Black Sea Basin Joint Operational Programme 2007-2013

BSBEEP

Black Sea Buildings Energy Efficiency Plan

Manual for Training on Energy Efficiency in Buildings

Municipal servants

Project funded by the EUROPEAN UNION

BSBEEP Black Sea Buildings Energy Efficiency Plan

Black Sea CROSS BORDER COOPERATION

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1. The BSBEEP PROJECT

The Black Sea Buildings Energy Efficiency Plan (BSBEEP) project aims at establishing strong regional partnerships and cooperation among Black Sea countries through the reinforcement of local administrative capacities in the sector of energy efficiency in buildings, a sector with major environmental and economic impacts locally and globally.

The ultimate goal is to achieve change in the way we treat energy for buildings, facilitating change in the way local societies act with respect to this scarce resource. Furthermore, the project focuses on the establishment of a knowledge and experience exchange network aiming at the promotion of energy efficiency in buildings. The network will engage a wide spectrum of organizations such as local and regional authorities, universities and NGOs, which will help in promoting energy efficiency in buildings at local and regional levels. Meanwhile, it will focus on raising awareness and mobilizing the private sector and leveraging funds to support future initiatives.

Figure 1*: The BSBEEP logo.*

Ten partners participate in the BSBEEP Project from six different countries: Municipality of Kavala (GR), Municipality of Galati (RO), Municipality of Cahul (MD), Municipality of Mykolayiv (UA), Municipality of Samsun (TR), Municipality of Tekirdag (TR), Democritus University of Thrace (GR), University Dunarea de Jos of Galati (RO), American University of Armenia (AM) and Renewable Resources and Energy Efficiency Fund (AM). More details on BSBEEP are available on its website: **www.bsbeep.com**.

2. TRAINING OBJECTIVES

2.1. Training overview and goals

Growing concerns on climate change, energy security and energy cost increases urge governments, energy providers and relevant agents to undertake new investments and energy saving initiatives. Many of these investments and initiatives focus on empowering citizens to manage their energy usage more actively and efficiently. Improving energy efficiency is considered to be the fastest and most cost-effective solution to the above-mentioned challenges[1]. Improving energy efficiency in commercial and institutional buildings is crucial as they hold significant energy saving potential.

The goal of this training booklet is to facilitate change in the way municipal personnel treat energy in their workplaces. It aims to do this by highlighting its significance and enhancing municipal employees' knowledge of building energy efficiency. The booklet briefly presents various technical aspects of energy efficiency in buildings, actions for improvement in building energy performance, as well as potential financing and other mechanisms for developing and implementing energy-savings policies.

2.2. Training learning outcomes

The booklet is addressed to all municipal servants regardless of their position and responsibilities. It can be used and applied by every employee in the tertiary sector (public sector, healthcare, services and commerce). Readers can easily and quickly learn about key

[1] Instituto para la Diversificacion y Ahorro de la Energía (IDAE), 2009, Changing Energy Behavior - Guidelines for Behavioral Change Programmes. Available from: http://www.idae.es/uploads/documentos/documentos_10457_BEHAVE_changing_energy_behaviour_09_c5724555.pdf (Date accessed 10/11/2014)

issues related to energy performance of buildings and respective technologies. Information included in the following pages can help them adapt their behavior to energy-efficiency demands and understand energy-management solutions. By applying the proposed actions, municipal servants will understand the impact of energy consumption not only on the environment, but on their utility bills as well. Finally, they can be informed about energy-efficiency programs and policies that are available in the E.U. and BSBEEP participating countries through links provided in the BSBEEP Library (see BSBEEP website).

3. INTRODUCTION

3.1. What is building energy efficiency?

Energy efficiency in buildings refers to the satisfaction of the needs of the occupants with minimal energy consumption and respective environmental burden. Energy efficiency promotes energy savings and rational use of energy, as a prerequisite for achieving sustainable development. The energy consumption of a building depends on the climate conditions where it is located, its architectural and construction characteristics (e.g. types and adequacy of insulation), the type and the condition of its electro-mechanical equipment, the desired internal temperature, humidity, ventilation, etc., the hours and duration of its operation, and the types of its use (e.g. educational, medical, office, etc.).

Energy efficiency means:

- ✓ Using less energy to achieve the same result;
- ✓ Using the same amount of energy to obtain a better result;
- ✓ The cheapest energy is the energy saved.

Key reasons why buildings consume large amounts of energy include[2]:

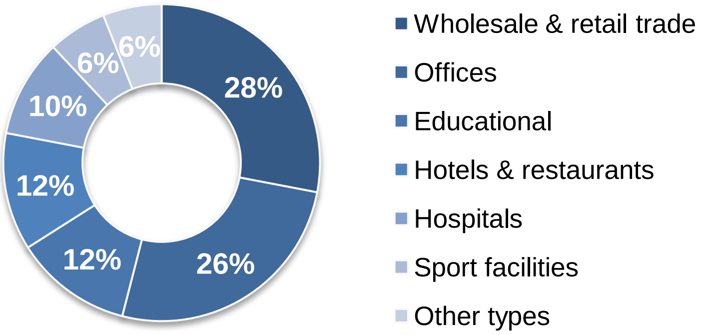
- Partial or total lack of heat insulation,
- Outdated technology or materials utilized for windows and doors (frames/single glazing),
- Lack of sun protection on southern and western sides,
- Inadequate utilization of the potential for renewable energy generation systems, and
- Outdated technology or inadequate maintenance of heating and air conditioning systems, resulting in poor performance.

