efficiency. One of the highlighted reviews is the Directive (EU) 2018/884 or the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

Both directives recently amended promote policies that will help achieve a highly energy efficient and decarbonised building stock by 2050, create a stable environment for investment decisions to be taken and that will enable consumers and businesses to make more informed choices for saving energy and money

The Energy performance of buildings directive (EPBD) includes specific measures to support national governments and take stock of their progress.

One of the most important decision included in the Energy performance of buildings directive is to require that all new buildings must be nearly zero-energy buildings (NZEB) as of 31 December 2020. The low amount of energy that NZEB require comes mostly from renewable energy sources.

Under the Energy performance of buildings directive, all EU countries have established independent control systems for energy performance certificates and inspection reports for heating and cooling systems.

Another important aspect included in EPBD refers financing renovations. In this sense EU countries can set up support mechanisms to help finance renovations that make

buildings energy efficient. These countries can provide a list of national measures for funding opportunities; these are updated every three years and can also be found in the national energy efficiency action plans.

EU countries have, since 2014, had to submit long-term renovation strategies (LTRS) that foster investments in the renovation of buildings. These strategies will as of 2019 form a key part of EU countries' integrated national energy and climate plans (NECPs), which have to be submitted every 10 years

As we can see, to achieve a highly energy efficient and decarbonised building stock and to ensure that the long-term renovation strategies deliver the necessary progress towards the transformation of existing buildings into nearly zero-energy buildings, in particular by an increase in deep renovations, Member States should provide clear guidelines and outline measurable, targeted actions as well as promote equal access to financing, including for the worst performing segments of the national building stock, for energy-poor consumers, for social housing and for households subject to split-incentive dilemmas, while taking into consideration affordability.

The role of EU countries in field of the energy performance of buildings is important. Let's see the legislation in the partner countries.

THE LEGISLATION IN THE PARTNER COUNTRIES

Italy

National and Local Legislation

National regulation	*Contents*
373/1976 Law	Requirements on envelope and system
10/91 Law	Requirements heating systems and its maintenance
192/2005 Decree (with consequent modifications and additions)	Requirements on envelope and system and requirements about energy certification
102/2014 (with consequent modifications and additions)	Requirements on nZEB and energy audits
Interministerial Decree 26 June 2015	Minimum Requirements for buildings about envelope, systems and nZEB

Italy has not specific law on school buildings, but it has law on minimum requirements for energy efficiency in new buildings and in deep renovated ones (wall transmittance, windows transmittance, efficiency of the heating system…).

Comments

A particular focus in this process is placed on the building sector, which accounts for about 40% of final energy consumption in the EU. The energy efficiency potential is huge: only a small proportion of buildings is subject to major renovation and it is expected that more than two-thirds of the total will still be in use in 2050.

Energy efficiency renovation of buildings is a priority for Italy. More than two thirds of the stock was built before 1976, the year of the first Italian law on energy performance of buildings. Energy saving potential is wide and often achievable through interventions characterised by a short payback period.

The Italian Strategy for the energy renovation of the national building stock assesses an energy saving potential of almost 5.7 Mtoe/year at 2020. The corresponding level of investments in the residential sector is about 13.6 billion euros per year for interventions aimed at the overall renovation of buildings, and 10.5 billion euros per year for partial interventions (roof, facade, windows, heating system).

Concerning the services sector, the amount of necessary investments is about 17.5 billion euros per year.

The Italian National Plan for Nearly Zero Energy Buildings provides an evaluation of the energy performance of some different typologies of reference buildings for different climatic zones. For NZEB renovations of existing buildings, additional costs are relevant for interventions on the heating system, especially in the case of a detached house.

Thanks to an immediate application of NZEB parameters to both new buildings and deep renovations, a 10 ktoe energy saving is assessed for the period 2015-2020, compared to current minimum energy performance requirements. The Italian construction sector is taking a new and evolutionary phase, reshaping strategic visions, processes and products, thus supporting the implementation of the aforementioned strategies. Indeed, some mature technologies are already available, though not so common in the market yet. This is mainly due to a lack of expertise of practitioners and/or higher costs compared to the market average.

Thanks to the adoption of the so-called Minimum Requirements Decree (Interministerial Decree 26 June 2015), Italy has focused more attention on the energy performance of buildings. Nevertheless, there are still barriers, many of which are outside the regulatory framework and, as in other sectors, prevent the energy efficient potential to be fully exploited. Better information and improved conditions to access financial instruments should play a key role in favouring the massive investments needed to achieve the 2020 objectives.

Local School Regulations

Local regulation	***Contents***
Emilia romagna Region Law 26/2004	Requirements on energy efficiency
Regional Council Resolution n° 1275/2015	Requirements on envelope, heating/cooling system, renwable sources and nZEB

Comments

Emilia-Romagna Region is very active in developing policies for the energy sector. In response to poor effectiveness of national initiatives, in 2004 the Emilia-Romagna Region developed the regional energy law (26/2004). This law provides the regional strategic plan for the energy sector Regional Energy Plan (REP).

Greece

National and Local Legislation

National regulation	*Contents*
Regulation on the Energy Performance of Buildings (KENAK)	An integrated energy planning in the building sector is set up in order to improve the energy performance of buildings, energy savings and protect the environment. Moreover, the regulation set minimum requirements for the efficiency of heating and cooling systems, as well as for hot water production for all types of buildings, and lighting for buildings of the tertiary sector.

Comments

The "**Regulation on the Energy Performance of Buildings**" (**KENAK**) replaced the previously existing "Thermal Insulation Regulation" which had been in force since 1979. According to this, the thermal insulation requirements were tightened, and the climatic zones of the country were modified, increasing the number of climatic zones from three to four. Moreover, the regulation sets minimum requirements for the efficiency of heating and cooling systems, as well as for hot water production for all types of buildings, and lighting for buildings of the tertiary sector.

The law for the transposition of the Directive 91/2002/EC was approved by the Parliament in May 2008 (Law 3661). For the implementation of this Directive, a Ministerial Decision for the new "Regulation of Energy Performance of Buildings" (KENAK) was issued in April 2010 (Ministerial Decision D6/B/5825, National Gazette 407). The presidential decree necessary for defining the qualifications and training requirements of energy auditors was published in the National Gazette in October 2010 (Presidential Decree 100/NG177). Full implementation started in January 2011 for all types of buildings and building uses, and for both new buildings and existing buildings undergoing major renovations. In the view of the requirements of the

Directive 2010/31/EU, the Law 3661 was amended in June 2010, so as to remove the 1.000 m2 limit undergoing for major renovations and to introduce the definition of Nearly Zero-Energy Buildings (NZEB) and to require a minimum 60% of Domestic Hot Water demand to be covered by Renewable Energy Sources in new buildings. Directive 2010/31/EU was transposed into national legislation on 19 February 2013 (Law 4122/2013).

The Law 4122/2013 mainly defines:

- the methodology to calculate the energy efficiency of a building
- the minimum requirements of energy performance
- the type and content of emergency study of energy efficiency
- the procedure and frequency energy efficiency inspection
- the type and the content of the energy performance certificate and the procedure to issue it,
- the energy inspection procedure

The methodology to calculate the energy performance of the building is based on European standards. According to this, every building is classified in a category according to city planning regulation. Schools are classified to the category educational buildings (article 3.6). Based on the law 4122/2013, every building needs to be renovated to a certain technically, operationally and economically fisible extend, in order for energy efficiency demands to be fulfiled (article 7). With a joint resolution of the Ministry of Finance, Ministry of Environment, Energy and Climate Change (currently Ministry of Environment and Energy) some financial or other incentives are given in order to improve the energy efficiency of a building. In addition, the Public Investment Programme provides financing to projects that aim at upgrading their energy efficiency and exploiting renewable energy sources. Finally, inspections to heating and air conditioning systems have to be conducted at every building.

Sources:

- *CONCERTED ACTION ENERGY PERFORMANCE BUILDINGS (2016). Implementing the Energy Performance of Buildings Directive (EPBD)*
- *CRES (2014). NATIONAL ACTION PLAN FOR ENERGY PERFORMANCE*
- *www.buildingcert.gr*
- *www.kenak.gr*
- *www.ypeka.gr*
- *www.cres.gr*
- *www.ktyp.gr*
- *Direct communications with competent authorities*

Local School Regulations

The local regulation is the same with the national one

Spain

Types of School Buildings

National Regulation	Contents
Law 8/2013, 26th June, on urban refurbishment	The aim is to boost the refurbishment of buildings and urban areas as a means of reconverting the traditional construction sector as long as promoting the sustainable development including energy efficiency criteria.
Law 38/1999 of November, on the regulation for constructions	The purpose of the law is to regulate the essential aspects of the building process by establishing the obligations and responsibilities of the agents who intervene in the process and to protect users interests.
RD 1027/2007, on 20th July, approving the review of the current 'Regulations for thermal installations in Buildings (RITE)	The need to transpose Directive 2002/91/EC on the energy performance of buildings and the approval of the Technical Building Code by Royal Decree 314/2006, obliged Spanish government to prepare a new text replacing the old RITE and incorporates also the experience of its practical application in recent years.
RD 238/2013 of 5 April, on thermal Building Regulations	RD 238/2013 modifies some technical instructions of the Regulation for Thermal Installations of Buildings (RITE) with the aim of transposing the provisions for thermal installations of buildings on Directive 2010/31/EU.
	RD 235/2013 establishes the obligation

RD 235/2013 5 April, approving the basic procedure for energy efficiency certification of buildings.	to make available purchasers and/or users of buildings an energy performance certification document.
Valencian Government Decree 39/2015, on 2nd April, regulating the building energy efficiency certification in the Valencian Autonomous Community	Autonomous adaptation in energy efficiency certification, according to RD 235/2013
Royal Decree 314/2006, of 17 March, approving the Technical Building Code	The Spanish Technical Building Code (TBC or CTE in Spanish) is the regulatory framework that establishes the safety and habitability requirements of buildings set out in the Building Act (LOE)
Royal Decree 842/2002, Low Voltage Electricity Regulation	Low Voltage Installations technical conditions
Royal Decree 900/2015. Electric Energy Self-consumption	Regulates the administrative, technical and economic conditions of the modes of supply of electric energy with self-consumption and production with self-consumption
Law 2/2011 of 4 March on Sustainable Economy	The purpose of the Sustainable Economy Act is to introduce the structural reforms needed to create conditions that favour sustainable economic development into the legal system.
Royal Decree 1890/2008, 14th November, on Energy Efficiency for Outdoor Lighting facilities	The main objective is to establish the technical conditions for designing, executing and maintenance the street lighting facilities (public and private)
Spain's Renewable Energy Plan 2011-2020 (PER 2011-2020)	Directive 2009/28/EC on the promotion of the use of energy from renewable sources, states that each Member State shall draw up a National Action Plan on Renewable Energy (PANER) to achieve the national targets set in the same Directive.
Action Plan 2011-2020 Energy Saving and Efficiency	Directive 2012/27/UE Article 4 dictates that no later than April 30, 2014, and every three years thereafter, Member

	States shall submit national action plans for energy

Comments
Nowadays Spain has not totally transposed the Directive 2012/27/EU.

Local School Regulations

Local regulation	*Contents*
Royal Decree (RD) 314/2006, of 17 March, approving the Technical Building Code	The Spanish Technical Building Code (TBC or CTE in Spanish (transposing 2010/31/EU Directive)
RD 238/2013 of 5 April, on thermal Building Regulations and RD 1027/2007	Those regulations transpose the provisions for thermal installations of buildings on Directive 2010/31/EU.

Croatia

Types of School Buildings

National regulation	Contents
Energy Efficiency Act (Official Gazette 127/14)	This Act regulates the area of efficient energy use, the adoption of plans at local, regional and national level to improve energy efficiency and their implementation, energy efficiency measures, energy efficiency obligations, energy regulatory bodies, transmission system operators, distribution system operators and energy market operators in connection with transmission, energy transportation and distribution, energy distributors, energy and / or water suppliers, in particular energy services, energy saving and consumer rights in the implementation of energy efficiency measures.
Building Act (Official Gazette 153/13, 20/17)	This Act regulates the designing, construction, use and maintenance of construction works and the enforcement of administrative and any other procedures relating thereto for the purpose of ensuring protection and planning of space in accordance with the

	regulations governing physical planning and providing the essential requirements for construction works and other requirements prescribed for construction works under this Act and regulations adopted on the basis thereof as well as under special regulations.
Ordinance on energy audits and energy certification of buildings (Official Gazette 48/14, 150/14, 133/15, 22/16, 49/16, 17/17)	This Ordinance stipulates the method and the conditions for the implementation of an energy audit of the building and regular audit of the heating system and the cooling or air conditioning system in the building, the content of the reports on these audits, the method of energy certification, the content and appearance of the energy certificate and criteria for buildings with low energy needs, method of energy management in buildings, determination of energy efficient measures and their cost effectiveness.
Ordinance on energy audits of construction works and energy certification of buildings (81/12, 29/13, 78/13)	This Ordinance stipulates the implementation of energy audits of buildings in order to determine the energy properties and the method of energy management in buildings, the determination of energy efficient measures and their cost effectiveness and the implementation of energy certification of buildings.

Comments

National legislation regarding energy efficiency in buildings is in jurisdiction of Ministry of construction and physical planning (http://www.mgipu.hr/default.aspx?id=3967).

Local School Regulations

There is no special local-level regulation regarding to energy efficiency in schools in the city of Split. However, the City of Split is being active in implementing various activities in the field of energy efficiency since 2008 with the aim of systematic local energy management, environmental protection and rational management of resources for the benefit of the local community and all its citizens. Since 2008., in co-operation with the United Nations Development Program (UNDP), a project "Systematic Energy

Management in Cities and Counties" (SEM) has been implemented, with the aim of continuously improving energy efficiency in public owned buildings and sustainable resource management at local level.

Within the aforementioned, Energy Management Information System (EMIS) was established (an internet application for supervision and analysis of energy and water consumption in the public sector buildings). Since the beginning of the project over 150 people, employees of the city administration, schools, kindergartens, cultural and sports institutions were trained to use EMIS system, in order to ensure a regular intake of energy consumption and energy.

Consumption of buildings, owned and used by local government, is monitored by EMIS system (4 kindergartens with 75 facilities, 30 primary schools, sports and cultural institutions).

It is also worth pointing out that the City of Split within its annual budget provides certain funds for the implementation of energy efficiency measures in public buildings, including elementary schools. Within these funds, various education is also provided to pupils in elementary schools, with the aim of raising the pupils' awareness of the necessity of efficient energy use and sustainable resource management for environmental protection purposes.

Ciprus

National and Local Legislation

National regulation	Contents
Law 142(I)/2006, Law 30(I)/2009, Law 210(I)/2012, Law 15(I)/2017	Basic regulation of the energy performance of buildings
Κ.Δ.Π. 568/2007, Κ.Δ.Π. 446/2009, Κ.Δ.Π. 432/2013, Κ.Δ.Π. 119/2016	Ministeral orders regulating minimum energy performance requirements for buildings

Comments

The first milestone in the implementation of the Energy Performance of Buildings Directive (EPBD) was made in December 2007, when the first ministerial order of minimum energy performance requirements was issued in Cyprus, and since then, minimum requirements are being revised on a regular basis.

In December 2012, Cyprus transposed Directive 2010/31/EU in the national legislation by the Law 210(I)/2012, which amends the Law for the regulation of the energy performance of buildings. Based on the new legal framework, the cost-optimal levels of minimum energy performance requirements were calculated and revised, minimum requirements on technical systems were implemented and measures to promote Nearly Zero-Energy Buildings (NZEB) have been taken. The implementation of the Energy Performance Buildings Directive (EPBD) in Cyprus is the overall responsibility of the Ministry of Energy, Commerce, Industry and Tourism (MECIT).

The energy efficiency of buildings is backed by the implementation of Directive 2012/27/EU on energy efficiency. Cyprus put in place the legislative framework for energy auditors in 2013, and for ESCOs and energy performance contracting in 2014.

The national scheme for the Energy Performance Certification of new and existing buildings was introduced in 2009 and was take into force the 1/1/2010. The Energy Performance Certificate (EPC) is required to be issued when a new building is constructed, or when a building is being sold or rented out. It is also required for buildings with a useful floor area of over 250 m_2 that is occupied by a public authority and is frequently visited by the public.

The current minimum energy performance requirements for new buildings regulate the building elements and the building as a whole and promote the use of Renewable Energy Sources (RES). The building elements requirements consist of maximum U-values for the building envelope and a maximum shading factor for windows. The requirements regarding RES, according to the 2010 ministerial order were the installation of a solar heater for the production of Domestic Hot Water (DHW) and the necessary provision in the event that RES will be installed in the future for the production of electricity. Since 2017, a RES share of 25% of the buildings' primary energy consumption is obligatory for new builidings. An energy class of B or better is required.

The definition of NZEB for residential and non-residential buildings in Cyprus is prescribed by the Requirements and the Technical Characteristics of the NZEB ministerial order of 2014 (Κ.Δ.Π.366/2014). For the NZEB it is required to reach energy class A (the best class), however, the EPC format was not affected for the moment.

Local School Regulations

National Regulations for the energy performance of buildings are used. There are no specific requirements for schools.

Comments

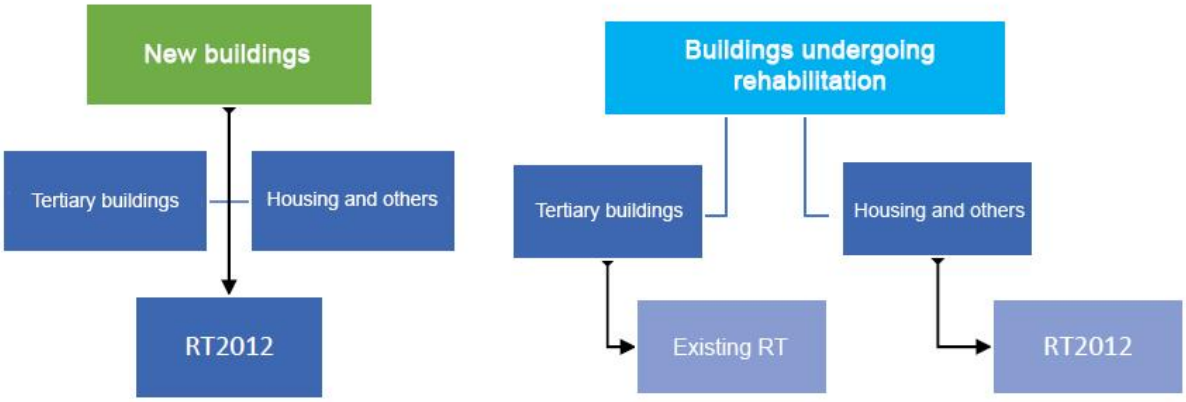
Local authorities (LA) have to issue an EPC if they use buildings that are above 250 m2 and visited by the public. The 833 public schools in Cyprus, according to the MECIT, are not considered to be visited by the public; therefore, an EPC only has to be issued for

new schools and the overall responsibility lies with the Ministry of Education and Culture.