Furthermore, a significant factor affecting a building's energy performance is occupant behavior. Occupants (tenants, residents, workers, etc.), who lack information about the rational use and management of energy, often tend to waste energy, e.g. by utilizing air conditioning with open windows, using low efficiency equipment and appliances, neglecting maintenance of heating systems, etc.[2].

3.2. Energy profile of non-residential buildings

The energy profile of non-residential buildings varies considerably. The end uses, such as lighting, heating, cooling, equipment etc., are different from one building category to another. Figures 2 and 3 provide an overview of the energy-use profile of buildings in countries across Europe. Figure 2 shows that Office and Wholesale & Retail buildings account for more than 50% of the energy use in non-residential buildings. The same Figure also shows that almost half of energy used by non-residential buildings comes from electricity and another 40% from fossil fuels oil and natural gas. While not shown in the chart, most of electricity worldwide is generated by fossil fuels, particularly by burning coal.

[2] http://exoikonomisi.ypeka.gr/Default.aspx?tabid=629&locale=en-US&language=el-GR (Date accessed 12/11/2014)



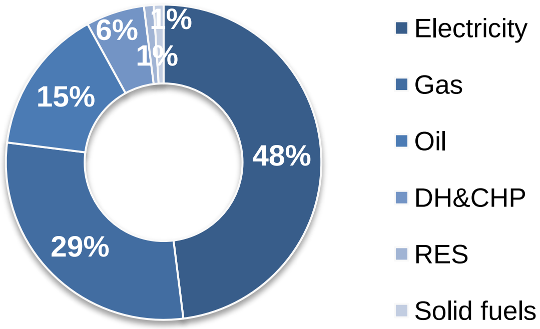


***Figure 2**: Share of total energy use in non-residential buildings per type and energy mix for different countries across Europe (in 2011) – percentages presented from higher to lower (Source: See footnote 4).*

Since electricity is the major source of energy used by non-residential buildings, Figure 3 shows the distribution of electricity use in office buildings throughout EU27. Office lighting accounts for 21% while space and water heating for 19% of all electricity used. It should be mentioned though that the specific figures are about electricity only, giving a fragmented view of building energy use. Buildings should be individually analyzed in order to identify special needs and characteristics before proceeding to energy efficiency interventions.

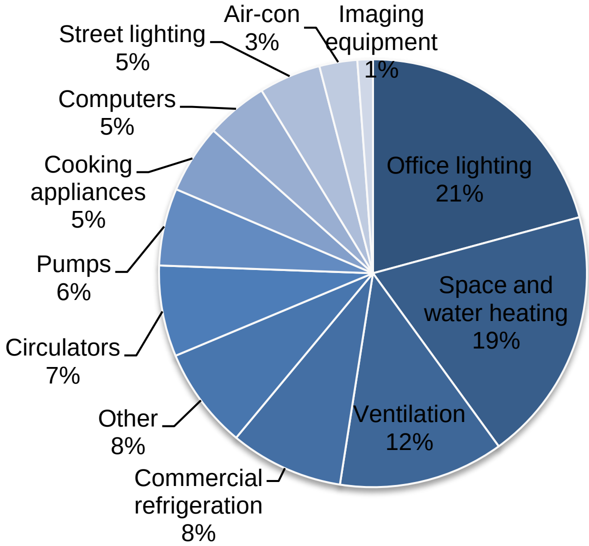


***Figure 3**: Electricity consumption breakdown in the EU-27 tertiary* sector (public sector, healthcare, services and commerce) in 2011 *(Source: See footnote 3).*

[3] JRC energy efficiency status report. Available from: http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/energy-efficiency-status-report-2012.pdf (Date accessed 15/11/2014)

3.3 Why is energy efficiency in buildings important?

The building sector accounts for 40% of the energy consumed in Europe, the largest user and showing continuous increase. The fossil fuels burned to generate this energy cause more than 45% of total CO_2 emissions in the atmosphere[4]. European non-residential buildings (offices, hospitals, educational buildings etc.) have increased their electricity consumption by 74% over the last 20 years[5]. It is estimated that the average energy consumption in this sector is at least 40% larger than that of the residential sector and equals 280 kWh/m^3.

Table 1 summarizes the key benefits that may be derived from implementing energy efficiency best practices and technologies in buildings. Although the energy performance discussion concerns both residential and non-residential buildings considering similar renovation interventions, the high share of electricity use in non-residential buildings makes the corresponding installation of smart energy management systems highly important.

***Table 1**: Benefits of implementing building energy efficiency best practices and technologies.*

Benefit/advantage	Description
Energy savings	• Significant reductions in energy consumption can be achieved if appropriate retrofits are selected or responsible behavior is encouraged.
Cost savings	• Significant cost savings result from reduced energy consumption, especially when life-cycle costs are taken into account.
Environmental benefits	• Best practices can contribute to the reduction of both direct and indirect GHG emissions, thus helping confront major environmental impacts such as climate change.
Higher property value	• Energy efficient buildings have a higher market value due to reduced costs of heating, cooling, maintenance needs etc.
Higher living and working conditions	• An energy efficient building offers a living or working environment which offers an increased quality of life (e.g. better indoor air quality, thermal comfort) thus increasing the happiness and productivity of the occupants.
Increased acceptance and raising awareness	• A best practice building attracts occupants and visitors more. In many cases, these buildings act as an exemplar, raising awareness regarding the potential benefits of available best practices.

4. BRIEF PRESENTATION of policies related to energy efficiency

Energy policy is guided by a number of crosscutting documents and initiatives. The European policy for buildings has been evolving since 1990's. Measures were taken by Member States to promote a better energy performance of buildings. In 2002, the Directive Performance of Buildings (EPBD) – Directive 2002/91/EC was adopted and in 2010 a recast made the goals more ambitious and reinforced the implementation. European Union presented in 2011 the "Roadmap for moving to a competitive low carbon economy in 2050" which provides a long term pathway to achieving an 80% cut in domestic emissions compared to 1990 by 2050. Indicative priorities were set by "Energy Roadmap 2050". A recent policy document on energy efficiency[6] was published in July 2014. The specific document includes a discussion on

[4] http://www.ktizontastomellon.gr/index.php/eksoikonomhsh-energeias/exoikonomisi_energeias/energiaki_apodotikotita/ (Date accessed 12/11/2014)

[5] Buildings Performance Institute Europe (BPIE), 2011, Europe's buildings under the microscope – A country-by-country review of the energy performance of buildings. Available from: http://www.bpie.eu/uploads/lib/document/attachment/20/HR_EU_B_under_microscope_study.pdf (Date accessed 15/11/2014)

[6] European Commission, 2014, Communication from the Commission to the European Parliament and the council, Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy. Available from: http://ec.europa.eu/energy/efficiency/events/doc/2014_eec_communication_adopted.pdf (Date accessed 15/11/2014)

energy efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy calling for a 30% energy efficiency target by 2030. Energy efficiency policy is also guided by an indicative target for 20% energy savings by 2020 and many policy reports and directives related to energy efficiency[7].

The Directive 2012/27/EU, adopted by Directive 2013/12/EU, establishes a common framework of measures for the promotion of energy efficiency within EU to ensure that the 20% target is achieved by 2020 and to facilitate further energy efficiency improvements beyond that date. All EU countries are required to use energy more efficiently at all stages of the energy life cycle – from the transformation of energy and its distribution to its final consumption. The Directive removes barriers and overcomes market failures that impede efficiency in the supply and use of energy and provides guidance for the establishment of indicative national energy efficiency targets for 2020.[8] It also includes specific measures including:

- Public sector to act as an example by renovating 3% of buildings owned and occupied by the central governments starting from 01 January 2014 and by including energy efficiency considerations in public procurement so as to purchase energy efficient buildings, products and services.

- The obligation of Member States to achieve certain amount of final energy savings over the obligation period (01 January 2014 to 31 December 2020) by using energy efficiency schemes or other targeted policy measures to drive energy efficiency improvements in households, industries and transport sectors.

- Major energy savings for consumers: easy and free-of-charge access to data on real-time and historical energy consumption through more accurate individual metering will empower consumers to better manage their energy consumption.

For further information regarding policies in EU and other BSBEEP countries please check the analytical study "GA1.2: Collection of information about funding opportunities, programs and political initiatives at EU, national and local level and evaluation in order to meet the needs of partners" developed by BSBEEP team, freely available on BSBEEP website: **www.bsbeep.com/library/reports/**.

5. Energy efficiency in buildings METHODOLOGY

The methodology for assessing and improving energy efficiency in buildings includes theoretical and technical procedures that concern both engineers and non-engineers. For engineers, this methodology is a formula that allows them to evaluate a building's energy performance. Through standardized steps they can evaluate and certify the energy efficiency of a building and propose specific interventions for improvement. For non-engineers, the knowledge of key technical and theoretical information regarding energy performance of buildings allows them to better understand the impact of their energy-related behavior and through proper management helps them handle energy more efficiently. The key steps include the identification of typical energy flows of a given building, the determination of current energy performance of the building, benchmarking its performance with a reference building, and the acquisition of an Energy Performance Certificate (EPC).

5.1. Typical energy flows in buildings

Walls including windows and doors, floors and roof constitute the **building envelope**. The role of the envelope is to retain the desired conditions (temperature, humidity, air quality and lighting) inside the building according to the needs of the occupants regardless of the weather

[7] http://www.eceee.org/policy-areas (Date accessed 15/11/2014)
[8] http://ec.europa.eu/energy/efficiency/eed/eed_en.htm (Date accessed 20/11/2014)

conditions outdoors. For this purpose, typical energy flows (including internal and external heat loads, solar loads), air movement and moisture penetration must be controlled.

The desired conditions can be only preserved if, firstly, all imposed energy loads by the climatic conditions stay outside the building and, secondly, energy loads that originate from factors inside the building are controlled properly. Consequently, the buildings must consume energy to balance external and internal loads.

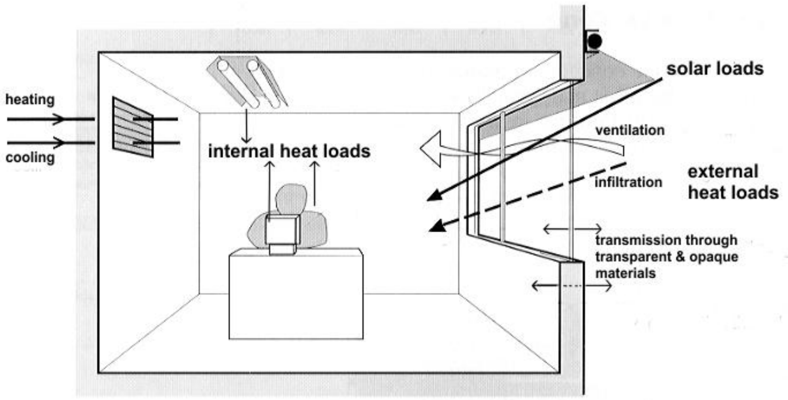


***Figure 4**: Typical energy flows in buildings.*

External loads can be **heat transmission**, **ventilation** and **infiltration** mainly due to the difference between indoors and outdoors temperature. These loads can be either a heat loss or a heat gain, depending on the outdoor temperature and climate conditions. Heat loss means that heating energy to compensate is required, while heat gain leads to cooling energy demand. The solar load is a permanent heat gain as it is independent of temperature.