France

The purpose of the thermal regulations is to set a maximum limit on the energy consumption of new buildings or buildings undergoing energy rehabilitation.

Two types of regulations exist:



THE THERMAL REGULATION RT 2012[NEW BUILDINGS]: The objective of RT 2012 is to limit the primary energy consumption of new buildings to a maximum of 50 kWhEP/(m².an) on average. The performance requirements imposed by the 2012 RT are of three types:

- The energy consumption of the building: [Cep]

The maximum conventional primary energy consumption requirement is expressed by the "Cepmax" coefficient, which covers the consumption of heating, cooling, lighting, domestic hot water and auxiliaries (pumps and fans).

- Summer comfort in the absence of air conditioning:[TIC]

Ensure a good level of comfort in summer without having to use an active cooling system.

- The energy efficiency of the building: [Bbio]

This requirement imposes a simultaneous limitation of the energy requirement for the components related to the design of the building (heating, cooling and lighting), thus requiring its optimization, independently of the energy systems used.

Cep: Primary energy consumption,
TIC: Critical indoor temperature,
Bbio: Bioclimatic needs

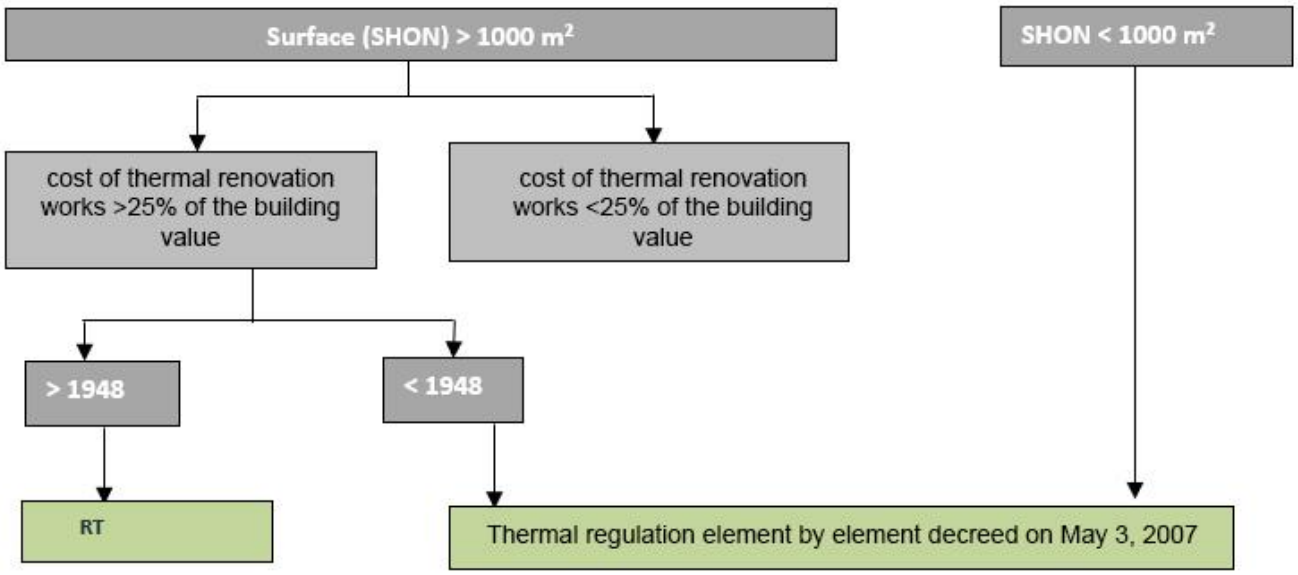
THERMAL REGULATION IN REHABILITATION

These regulations have applied since November 1, 2007 to existing buildings as soon as they are the subject of improvement work. It lays down the minimum requirements for the products and equipment to be used for any intervention concerning insulation, heating, air conditioning, domestic hot water, regulation, ventilation and lighting.
The thermal regulation of existing buildings is based on Articles L. 111-10 and R. 131-25 to R. 131-28 of the Building and Housing Code, as well as their implementing decrees.
The regulatory measures are different depending on the importance of the work undertaken by the contracting authority:

o Global thermal regulation known as "Global RT" for major renovations of buildings of more than 1,000 m², completed after 1948. The regulations define an overall performance objective for the renovated building. This first part of the RT is applicable for building permits submitted after 31 March 2008.

o Thermal regulation element by element called "RT element by element" for all other renovation cases. The regulations define a minimum performance for the replaced or installed component.

The application component of the Thermal Regulations (RT) is based on three criteria: the date of completion of the building, the net floor area and the cost of thermal work



Thermal regulation RT2020 :

The RT2020 thermal regulation brings together a set of standards for the construction of positive energy buildings and passive houses. A building meeting the requirements of RT 2020 must have a heating consumption of less than 12 kWhep per m2 and a total energy consumption (heating, domestic hot water, lighting and electrical appliances) of less than 100 kWh per m2. RT 2020 standards target zero energy waste and energy production. They also make the user an actor in the energy transition.

Bosnia and Hercegovina

National and Local Legislation

Bosnia and Herzegovina is at the very beginning when it comes to aligning with the EU in the field of environment and measures to mitigate their consequences. The Council of Ministers in 2013 singled out four sectors that are a priority for the Strategy for low emission development: electricity generation, energy efficiency in building sector, the district heating system, transportation / traffic4 Inadequate energy efficiency of buildings and the poor state of district heating system create a problem of health and quality of life of the population, as well as many socio-economic problems due to heating costs, which are in relation to the purchasing power of the population very high ("energy poverty"). Investing in the improvement of energy efficiency, renewable energy and district heating systems will have a positive social and economic impacts and reduce emissions in the building sector should therefore be regarded as a key priority.

Energy Efficiency Regulation in the Public Buildings Especially in Schools

Energy efficiency policy of the EU should represent an important determinant of energy policy of FBiH which is reflected trough the legislation in the field of energy efficiency and construction. The same is carried out by adopting legislation in the field of energy efficiency, as well as through the Energy Efficiency Strategy, Action Plans to improve energy efficiency (EEAP FBiH) and Operational Plans of energy efficiency. Indicative objectives of the Federation of Bosnia and Herzegovina in achieving savings in energy consumption are determined by the Action Plan for Energy Efficiency FBiH (FBiH EEAP). The Action Plan defines the measures to achieve savings in final energy consumption.

Federation of Bosnia and Herzegovina Energy Efficiency Law

This law was passed only in 2017 and was partially coherent with the Directive 2006/32 / EC relating to energy efficiency in final consumption and energy services, as

well as Directive 2010/31 / EC concerning the energy performance of buildings and Directive 2010/30 / EU on the labelling of the consumption of energy and other resources, to mark energy efficiency and standard information on energy-using products. The purpose of this law is to achieve the goals of sustainable energy development: reduction of the negative impact on the environment, increasing the security of energy supplying, meet the energy needs of end consumers and fulfilment of international obligations assumed by Bosnia and Herzegovina in terms of reducing emissions of gases

This law regulates:

- Energy efficiency in the final consumption which increase is the activity of general interest,
- Adoption and implementation of plans to improve energy efficiency,
- Measures to improve energy efficiency including energy services and energy audits,
- Obligations of the public sector, the obligations of big consumers and consumers' rights in respect of the application of energy efficiency measures,
- Way of financing energy efficiency improvements and
- Other issues of importance for energy efficiency

In order to fulfil its obligations, the entities in the public sector will be required to periodically, at least once a year, analyse energy consumption, implement energy audit, provide obtaining a Certificate of energetic efficiency, adopt a program of efficiency end-use efficiency, but implement measures energy efficiency programs.

The Law on Urban Planning and Construction of Zenica-Doboj Canton

The adjustment of BiH legislation with the European legal heritage is the condition for the accession to the European Union. One of the most important activities in this respect is the transfer of the Directive on the Energy Performance of Buildings (Directive 2002/91 / EC on Energy Performance of Buildings). In the last ten years or so the initiatives contained in the package of measures to encourage the use of energy from renewable sources as well as a processed Directive on the energy performance of buildings (Directive 2010/31 / EU on the Energy Performance of Buildings - recast), set the construction sector in the key role of energy policy. The Law on spatial planning and land use of FBiH and the Regulation on Energy Certification prescribes the obligation of energy certification, which is among other things related to all public buildings whose size exceeds 500 m2.

Law on Spatial Planning and Construction of Zenica-Doboj Canton (Year XIX No. 1, 2014) determined the conditions of design, construction, use and maintenance of the building, technical specifications and other requirements. Further analysis of this law based on an attempt to find items that indicate the obligations of energy efficiency have only led to the indication of commitments for saving energy and thermal protection of buildings.

It is evident that the legislation in the field of energy efficiency of buildings in the FBiH is mostly adopted and is in line with EU directives.

Local School Regulations

The obligations of local government (municipal services for construction and Urban Development) in the field of energy efficiency, originate from the adopted laws on energy efficiency and related regulations at the cantonal level which originate from the 3 following laws:

- Law on spatial planning and land use in the FBiH (Official Gazette FBiH, No. 2/06, 72/07, 32/08, 4/10, 13/10 and 45/10), and the Regulation on energy certification of buildings (FBiH official Gazette, no. 50/10)
- Law on Energy Efficiency (draft law of 2012 and adopted a law in 2017)
- The law on the use of renewable energy sources and efficient cogeneration (Official Gazette of FBiH, no. 70/13), as well as
- Under legal acts (secondary legislation) which should be adopted, and mostly already in the process of drafting

Local governments should adopt its Energy Efficiency Action Plan, which also applies to public institutions (schools), which is aligned with the plan of energy efficiency.

nZEB CONCEP IN EUROPE (EU communication) AND PARTNERS COUNTRIES

The Energy Performance of Buildings Directive (EPBD, 2010/31/EC) introduced the definition of nZEB as a building with very high energy performance where the nearly zero or very low amount of energy required should be extensively covered by renewable sources produced on-site or nearby.

We enter now in detail in the concept in each of the countries

Italy

Italian National law considering nZEB is the Legislative Decree 102/2014 (with consequent modifications and additions) and the Interministerial Decree 26 June 2015 that establishes minimum requirements for buildings about envelope, systems and nZEB.

Italy defines a nZEB as a building with very high energy performance in which the energy requirement (very low or almost zero) is covered by a significant part of energy from renewable sources, produced locally.

A nearly zero energy building (nZEB), both for new and existing building, must meet the following technical requirements:

a) minimum requirements established by the Ministerial Decree of 26 June 2015 "Minimum building requirements"
b) the obligations of integrating renewable sources are respected in compliance with the minimum principles set out in Annex 3, paragraph 1, letter c) of Legislative Decree 3 March 2011, n. 28.

From 2021, all new buildings or buildings subject to a major first-level renovation will have to be nZEB. In the same cases public buildings will give the example, responding to the NZEB requirements already from 2019.
Some regions have even been more ambitious. For new buildings, in Lombardy the date was brought forward to 2016 and, in Emilia Romagna, to 2017 for public buildings and to 2019 for others.

Regarding the numerical indicator for energy demand will be defined on the basis of the definition and of the minimum energy performance requirements which, for the year 2020, will be validated on the basis of the results of the cost-optimal method, it will also be possible to establish a range for primary energy consumption expressed in kWh/m²/y, differing according to building type, location and use.

Regarding the share of renewable energy sources at nZEB, the obligation to include renewable energy sources in new buildings and buildings undergoing major renovations is equal to 50% of the expected consumption for hot water and to 50% of total consumption for heating, cooling and hot water. This latter share is to be increased to 35% from the beginning of 2014 and to 50% from the beginning of 2017.

Greece

Currently the latest update of NZEB definition procedures in Greece is that only the basic definition has been decided and the details about more minimum requirements concerning the envelope characteristics, the energy systems, the contribution of renewable energy sources etc. are still to be defined by the appointed group by the relative ministry. So for now, for a building to be NZEB it must be in energy class A, if it's new and in energy class B+ if an existing building is undergoing a deep energy renovation that is specifically defined.
The energy class refers to the national energy performance certification classification. There is no energy consumption thresholds that make the energy classes because the energy performance certificates in Greece use the reference building method. So there are no specific boundaries of energy consumption that make a building NZEB.
In conclusion, NZEB definition in Greece has been partially decided. Detailed requirements that are probably going to be differentiated depending on building use and climate zone are yet to be defined. These requirements may include:

- minimum requirements for insulation level which mean maximum values of thermal transfer coefficient for building elements
- minimum contribution of renewable energy sources in the energy balance of buildings
- minimum standards of energy systems technologies (heating, cooling, lighting and DHW systems)

Unless all relative requirements are specified, what is NZEB in Greece can be not fully defined.

Spain

Spain has a not yet official nearly zero-energy buildings (NZEB) definition in the national legislation. This is under development and a new update of Spanish Technical Building Code (CTE) defining NZEB was expected to be officially approved by the end of 2018. Meanwhile, there is only a draft proposal of a new CTE DB HE published at July 2018 but pending to be approved.

New CTE DB HE draft proposal contains the following requirements for NZEB[1], as show here below green shaded:

LIMITS TRANSMITTANCES					
Transmittances *U (W/m2K)*	**CTE 2006**	**CTE 2013[1]**	**CTE 2013[2]**	**NZEB[3]** ***(Pending to be approved)***	**Technical Limits**
Facade Walls	0,95	0,75	0,29	0,2	0,1
Roofs	0,59	0,5	0,23	0,2	0,1
Building envelope	0,65	0,5	0,36	0,25	0,15
Windows (casement + frame)	4,4 - 3,5 Depending on orientation and % size hole)	3,1	1,6-2,05	1,4-2,1 (Depending on Solar Capture parameter)	0,8

1: 2.3 CTE DB-HE1 2013 table, limits values C2 zone
2: E Appendix CTE-2013 - Values thermal envelopment residential uses
3: Maybe in the future NZEB regulation won't be transmittances limit values

Moreover, new CTE proposes for Mediterranean part of Spain the following NZEB requirementes for a non-residential buildings (single-family dwelling):

- Primary energy consumption between 158-190 kWh/m2 year.
- Renewable energy sources (produced on-site) supply 105 kWh/m2 year.

Croatia

nZEB stands for “Nearly Zero Energy Building” and in EU is defined as a building that has very high energy efficient properties, as it is defined by Annex 1 of EU Directive 2010/31/EU. Also that small “nearly zero” amount of energy needs to be satisfied, at least to a significant extent, from renewable energy produced in the building or close by building.

Sustainability of the European society and economy is based on renewable energy and energy efficiency. To accomplish this a large scale development of new buildings should be done by nZEB standards, and existing buildings should be renovated as best as possible to accommodate nZEB standard. The technology is available and proven, however the large scale uptake of nZEB construction and renovation is still a challenge for all market actors and stakeholders involved. It is important

The goals of EU Directive 2010/31/EU are, for all new public buildings that are built after December 31st 2018, to be built by nZEB standards, and for all buildings, public or private, that are built after December 31st 2020 to be built by nZEB standards.

It is important to note that every EU Member State needs to draft final definition of nZEB standard to best accommodate their own capabilities. The European Commission does not determine what the minimum properties are for virtually zero energy

[1] Consorci de la Ribera (2017). NZEB Spanish regulations. TEESCHOOLS Split project meeting presentation.

buildings, but leaves it to the Member States to define them on their own. In Croatia, these requirements are defined in the "Technical Regulation on Rational use of Energy and Thermal Protection of Buildings".

In that regulation nZEB building is defined as following:

"*Nearly zero energy building is a building with very high energy properties. This near zero or low energy should be covered to a very significant extent by renewable energy, including renewable energy produced on or near the building for which the requirements are set out in this regulation.*"

Renewable energy is defined as energy from renewable non-fossil sources like wind energy, solar energy, aerothermal, geothermal, hydrothermal and marine energy, hydropower, biomass, landfill gas, sewage gas and biogas. At least 30% of used energy should be from renewable energy.

Almost zero energy residential and non-residential building is a building where the annual heat demand for heating per unit area of the useful floor area of the heated building is not greater than the permitted values established by this regulation, and the annual primary energy per unit area of the useful floor area of the heated building part, which includes the energies listed in the table and is no higher than the statutory limit values for near zero energy buildings.

nZEB concept can be defined trough 5 crucial factors:

- optimum level of thermal insulation of the building envelope
- thermal insulated window frames with optimum glass
- broken thermal bridges
- airtightness of the envelope
- ventilation with heat recovery

If all these key factors can be met when building new buildings or renovating existing ones, the nZEB standard can be assured.

Cyprus

The first attempt to adopt energy savings measures for buildings in Cyprus, was made in 1999, before the EU, by adopting the national standard CYS98:1999 in accordance with, the U-value for opaque structures should be lower than 1 W/m2K. Conformity to the standard was optional.

From 2004 to 2007, the minimum energy performance requirements were adopted, conformity thereto was a precondition for aid to be granted under the energy savings measures by a Special Fund for RES and Energy Conservation. The mandatory energy performance improvement of new buildings was adopted upon transposition of Directive 2002/91/EC on the energy performance of buildings and the setting of minimum energy performance requirements.

The requirements for new buildings and building units are laid down in the Regulation on the Energy Performance of Buildings (Minimum energy performance requirements for buildings) Decree, as adopted by the Minister for Energy, Commerce and Industry under Article 15(1) of the Regulation on the Energy Performance of Buildings Laws of 2006 to 2012 and published in the Cyprus Government Gazette.

The first Minimum Energy Performance Requirements Decree in Cyprus, was adopted in December 2007 and laid down maximum permissible U-values for new buildings, thus making the thermal insulation of the building envelope and double glazing essentially mandatory. In December 2012, Cyprus transposed the recast of EPBD Directive in its national legislation by the Law 210(I)/2012 which amended the Law for the regulation of the energy performance of buildings. Based on this new legal framework, the cost-optimal levels of minimum energy performance requirements were calculated and revised, minimum requirements on thermal systems were implemented and measures to promote NZEB have been taken.

In August 2014, a ministerial order, Decree of 2014 (RAA 366/2014)2, was issued defining the requirements and technical characteristics that a building has to fulfil in order to be a NZEB [Table x]. This definition includes all buildings and it differs only between residential and non-residential buildings. In accordance to the Decree, all new buildings must be NZEBs by the 31st of December 2020, whereas after the 31st of December 2018, all new buildings occupied or owned by public authorities must be NZEBs. A recent study3 confirmed that NZEBs are, in their majority, very close to the cost-optimal levels.

From the 1st Minimum Energy Performance Requirements Decree until today, Cyprus has put in place a series of energy efficiency legislations [2010, 2013, (2015), 2017], including requirements for new constructions and renovations to ensure a smooth transition to the NZEB requirements as laid down in RAA 366/2014.