Internal loads include heat gains. People, lighting, equipment and hot water systems give off energy to the building space. People release energy in the form of dry heat and moisture depending on their body mass, their activity and their dressing habits. Heat gains from equipment can be either desirable in cold weather or not in hot weather, increasing the need for cooling.

5.2. Determining a building's energy performance

Directive 2010/31/EU specifies that all Member States should harmonize their national methodology for the calculation of building energy performance within a common general framework. This framework, which leads to a standardization of European Policy, is described in Annex I of the Directive, containing all main characteristics and variables that are included in the calculations of a building's energy performance:[9]

1. Actual (or calculated) annual energy is the energy consumed in order to meet the different typical needs. These needs include either energy for heating or cooling so that both the desirable temperature conditions of the building and the domestic hot water needs can be maintained. This is the basis according to which the energy performance of a building is determined.

2. The expression of the energy performance, which may be based on national or regional annual weighted averages or a specific value for on-site production, shall be transparent. Indicators of energy performance and numeric values of primary energy use based on primary energy factors (per energy carriers) are also included.

3. There are variables and characteristics that should be definitely taken into consideration and concern the thermal and geometrical properties of the building, relative facilities or other systems, and the outdoor or indoor conditions. The inventory of these variables and characteristics includes:

[9] Official Journal of the European Union, 2010, Directive 2010/31/EU, ANNEX I. Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF (Date accessed 3/12/2014)

- Actual thermal characteristics of the building including its internal partitions (**thermal capacity**, insulation, **passive heating**, cooling elements, **thermal bridges**),
- Heating installation and hot water supply, including their insulation characteristics,
- Air-conditioning installations,
- Natural and mechanical ventilation which may include air-tightness,
- Built-in lighting installation (mainly in the non-residential sector),
- Design, positioning and orientation of the building, including outdoor climate,
- Passive solar systems and solar protection,
- Indoor climatic conditions, including the designed indoor climate, and
- Internal loads.

4. Considering the calculation, there are some aspects that have a positive influence in the thermal balance of the building and concern both natural and technical systems. They can be:

    - Local solar exposure conditions, **active solar systems** and other heating and electricity systems based on energy from renewable sources,
    - Electricity produced by **cogeneration**,
    - District or block heating and cooling systems, and
    - Natural lighting.

5. Each building depending on its type, size, use and properties (whether it is residential or not) is classified into specific categories that can be either single-family houses of different types and apartment blocks or offices, educational buildings, hospitals and other types of energy-consuming buildings.

5.3. Benchmarks

The minimum energy performance requirements are expressed in relation to a reference building of predefined characteristics. The relative benchmarking mechanism is a way to determine cost-optimal levels for comparing and setting these requirements as a common framework. This comparative methodological framework requires:[10]

- A definition of a reference building (residential or not, new or existing) that is representative for its functionality and climate conditions.
- A definition of energy efficiency measures (for whole buildings, for building elements or a combination of them) that are evaluated for the reference building.
- An assessment of the final and the primary energy needs of the reference building (with and without energy efficiency measures). Related calculations are according to relevant European (or national) standards.
- A calculation of the costs of the energy efficiency measures during the expected economic life cycle applied to the reference building. Investment costs, maintenance and operating costs and earnings from energy produced and disposal costs must be taken into account.
- A calculation of **cost-optimal level** for each reference building.
- A comparison of the current minimum energy performance requirements with the cost-optimal levels identified.

The comparative methodological framework is not meant to harmonize the minimum energy performance requirements per se, but to ensure that the level of ambition of every EU Member State in its given context is similar.

[10] Official Journal of the European Union, 2010, Directive 2010/31/EU, ANNEX III. Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF (Date accessed 3/12/2014)

5.4. Certifying energy efficiency

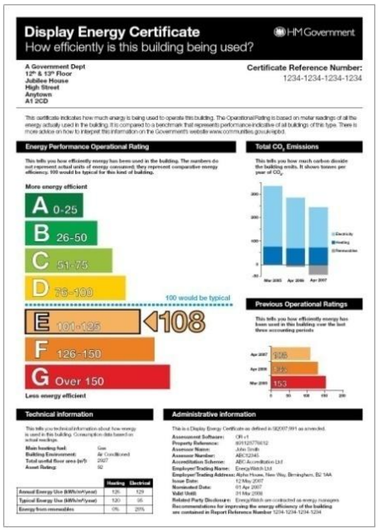


***Figure 5**: Building energy certificate example.*

Energy Performance Certificates (EPCs) play a significant role in enhancing the energy performance of buildings. They are an integral part of the Energy Performance Building Directive (EPBD) and their main objective is to constitute an information tool for all property actors (owners or occupiers) in the process of a building transaction. Consequently, EPCs can create demand for energy efficiency in buildings as they can be help improving decision – making criteria in real estate transactions and by providing recommendations for the cost – effective or cost – optimal upgrading[11].