Is noted that Cyprus is currently at the process of transposing the Directive (EU) 2018/8444 on the energy performance of buildings, in its national legislation. Emphasis is given to the energy efficiency of the existing building stock and the increasing the number of Nearly Zero-Energy Buildings (NZEBs). In addition, the cost-optimal levels of minimum energy performance requirements and the

[2] Greek: (Κ.Δ.Π.366/2014)

[3] Report on the results of calculating the optimal levels of minimum energy performance requirements for buildings [2018].

[4] Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

methodology for calculating the Energy Performance of Buildings are currently upgraded in order to include new requirements and new market needs.

Table x1: Requirements and technical characteristics that must be met by a nearly zero-energy building, as laid down in RAA 366/2014 – Source: 2nd National Plan for increasing the number of Nearly Zero-Energy Buildings (NZEBs), in accordance with Article 5A of the Regulation of the Energy Performance of Buildings Laws of 2006 to 2017. [2017]

	Requirements	
1	Energy efficiency class in the energy performance certificate of a building.	A
2	Maximum primary energy consumption in residential buildings, as determined in accordance with the methodology used to calculate the energy performance of buildings.	100 kWh per m^2 per year
3	Maximum primary energy consumption in non-residential buildings, as determined in accordance with the methodology used to calculate the energy performance of buildings.	125 kWh per m^2 per year
4	Maximum energy demand for heating for residential buildings.	15 kWh per m^2 per year
5	At least 25% of total primary energy consumption, as determined in accordance with the methodology used to calculate the energy performance of buildings, comes from renewable energy sources.	
6	Maximum mean U-value for walls and load-carrying elements (pillars, beams and load-carrying walls) which are part of the building envelope.	0.4 W/m^2K
7	Maximum mean U-value for horizontal building elements (floors in a pilotis, floors in a cantilever, terraces, roofs) and ceilings which are part of the building envelope.	0.4 W/m^2K
8	Maximum mean U-value for (door and window) frames which are part of the building envelope. Excluding shop windows.	2.25 W/m^2K
9	Maximum mean installed lighting power for office buildings.	10 W/m^2

Bosnia and Herzegovina

Bosnia and Herzegovina has not yet an official Nearly Zero Energy Buildings (NZEB) definition in the national legislation.

The organisation of the energy sector in Bosnia and Herzegovina (BiH) is complex and the competencies in the sector are divided between the state, two entities of BiH (Federation of BiH and Republika Srpska) and Brcko District

of BiH. The energy sector is of strategic importance for BiH's competitiveness and economic and social development. The adoption of countrywide energy strategy and a legal framework in compliance with the Energy Community Treaty (EnCT)[5], has been recognized as a priority under a policy guidance of the Economic Reform Program (ERP) for BiH 2019-2021[6].

With the aim to move forward with energy sector reforms, BiH adopted a countrywide sector strategy, namely Framework Energy Strategy until 2035 in August 2018[7]. This document represents the strategic framework which allows for, among others, a harmonized countrywide approach in transposition, implementation and enforcement of the relevant EU energy *acquis* necessary to ensure that BiH makes credible and measurable progress in meeting its commitments under EnCT. Commitments imply adoption of core EU energy legislation, keeping the pace with EU developments and continiously aligning its regulatory frameworks in energy and other sectors. BiH is lagging in the transposition and implementation of adapted EU legislation and regulations.

According to the EnCT Report, the reform of the renewable energy sector has to be speeded up in Bosnia and Herzegovina. Although, certain progress has been achieved with the adoption of the state-level Energy Efficiency Action Plan, additional measures remain to be adopted in order for BiH to be compliant with the energy efficiency *acquis*.

Future commitments stemming out from different contractual obligations[8] that BiH has signed, pose the challenge for the relevant institutions in the energy sector in BiH due to the complexity of the tasks ahead and the timeline for their completition. One of the obligations represents the development of the Integrated National Energy and Climate plan (NECP 2021-2030). BiH has already started preparing NECP with the deadline for draft completion set to the end of 2020.

France

The French thermal regulation defines the differences between residential and commercial buildings. The NZEB definition is different depending on the use of the buildings.

[5] „Official Gazette BiH – International Contracts“, number 09/06.

[6] Council of Ministers of BiH adopted ERP BIH 2019-2021 at its 165. Session (30/01/2019).

[7] „Official Gazette BiH“, number 70/18.

[8] BiH, as a Contracting party of EnCT is obliged to develop an Integrated National Energy and Climate Plan (NECP), that should cover the period from 2021 to 2030, including a perspective until 2050m which ensures the achievement of the objectives and targets of the Energy Union in line with the 2015 Paris Agreement on climate change, United Nations Framework Convention on Climate Change (UNFCCC) and Energy Community obligations. According to the decisions from the EnCT Ministerial Council from November 2018, at the end of 2019 within the Energy Community, through the adaption of the new Energy Efficiency Directive, Renewable Energy Directive and Governance Regulation once they are in force in EU, a 2030 energy and climate targets should be established.

Residential construction :

For new residential buildings: maximum primary energy consumption target set at 50 kWh/m².an, to be modulated according to the climate zone and altitude.

Commercial buildings :

The tertiary sector, with more than 800 million square meters, represents an important source of energy savings. The Energy Transition Law on Green Growth reinforces the existing obligation to improve the energy performance of tertiary buildings, by providing that the overall fleet concerned will reduce its energy consumption by at least 60% by 2050.

Several requirements, depending on the type of renovation:

THE GLOBAL RT:

The global RT applies in the case of a major renovation, it concerns buildings whose :

- the net floor area (SHON) is greater than 1000m2;

- the cost of "thermal" renovation works decided by the contracting authority is higher than 25% of the building's value excluding land.

The overall energy performance to be achieved is that which the building would have achieved if all the elements likely to influence energy consumption (insulation, heating, hot water production, cooling, ventilation, lighting, use of renewable energy) had been replaced.

The renovation work must result in a 30% reduction in energy consumption compared to the initial consumption.

THE EXISTING RT "ELEMENT BY ELEMENT"

The "element by element" RT applies to existing residential or tertiary buildings subject to element replacement such as boilers, windows, insulation, radiators, hot water tanks, air conditioners.

It applies to all buildings to which the global RT does not apply.

The energy performance requirements of each element depend on certain criteria such as the geographical area or the altitude at which the building is located.

THE ACTUAL CONDITIONS OF SCHOOLS BUILDING IN PARTNER COUNTRIES (materials, typology, construction years)

Italy

Types of School Buildings

BUILDINGS BUILT BEFORE 1976	
Contruction type	MASONRY
Envelope characteristics	BRICKS WITHOUT INSULATION SINGLE GLASSES WINDOWS ROOFS WITHOUT INSULATION BASEMENT WITHOUT INSULATION
Heating System	NO ZONING SYSTEM NO TEMPERATURE REGULATION EQUIPMENT HIGH TEMPERATURE BOILER NO INSULATINNG PIPES
Renewables sourses	NO PHOTOVOLTAIC SYSTEMS NO SOLAR HEATING SYSTEMS NO OTHER RENEWABLES SOURCES SYSTEMS

BUILDINGS BUILT FROM 1976 TO 2005	
Contruction type	REINFORCED CONCRETE
Envelope characteristics	POT BRICKS WITHOUT (OR VERY LITTLE) INSULATION SINGLE GLASSES WINDOWS ROOFS WITHOUT (OR VERY LITTLE) INSULATION BASEMENT WITHOUT (OR VERY LITTLE) INSULATION
Heating System	NO ZONING SYSTEM NO TEMPERATURE REGULATION EQUIPMENT HIGH TEMPERATURE BOILER NO (OR VERY LITTLE) INSULATINNG PIPES
Renewables sourses	NO PHOTOVOLTAIC SYSTEMS FEW SOLAR HEATING SYSTEMS FEW OTHER RENEWABLES SOURCES SYSTEMS (BIOMASS)

BUILDINGS BUILT AFTER 2005	
Contruction type	REINFORCED CONCRETE, WOOK, OTHER
Envelope characteristics	POT BRICKS WITH INSULATION DOUBLE AND TREATED GLASSES WINDOWS

	ROOFS WITH INSULATION BASEMENT WITH INSULATION
Heating System	ZONING SYSTEM TEMPERATURE REGULATION EQUIPMENT LOW TEMPERATURE BOILER INSULATINNG PIPES
Renewables sourses	PHOTOVOLTAIC SYSTEMS SOLAR HEATING SYSTEMS OTHER RENEWABLES SOURCES SYSTEMS (BIOMASS)

Comments

The data reported can be considered valid throughout the Italian territory, but some distinctions must be made: Italy has constructive features that are often different from region to region and in regions such as Emilia-Romagna, Friuli Venezia Giulia or Sicily we can find constructive differences from one city to another. For this reason, in this paper, we have considered medium buildings in the national territory but that are much closer to pilot buildings that will be modelled.

Energy Indicators by the Type of the School

Types	Energy Indicato (kWh / $m^2 \cdot y$)
All types of schools built before 1976	200-250
All types of schools built from 1976 to 2005	90-150
All types of schools built after 2005	50-70

Comments

The consumption shown refers only to heating system and use of domestic hot water. In Italy, until 2015 no consumption assessment was expected in other sectors. With the introduction of the Interministerial Decrees of 2015, all energy certification for residential buildings also includes data on the consumption of the cooling system and for all other types of buildings (offices, buildings, public, schools, warehouses etc.), energy certification includes also the consumption data relating to the ventilation system, the lighting system and the transport system of things and/or people. Because of the explained reasons, there is no national reference benchmark for using electricity in school buildings.

Greece

Types of School Buildings

School buildings in Greece

Period	Types
until 1950	The buildings are neoclassical, the walls are compact, made by stone with thick. Structures made of stone or brick with belts, concrete slabs, concrete roofs or even wooden, without insulation. Window frames are metallic (iron) with poor fitting and single glazing.
1950-1980	During this period, the thickness of the walls is reduced. Iron and steel frames. Insulation is absent and the roofs are without insulation. Special category is the schools of MOMA, which are prefabricated, with high thermal inertia (concrete elements 50 cm thick).
1980 - present	This period includes school buildings that were built after the Thermal Insulation Regulation. These buildings have the following problems: 1. The thermal insulation (mainly polyurethane and polystyrene) covers only up to 30% of its shell. The rest of its surface either creates thermal bridges (All slabs, girders, partitions, columns and protective shelters of the frames do not have insulation and make up the largest proportion of the solid elements of the shell) 2. The transparent surfaces are very large and really harmful when heading to the north. 3. The transparent surfaces have grown in size without however, having shade protection or being carefully oriented as the selection of orientation was mainly based on morphological criteria design. In this context,

	there is a major problem of lighting and, above all, overheating, even during the sunny winter days.

Typologies and materials

In the school buildings constructed before 1980, a linear arrangement is appeared, where the corridor is cited in the one side and the classes are cited in a row in the other side. Most of the times, the corridors are cited outdoor. In school buildings near and after 1980 the typology is described with internal corridors with classrooms on one or on both sides of the corridors, depending on the building shape. Big openings in one side of every classroom is a constant characteristic through the years and usually is not related with the orientation.

After the stone walls that were the main building material before the 1950, concrete, steel, bricks and wood are the typical materials used. Strong load bearing structure (columns, beams floor slabs, roof slabs) are made from concrete reinforced with steel. The rest of the walls to fill up the structure are made from double brick walls with insulation in the middle after the 1980. Roofs are either flat slabs or inclined slabs with roof tiles. Rarely in older schools have wooden roofs been observed. Finishing layer is usually made by plaster and paint coatings for walls and ceilings for the most common spaces. Floors slabs were usually covered with marble, granite tiles or typical tiles. Openings and windows frames used to be wooden with single glazing and gradually were replaced with aluminium in the late 70s early 80s. Double glazing was introduced in the early and mid 90s in school buildings depending on the region. External doors without glazing are either wooden, metallic or a combination of both.

Spain

Types of School Buildings

Period	***Types***
Before 1981	Plants: 1 or 2 floors + Inclined roof with ceramic tile Type of structure: reinforced concrete Exterior walls: Brick and hollow brick blocks Insulation: None Orientation: Not Specified
Between 1981-2007	Plants: 1 or 2 floors + Tilted roof with forging finished with ceramic tile Type of structure: reinforced concrete Exterior walls: Brick and hollow brick blocks Insulation: Projected Polyurethane Orientation: Not Specified
Between 2007-2014	Floors: 2 or 3 floors + Flat roof with unidirectional pavement Type of structure: reinforced concrete Exterior walls: Brick, chamber and hollow brick blocks Insulation: Extruded Polystyrene (XPS) and Projected Polyurethane Orientation: Not Specified
After 2014	Plants: 2 or 3 floors + Deck plant Type structure: Reinforced concrete Outside walls: Brick and concrete blocks Isolation: Mineral wool Orientation: South – West

Comments

It is important to know if building is a historical building

Energy Indicators by the Type of the School

Types	***Energy Indicator (kwh/m²)***
Kindergarten (9 a.m. to 5 p.m.)	Electricity: Fluorescent light = 0,104 kWh / m² Led lighting = 0,04 kWh / m² Driving force = 0,12 kWh / m² Heating: Heating (radiators) = 0,52 kWh / m² Ventilation (air treatment) = 0,456 kWh / m² Thermal Installation (heating + Air treatment = 0,976 kWh / m² 1 Line (3 IE) Surface useful spaces 270 m2 2 Line (6 IE) Surface useful spaces 551 m2 3 Line (9 IE) Surface useful spaces 834 m2
Primary school center (9 a.m. to 5 p.m.)	1 Line (6 PE) Surface useful spaces 1.034 m2 2 Line (12 PE) Surface useful spaces 1.563 m2 3 Line (18 PE) Surface useful spaces 2.024 m2
Primary school center and Kindergarten (9 a.m. to 5 p.m.)	1 Line (3 IE + 6 PE) Surface useful spaces 1.280 m2 2 Line (6 IE + 12 PE) Surface useful spaces 2.023 m2 3 Line (9 IE + 18 PE) Surface useful spaces 2.698 m2

Comments:

Order of May 15, 1992, from the Ministry of Culture, Education and Science, approving the needs programs for the drafting of projects in the construction of Kindergarten centers (Annex I), primary education centers (Annex II) and primary education and Kindergarten centers. (Annex III), owned by the Generalitat Valenciana.

ELECTRICITY:

Fluorescent light = 13 W / m²
Led lighting = 5 W / m²
Driving force = 15 W / m²

HEATING:

Heating (radiators) = 65 W / m²
Ventilation (air treatment) = 57 W / m²
Thermal Installation (heating + Air treatment = 122 W / m²

Croatia

Types of School Buildings

Period	***Types***
'60s (1968.)	2 floors, Reinforced Concrete structure, no insulation **(Bol Elementary School)**
'80s (1988.)	2 floors, Reinforced Concrete structure, styrofoam insulation **(Visoka Elementary School)**
70s (1978.)	1 floor, Reinforced Concrete structure, styrofoam insulation **(Trstenik Elementary School)**
'80s (1983.)	1 floor, Reinforced Concrete structure, no insulation **(Gripe Elementary School)**
'70s (1976.)	2 floors, Reinforced Concrete structure, aerated concrete, no insulation **(Kman Kocunar Elementary School)**

Comments

All the data was collected from available technical documentation for specified buildings (elementary schools).

Energy Indicators by the Type of the School

Types	***Energy Indicator (kWh/m2)***
Bol Elementary school	Electric energy: 16,76
	Fuel Oil Extra Light: 56,11
Visoka Elementary school	Electric energy: 18,46
	Fuel Oil Extra Light: 15,53
Trstenik Elementary school	Electric energy: 32,79
	Fuel Oil Extra Light: 110,22
Gripe Elementary school	Electric energy: 23,32
	*Fuel Oil Extra Light: 49,69****
Kman - Kocunar Elementary school	Electric energy: 16,50
	Fuel Oil Extra Light: 45,29

Comments

All the data was collected from available technical documentation for specified buildings (elementary schools). Energy indicators are calculated for energy consumption in 2016.

****Energy indicator is calculated for energy consumption of fuel oil extra light in 2009.*

Cyprus

Period	***Types***
Before 2007	Description 1-2 floors, reinforced concrete structure, flat concrete roof or inclined roof with tiles, brick walls, no insulation, single or double glazing with aluminum frame Energy characteristics Walls 1,42 W/m2K, roof 3,20 W/m2K, door/windows 6,05 W/m2K floor 2,00 W/m2K
2007-2009	Description 1-3 floors, reinforced concrete structure, flat concrete roof or inclined roof with tiles, brick walls, envelope thermal insulation 3-5 cm, double glazing with aluminum or u-pvc frame Energy characteristics Walls 0,85 W/m2K, roof 0,75 W/m2K, windows 3,8 W/m2K, floor in covered and non air-conditioned space 2,0W/ m2K
2010-2013	Description 1-3 floors, reinforced concrete structure, flat concrete roof or inclined roof with tiles, brick walls, envelope thermal insulation 5 cm, double glazing with aluminum or u-pvc frame Energy characteristics At least B+ on EPC, walls 0,85 W/m2K, roof 0,75 W/m2K, windows 3,8 W/m2K, floor in covered and non air-conditioned space 2,0W/m2K, U mean 1,3W/m2K (residential buildings) and 1,8W/m2K (nonresidential buildings), solar heater for DHW, provision for electricity production by RES systems
2014-2016	

	Description 1-3 floors, reinforced concrete structure, flat concrete roof or inclined roof with tiles, brick walls, envelope thermal insulation 5-8 cm, double glazing with aluminium and thermal brake or u-pvc frame Energy characteristics At least B+ on EPC, walls 0,72 W/m2K, roof 0,63 W/m2K, windows 3,23 W/m2K, floor in covered and non air-conditioned space 2,0W/m2K, U mean 1,3W/m2K (residential buildings) and 1,8W/m2K (nonresidential buildings), shading factor 0,63, solar heater for DHW, provision for electricity production by RES systems, at least 3% of total primary energy consumption must be produced by RES for nonresidential buildings
2017	Description 1-3 floors, reinforced concrete structure, flat concrete roof or inclined roof with tiles, brick walls, envelope thermal insulation 8-10 cm, double glazing with aluminum and thermal brake or u-pvc frame Energy characteristics At least B+ on EPC, walls 0,4 W/m2K, roof 0,4 W/m2K, windows 2,9 W/m2K, shading factor 0,63, maximum installed lighting power capacity in offices 10W/m2,) at least 25% of the total primary energy consumption must be produced by RES for residential detached buildings, for building blocks used as residential buildings at least 3% of total primary energy consumption must be produced by RES, at least 7% of total primary energy consumption must be produced by RES for nonresidential buildings

Comments

Before 2007 no national regulation was in place regarding insulation and energy efficiency of buildings. Thus, the energy characteristics provided for the period before 2007 are the typical ones for the buildings constructed in Cyprus during these years. In 2007 the levels of minimum energy performance requirements were calculated and are revised over the year

Energy Indicators by the Type of the School

Tipes	**Energy Indicator (kWh/m^2)**

Elementary schools	5.7 GWh/year, mean energy consumption 11,280 Kwh/year
High Schools	17.2 GWh/year, mean energy consumption 20,590 Kwh/year
Universities	10.6 GWh/year, mean energy consumption 61.270 Kwh/year
Other education, institution etc.	6.9 GWh/year, mean energy consumption 6,600 Kwh/year

Bosnia and Hercegovina

Types of School Buildings

General characteristics of schools built before 1990 show design solutions that are not the state of art, a lower level of construction quality, insufficient maintenance and technically inefficient use of heating and cooling systems. Schools are characterized by a large number of users and their frequency. The services of these organizations are more oriented towards maintaining the basic functions (education of students, maintenance of existing energy system) facilities. The users themselves (students) use these systems very inefficient (usually the temperature control is done by opening the windows and not by controlling the valves in heating systems).

School buildings constructed until 1960s are monolithic blocks, and are distinguished by their monotony, monumentality and additions of almost "brutal" architecture. Such construction enables the creating functional areas of the school building. The emphasis on functionalism (classrooms, corridors and Administration's supporting facilities) of this housing concept, going so far as to give them the label "Dormitory": buildings where there is a lack of resting space, outside the curricular activities and cultural events.

Dealing with modernist architecture constructed during the 70s and 80s, school buildings from the time of construction, belonging to the situation of rapid modernization up to that time, mostly lagged behind, rural region, encouraged and supported the needs of the urban transformation of the former Yugoslavia, which was building a cultivated variety of architectural school. The material conditions were improved, and in particular are starting to use new materials and new construction composition.

Typology of a more modern construction after 90s is painted as a natural intervention, ie. a solution that combines internal and external spaces through the use of external texture and ports which corresponds functionally and a variety of programming needs of teaching. In these facilities, it is taken into account the composition of the facade

and given a sense of belonging to the students of the school. The front (the existence of the main school square) is the integration of complex buildings, grounds, and the fence gives a gesture of linking different parts of the school and insulation space.

Analysis of the current state of energy properties of the object, that is, the characteristic of major building components of the facility include: exterior wall, floor on the ground, ceiling towards the unheated attic, construction between the floors, external openings - windows and doors.

External walls - for a specific typology of school buildings, the composition of the layers of the construction element is defined (brick, reinforced concrete ring beams, plasters, insulation), the thickness of individual layer [cm], and for a detailed review of the energy and heat transfer coefficient [W / m2K.

Floor on the ground . Depending on the purpose of the room the topcoat is applied from the floor ceramics, wood trim or laminate flooring. A poor characteristic can be a lack of the thermal insulation layer, also in the construction between the floors and ceiling towards the unheated attic

External openings - openings with wooden frames with single or double glass. Due to the deterioration, they are poor thermal characteristics and as a result cause large losses of heat. For school object some of the construction characteristics of the overlap, and can be classified into two main periods:

A massive structural system of walls of hollow brick, thickness 25 and 38 cm, plastered on both sides, only the horizontal reinforced concrete ring beams are characteristic to the period of construction of the school buildings from 1945 to 1960. Construction between the floors is made of reinforced concrete slabs. During this period, the layer had no thermal insulation. The windows and balcony doors are double, wooden wings which have two ordinary single glass. The buildings have unheated spaces. There are large surface heat losses in the position of all the windows, at the construction between the floors and ceiling towards the unheated attic.

For the construction period from 1971 to 1980 of the school buildings, the building is a compact square base with a flat walk-trough roof. It is characterized by massive structural system, the walls of 25 cm in both directions from the hollow bricks with a vertical reinforced concrete ring beam, while the outer walls are more massive, 38 cm and both sides were plastered. Construction between the floors is filled with reinforced concrete slabs, and emerges as half-montage, the filling of the hollow blocks. During this period, thermal insulation appears only in the roof, from 3 to 5cm thicknesses. The windows and balcony doors are double wooden jointed wings with two ordinary single glass. The buildings have unheated spaces; staircases and basement rooms. The larger line of heat loss is in the existing windows in the upper frame zone and balconies.

Energy Indicators by the Type of the School

Indicators of energy efficiency in general are indicators which will help to show how something is more energy efficient than the other. Indicators of energy efficiency can be collective (e.g. the total energy consumption per device) or non-collective (e.g. The average consumption of heating per surface). In general, energy efficiency intensity indicators represent it as the ratio of energy consumption (measured in units of energy) and the activity data (measured in physical units): energy efficiency = power consumption / activity.

Various indicators are used for different purposes and interests in building construction, and the choice itself depends on the needs of the user.

Analyzes of specific energy consumption (SEC), measured in kWh / m2 is an indicator of general purpose already commonly in use. However, in its plain form it should not be taken into account the time of use and idle state of building.

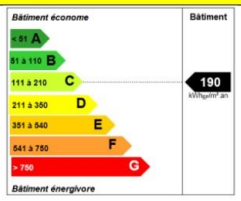
France

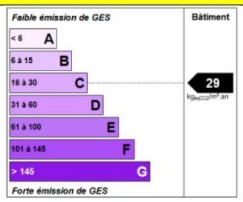
III. Etat du bâti des écoles audité des CFA PACA :

1- CFA DE GAP

Année de construction : 1992
Surface SHON : 4 402 m²

Year of construction



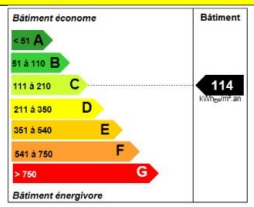


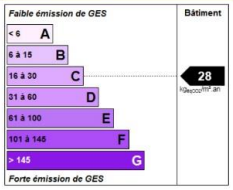
Murs extérieurs external walls		Vitrages glasses	
Wall 1:[U = 0.50 W/m2. K] - 20 cm thick cellular concrete, - Interior cement coating. Wall 2:[U = 0.17 W/m2. K] - 20 cm thick cellular concrete, - External cement coating, - Expanded polystyrene (13 cm)		Glazing 1:[Uw = 3.70 W/m2. K] -Double glazing 4/6/4. -Metal joinery. Glazing 2:[Uw = 4.60 W/m2. K] - Single-glazing, - Metal joinery.	Workshop doors : [Uw = 4.60 W/m2. K] [Uw = 2.25 W/m2. K] - Single-glazing, - Metal and PVC joinery.
Planchers bas low floors		***Planchers hauts*** high floors	
Low floors on the ground floor:[U = 2.94 W/m2. K] - Low floors are not insulated. - 18 cm concrete slab.		Workshops : [U = 1.30 W/m2. K] - Metal supporting structure, - Steel tank high floors, - Polyurethane inner plates. Hairdressing salon: [U= 0.13 W/m2. K] - Single-glazing, - Metal joinery.	Food building 1 : [U = 0.52 W/m2. K] - Concrete slab of 20 cm, - 5 cm polyurethane, - Gravel. Food building 2 : [U= 0.13 W/m2. K] - tiles, - Insulation with 12 cm of glass

2- CFA d'Avignon

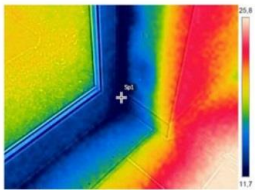
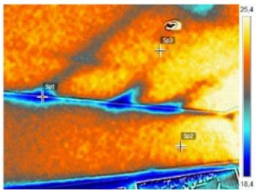
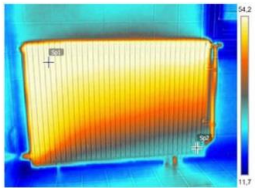
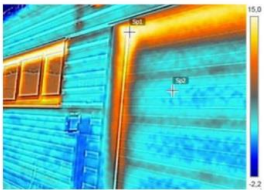
Année de construction : ~1980
Surface SHON : 2003 m²

Year of construction



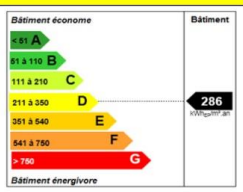


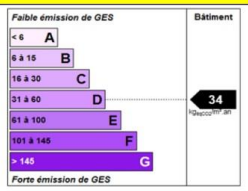
Murs extérieurs external walls		Vitrages glasses	
Wall 1:[U = 0.22 W/m2. K] - Solid concrete of 30 cm, - 10 cm outdoor polystyrene, - Coating - internal cement. Wall 2:[U = 0.17 W/m2. K] - 25 cm cellular concrete, - Expanded polystyrene (13 CM).	Wall 3:[U = 1.43 W/m2. K] - The walls are not insulated. Wall 4:[U = 0 W/m2. K] - Aerated concrete wall, - Non-water-repellent walls, - Walls in contact with LC.	Glazing 1:[Uw = 4.65 W/m2. K] - Single-glazing, - Aluminium roller shutters, - Aluminium carpentry. Glazing 2:[Uw = 3.70 W/m2. K] - Double glazing 4/6/4, - Aluminium roller shutters - Aluminium joinery	Glazing 3:[Uw = 2.25 W/m2. K] - Double glazing 4/16/4, - PVC roller shutters, - PVC carpentry. Glazing 4:[Uw = 5.70 W/m2. K] -Single glazing, -Metal joinery.
Planchers bas low floors		***Planchers hauts*** high floors	
Low floors on the ground floor:[U = 2.94 W/m2. K] - Low floors are not insulated. - Concrete slab of 20 cm.		Ph 1:[U = 1.22 W/m2. K] - High floors are poorly insulated, - Steel tank high floors, - Bitumen exterior coating (waterproofing) -Polyurethane inner plates.	Ph 2 : [U = 0,52 W/m2. K] - Dalle béton de 20 cm, - Polyuréthane de 5 cm, - Gravillon.

3- CFA des Arcs

Year of construction: 1974 (A, B, C, D, E, G, H), 1998 (Building F), 2014 (modular)
SHON surface area: 3,369 m2





Murs extérieurs external walls

Wall 1:[U = 0.47 W/m2. K]
- Solid concrete 20 cm thick,
- Coating - external cement.

Wall 2:[U = 0.15 W/m2. K]
- Solid concrete 25 cm thick,
- External cement coating,
- Expanded polystyrene (11 CM).

Wall 3:[U = 1.14 W/m2. K]
- Wooden structure (obsolete)
- Uninsulated walls.

Wall 4:[U = 0.10 W/m2. K]
- Walls made of sandwich panels,
- Insulation (10 cm of rock wool)

Vitrages glasses

Glazing 1:[Uw = 2.25 W/m2. K]
- Double glazing 4/16/4.
- PVC roller shutters,
- Thermal bridge switches,
- PVC carpentry.

Glazing 2:[Uw = 3.50 W/m2. K]
- Double glazing 4/12/4,
- Woodwork.

Glazing 3:[Uw = 3.70 W/m2. K]
- Double glazing 4/6/4,
- Metal joinery.

Glazing 4:[Uw = 4.90 W/m2. K]
- Single-glazing.
- Woodwork woodwork

Planchers bas low floors

Low floors 1[U = 3.24 W/m2. K]
- Low floors are not insulated,
- 10 cm wooden floor (Hypothesis).

Low floors 2[U = 2.74 W/m2. K]
- 22 cm concrete slab.

Planchers hauts high floors

Ph1 :[U = 0.51 W/m2. K]
- High floors in flat roofs,
- Polyurethane exterior insulation,
- Gravel for mechanical protection.

Ph 2:[U= 0.13 W/m2. K]
- Concrete slab of 20 cm,
- Insulation underneath (20 cm of

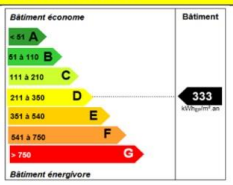
Ph3:[U = 0.72 W/m2. K]
- The high floors are insulated.
- High wooden floors,

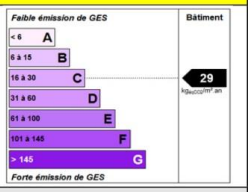
Ph3:[U = 1.25 W/m2. K]
- Metal supporting structure,
- Steel tank high floors,
- Polyurethane inner plates.

4- CFA du Beausset

Year of construction: 1974

SHON surface area: 3,263 m2





Murs extérieurs external walls

Wall 1:[U = 0.45 W/m2. K]
- Hollow concrete 20 cm thick,
- Coating - external cement.
- BA 13 plasterboard inside.

Wall 2:[U = 0.19 W/m2. K]
- Solid concrete 25 cm thick,
- Indoor expanded polystyrene (11 CM).

Wall 3:[U = 0.36 W/m2. K]
- Wooden structure (obsolete)
- Walls made of sandwich panels (5 cm of glass wool).

Wall 4:[U = 0.16 W/m2. K]
- Hollow concrete walls,
- Insulation (10 cm of polystyrene),
- Interior plasterboard.

Vitrages glasses

Glazing 1:[Uw = 2.10 W/m2. K]
- Double glazing 4/16/4,
- PVC carpentry.

Glazing 2:[Uw = 1.8 W/m2. K]
- Double glazing 4/16/4.
- Thermal bridge switches,
- Aluminium carpentry.

Glazing 3:[Uw = 3.70 W/m2. K]
- Double glazing 4/6/4.
- Metal joinery.

Glazing 4:[Uw = 4.90 W/m2. K]
- Single-glazing.
- Woodwork woodwork

Planchers bas low floors

Low floors 1[U = 3.24 W/m2. K]
- Low floors are not insulated,
- 10 cm wooden floor (Hypothesis).

Low floors 2[U = 3.10 W/m2. K]
- Low floors are not insulated.
- Non-insulated solid concrete floor.

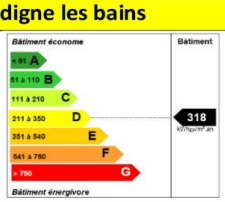
Planchers hauts high floors

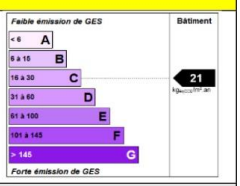
Ph1 :[U = 0.28W/m2. K]
- High floors in flat roofs,
- Polyurethane exterior insulation (15 cm hypothesis)
- Gravel.

Ph2:[U = 0.38W/m2. K]
- High wooden floors,
- Insulation of 15 cm of glass wool on the underside.

1- CFA de digne les bains

Year of construction: ~1977
SHON surface area: 8 117 m2





Murs extérieurs external walls

Wall : U = 0.22 - 1.85 W/m2. K] (20 different typologies)

Vitrages glasses

Wall : U = 0.22 - 1.85 W/m2. K] (20 different typologies)

Planchers bas low floors

Low floors : [U = 1.55 -2.74 W/m2. K]

Planchers hauts high floors

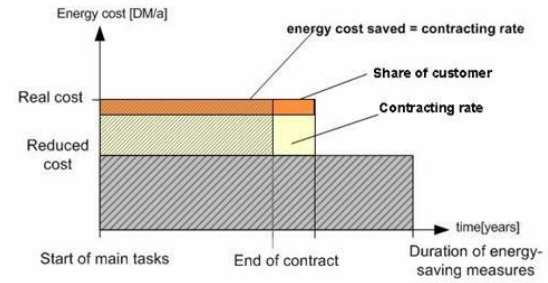
High floors : [U = 0.15 - 0.38 W/m2. K] [8 different typologies]

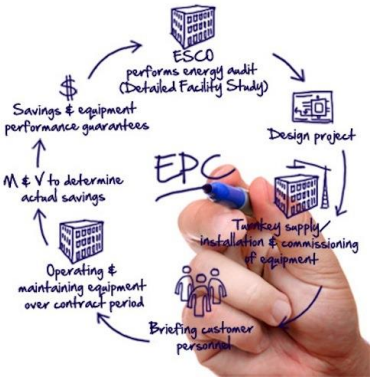
FINANCING MECHANISM IN PARTNER COUNTRIES

Italy

There are several important instruments that should be used in the field of public buildings management included:

- **energy certification (APE):** Knowledge of public assets and the services offered is indispensable for preparing the energy balances, proposing solutions, measuring results, and, based on this, securing access to incentivizing mechanisms.
- **energy audits and monitoring:** The energy accounting is decisive both for the possibility of securing third-party financing, and to optimize the management of energy consumption.
- **energy manager:** Energy Manager(Art. 19 of Italian Law 10/91) provide and ensure energy efficiency and saving within its institution and take care of a functioning energy management system. He is fundamental for implementing effective action
- **ISO 50001 Energy Management System (EMS):** ISO 50001 is based on the management system model of continual improvement also used for other well-known standards such as ISO 9001 or ISO 14001. This makes it easier for organizations to integrate energy management into their overall efforts to improve quality and environmental management.
- **Energy Performance Contracts (EPC) and third-party financing**: These allow energy renovation of buildings in the absence of the financial resources requested for the necessary investments.





- **Green Public Procurement (GPP) and LCCA** Energy-efficiency combines together with environmental aspects and with the exact assessment of investments in their entire life cycle including therefore also service and maintenance costs

- **Incentives**

The main incentives used by Local Authorities in Italy are:

- **Thermal account (Conto termico)**
  Thermal Account encourages interventions to increase energy efficiency and the production of thermal energy from renewable sources for small systems. By applying this incentive it is possible to refurbish buildings to improve their energy performance, thus reducing consumption costs and quickly recovering part of the expenditure incurred. The "conto termico" subsidy has an average coverage between 30% and 40%, till 65% if applied to nZEB renovation, of the expenses incurred for the energy efficiency investment. It is especially designed for the Public Administration and it is allocated over 2 or 5 years. Beneficiaries will be able to access funds for € 900 million per year. The beneficiaries of the Thermal Account are individuals, condominium companies, public administrations and ESCo (Energy Service Company), or engineering companies that carry out interventions on behalf of third parties in compliance with UNI CEI 11352 standard. The incentive includes both the repayment of individual energy improvement measures and the repayment of complex actions, such as the refurbishment in nZEB class. To obtain the incentive it is mandatory, among other things, to carry out an energy audit in accordance with ISO 16247 standards.
- **Regional incentives**
  Many Italian regions publish regional calls (usually called POR-FESR - plans for regional development) to support public and private sectors to improve the efficiency of various buildings (condominiums, public buildings, school buildings and public administration offices). The calls make available an annual budget, which is assigned after evaluating and scoring different proposals. A ranking of the best projects is created and these are financed until all the economic resources are exhausted. In Emilia Romagna region, as an example, the tender provides grants equal to 40% of the total investment, up to a maximum of 500.000 € for energy efficiency measures. The great advantage of regional calls is that they can be combined with national incentives, so even with the Thermal Account: if we consider, for a building refurbished in nZEB class, 65% of the

latter, added to the regional 40%, the entire expenditure (maximum 100%) is covered by public funding.

Greece

There are 5 identified types of financing models for EE projects as:

1. **Own (budget) financing:**

Reliance on transfers from other levels of government also exposes municipalities to the risk that permitted levels and uses of funds may be affected by changes in national budgetary or political priorities. One of the financing challenges facing municipalities, more often for smaller municipalities rather than larger ones is the insufficient revenue base with which to fund projects (not only EE projects, but also other development projects as well).