Another important issue of EPCs is that they constitute significant sources of information on the energy performance of the building stock and impact of renovation measures (confirmed by several studies and Building Performance Institute Europe (BPIE) surveys in 2011 and 2013). Therefore, they cannot only be an information tool, but also an effective instrument for improving the energy efficiency of the building stock. With EPCs, the energy performance of a country's building stock can be mapped, the impact of building policies can be monitored and minimum energy requirements within the regulatory process can be supported. These data should be reliable, accessible and reusable by the building community in order to maximize certificates' benefits[11].

In order to achieve the anticipated benefits, the Member States have to properly implement and endorse these EPC systems through proper management, control and mechanisms. In this way the EPCs will increase the market value of energy efficiency in buildings and effectively support the transition of the real-estate sector towards low-energy buildings.

6. Energy efficiency MEASURES for buildings

The key to the energy efficiency of a municipal office building is in the proper management of the energy use of the facility. Energy costs and carbon emissions can be minimized either with the implementation of technical interventions in the building but also by efficient maintenance and proper behavior. The "upper management"[12] is responsible for organizing an efficient energy plan including actions for improving both the efficiency of the building and the energy behavior of its occupants whereas employees[13] must participate in the ambition and achievement of business's goals for lower levels of energy consumption through simple actions in their daily work. Therefore, an energy use baseline must be firstly established with the implementation of different intrusive measures concerning potential refurbishment while proper behavior in energy use is being applied[14]. Relative ameliorations actions can be divided into two groups, these of upper management and of lower management, as Table 2 illustrates.

[11] Buildings Performance Institute Europe (BPIE), 2010, Energy Performance Certificates across Europe – From Design to Implementation. Available from: http://bpie.eu/uploads/lib/document/attachment/81/BPIE_Energy_Performance_Certificates_EU_mapping_-_2014.pdf (Date accessed 4/12/2014)

[12] United Nations Environment Programme (UNEP) - SKANSKA, Sustainable United Nations, , Energy Efficiency in Buildings - Guidance for UN facilities managers. Available from: http://www.group.skanska.com/cdn-1cc5cbfaaeb76ae/Global/sustainability/Materials/UNEP_Energy%20Effic%20Broch%20final.pdf (Date accessed 11/12/2014)

[13] Shui Bin, 2012, Greening Work Styles: An Analysis of Energy Behavior Programs in the Workplace – Report Number B121. Available from: http://www.aceee.org/research-report/b121 (Date accessed 20/12/2014)

[14] United Nations Environment Programme (UNEP), Sustainable United Nations – Environmental Resources Management, Climate Friendly Buildings and Offices – A practical Guide. Available from: http://www.unep.fr/shared/publications/pdf/DTIx1278xPA-Climate%20Friendly%20Buildings%20and%20Offices.pdf (Date accessed 20/12/2014)

__Table 2__: Indicative energy efficiency measures to be applied by municipal servants.

Upper Management	**Establish a baseline of energy use**	• Identify levels of current energy consumption. • Identify possible areas for energy saving. • Define the optimal temperature in the office.
	Incorporate maintenance activities	• Regular maintenance checks to identify possible problems and sources of waste. • Maintenance by expert staff or trained teams of employees. • Maintenance of the HVAC systems.
	Increase energy efficiency of lighting systems	• Install low wattage lamps or LED lighting. • Lighting controls and sensors should be installed and • Natural daylight should not be obstructed. Use of sun pipes can reduce the need for artificial light. • Photocells will automatically turn off the lights when daylight is adequate. • PIR (motion) sensors ensure that lights are used only when needed.
	Increase energy efficiency of heating, ventilation and air conditioning (HVAC) systems	• Timers and temperature controls maximize heating efficiency (Installation of Building Management Systems). • Control systems must match occupancy hours and operational requirements. • Water heating systems should be properly insulated. • Solar water heating panels should be considered. • Good air distribution leads to proper temperatures in office. • Air economizers reduce the start-up energy needed. • Units in common areas must be set to the same mode of operation. • Sources of unwanted heat should be removed away from air conditioned areas, especially from the thermostats. • Avoid excess cooling (below 24°C) and excess heating (above 19°C). • Options for free cooling (shading from tree planting, re-using exhaust ventilation from offices to garages etc.) and natural ventilation (mechanical systems switched off).
	Intervene in the building envelope	• Proper insulation of walls, floors and roofs. • Good ventilation keeps insulation dry. • Installation of double- or triple-glazed windows. • Draughts or air infiltration should be eliminated from ill fitting windows and doors (with draughtstrip or PVC seal). • Use of external building envelope treatments such as solar reflective surfaces is appropriate. • Retrofit existing roof with Green roof or Cool roof. • Use of reflective exterior wall coating.
Lower Management	**Sustainable use of equipment**	• All monitors, when are not in use, should be turned off. • Computers should be customized in power saving settings (stand-by, sleep mode etc.). • Photocopiers should be turned off during non-business hours. • Equipment, machines or printers should be turned off when they are not in use. • Copies should be minimized or double - sided printed whenever possible. • Chargers should be unplugged when they are not charging a laptop or a mobile phone. • Laptops, if possible, should be used more than desktop computers. • Inkjet printers, if possible, should be used more than laser printers. • Use of ENERGY STAR labeled office equipment.
	Sustainable use of lighting	• Lights in rooms not in use should be turned off. • Day lighting should be taken advantage of. • Louvers should be used wisely both in summer and in winter. • Artificial lighting should be used wisely depending on the activity. • Reduce ambient light and use task lighting.
	Sustainable use of heating and thermal comfort needs	• Thermostats should be used wisely both in winter or summer, keeping a steady temperature. • Clothing should be adjusted to the office temperature needs.