An insufficient revenue base, which may be the result of a small number of tax-paying commercial businesses and/or high-income residents, can reduce the availability of adequate funds for capital investments.

2. **Credit (loan) financing**

Such credit lines are often provided by national or international development banks (such as European Investment Bank (EIB) and European Bank for Reconstruction and Development (EBRD) and are further distributed to designated markets through regional partner retail banks.

3. **ESCO model**

ESCOs are companies that work on a basis of energy performance contracts (EPC). In an energy EPC arrangement, the ESCO is responsible for optimizing building services systems and system operations in existing buildings across all branches of construction and maintenance. The main service provided by the ESCO is a guaranteed level of savings over a defined period.

4. **PPP model**

In a PPP arrangement the public and private sectors collaborate to deliver public infrastructure projects. They require detailed project preparation and planning, proper management of the procurement phase to incentivise competition among bidders. They also require careful contract design to set service standards, allocate risks and reach an acceptable balance between commercial risks and returns.
The rationale for using a PPP arrangement instead of conventional public procurement rests on the proposition that optimal risk sharing with the private partner delivers better “value for money” for the public sector and ultimately the end user.

5. **Subsidies (grants)**

Most of available grant schemes are based on the use of European Union structural and investment funds (ESI). EE projects in buildings belong to projects that generate net income after completion, i.e. the energy cost savings of the project are treated as net income.

In the financing mechanics applied in Greece, it can be observed that having own financing is not available but the acceptability to have one is positive. The Greeks preferred to have this model of financing than other one. If we talk about loan financing and grants, Greece has as much availability as much acceptability but their percentage of interest rate is between 3.00 to 5.00 rate with duration of 5-7 year for loan financing, and 100% for grant rate. On the other hand, transferring this information related to ESCO model, there is availability, but, not acceptability and for the PPP model, there is no case for both of them and no preferences for financials models too.

To conclude, all schools have solid repayment period, with exception of school 1ST JUNIOR HIGH SCHOOL OF VOULA. Due to budget limitations and restrictions to increasing public debt, we recommend using ESCO model. It is also very desirable to combine with some form of subsidy. 1ST JUNIOR HIGH SCHOOL OF VOULA needs 81% of subsidy to breakeven. Other schools need 60-70 % to be feasible.

Below, it is presented the cost of nZEB renovation and feasibility of such renovation expressed with simple pay-back period for Greece.

- The average specific investment cost in nZEB renovation is over 50.00€/m2
- The average specific annual energy cost saving is lower than 5.00 €/m2
- The average simple pay-back is between 20.00-30.00 period of years
- The average specific energy saving is a little bit over than 20.00 kWh/m2
- The average energy saving is less than 200%
- The average energy price is more than 0.10 €/kWh

There are different measures proposed for improvement of heating systems and the selection of these measures significantly influences the costs of renovation with average specific cost of 2,80 €/m^2 of a Greek building floor area and in Greece there is a proposal installation of geothermal heat pumps is envisaged with average of specific cost of 17,50 €/m2 of a building floor area, respectively.

Spain

At Spain national level, there are two financing mechanism. On the one hand, a funding Programme to Improve the Energy Efficiency of Existing Buildings (PAREER - CRECE Programme). It's second phase, PAREER-II was launched in 2018 and implemented by Spanish National EE Fund. Grant amounting to 30-90% of eligible investments are available to public and private bodies, with total allocated a budget of EUR 125,658,000. [9] On the other hand, The Low Carbon Economy Program is aimed at public organizations and is the only financing mechanism created with a clear intention to improve the energy performance of the public buildings. The institution responsible for disbursment is the IDAE (Instituto para la Diversificación y Ahorro de la Energía which depends on Spanish Ministry of Energy, Tourism and Industry), the funds are European (ERDF funds) and the maximum grant amounting is 50%. The total budget have been changed along the years, the last actualisation fixed a total budget for the Region of Valencia of 120.503.322 €.

Autonomous Community of Valencia (regional government) runs an EE programme for buildings through which it is possible to obtain up to 40% of grant for EE investments in non-residential public or private buildings. Valencia also runs the programme Edificant, aimed at improvement of educational centres, but in a general meaning, not regarding the improvement of the energy performance of the building. EUR 700 million are available in period 2018-2022 for building more than 200 schools and institutes and for renovating another 500.

Name	**Name of institution responsible for disbursement**	**Source of funds**	**Total budget (EUR)**	**Grant amounting (%)**	**Who is eligible for applying**

[9] Source: 4th National Energy Efficiency plan, avaialble at: https://ec.europa.eu/energy/sites/ener/files/documents/es_neeap_2017_en.pdf (accessed 16/05/2018)

PAREER II	IDAE	Spanish National Energy Efficiency Fund	125,658.00	30-90	Existing Buildings
Low Carbon Economy Programme	IDAE	EU funds	120,503.322€	50	Public organizations
EE programme for buildings	IVACE	EU (ERDF funds)	500,000 €/year	40	Non-residential public or private buildings
Edificant	Valencia Ministry of Education	Regional funds	700 M€	100	Educational centres

Croatia

So far, investors in Croatia have mostly relied on public grants, that is, various forms of subsidized financial instruments. Longer payback periods and very high levels of investment in increasing energy efficiency are the reasons why this form of financial support has been introduced in most EU Member States and has provided investors with a higher level of return on investment. Although financial institutions have developed market models for more favourable lending conditions for energy efficiency projects, the role of the state in this sector remains crucial to the success of their implementation. This is because the Ministry of Construction and Physical Planning has developed energy renovation programs for the four identified uses of buildings (public, commercial, multi-residential buildings and single-family homes). These programs also envisage specific financing models that are joined by existing instruments.

Nacional programs and funds

Public Sector Buildings Energy Renovation Program 2016-2020

The government program envisages the implementation of a MODEL III renewal which provides partial non-reimbursement co-financing from ESI funds, while the beneficiary, depending on the possibilities of securing his own participation, chooses the optimum type of implementation from the following models:

- Contracting the energy service that the service provider (ESCO) commits to implement measures to achieve energy savings in exchange for the compensation paid by the contracting authority from the realized savings
- A financial instrument in the form of a specialized credit facility with a favourable interest rate and deferred payment until completion of the renewal

- Funds from the EU Project Co-financing Fund provided by the MRRFEU to co-finance the implementation of EU projects at regional and local level
- Own funds secured in the applicant's budget.

Energy recovery program for commercial non-residential buildings for the period 2014-2020 with a detailed energy recovery plan for commercial non-residential buildings for the period 2014-2016

The program provides for the co-financing of energy renovation of commercial buildings from the state budget (2014-2015) and the European Regional Development Fund (2016-2020) through the following financial mechanisms:

- Establishment of specific financial instruments with the assistance of the European Union the Regional Development Fund
- Introducing legal obligations for energy suppliers to achieve energy savings for their customers
- Continuous implementation of programs and projects of the Environmental and Energy Efficiency Fund.

The Environmental Protection and Energy Efficiency Fund

The Fund provides systematic technical and administrative support for the implementation of energy renewal programs and conducts educational activities for users from the public and private sectors.

Development banks, funds and credit lines

Croatian Bank for Reconstruction and Development (HBOR)

Preferential loans and guarantees are offered as part of several energy efficiency improvement programs for public and private sector investors.

Croatian Small Business, Innovation and Investment Agency (HAMAG-BICRO)

Financial instruments support investment through loans, guarantees with the ability to combine with interest rate subsidies and for the energy renovation of business facilities.

European Development Banks and Funds (EIB Group, EBRD, European Energy Efficiency Fund, European Strategic Investment Fund)

Direct and indirect preferential loans and guarantees are offered to public and private sector investors for major energy renewal projects.

Technical support programs

European Technical Assistance Programs (ELENA, JASPERS, Horizon2020)

Co-financing and technical support programs for the preparation of major public sector projects.

Cyprus

Financial mechanisms, for energy efficiency renovations in buildings should have a central role in national long-term renovation strategies and be actively promoted. In the case of public school buildings in Cyprus this is even more crucial, as energy efficiency projects are not a priority. The main reasons for proceeding to buildings' renovation are the seismic upgrade, the emergency works and the expansions due to increasing needs. There is also low confidence on investment projects related to energy efficiency in schools, as they have a complicated management structure and in general, have low energy consumption and low occupancy rates, therefore any measure taken is seen as risky and fragmented. Furthermore, there are limited available energy and operations' data, which becomes a barrier in the establishment of a typical energy profile for school buildings. Furthermore, no relative benchmarks are available at national level.

Overall, schools' budgets are managed by the Local Authorities [School Boards or Community Councils], which are responsible for the financial and overall management of the school building. However, the buildings belong to the central government, under the responsibility of the Ministry of Education, Culture, Sports and Youth, which is the body that decides whether a big-scale intervention on the building will take place. The Ministry is responsible for the school's annual budget and grants given to the schools, as well as for meeting the schools' annual financial obligations. The annual budget and the application for a big-scale or emergency projects, is submitted by the School Board in cooperation with the School Advisory Committee which consists of the Principle and other members. At the same time, the Technical Services of the Ministry is the responsible department for the improvement of the school buildings, taking into account any education or technical requirements.

In regards the implementation of energy renovation projects, even if is not directly assessed, the main responsible for making decisions is the Ministry, through the Technical Services. Nonetheless, the School Advisory Committee, in advance, has to declare and sufficiently substantiated the needs of the school. In cooperation with the School Board, the School Advisory Committee, can apply for works needed and if/when the Ministry approves them, the Technical Services are responsible for their implementation.

Is noted that the responsible department for the implementation of energy renovation in public buildings, and the implementation of the EPBD in Cyprus in general, is the Ministry of Energy, Commerce and Industry. In Cyprus emphasis is given to stricter

energy efficiency standards and investments for public buildings to reach their obligations and more specifically, in buildings with the lowest energy efficiency[10].

Over the last decade, financial support for investments in energy efficiency and renewable energy technologies has been made available to Cypriot households, commercial companies and public sector through various government-supported schemes, nonetheless, schools are not included in these, except for an initiative for installing 5 MW of Photovoltaic systems in school buildings[11].

An allocated budget for Energy Efficiency projects in public school buildings is not directly available, but the Technical Services of the Ministry have a budget for maintaining the schools at a good state. By using the results from the energy audits of the schools, potential ways of financing Energy Upgrades of Public school buildings, have been identified but no decision has been taken at political level:

- Own Funding: Use of a proportion of the annual State Budget provided to the Ministry of Education, Culture, Sports and Youth for Energy Efficiency projects in specific. The Ministry of Agriculture, Rural Development and Environment, and the Ministry of Energy, Commerce and Industry can also be involved in this.
- Local Funding: Use of a proportion of the annual budget of the Local Authority [Municipality or Community], where the school is located, to improve the energy efficiency of the schools.
- From Subsides or Incentives: Those can be derived from relevant Incentives or Schemes, i.e. Provided by the Ministry of Energy, Commerce and Industry. At local level, these Subsides are usually deriving from the Structural Funds[12] or from the Special Fund[13] for Renewable Energy and Energy Conservation.
- From ESCOs (Private Money)[14]: Through Energy Performance Contracts and based on the most cost-effective scenarios. Combined measures for energy upgrades of more than one building are necessary to make this investment attractive as currently the majority of the energy upgrades scenarios for school buildings [low consumptions and limited operation], have limited potential for energy savings.

[10] Article 7, directive 2010/31/EE – Adapted in: Cyprus' 'Long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private'.

[11] Specific details are not available yet.

[12] The budget of the relevant Axis of the current Programming Period is closed.

[13] The Fund is financed through the implementation of an energy fee equal to EUR 0.01 cent per kWh on electricity consumption for all final consumers [green taxation]. The Fund is managed by the Special Fund Managing Committee.

[14] The relevant law for ESCOs was adapted in Cyprus in 2014 and until today, only few ESCOs are officially registered, with no available projects for demonstration and validation.

By financing Energy Upgrades of [Public] school buildings it will allow transformational and sustainable change in the education sector, by improving the living conditions of pupils and teachers. Therefore, there is a need to utilize the school's role as an observation and learning space with regards to energy efficiency, environmental consciousness and quality of living conditions.

Bosnia and Herzegovina

In reference to financial mechanisms that provide funds needed for the implementation of energy efficiency projects (EE) in the public sector (including the public education sector), the most frequently used instruments in Bosnia and Herezgovina are: own funding (self-financing), loans (debt-financing) and grants (non-refundable incentives). Public-private partnership (PPP) and Energy Performance Contracting (EPC) as new instruments have only recently entered the Bosnian investment market.

No	Financing Mechanism	Note
1.	Own funding for EE (self-financing)	A frequent financial instrument used in education sector in BiH projects of lower grades. Revolving fund for EE established by the Fund for environmental protection FBIH will raise the level of available funds to Bosnian schools.
2.	**Loans (debt-financing)**	Offered by banks, microcredit organizations and funds.
3.	Grants (non-refundable funding EE incentives) combination with	Grants are the most frequently used instrument for financing projects in education sector in BiH – it is often used in instruments no 1 and 2.
4.	Public-private partnership	Only pioneer cases are registered in the investment market of BiH.
5.	EPC (Energy Performance contracting)	Only beginning steps reached - project announcements; EPC as an instrument has only recently entered the Bosnian investment market.

Other promising financial instruments that can be used to stimulate energy renewal, such as “crowdfunding“ and “on-bill lending”, have not been recorded either in EE projects in the public education sector or in the general public sector in Bosna and Herzegovina.

2.1. Own funding – Self-financing

Self-financing is traditional and still one of the most frequent financial mechanisms in Bosnia and Herzegovina in general, including EE projects in public education sector. Its application is related to the fact that BH school buildings are mostly old (most of them are built in the 1970’s), inadequately maintained and technically outdated. For this reason, and in order to provide normal working conditions, school buildings often require emergency interventions. These projects (that are often actually EE projects) are mostly of lower value, which implies legal possibility of shorter and quicker tendering procedures. They usually include emergency roof repairs, replacement of windows and doors on the facility or replacement of old and non-functional heating systems. As these projects always require quick implementation, school managers or schools founders often decide to quickly invest their own available financial resources to prevent further

devastation of the facility or simply to reach conditions needed for work. Under the usual BH conditions in which financial resources are limited, the practice of using this instrument significantly reduces the level of available funding for EE projects in school facilities. The Federal Revolving Fund for Energy Efficiency established by the Environmental Protection Fund of FBiH will significantly help in overcoming the mentioned problem of insufficient financial resources for energy efficiency projects in public schools in BiH.

2.2. Loans (Debt-financing)

Loans given to founders of public institutions (schools) is a frequent source of financing EE projects in the public/education sector in Bosnia and Herzegovina. Loans are a financial instrument extended by banks, funds and microcredit organisations in BiH. Usage of this instrument doesn't mean that it is the best solutions for schools but is a result of the fact that managers and founders of the schools can't attain other sources of funding for EE and other projects. This can be traced to the fact that taking loans in BiH is an expensive and administratively difficult procedure.

The most frequent financial instruments incorporated into debt-financing (loans) mechanisms for EE projects in the public/education sector in BiH are:

- Bank loans (different types of loans offered by commercial banks)
- Incentives in the form of loans. These loans are offered by Banks specifically for EE projects. They are offered to clients under preferential terms such as longer grace period, longer loan duration and/or lower interest rates. A certain percentage (15-30% for instance) of total loan amount is returned as an incentive to the client after the project is completed. This type of loans in BiH is usually provided by development banks (international or domestic), such as the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD) and the German KfW Development Bank. The funds reach the final beneficiaries through domestic commercial banks.

Examples of Bank loan terms for EE projects in BiH

Note: Mentioned terms of loans given by one of the commercial banks in BiH are similar to terms of others banks. Funds can have different sources, usually EBRD, EIB, KfW.

Example 1: With the support of KfW Development Bank, one commercial bank from Bosnia and Herzegovina has introduced a special type of loan to finance EE projects. Applicants must meet a number of economic and technical criteria to get the loan. The client is refunded up to 20% of the loan value. More favorable terms for loans are provided (longer grace period, duration period). Energy savings must be of 20% or more. Environmental protection from reduced gas emissions and CO_2 is taken

into consideration. Fixed interest rate is 5.00% (EKS 5.53%), depending on the legal status of the applicant.

Example 2: Loan from UNION Banka - the only state-owned commercial bank in BiH and the Environmental Protection Fund FBiH The Environmental Protection Fund FBiH has established a Revolving Fund for Energy Efficiency. Public invitation to applicants is constantly open. The establishment of the Revolving Fund created a better basis for the sustainable financing of EE projects in BiH. The initial fund of this Revolving Fund is 1 (one) million KM. The minimum amount of the loan is 25,000 KM, the maximum amount is one million marks (1 euro = 1,95583 KM). Repayment period is up to seven years, grace period up to 12 months (included in repayment period), fixed interest rate is 2% per annum.

2.3. Grants (non-refundable funding)

Grants for EE projects in schools are widely present and in fact the most common financial instrument in EE projects in Bosnia and Herzegovina. The use of grant funds has for years been the most significant factor in increasing the number and value of energy efficiency projects altogether, and especially in schools in BiH. These funds usually come from international sources (EBRD, funds, programs, development organizations, government and non-governmental organizations of many countries ...) and are usually combined with other mechanisms such as self-financing and loans. In BiH, dozens of EE projects have already been implemented in schools through the use of grant funds. (For example, "*The WeBSEFF II credit line finances two credit lines, several incentive bonuses (grants), loans and incentive bonuses for private companies, as well as loans and incentive bonuses for local authorities*"; available at https://topaodom.ba/kako/financirajte-projekt/posebni-dostupni-krediti-fondovi/, viewed on 24/07/19).

2.4. PPP (Public Private Partnership) and EPC (Energy Performance Contracting)

New, innovative financial models for energy efficiency projects that would surely help overcome the limited capacity of BH local communities to implement EE projects and limited access to capital, including the most important – public-private partnership (PPP) and energy performance contracting (EPC), are only now emerging on the BH investment market. Cantons and entities are adopting basic strategic documents needed to initiate such projects, prepare databases, project catalogs, etc., or are still working on subordinate and implementing documents. A few pilot projects have also begun in the area of education but the PPP can not yet be considered a standard practice in BiH for energy efficiency projects in schools. Significant advances in the use of financial mechanisms that are not part of the usual financial models in BiH (such as JPP, EPC and ESCO companies that do not exist or are struggling to enter the market due to unclear regulation) are certainly models of the future and need to be introduced to the BH investment market and specifically to investors of EE projects in the BH school system.

France

The energy renovation of a tertiary building can benefit from 2 types of support:

1- Energy saving certificates (CEE) :

Energy saving certificates are a national system that obliges energy sellers (electricity, gas, fuel oil and fuel sellers) to save energy. To this end, these so-called "obligated" operators can carry out operations to encourage their customers to make savings or directly purchase certificates obtained by other so-called "non-obligated" operators.

For project owners, it is thus possible, when carrying out energy improvement works (insulation, boiler replacement, etc.), to negotiate (on the market for local authorities or directly) with an obliged operator the transfer of energy saving certificates.