A comprehensive collection of the best available retrofitting actions that can be applied to increase the energy efficiency of municipal buildings, including specific case studies, is freely available on BSBEEP website: **www.bsbeep.com/library/reports/**.

7. FINANCING energy efficiency in buildings

Limitation of resources that are insufficient to meet the needs of relevant market programs and ineffectiveness of public subsidies to alleviate all the barriers to sustainable energy financing, make specific financing mechanisms necessary. These mechanisms lead to a more efficient use of public money and reveal existing market failures and issues of sustainable energy projects' financing[15].

European Commission intends to introduce financial mechanisms for funding under a centralized management or under a shared management (between European Commission and Managing Authorities). For the 2014 – 2020 programming period, Managing Authorities can allocate budget to Funding Instruments within all their Operational Program's thematic objectives. Additionally, a combination of Funding Instruments and non-refundable grants (for investments in sustainable energy in buildings) is possible. In Table 3, the existing financial and fiscal mechanisms for the building sector are summarized.

Table 3*: Existing financial and fiscal mechanisms for the building sector.*

Mechanism	Adequacy	Source of funding	Uses of funds
Grants	High for large buildings	State budget, funds, international financial institutions, bilateral donors	Short term priority; aimed at determining the level of investment demand and supporting owners in loan applications; energy audits, feasibility studies; public buildings, commercial services, multi-apartment buildings
Preferential loans	High for commercial services and residential buildings	International financial institutions, Energy Efficiency funds, guarantee funds, development funds/banks, local commercial banks	Short term priority; assessed investment demand serves as a base for Government loan applications to international financial institutions
Third Party Financing (TPF)/ESCO (EPC)	Medium	Energy service companies, leasing companies	Mid-term; prerequisites: legislation, standardized monitoring and verification protocols, training, cost-reflective energy carrier prices
White certificates	Low	Developed countries	Mid- to long-term
Tax Rebates	Low to medium	State budgets; more suitable for companies	Mid-term
Tax Deduction	Low to medium	Income tax reduction for legal and natural persons investing in EEI of own buildings	Short- to mid-term
VAT Reduction	Low to medium	State budgets; suitable for measures with short payback	Short- to mid-term

[15] European Commission, 2014, Technical Guidance – Financing the energy renovation of buildings with Cohesion Policy Funding. Available from: http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/financing_energy_renovation.pdf (Date accessed 10/01/2015)

During last five years, a wide spectrum of international organisations and bodies has been involved in preparation and funding of mid-term programmes and short-term projects on energy efficiency either in the building sector or in a more integrate approach. EU member states (Greece and Romania) are almost exclusively dependent on EU structural funds to promote energy efficiency, while the other countries (Moldavia, Ukraine, Armenia and Turkey) have been active to attract funds from a much more differentiated type of donors.

EU-funded initiatives are abundantly funded, have a middle-to-long term perspective, are part of a comprehensive approach for the overall development of EU and finally having a quite “permanent” character, as they constitute part of EU cohesion policy targeting the convergence of EU regions. On the other hand, programmes and projects implemented at rest four countries are documenting their ability to attract funds from a wide array of institutions (most of these though have EU sources).

For further information regarding financing opportunities in EU and other BSBEEP countries please check the analytical study “GA1.2: Collection of information about funding opportunities, programs and political initiatives at EU, national and local level and evaluation in order to meet the needs of partners” developed by BSBEEP team, freely available on BSBEEP website: **www.bsbeep.com/library/reports/**.

8. DEVELOPING and IMPLEMENTING POLICY on energy efficiency

Public and private investments are necessary to develop and implement the increasingly critical mandate of energy efficiency in buildings. Figure 6 provides a generic scheme for developing and implementing policy on energy efficiency in buildings.

These actions concern European Union‘s objectives for climate change, energy and decarbonisation up to 2020 and 2050. For these objectives to be met, investment funds are required, playing a major role in the sustainable renovation, upgrading, and construction of buildings that are governed by the Common Provisions Regulation and other regulations.[14]

Europe’s Cohesion Policy for investments in the 2007 – 2013 programming period concerned the improvement of public, commercial and residential buildings. In the 2014 – 2020 programming period the renewable energy and sustainable measures have a higher budget. Considering this fact, Cohesion Policy Managing Authorities, should plan and deploy sustainable energy investments in buildings within Operational Programs and innovative financial mechanisms. They should consider European requirements on buildings, the different financing mechanisms and the various national legislations in the energy renovation of buildings that must adjust to the several EU Directives for sustainable energy[14].

All these actions are incorporated in a general plan with supplementary major stages concerning priority intervention areas and proper strategies, evaluation framework of economic, social, energy-related and environmental impacts, appropriate financing mechanisms, the design, and implementation and monitoring of sustainable energy programs.

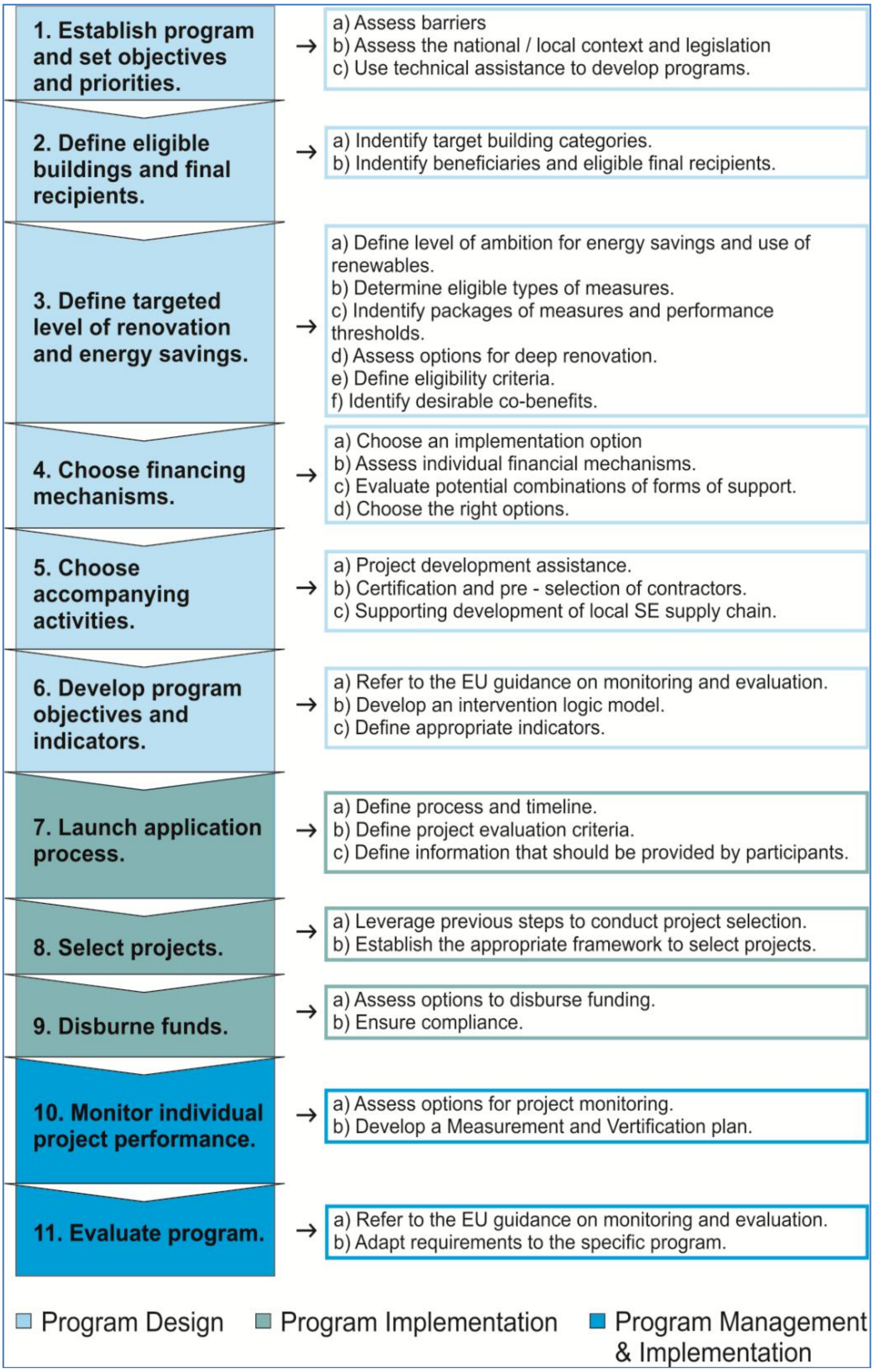


Figure 6: *Developing a sustainable energy programme for buildings (Source: See footnote 14).*

9. TOOLS to promote building energy efficiency

There are an important number of initiatives with websites and publications that promote good practice on energy efficiency. Below is a listing of some of these initiatives.

- The Covenant of Mayors (CoM) helps municipalities estimate and reduce their carbon footprint. CoM is an EU-scale initiative involving a significant number of municipalities within EU and partner countries. The participating municipalities voluntarily commit to increase energy efficiency within their jurisdiction and the basic quantitative objective of the specific initiative is a 20% reduction of CO_2 emissions by 2020 (www.covenantofmayors.eu)

- The BUILD UP initiative, established by the European Commission in 2009, supports EU Member States in implementing the Energy Performance of Buildings Directive (EPBD). The BUILD UP web portal is intended to reap the benefits of Europe's collective intelligence on energy reduction in buildings for all relevant audiences. It will bring together new practitioners and professional associations while motivating them to exchange best working practices and knowledge and to transfer tools and resources (www.buildup.eu).

- The Sustainable Energy Europe Campaign created by the European Union in 2005 as its major effort to promote energy efficiency and renewable energy sources. Now managed by the EU’s Executive Agency for Competitiveness and Innovation (EACI), more than 1200 energy projects comprise the Campaign. Sustainable Energy Europe is designed to spread best practices in sustainable energy technology, build alliances, and inspire new energy ideas and actions. (www.sustenergy.org)

- ManagEnergy is a technical support initiative of the Intelligent Energy – Europe (IEE) program of the European Commission that aims to assist actors from the public sector and their advisers working on energy efficiency and renewable energy at the local and regional level. (www.managenergy.net)

- The European Council for an Energy Efficient Economy - ECEEE is a non-profit, membership-based European NGO. The goal of ECEEE is to stimulate energy efficiency through information exchange and co-operation. (www.eceee.org)

- The Buildings Performance Institute Europe (BPIE) focuses on the improvement of the energy performance of buildings across Europe and therefore, it helps to reduce CO_2 emissions from the energy used by buildings. BPIE's mission is to take over the necessary analysis and provide knowledge and advice so that a sustainable and low carbon built environment can be achieved by addressing the existing gaps of EU policies for buildings. It also supports a vigorous implementation of the relevant Directives and programmes at country level. (www.bpie.eu).