Many improvement actions promoting energy savings can be promoted in the form of "energy saving certificates" (see standardised sheets available on the website (https://www.ecologique-solidaire.gouv.fr/dispositif-des-certificats-deconomies-denergiel). For each action, a quantity of energy is defined that will be saved thanks to this action and is expressed in kWhcumac (kWh accumulated and updated over the conventional lifetime of the equipment).

Example: Installation of 100 m² of insulation from the inside in a school located in the H1 climatic zone:

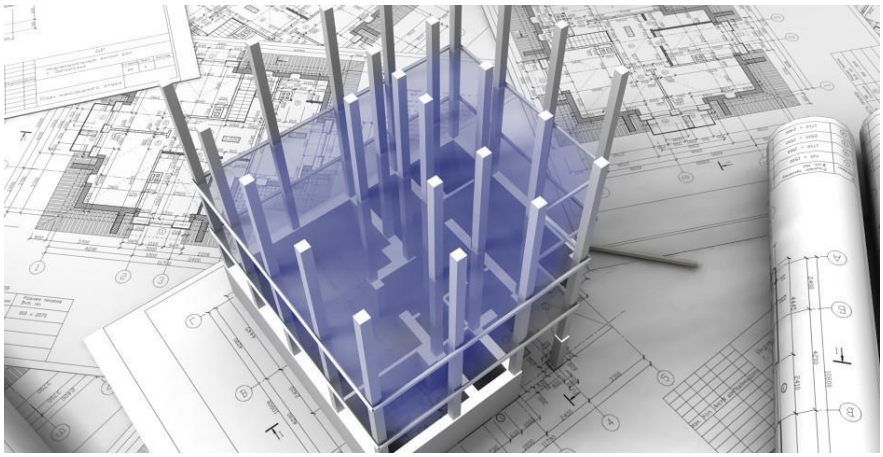
366,000 kWh cumulative or €733.

The selling price of energy saving certificates is subject to variations.

The EWC application must be submitted no later than one year after the work has been carried out. The national register of energy saving certificates (accessible on the emmy.fr website) is the materialization of the energy saving certificates issued by the national centre. The website provides access to lists of certificate buyers and sellers.

2- Support from local authorities

Each community, depending on the size of its tertiary fleet and the energy conservation plan it has put in place, can contribute to thermal renovation projects. This aid, which is not systematic, depends strongly on the nature of the project and the community's policy.



METHODOLOGY OF CONSULTATION ADOPTED IN THE PROJECT

The TEESCHOOLS project has adopted an active and participatory consultation methodology through different formats:

WORLD CAFÈ

The aim has been to bring together experts, local authorities and technicians and give rise to innovative reflection using a natural process on energy efficiency issues in schools. World cafè was organized locally in all the countries of the project.

REGIONAL CONFERENCE

Regional Conferences are communication events where the findings and results of the TEESCHOOLS project have been given to several actors. In these conferences, local authorities, technicians and staff of schools exchange experiences through a participatory learning.

PHONE ASSISTED INTERVIEW

In phone interviews, experts and stakeholders have given their point of view, approaches and methods in the field of the energy efficiency.

PARTNERS DAILY WORK EXPERIENCE

One of the most important assets of the TEESCHOOLS project is the experiences of the partners involving. Technical partners are relevant entities in their countries on the field of energy efficiency where them recognize methodologies worth.

This daily word experience of the partners adds value to the different activities and results of this European project.

OUTCOMES: WEAK POINTS

This section is analyzed from the following points:

Financing, incentives and fares (including payback period)

Technical

Changing behaviour

Organizational

Italy

Often the use of national and regional incentives by the Municipalities (owners of the schools) is not favored for several reasons hereafter outlined:

- **Budget restriction for LA, problems in doing debts**

  Although in Italy there are valid incentive systems, local administrations face overwhelming impediments to make energy efficiency interventions. Apart from non-repayable incentives, it is very difficult for local authorities use any of the other tools made available by the State to incentivize energy efficiency and renewable sources for a number of reasons

  I. LA do not have own resources: over the years, state contributions to the Italian municipalities have been significantly reduced and local taxes cannot be increased because they are regulated by state laws. The few resources collected by the Municipalities are used to pay current expenditure (personnel, road maintenance, green area maintenance, bills, etc.) and cannot be diverted for investments.
  II. The Municipalities cannot take resources from the Cassa Depositi e Prestiti or from the conventional financial sector due first of all to the Stability Pact and then to the 2016 Stability Law which on the one hand it has eliminated the internal stability pact, but on the other it has introduced some other obligation on the municipal budget which make very difficult for municipalities to contract a mortgage.
  III. Even if the intervention leads to a guaranteed energy saving with a bank guarantee from the contractor superior to the mortgage payment, the law prohibits indebtedness. The penalties for those administrations that

exceed a balanced budget have been considerably tightened, going to act on the appropriations of the following years.

For this reason several funds introduced by State or Regions in these years were not used at their full potential. For regional calls based on mortgages or loans to Municipalities many administrations withdraw when they realize that the funding is not forfeited. The impossibility of finding resources in the budget and the impossibility of indebtedness also impacts on the ability of Municipalities to access the Thermal Account , even in the version that provides a 65% non-repayable loan: the instrument is not fully usable as the incentives are deferred in five years and at best the GSE manages to anticipate only 2/5 of the contribution in advance. In this case the Municipality must in fact recover at least 74% of the resources using the mortgage or its own resources.

- **Complexity of technical procedures for applying for financial incentives, LA understaffed**

Incompatibility of some solutions (eg. Public Private Partnership (PPP)) with the public procurement code. Only recently the Italian legislator, implementing the aforementioned Directive CE/32/06, through Legislative Decree 115/2008, introduced (or better translated) the normative notion of the EPC contract.
The EPC, therefore, is an atypical contract, since it lacks a complete legislative discipline. The formation of the energy efficiency contract therefore represents a delicate phase, implying not only the precise definition of the relationship among parts (the exact regulation of the roles, responsibilities, risks and benefits of the transaction, of the guarantees , also through clauses aimed at spreading and mitigating the risks inherent in the intervention), but also the assessment of technical and economic - financial aspects of the actual intervention, based on studies of the technical and economic feasibility of the project. It is not always simple therefore a clear allocation of responsibilities between administrations and financing.

- **Lack of technical advice and lack of internal skills** that can follow the necessary administrative practices, determine what actions can be undertaken and prioritize them. It is difficult for these reasons to carry out long-term interventions characterized by a better cost-effectiveness ratio.
- **Complexity of the ownership**:

In Italy owners of school buildings are in general Municipalities and Provinces. Users of buildings (school directions) are not the owners of the structures and they do not have direct means to improve the situation of their building: they do not pay for heating expenses nor have any economic advantage form energy saving, but on the other side students and school workers are the ones which

suffers for no comfortable indoor conditions. This situation can lead to a sense of powerlessness instead of pushing for behavioral change. Moreover re-qualification of secondary schools are assigned to the provinces whose programming in general does not take into account real consumption levels but it is driven by emergencies

- **nZEB: payback period is too long with the actual incentives**

  As emerged also by pilot activities, payback period of energy refurbischment towards nZEB , based on existing incentives, is very long and do not stimulate actions in this direction.

Greece

a. Financing, incentives and fares(including payback period)

The major weak point of Greece in implementing energy efficiency projects is the lack of funds. Especially after the economic crisis of the last decade, financing big and expensive projects became even harder. Apart from this, financing methods such as PPP and ESCO models are not yet mature in Greece to be used in building energy renovation projects. Financial institutions are not interested enough or they do not have enough confidence to energy projects in order to invest on them. On the other hand, mild climate of Greece in combination with the mostly morning hours school operation results in high payback periods for insulating or heating system replacement renovations. The combination of the above means that energy efficiency projects in public buildings like schools can be currently funded only by public, national or European funds if and when they become available for the specific purpose.

b. Technical

On the technical aspect there is a weak point that concerns the municipalities and their staff. Although all public entities in Greece are required to have an energy manager at every public building these personnel is oftenunder qualifiedfor the position tasks that include proposition of energy saving measures in the buildings. In addition, the employees in the technical department of the municipalities that are responsible for the general management of the municipality buildings and schools are also not trained to evaluate, coordinate or even supervise energy efficiency projects. As a result, when feasibility studies or energy audits need to be conducted for the participation of public buildings in energy efficiency projects external expertise is always required. This costs even more money and also time making the

submission for energy efficiency funding programs more difficult to decide by the administration.

c. Changing behaviour

Raising the environmental awareness of children must begin early at school, where children are socialised, shaping viewpoints and behaviours, setting the foundation for their future life. Teachers, parents and schools are small communities that have the ability to contribute to more suitable behavior of young generations regarding energy and the environment.

Doing some small things can make a big difference to the energy consumption and the energy bills, for example, if we follow the next steps, as see how much energy saving are possible and monitoring their use, we can identify and save energy. After look which is the best practice and take and expert advice to conduit our own experiment and have success in the change. If we transfer this information to school, they can put together an energy saving plan, create people responsible and influence families, employers and friends to do the same. There are several ways to achieve these, as for example, learning the different types of energy, type of light equipment, recycling and reuse etc.

There are successful examples of simple ways – the 50/50 methodology to achieve energy savings without making large investments, basically through behavioural changes in the use of the facilities. The idea of 50/50 came from 50% of financial savings achieved thanks to the energy efficiency measures taken by pupils and teachers is returned to school through a financial payment and 50% of financial savings is a net saving for the local authority that pays the energy bills.

Finally, to have a change in behaviour it is important to educate, have authority figures, build a routine and the most important to have an individual formal commitment.

d. Organizational

School buildings in Greece are managed by the municipalities which are also paying their energy bills. The first organizational issue is the lack of energy consumption data especially for heating (for oil boilers which are the common systems)while electrical data are very often given in periods longer than monthly which makes them less useful for energy consumption monitoring.

Another situation that causes organizational problems is the lack of qualified personnel to manage building from an energy point of view as already mentioned as a technical barrier. Apart from it, is causes delays in possible energy efficiency evaluations. In combination with the bureaucratical procedures needed, it makes the process very slow when a decision needs to be made or a submission to be given for an energy funding procurement. Finally, the whole building energy efficiency policy of each municipality depends on the ideas and vision of a small group of people (mayor and council, administrator) and their energy efficiency awareness level.

Spain

Financing, incentives and fares (including payback period)

1. There are not incentives enough to invest in the schools in order to improve their energy performance.
   The only program that has been developed with this purpose is The Low Carbon Economy program from IDAE (with EU founds) and it is really hard to have access to a grant to improve the thermic or energy isolation of the façades. Concerning the program *Edificant,* it is specific for schools but in a general meaning, it is not really developed with an energy efficiency view. However, it is interesting because rehabilitation of schools have been made with these funds but because of the age of the majority of the buildings, the funds destined are not enough. Finally, there is a lack in the publicity of this grant; there are Municipalities and schools that do not know about it. In whole, if the Administration gave enough encouragement to improve the sustainability of the schools buildings, much more schools would improve their energy performance.
2. Energy rehabilitation requires huge investments and the simple payback period is extremely long.
   The problem is that the decision to do large energy improvements in the school buildings is almost never made regarding the energy performance, but to improve better pupils comfort conditions.

Technical

3. Boilers are, in many cases, obsolete.
   In general, boilers and all the installation of the heating in the schools are quite old and the majority work with fossil fuel. In this point, the main problem is that in Spain, boilers work few months in a year, so the simple payback periods to change the existent boilers for other which work with

fuel more performant is very long and is not economically feasible. In addition, the installation of all the heating system is not normally well isolated and in many cases not well drawn, what makes that in some classrooms the temperature is too hot while in other it is too cold.

4. There is a clear lack in technical advice.
   The management of schools need to have an expert who gives advice about the actions to do and how prioritize them.

Changing behaviour

5. The education community is not aware of the importance of transmitting this kind of competences to the students.
   The school community have to change their position against the energy efficiency and learn about it and the sustainability, especially in the context of using the school facilities. The staff of the school must know the importance of the reduction of the energy consumption and they must transmit it properly to the students.
6. The environmental education is considered as an isolated subject.
   A transversal program kept over the time and aimed to the students is required to cause changes in the students behaviour related with best practices in energy and environment.

Organizational

7. The competences in the school have to be clearer.
   In many cases, the regional government is the owner of the schools, but the maintenance of all the buildings, installations and facilities is the responsibility of the local government. In spite of that, the local government cannot manage itself the grants or incentives what complicates too much the process. It is essential a better relation between governments and a properly definition of the competences of each one.
8. In general, school is not really implicated in the social life.
   More implication of the whole education community, every government and administration and even the private companies is desirable.

Croatia

Financial weak points and policy recommendations

Barriers of a financial nature that are currently hindering the development of energy renovation projects include:

- **limited funding for municipalities available**

To resolve this barrier establishment of financial instruments is needed - an urban renewal fund for energy renewal projects through European Structural and Investment Funds and development banks should be established to offer long-term and sustainable financing mechanisms (loans, guarantees and equity) for public and private sector users.

This would ensure continuous availability of funds ensured regardless of the budgetary resources of the state and local and regional self-government units, involvement of commercial financial institutions and mobilization of more private equity and reducing the risk of investing in energy renewal projects for financial institutions.

- **the absence of specific support programs for the energy renovation of cultural heritage buildings**

A large percentage of schools and public buildings belong to protected cultural heritage. Energy renovation of such buildings is very expensive and cost-effective, and enough financial resources need to be provided for the renovation of such buildings by:

o Establishment of a special support program for co-financing the energy renovation of protected cultural heritage buildings to ensure high economic return rate and low financial internal return rate.

- **Underdeveloped ESCO market**

The lack of support from financial institutions in the form of long-term preferential loans, guarantees and project financing has caused the very high cost of ESCO projects and the consequent reluctance of investors to choose this model. This problem could be remedied by development of standardized energy performance contracts and standardized methods for measuring and verifying energy savings that will increase the confidence of users and financial institutions in the ESCO model.

- **Lack of public grants and subsidies**

Public grants must take on the role of complementary funding, which will mobilize private investors' funds in a way that makes them more attractive for their involvement in the financing of reconstruction. This objective can be achieved by introducing the following financial and regulatory mechanisms:

- Establishment of a national revolving fund by diverting ESI funds will give energy service providers access to a long-term source of financing under more favorable market conditions and give banks the opportunity to place funds through the fund
- The introduction of special guarantee instruments will reduce the risk of placement of funds by private investors
- Subsidizing commercial loan interest will enable commercial banks to invest in energy renovation of buildings

Generally, financial institutions are a key stakeholder in the strategic renovations of buildings because the public sector does not have the financial strength to support the implementation of all planned measures on its own. In the past, the involvement of private investors and banks in energy efficiency projects was minimal and limited to commercial projects. Energy renewal projects do not generate direct cash receipts but have the effect of reducing existing costs. These financial benefits are more susceptible to technical risk and user behaviour, and are the reason why banks have been less inclined to finance this type of project or with high interest rates and large guarantees. Eliminating and overcoming these risks, as well as distrust of the ESCO financing model, is a key prerequisite for greater involvement of financial institutions, with the State having mechanisms in place to enable this.

Technical barriers

- **Inadequate documentation of public sector buildings (including schools)**

Information on the existing condition of the building, the legality of the building, projects of the completed condition of the buildings are often missing in practice, original documentation is rarely available in the archives or in the possession of the user or the owner of the building. With that this is also compounded by the fact that public sector buildings are often subject to interventions that are not accompanied by appropriate documentation, which also affect the location conditions or the legality of the building.

According to the experience from the implementation so far, potential bidders are hampered by the fact that, in preparation bids, they must conduct research and evaluations on their own about the actual condition of the building being renovated.

Contractor is not responsible for the input data it provides, which are required for the assessment of energy savings, i.e. status of elements of the building and the main project is made only after the selection of the offer and the signing of the energy performance contract.

For this reason, potential bidders incur significant costs in the preparation phase of the bid, and take on more risks, which is why there is decreased interest of potential bidders to participate in the renovation programs.

Potential solution to the problem is the insistence on the obligation to provide quality information about the object (technical blueprints and existing condition) on which energy renewal is planned, on the basis of which a quality and reliable offer for energy renewal can be made. Public sector should develop funds to finance development of required documentation, and therefore relive potential contractors of financial pressure.

- **Lack of option to include "soft" measures**

Soft measures are those measures that cannot be directly linked to the energy renovation of a building but have an influence on the rational management of energy or the more rational behaviour of building occupants (i.e. rational use of heating systems and lighting fixtures, rational use of electricity….). Such measures do not require significant investment and do not need to be specifically funded, but can lead to significant energy savings.

The previous type of energy performance agreement did not foresee the possibility of determining of energy savings achieved by soft measures and the possibility of making the energy performance contract more attractive to potential bidders was not exploited.

To remove this barrier, it is necessary to adjust the standard energy performance agreement.

Standardised contract needs to separate the way to determine energy savings by applying two principles:

- **Savings, evidenced by an estimate, for the realization of which the contracting authority pays the compensation determined in the public procurement procedure.**

The savings evidenced by the estimate relate to the reduction of energy needs, that is, energy consumption for performing activities of the occupant in the building under the reference conditions of use. Investments can be related to the building envelope and / or thermos-technical systems.

National Algorithm is applied to prove the savings, and the calculation is determined in relation to modelled consumption, which is given by the technical background. The technical background contains a compulsory calculation of the building's energy requirements in the design conditions elaborated by elements. The same technical background must specify the rules (standards) that apply to the calculation of savings, and to elaborate the existing consumption according to all the elements of the envelope and thermos-technical system in relation to which savings are realized.

In this way, the cost of preparing the tender is also reduced, as well as the transparency of the conditions for the tenderers.

- **Savings evidenced by measuring consumption mean the difference between the reference cost and the realized cost**

The reference cost is the amount of building demand for energy that would be generated under the conditions of use in the period preceding the energy performance contract. The reference cost is calculated by taking into account the actual energy expenditure incurred in the building under the reference conditions of use, and the calculation of the reference cost is contained in the technical background, and is

aligned with the price oscillation of energy products used by the building prior to the energy performance contract.

Organizational, behavioural and social weak points and recommendations for improvement

- **Complex administrative procedures**

Complex administrative procedures are affecting efficiency of awarding energy efficiency pilot projects. Only 30-35% of the projects passed and the awarding process was lengthened to maximal allowed deadlines because of complex administrative procedures that the Project Selection Board had to implement, in accordance with the Common national rules (PDO). In that sense, the largest number of applications was excluded because they did not meet all of the requirements the terms at the administrative stage of the award process.

From the above it can be concluded that in future calls for projects at all stages of the award procedure, and especially in the administrative phase, and at the stage of verifying the eligibility of the applicant, should be able to seek further clarification when in the project proposal when the provided information about the requirements is not clear or contains errors, thus preventing the award procedure from being carried out objectively and lengthy.