10. The BSBEEP E-TOOL

The numbers of buildings that fall under a municipality’s jurisdiction are in the order of hundreds and in that aspect the analytical energy assessment of every building is costly in terms of time and effort. Analytical tools are already available in the market that can comprehensively assess various aspects regarding energy efficiency and performance of buildings. However, often, using these tools requires a degree of expertise. In many situations municipal authorities need to decide quickly using evaluation and results that have been obtaioned by civil servants or other staff with limited scientific knowledge.

The BSBEEP e-tool (Figure 7) can enhance decision making of municipal authorities and relevant agents by helping them assess the energy consumption of buildings fast but effectively. The proposed e-tool is based on the following concepts:

- The inputs are easily accessible or easily calculated by the e-tool user,
- The e-tool has a qualitative and quantitative output,
- The e-tool is easily installed and operated in every PC (with Microsoft Excel application) by experts or non-experts,

General Characteristics	
Country	Greece
Building use	Educational
Year of constr.	1991

Qualitative assessement data	
Heating (HS)	
Type	Oil boiler
Automation	None
Maintenance	Yes
Cooling (CS)	
Type	AC (regular)/Floor fans
Automation	None
Maintenance	No/Unknown
Lighting (LS)	
Type	Fluorescent lamps
Automation	None
Day lighting	Required
HDW	
Type	Electrical boiler
Automation	None
Maintenance	No/Unknown
Building envelope (BE)	
Insulation	Only in building frame
Glazing	Double insulated
Frames	Aluminum/steel
Renewable source	
RES ?	No/Unknown

Quantitative assessement data		
Number of floors	3	
Building floor perimeter	274	[m]
Building height	12	[m]
Building envelope area	3288	[m2]
Windows area	452	[m2]
Wall area without windows	2836	[m2]
Building floor/ceiling area	1580	[m2]
Building volume	18960	[m3]
Wall material	Brick	
External wall thickness	25	[cm]
Insulation material	Expanded polystyrene (EPS)	
Insulation thickness	3	[cm]
Exterior carpentry	Double/metal	
Total annual energy consumption per use		
Heating	67606	[kWh]
Cooling	1734	[kWh]
DHW	0	[kWh]
Lighting	8667	[kWh]

***Figure 7**: The BSBEEP e-tool.*

The proposed assessment mechanism consists of two levels of assessment:

1. **Qualitative assessment** (0-50 points)
<u>Focus</u>: Energy saving potential

- The specific procedure assesses the current features of the examined building in order to provide a quick qualitative image of the performance of the building based on best available practices.
- The qualitative assessment is performed through the evaluation of five generic categories related with the features of the examined building namely: a) Building envelope (BE), b) Heating system (HS), c) Cooling system (CS), d) Lighting system (LS) and e) Domestic hot water (DHW)
- The specific method requires simple qualitative inputs (questions in multiple choice form) to perform the assessment. In that aspect, if someone is not aware of the energy consumption of the building can also use the tool.
- Buildings with high score are energy efficient and have therefore low potential for energy efficiency interventions. On the other hand, buildings with low score have high potential for energy efficiency interventions.

2. **Quantitative assessment** (0-50 points)
<u>Focus</u>: Building energy demand and building actual consumption

- The specific procedure takes into account European energy assessment methodologies and legislation and provides sound and more technical analysis of the expected energy demands/consumption of the building. More concretely, it compares the annual energy consumption of the building (per end use) with the national average for the specific type of buildings (in KWh/m^2). In that respect, even if someone has only energy consumption information (not knowing type of insulation, glazing type etc.) can also use the tool.
- Many users despite the fact that they live in relatively energy efficient buildings act irresponsibly in terms of energy saving (e.g. air condition with open windows on municipal offices). In that way the e-tool can also capture in its score energy irresponsible behavior.

With the categorization of the assessment in two levels, someone is able to use the e-tool even with a small amount of data, whereas those who wish to have a more analytical assessment can also apply it. The compilation of quantitative and qualitative assessment provides the final score ranging from 0-100 Pts, with 100 representing maximum performance.

The BSBEEP E-tool and all supportive material for its efficient implementation are available on **www.bsbeep.com**.

GLOSSARY

Building envelope: integrated elements of a building that separate its interior from the outdoor environment.

Heat transmission: an exchange of thermal energy between physical systems by three mechanisms (conduction, convection, radiation).

Ventilation: the process of “changing” or replacing air in any space to provide high indoor air quality.

Infiltration: a heating, ventilation, and air conditioning term for air leakage into buildings.

Thermal capacity: the heat capacity of a defined system is the amount of heat (in calories, kilocalories, or joules) needed to raise the system's temperature by one degree (in Celsius or Kelvin). It is expressed in units of thermal energy per degree temperature.

Passive heating: passive heating uses the energy of the sun to keep occupants comfortable without the use of mechanical systems. The systems for passive heating are called passive solar systems (e.g. solar thermal collectors, solar walls, Trombe walls).

Thermal bridges: the parts of the building which have an increased heat transmission and cause heat loss. There are geometrical thermal bridges due to parts of the building and material thermal bridges due to different materials’ conductivity when combined.

Active solar systems: Active solar systems collect solar radiation and convert it in the form of heat to water, air, or some other fluid.

Cogeneration: (or Combined Heat and Power) is the simultaneous production of electricity and useful heat, both of which are used.

Cost-optimal level: Cost-optimal level means the energy performance level which leads to the lowest cost during the estimated economic lifecycle.