Subjective clarifications can be given to so the concept or activities of the project proposal are not affected and the quality assessment of the project proposal is not affected.

- **Undefined commitments of the public sector in the implementation of the National Program for energy efficiency**

In the implementation so far, one of the key problems has been different interpretations of public sector obligations in energy services contracts. The heads of individual public sector bodies did not even sign the energy performance contract after it was implemented after public procurement and selection decision. Such conduct seriously undermined the confidence of the energy service provider and greatly delayed implementation. Furthermore, representatives of certain public bodies expressed doubts regarding the implementation of the National Budget Law or expressed doubts as to whether the conclusion of an energy performance contract prior consent for obligation.

- **Insufficient user education for public procurement procedures**

During the implementation of contracted projects users are required to negotiate the project activities based on the Public Procurement Act, which caused difficulties due to insufficient education of users about public procurement rules. To avoid these implementation issues, four implementation workshops were organized. Some of the errors were pointed out that occur in the public procurement process and all users were instructed as to how they can solve that problems. If results of taken measures

are not adequate more detailed workshops for all members and all public bodies involved should be carried out.

- **Low awareness of contracting authorities (public sector) and potential energy service providers**

Awareness of public sector building users about the opportunities and goals of energy renewal, and the energy renewal program of public sector buildings and the way the contract works are very low. Continuous promotional and educational activities can increase the understanding of the program, the options for implementing measures and how the contract works.

It is recommended that an implementation agency is set up, whose role would be conducting preliminary analysis and proposing an optimal model for achieving energy efficiency.

- **Lack of long-term and short-term building management plans**

State - owned property management is obligation of the Ministry of State Property. The owners, that is, the real estate users, carry out their usage and maintenance plans independently without full coordination with the state authority. The Ministry of State Property will propose and implement annual plan for the management of state property in accordance with the Strategy for management and disposal of property owned by the Republic of Croatia. The said plan will have the obligation to issue energy the certificate and also to include the objectives of the Public Sector Building Renovation Program 2016-2020.

Cyprus

Summarizing, the basic Barriers and potential problems in implementing and financing Energy Efficiency projects in public schools in Cyprus are:

<u>From administrative point of view:</u>

- Operating based on complicated management structures [many stakeholders are involved]
- Lack of awareness and lack of technical expertise on EE issues
- Limited available energy and operating data
- No Benchmarks available
- There are no appointed Energy Managers in schools

<u>From legal point of view:</u>

- Difficulty regarding the right use of EPCs and Public Procurements for buildings' energy upgrade.
- Increased bureaucracy
- Fragmentation of responsibilities

From financial point of view:

- Limited, stable available funding
- Difficulties to access the funding
- Time consuming processes and complicated tendering procedures to access alternative funding, such as the funding from ESCOs and Banks

From accounting point of view:

- Energy Data and Energy Bills are not acquired easily
- A time-consuming process is needed and usually the older data are archived
- A suitable accounting system is not available for the recording of the energy data/bills, which can be used for evaluating such projects

Overall, it can be seen that there is lack of a holist approach, whereas the launching of concrete investments is limited by the need of establishing technical, economic and legal expertise for project development.

Bosnia and Herzegovina

In line with the needs of the current activities of the TEESCHOLS project (D 5.3.1), this paper highlights five weaknesses related to energy efficiency in schools in Bosnia and Herzegovina. This does not mean that a whole series of other problems encountered in the EE area in BiH are not equally important, but the weak points outlined here are those that should be addressed without delay.

a. Financing, incentives and fees (including the payback period)

With regard to funding, incentives, remunerations, payback period and other financial aspects of EE projects in public facilities / schools in BiH, **the following key weak points are**:

Weak point a.1. No clear, applicable, viable or innovative EE financing mechanisms have been developed in the public sector / education of BiH. This prevents the realization of more significant number and projects of higher investment value in the energy efficiency segment of public or school buildings. This situation is the result of the fact that the competent authorities and institutions have not yet undertaken all the necessary (political, legal, organizational, economic, technical, ...) steps to improve EE in the public sector. Management of BH schools, due to a real inability to

reach different sources of funding for EE projects within a reasonable time horizon, continues to use traditional models:

- self-financing (due to chronic insufficiency of funds, does not allow a significant EE investment,
- loans (financially expensive and nonstimulative, administratively demanding and complex, often unavailable because the requirements of loan applications are complicated and demanding),
- grants (they are attractive but are inadequate and difficult to access most schools because they often fail to provide their own participation or meet other criteria for grant funding).
-

Weak point a.2. Lack of knowledge, information and training of managers and even lack of interest and lack of understanding of EE problems in the public sector (including schools) in BiH is evident. Managers are not familiar with all the possibilities of financing energy renovation projects. This is complemented by the problem of not knowing of new, innovative financial instruments such as the Public Private Partnership (PPP) and the EPC (Energy Performance Contracting) and other models which simply keeps them out of managers' sight when choosing the EE project financing model. In BiH, emphasis has recently shifted towards the PPP, but no major steps have yet been taken. The EPC model and its benefits, as well as the ESCO energy services companies, are completely unknown to BH public sector managers and are therefore on the margins of their interest.

b. Technical weaknesses

When it comes to technical weaknesses related to energy projects in education in BiH, apart from others, the problem of enormous, often unjustified, energy consumption in the public sector / schools is particularly pronounced. Such consumption is the result of old school buildings and obsolescence of equipment, but often the users of the facility are also responsinble for these issues. Lack of accurate data on energy consumption in FBiH is a problem to be observed and is highlighted in the draft version of the FBiH Action Plan on EE (EEAP). Due to this problem, an approximation method is used to calculate average energy consumption. Unfortunately, although this problem has been identified, activities have still not been undertaken to systematically provide the necessary data (although this is one of the basic requirements of the EE directive), which prevents further steps of systematic improvement of the EE área.

c. Change in behavior

Weak points in behavior of managers, employees, students and other stakeholders in public education when it comes to energy management and raising energy efficiency to a higher level are evident in BiH. All listed categories of users of BH school facilities

show a low level of knowledge about EE in general or lack of understanding of the importance of energy efficiency as well as the direct and indirect benefits of EE projects for their and the lives of their families and fellow citizens. Changing behavior is necessary but is not possible without systematic engagement on quality education of all stakeholders. The change of behavior is also not certain without the quality communication strategy of the competent institutions, which would stimulate these changes of behavior and a proper understanding of the importance of EE for the entire BiH society and every individual.

d. Organizational Weaknesses

The audit of EE activities in federal institutions has revealed a number of weaknesses in the organizational aspects of energy efficiency in the BH public sector / education. Unfortunately, strategic, consistent and complete measures and activities that would improve the EE's status in education and other sectors of the public sector in BiH have not been undertaken. For example, in the organizational structures of public institutions (schools), no positions are foreseen for employees who would be tasked with managing the EE of the organization, nor are school managers in charge of energy management in the institution. It should be said that the Law on Energy Efficiency of the FBiH has actually provided the solution to these issues, but has not brought any changes in real life.

“For the strategic steps to improve the organizational aspect of the EE in the public sector and specifically in BH education, the legal framework is not fully completed. No basic planning documents have been issued in the EE area nor has the institutional framework for EE development in FBiH been developed. No key player in EE activities, the umbrella organization responsible for the organization, implementation, monitoring and evaluation of the implementation of the established obligations and EE measures has been identified; the responsibilities of individual participants in the field of energy management are ambiguous; there is a lack of cooperation and coordination of the activities of numerous institutions and offices that are obliged to deal with with the EE questions; no concrete tasks for the institutions were set up to access the activities of systematic data collection on energy consumption in FBiH.” (www.revizija.gov.ba/revizioni_izvjestaji/revizija_ucinka/Izvjestaji2015/?id=4124, viewed on 24 July 2019). Special attention should be put on the fact that in the organization of EE activities (at none of the institutional levels in BiH) there is still no clearly established, unique body for the implementation of a common and specific communication strategy.

France

Several weaknesses characterize the energy renovation of commercial buildings in France:

1- FRENCH LEGISLATION:

Without effective legal monitoring it is very difficult for economic actors to keep up to date with energy renovation, in fact the French legislative system is complex, the absence of a regulatory body that coordinates all the actors[ADEME, Design offices, local authorities, regulatory companies...], makes energy renovation complex to carry out.

French legislation comes from several sources:

(a) Ministerial decrees:

A ministerial order is an administrative act, a decision taken by a minister. This decision is formalized by a written order https://www.legifrance.gouv.fr/.

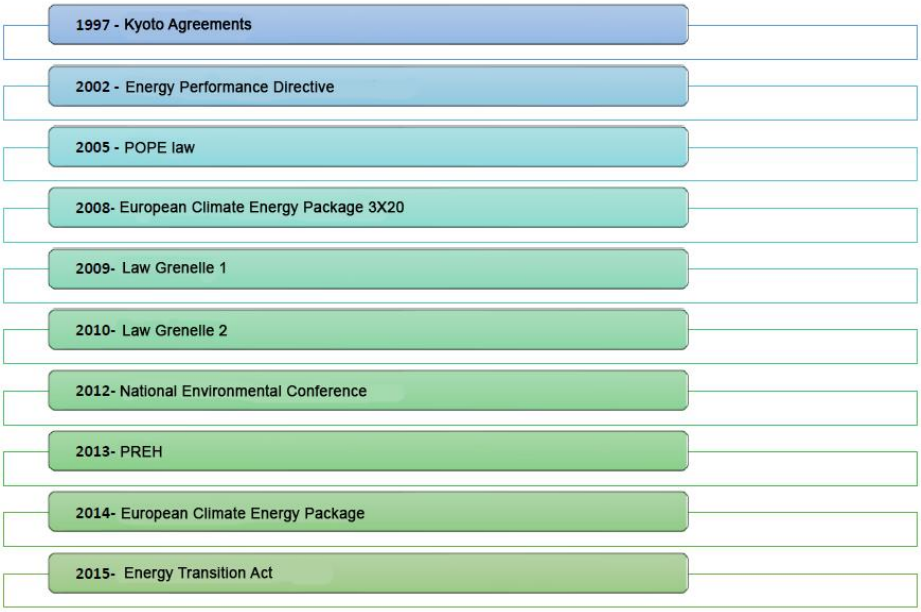
b) ADEME:

The Environment and Energy Management Agency is better known by its acronym "ADEME". Since its creation in 1991, it has been responsible for implementing policies to protect the environment, sustainable development and energy in France. Its scope of action covers a wide range of areas such as waste management, soil pollution, transport or air quality.

(c) Laws:

For many years, each government has proposed its own measures, and transcribed them into law, it is a real administrative ball, difficult to understand.

Attached are the main regulatory texts dealing with energy issues:



FINANCIAL ASSISTANCE FOR ENERGY RENOVATION WORK:

In the case of energy-efficient housing renovation, there are many ways to make your home more energy-efficient: in the form of a tax credit, loan or energy cheque, everyone can find the

most appropriate assistance for their energy renovation project. This is not the case in the tertiary sector, let us calculate the financial aid linked to the EWC (energy saving certificates), in the context of the installation of thermal insulation from outside a school. The decree published in the Official Journal of 24/12/2014, under the reference BAT-RN-102, lays down the following procedures:

Amount in KWH cumac per m² of insulation		
Climatic Zone	Heating energy	
	Electricity	Fuel
H1	3 400	5 400
H2	2 800	4 400
H3	1 900	3 000

X

Activity sector	corrective factor
Offices	0,6
Education, trade, tertiary	0,6
healthiness	1,1
Others	0,6

X

insulation surface area in m²
S

School data:

City Nice

Climate zone H3

Heating Fuel Heating

Wall area 590 m² 590 m²

Price of the insulation work 70 800 €

The amount of EEC aid linked to this operation is €3,186, i.e. 4.5% of the cost of the work.

POLICY RECOMMENDATIONS AND GOOD MANAGEMENT PRACTICES

Italy

- **National register of school buildings;**

  Since 2016 is active in Italy a **National register of school buildings** which provides updated data on the main characteristics of Italian school buildings (for example it includes information on the seismic adaptation of buildings, on the presence of collective spaces such as gyms or auditoriums, on the state of the supporting structures) and moreover provides data on mobility, environmental sustainability and the quality of the infrastructures of the school institutions (for example 63% of Italian schools have a school bus service, 71% of school buildings took steps to overcome architectural barriers - access with ramps, doors and in 58% of cases they identified solutions to reduce energy consumption, through zoning of the heating system (64%), double glazing (62%), solar panels (46%).

  The register includes more than 42.000 school buildings and will allow to overcome the lack of data on buildings plans and structures, disseminate to public the knowledge on the buildings and to schedule with greater effectiveness maintenance operations. The school building characteristics saved in the national register are increasing year by year. Moreover the national register is joined by regional databases which have been instituted by several regions.

- **CONSIP framework contracts**

  CONSIP is a joint-stock company, 100% owned by the Ministry of the Economy and Finance, which operates at the exclusive service of the Public Administration (PA) with the mission is to make the use of public resources more efficient and transparent, providing administrations with tools and skills to manage their purchases and stimulating companies to compete with the public system.

  As energy efficiency is becoming a very important issue for PA, CONSIP developed framework contracts in the field of energy services based on Energy Performance Contracting (EPC) model. EPC contracts in fact are not applied as widely as they can in Italy, because of the complexity of technical procedures and the lack of specific expertise that often

discourages PA. These weaknesses can be overcome by CONSIP wide and pluriannual expertise and guiding role.

In terms of results, the action developed in the energy sector has allowed for "savings on unit prices" of around € 1.2 billion (2018), but above all "savings from efficiency and innovation". And in fact the more than 5.000 energy redevelopment projects carried out since 2008 have made it possible to obtain lower primary energy consumption in terms of "TEP" (i.e. Tonnes of Equivalent Oil) equal to 803.644 and lower emissions of 2.012.090 tons of CO_2.

- **Strong political commitment;**

  Several weaknesses of PA (understaffing of PA, lack of technical advice) can be overcome by a strong political commitment which will allow:

  - activation of working groups within the Municipalities dealing with issues related to energy efficiency and which include an energy manager (CSPT is an important example).

  - ability to find cumulative incentives (national and regional). Municipalities must have internal competences able to identify and combine different available funds.

  - continuing training on energy issues and crowdfunding is a necessary and indispensable action.

Greece

Using own funds of municipalities or regional governments for financing energy efficiency projects in schools is almost impossible, at least currently. Furthermore, in some cases behavioral change issues due to lack of/or poor information is also an issue that need to be addressed. In this context, the following policy recommendations are proposed in order to overcome the identified barriers.

1st Policy Recommendation (at municipal level):
Establishment of a department for the Monitoring of the Energy Efficiency of Municipal Buildings & for the identification of National & EU funds for building interventions.

Due to the limited financial resources, the Municipalities should take advantage of every possible national or European fund available for energy efficiency. To achieve these, municipalities should be able to monitor the energy consumption of their buildings, conduct feasibility studies, make their own proposals or even conduct energy audits to their buildings. Technical Experts should be hired permanently or by contract and have as their main job to plan and implement energy efficiency upgrades of the municipalities building stock. In this way, municipalities will be ready to participate in any available funding programs.

2nd Policy Recommendation (at national level):

Simplify the procedures of the existing Legal Framework favoring the application of ESCO or other financing models.

This recommendation requires the involvement of the national government. A solid legal framework should be developed for other models of energy projects financing like the ESCO models with the energy performance contracting. The procedure that should be followed should be defined which will involve the owner the ESCO and the investor. The goal is to create confidence in energy saving projects and increase the interest of every possible investor.

3rd Policy Recommendation (at municipal or regional level):

Organization and promotion of information/training events to raise energy efficiency awareness.

A good initiative would be the establishment of training programs and organisation of info-days (behavioral change events etc.) for the staff of the municipalities, the students and the teachers of schools, the staff of the regional governments and the citizens in order to raise their energy efficiency awareness.

4th Policy Recommendation (at municipal or regional level):

Appointment of Energy Managers to public buildings (including schools).

Central energy management of municipal buildings would also be an advisable policy. Energy managers for all school buildings should be appointed with their main task to monitor energy consumption in schools, to report related problems and to facilitate any proposal for an energy upgrade. They could also communicate with the buildings users, in case of schools with the teachers and the students in order to promote behavioral change for energy saving in buildings.

Spain

1. There are not incentives enough to invest in the schools in order to improve their energy performance.
   The regional government has to include the objective of energy efficiency and installation of renewable energy sources in the program "Edificant".
2. Energy rehabilitation requires huge investments and the simple payback period is extremely long.
   The criteria of improvement of the energy efficiency have to be considered in all grants offered by the different governments.
   The increase of funds and subsidies availability would drive local authorities to improve the energy performance of their buildings.
3. Boilers are, in many cases, obsolete.
   Regional and local governments should promote the change of the boilers into more performance ones. They have to give incentives and financial eases to do these changes.
4. There is a clear lack in technical advice.
   The creation of the figure of a local energy manager would be desirable. This expert would be responsible of the energy management of all the public buildings, including primary schools.
   It would be interesting that schools have a direct way to consult about technical solutions to specifics problems related with energy efficiency. It would be desirable if schools and local technicians had a closer relationship. Local authorities' technicians should better know the installations of schools and try to improve their energy performance and efficiency.
5. The education community is not aware of the importance of transmitting this kind of competences to the students.
   The school's staff has to be taught in best energy practices, sustainability, energy efficiency, etc. and they have to put it into practice in order to be an example to the students. Therefore, they will be able to transmit all this knowledge effectively to the students. Many easy and not very expensive practices can help to show the importance to save energy such as the installation of presence detectors in the classrooms, halls, dining room or the installation of programmers on electrical devices. These actions can be made directly by the school's staff.

6. The environmental education is considered as an isolate subject.
   The environmental competences have to be included in educational programs as a transversal subject to be taught during all the courses in primary school. Moreover, it must be related with several subjects.
7. The competences in the school have to be clearer.
   It would be interesting and more realistic if the energy rehabilitation of the school buildings was promoted by the local governments.
8. In general, school is not really implicated in the social life.
   The local government could promote join activities among schools, government and companies of the energy sector in order to share experiences and knowledge.

Croatia

INSTITUCIONAL AND GOVERMENTAL BARRIERS:

- Regulation and planning
- Institutions
- Different stakeholder interests

Regulatory obligations for implanting energy efficiency

Solutions for the problems can solved by introducing a state-level legal obligation through the Energy Efficiency Act. The Ministry may prescribe and finance the creation of special departments and teams within the regional and city bodies, which would have experts from the technical, economic and legal professions and who would be solely responsible for developing Action Plans and monitoring the implementation of the plans.

Alternatively, partnerships could be formed between local government units and the private sector, where private companies with knowledge and expertise could make plans for regional governments or major cities.

There are also Legislative measures that can be implemented to aid in renewal of public buildings:

- identify the most effective legislative mechanisms whose implementation would result in improvement of the energy efficiency of buildings (energy certification, boiler room inspection, stricter technical standards, etc.)
- oblige legislative acts to use renewable energy sources and apply energy efficiency measures in existing buildings
- amend or repeal restrictive legislative acts that discourage the improvement of energy efficiency in buildings
- make a legislative commitment to improve buildings with poor energy performance (e.g. introduce various restrictions and restrictions on the sale and lease of buildings of less than D energy class)

Covenant of Mayors

Thanks to the Covenant of Mayors, signatories benefit not only from the experience of thousands of other cities but also from a community of stakeholders that are supporting them in designing and delivering their energy and climate actions

FINANTIAL BARRIERS:

- Access to funding
- Long investment return period
- Lengthy and complex public tenders to obtain funding

Financial measures for energy efficiency in public buildings

- Development of financial instruments
- The method of awarding the financial grant

In order for financial institutions to track energy service providers, it is necessary to develop financial instruments in accordance with the rules of use of ESI funds, with a specific purpose for energy service providers. The development of financial instruments should also create the conditions for the development of the energy services market, including through the PPP model, that is, the development of the market among private entities seeking to operate on the principles of energy service provision.

The following objectives can be achieved: to provide access to financing EE projects to encourage the development of ESCO markets through specific products to reduce the cost of financing for EE projects. The co-financing model should be adjusted in such a way that the aid is awarded in direct relation with the service provider, without a mediating role or that the risk of receiving the aid is sustained by the energy service provider, without affecting the obligations under the energy performance contract.

Financial grant schemes

The use of a grant scheme can (and should) achieve the following objectives:

- Encourage end-users to develop the technical bases needed for the implementation of energy renewal projects to develop a range of ready-to-carry energy renewal projects
- Encouragement to invest in energy efficiency technologies that have not yet been proven in the domestic market, with the aim of early exploitation of the many innovations existing in the market

- subsidizing projects whose cost-effectiveness is below the marginal level of market interest;
- encouraging the market to invest in energy efficiency measures that achieve a technical standard higher than the minimum required
- subsidizing ESCO projects by co-financing compensation for the duration of the contractual relationship

Given the above objectives the grant schemes should be designed in such a way as to encourage:

- motivation to use market funds
- investing in technical documentation
- investing in innovative technologies
- investing in projects that are below the market viability level but have high economic benefits for the community
- investing in measures that achieve higher levels of technical standards

The grant schemes would encourage the financing of commercially viable projects to further motivate beneficiaries to pursue those projects and it would finance the development of a technical and economic documentation showing the cost-effectiveness of investing in a potential energy renewal project. As the implementation of the energy renewal project depends on the findings and conclusions of the documentation in question, a high proportion of co-financing is recommended in this case, to encourage the end recipients to take risks and invest their co-financing.

Financial grant scheme would also encourage investment in non-marketable projects. Non-viable projects are those projects that, under the available financing conditions, offer the investor a return on equity that is below the possible level profit in the market. The logic is that in case of insufficient return on own investment in an energy efficiency project, the rational entity will engage its own capital elsewhere, and therefore such investment should be encouraged in such a way that projects below acceptable level of return on own investment are given grants that will make up the difference needed.

Long term energy efficiency financial model

Subject to the requirements for the introduction of innovative and sustainable financial instruments, and taking into account previously identified barriers an overview of financial measures that should accelerate the implementation of energy efficiency projects.

1. Establishment of financial instruments - an urban renewal fund for energy renewal projects through European Structural and Investment Funds and development banks to offer long-term and sustainable financing mechanisms (loans, guarantees, equity) for public and private sector users that would have several effects on previously identified barriers:

- Continuous availability of funds ensured regardless of the budgetary resources of the state and local and regional self-government units
- Involvement of commercial financial institutions and mobilization of more private equity.
- Reducing the risk of investing in energy renewal projects for financial institutions.
- The possibility of obtaining grants to increase the cost-effectiveness of ambitious and innovative projects.
- Easier access to capital and lower financing costs for energy providers and PPP projects.

2. Further implementation of the Energy Sector Building Renovation Program:
   - Encouraging the development of the energy services market.
   - Reducing the burden on public sector budget users while avoiding additional borrowing.
   - Engagement of financial resources and capacity of the private sector
3. Establishment of a special support program for co-financing the energy renovation of protected cultural heritage buildings:
   - Promoting the energy renovation of cultural heritage buildings that have a high economic return (ERR) and low financial return (IRR).
4. Establishment of a special instrument for co-financing the technical preparation of projects:
   - Avoiding high development costs of projects.
   - Creating a database of projects ready for funding and implementation.
5. Introduce a legal provision shifting the obligation to implement energy efficiency projects for large enterprises through the contribution system to energy suppliers:
   - Secured sources of grants for large enterprises with state aid amounts are not sufficient.
   - Unburdening the financial and human capacities of public institutions.

How to make energy efficiency investments make more attractive for banks or private investors.

The long-term strategy for encouraging investment in the reconstruction of public buildings aims to ensure the long-term removal of obstacles to private investment in the energy sector, by providing guidance on creating a clear, unambiguous and stable legal and administrative framework that will be incentivized to undertake investments in the energy renovation of public buildings which will reduce the degree of uncertainty that investors face.

Financial institutions are a key stakeholder in the strategic reconstruction of the National Building Fund because the public sector does not have the financial strength to support the implementation of all planned measures on its own. In the past, the involvement of private investors and banks in energy efficiency projects was minimal and limited to commercial projects. Energy renewal projects do not generate direct cash receipts but have the effect of reducing existing costs. These financial benefits are more susceptible to technical risk and user behaviour, and are the reason why

banks have been less inclined to finance this type of project. Eliminating and overcoming these risks, as well as eliminating distrust of the ESCO financing model, is a key prerequisite for greater involvement of financial institutions.

The biggest barrier for private investors and energy service providers is limited access to affordable sources of financing. The lack of support from financial institutions in the form of long-term preferential loans, guarantees and project financing has led to the very high cost of ESCO projects and the consequent reluctance of investors to choose this model. EU cohesion policy requires that sustainable energy projects be implemented with greater involvement of private investors. In doing so, public grants must take on the role of complementary funding, which will mobilize private investors' funds in a way that makes them more attractive for their involvement in the financing of reconstruction. This objective can be achieved by introducing the following financial and regulatory mechanisms:

- subsidizing commercial loan interest will enable commercial banks to invest in energy renovation of buildings
- promoting the development of the energy services market through the implementation of the Public Buildings Renovation Program
- development of standardized energy performance contracts and standardized methods for measuring and verifying energy savings that will increase the confidence of users and financial institutions in the ESCO model

LACK OF NECESSARY KNOWLEDGE AND MOTIVATION:

- Lack of information
- Insufficiently addressed public
- Insufficient knowledge of the construction sector

Technical and social component of energy efficiency renewal

The precondition for successful launching and implementation of the integral energy renovation of the public buildings is a good development of the construction and energy services market, and a sufficient number of experienced companies specialized in the implementation of integral energy renovation, which covers the mechanical, energy and construction elements of the building and requires an interdisciplinary approach. The crisis in the Croatian construction and energy sector, resulting in the closure or bankruptcy of a large number of companies, has further strengthened the existing barrier of insufficient capacity, knowledge, ability and skills to successfully complete the complex task of integral building renovation.

However, the construction sector can quickly get back on its feet and provide the necessary expertise when private and governmental companies start to feel safe about security and better future of the construction sector. The direct impact of the National Building Fund Renewal Program on construction employment by (including) 2020 could be up to 26,000 new jobs. This is a big increase over the current headcount. At the end of 2016, 68 653 employees were employed in companies

registered in construction. However, it is questionable how much all companies whose construction is the main registered activity are engaged solely or exclusively in that activity. According to the CBS special report on construction, the average number of construction site workers in 2015 was 41 037 and was still declining compared to previous years. Although the National Building Fund redevelopment program not only mobilizes construction site workers but also designers, engineers, managers and administrative staff, it is clear from these figures that there is a large mobilization of resources, especially in construction. Mobilization potential can be roughly estimated at 40-50% of current resource engagement in construction.

Also, governmental bodies could add to improvement of construction sector by implementing several technical measures that should cover the following:

- continuously align technical norms and standards with new technological solutions available on the market
- analyse and apply centralized heat systems for heating and cooling buildings as much as possible
- build district biomass heating systems
- ensure proper control of compliance with construction regulations and enforcement of penal provisions in the event of non-compliance
- develop standard solutions for easy application in buildings of the same purpose
- introduce mandatory certification of the quality of installation services and products

The next barrier to be taken into account is only partial information, education and public participation in making important decisions about the renovation of buildings. Insufficient awareness of the positive effects for each individual and society as a whole, which the integral restoration of the entire national building stock certainly brings, results in insufficient motivation and often unjustified increase in risks that further block potential investors.

Some measures could be implemented to remedy lack of information and knowledge among all participants in energy renewal of public buildings:

- establish publicly accessible databases with good practice examples and all necessary data for launching and implementing energy renovation projects for buildings
- initiate and continuously implement educational programs for all categories of construction workers
- establish good communication channels for sharing knowledge and experience between different levels of government (national, regional, county, local)
- continually carry out promotional and educational activities for different target groups with an emphasis on the positive effects of energy renovation of buildings;

- continuously inform stakeholders and the public about the implementation of this Long-Term Strategy to encourage investment in the reconstruction of the National Building Fund of the Republic of Croatia

Cyprus

The European climate and energy targets for 2030 require a reduction of the greenhouse gas emissions, an increase in energy efficiency and a share of renewables in the total use of energy. Those will set the basis for the 2050's target, which commits to a reduction in GHG emissions by 80%-95%, in order to develop a sustainable, secure and decarbonised energy system.

The national commitment has been set to at least 24% cuts in greenhouse gas emissions by 2030 (compared to 2005 levels). The building sector, currently responsible for more than a third of the total GHG emissions, is expected to make a substantial contribution to achieve these goals. In addition to tightening requirements on new buildings, the focus is set on improving the energy performance of the current building stock, to ensure that the long-term renovation strategies increase the transformation of existing buildings into nearly zero-energy buildings.

TEESCHOOLS project and the outputs of the Energy Audits are an important asset to overcome the weak points when implementing and financing Energy Efficiency projects in (public) schools in Cyprus. Through TEESCHOOLS a list of proposals in order to improve the energy efficiency of typical primary schools and the thermal comfort conditions in the classrooms, has been established. Those can be used to eliminate the legal and administrative barriers for mainstreaming large scale -energy- renovations in schools, by addressing the main existing barriers and challenges as follows:

- Through the School Boards and the School Advisory Committee, the Ministry of Education, Culture, Sports and Youth can be reached in order to establish a specific programme for the energy efficiency of school buildings;
- By uptaking the results of the TEESCHOOLS project, a procedural framework to select existing (public) school buildings based on pre-defined criteria to implement energy renovations can be developed;
- If there are available Funding Schemes [Subsides or Intensives], the reports will help to set clear goals and targeted actions;
- If there no relevant Funding Schemes are available, then the Energy Audits reports can be used as the basis for the initiation of a financing mechanism;

- Energy and operating data collected within the project's duration can be provided to build-on and establish typical energy profiles for school buildings [benchmarks];
- Energy Managers can be allocated either per district/location, either centralised to simplify procedures and provide awareness and technical expertise, while collecting relevant data;
- The use of Energy Performance Contracts will be encouraged based on the most cost-effective scenarios.

All the solutions need to be confirmed with the Ministry and the national targets, to confirm that the results will be assessing, technical, economical and legal aspects and can be replicated. The solutions identified, will be aligned with the Ministry's priorities, capacity and commitment.

If a policy decision is not taken at national level, then local policies, can be assessed. Signatory Local Authorities of the Covenant of Mayors can be an alternative as they include in their SEAP's, measures for the energy upgrading of their building stock, as a key component to improve the overall energy efficiency of the Local Authority.

Bosnia and Herzegovina

Recommendation 1: With regard to the weakness in the segment of financing, incentives and remuneration mentioned in Part 3.a.1. of this document, it is necessary to proceed without delay to developing (or adapting the models from other markets to the local conditions) clear, less administratively complex and viable EE funding mechanisms applicable to public education in BiH. Of course this should be a part of a strategic approach to the development of financial instruments for EE projects in BiH. This would be the task of the competent authorities and institutions that should provide all the necessary political, legal, organizational and other steps necessary for these activities. Models of financing that already exist in the BH market need to be improved at least in the following partial segments:

- Self-financing: Provide initial capital investment for the establishment of revolving funds at different levels for EE projects, which would significantly contribute to easier and faster access to financial resources (the first fund of this kind in the region was established by the FBiH Environmental Protection Fund)
- Debt financing: Make it cheaper and more stimulating, lower interest rates, extend grace period and loan repayment period, reduce administrative procedures

for obtaining funds, review sustainability and other application criteria to adapt to market conditions in BiH)

- Grants: It is necessary to make a step away from this source of financing and towards sustainable financial instruments that, inter alia, increase the involvement and interest of EE project participants.

Recommendation 2. In relation to the weak point noted in section 3.a.2. of this document, it is necessary without delay to begin with the quality and continuous informing of all relevant public groups about the available funding models of EE projects in the public sector and public education in BiH. The information must be clear, accurate and timely. In addition to informing them, it is necessary to immediately start educating managers, employees, pupils or users of school facilities about the importance, as well as direct and indirect benefits of implementing energy renovation. Education should also include new, innovative models of funding. For example, increasing knowledge of PPP and EPC models, the potential of ESCO companies and so on, will make it easier and quicker for managers of public education in BiH to start energy renovation projects in schools. Namely, these models that provide funding for EE projects from future energy savings and distribute the risk onto multiple project participants are undeniably a stimulus for launching new energy projects. Increasing knowledge of stakeholders in education about EE can also put a welcoming pressure on higher instances of government to more actively approach this subject.

Recommendation 3: In relation to overcoming the technical weaknesses observed in EE in BiH schools, it is especially important to devise and implement measures to reduce their enormous, often unjustified energy consumption. In this sense, it is also necessary to immediately approach the measurement of energy consumption in the facilities and ensure systemic provision of accurate data on energy consumption. Namely, the lack of this data in BiH is a problem that needs to be addressed in order to implement further activities in the field of energy management in BiH. Measurement of energy consumption further enables determination of energy savings that can be achieved through a whole range of individual activities. Although this recommendation, due to the age of objects and obsolescence of equipment, basically implies investing in energy renovation of facilities or their parts, it is important to draw attention to the possibility of reducing energy consumption by non-investment: awareness-raising, increasing concern and changing user behavior. Stimulating users to save energy without decreasing their confort is a recommendation that does not require a large investment, but rather a continuous and persistent education of owners, employees and school students.

Recommendation 4: Regarding behavioral changes, deviations in relation of managers, employees, students and other public education stakeholders in the area of energy management in schools in BiH are evident. They are often a consequence of the low level of knowledge about EE at all, the lack of understanding of the importance of implementing EE measures in schools or the lack of understanding the direct and indirect benefits and cobenefits of these projects for society and individuals in it. To

change behavior and move towards more responsible energy management in schools, it is necessary without delay to enter into education of all these stakeholders on different aspects of EE projects. It is also necessary for competent institutions to develop and implement a unique communication strategy (with carefully selected messages, techniques and channels of communication) that would stimulate changes in knowledge, awareness and behavior and to properly understand the importance of EE projects for the individual, the education sector and the BiH society as a whole. "*In BiH, due attention has yet to be paid to public campaigns to promote energy efficiency. Promotional campaigns that provide clear information on how to achieve energy savings and encourage consumers to action can influence change in understanding and lead to action. They may, among other things, provide information on how to reduce energy consumption at workplaces, suggesting efficient lighting and heating, and making reasonable decisions when selecting construction and other materials and purchasing equipment. Information, education and training are extremely important for strengthening the culture of energy efficiency. Examples from other countries can be a good guide for similar programs in BiH."* (http://ekologija.ba/wp-content/uploads/2017/06/Zelena-knjiga-EU-o-energetski-efikasnosti.pdf)

Recommendation 5: To eliminate organizational weaknesses in the EE sector in the public sector / education sector in BiH, it is imperative to make and implement a strategy for improving energy efficiency without delay. A strategic approach to the EE area in the public sector / education means the formation of all necessary bodies and institutions, the adoption of all necessary laws, standards, procedures, plans and the like, and their alignment with the EU legislative framework. So, for the strategic steps to improve the organizational aspect of the EE in the public sector and specifically in BiH education, it is necessary first of all to have a firm legal framework. It will enable further drafting of planning documents in the field of EE and further institutional development of EE in BiH. The EE promotion strategy in the BiH public sector must also include organizational charts that clearly point to the structure and hierarchy of relevant organizations relevant to the implementation of EE measures. In the organizational structures of public organizations (schools), consistently, all legal acts should provide for the engagement of staff who will be concerned with EE and energy management.

Particular attention should be put on the fact that the organization of EE activities must provide the staff tasked with leading an adequate and specific communication strategy necessary to change the views of BiH citizens on energy efficiency.

France

Recommendation 1:

Creation of a regulatory body

The creation of a regulatory pole that acts as an intermediary between the various actors in energy renovation would make it possible to:

1- Converge regulatory aspects, and implement a single regulation that is easy to understand and accessible to all stakeholders,

2- Creation of an energy sheet with clear, precise objectives.

3- Create a database of feedback,

4- Do not pass new laws that call into question projects under construction, and impose new standards.

Recommendation 2: Administrative simplification

Administrative procedures in the context of energy renovation may take years before the actual implementation of these projects, administrative simplification would reduce the waiting times of the various state agencies[prefecture, department...].

The simplification of administrative formalities and procedures consists of a series of pragmatic and concrete measures designed to facilitate relations between the administration, companies and state agencies (e.g. ADEME).

Recommendation 3: Financial aspects

The implementation of real aid to local authorities would facilitate investment, which is also a factor in economic growth.

CONCLUSIONS

EU has an important challenge in trying to reach the energy efficiency objectives established for 2020 and 2030 based on reducing greenhouse gas emissions, increasing EU energy from renewables and improving energy efficiency. The Commission urges the Member States to intensify their current efforts to ensure the collective achievement or these objectives. In that sense, EU wants to focus the attention in buildings sector that has a significant potential for energy saving.

At present, about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient. Renovation of existing buildings can contribute to significant energy savings and play a key role in the clean energy transition, in addition to get economic, social and environmental benefits or contribute to the improved health among other things.

For the building sector, the TEESCHOOLS project provides a perspective by focusing its attention on energy efficiency in school buildings.

The audits carried out in the project have allowed observing the current state of school buildings in Mediterranean area from point of view of energy efficiency with notable differences depending on construction year or climatic zone.

Incentives and grants for renovation buildings are complex with differences among partner countries and differences in the financing mechanisms that they are significant in some cases.

Weak points have also been detected in financing, technical, changing awareness or organizational issues from which improvement actions on these matters can be planned.

Finally, these Green paper document include some basic recommendations are proposed to improve processes, incentives, changing awareness and training of actor from educational community that can help achieve the objectives.