UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

UNIVERSITY OF SARAJEVO
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

IMPROVING ENERGY EFFICIENCY IN PUBLIC BUILDINGS OF BOSNIA AND HERZEGOVINA

Ljubljana, September 2017 AIDA ĐOZIĆ

AUTHORSHIP STATEMENT

The undersigned Aida Đozić, a student at the University of Ljubljana, Faculty of Economics, (hereafter: FELU), author of this written final work of studies with the title "Improving Energy Efficiency in Public Buildings of Bosnia and Herzegovina", prepared under supervision of prof. dr. Nevenka Hrovatin

DECLARE

1. this written final work of studies to be based on the results of my own research;

2. the printed form of this written final work of studies to be identical to its electronic form;

3. the text of this written final work of studies to be language-edited and technically in adherence with the FELU's Technical Guidelines for Written Works, which means that I cited and / or quoted works and opinions of other authors in this written final work of studies in accordance with the FELU's Technical Guidelines for Written Works;

4. to be aware of the fact that plagiarism (in written or graphical form) is a criminal offence and can be prosecuted in accordance with the Criminal Code of the Republic of Slovenia;

5. to be aware of the consequences a proven plagiarism charge based on the this written final work could have for my status at the FELU in accordance with the relevant FELU Rules;

6. to have obtained all the necessary permits to use the data and works of other authors which are (in written or graphical form) referred to in this written final work of studies and to have clearly marked them;

7. to have acted in accordance with ethical principles during the preparation of this written final work of studies and to have, where necessary, obtained permission of the Ethics Committee;

8. my consent to use the electronic form of this written final work of studies for the detection of content similarity with other written works, using similarity detection software that is connected with the FELU Study Information System;

9. to transfer to the University of Ljubljana free of charge, non-exclusively, geographically and time-wise unlimited the right of saving this written final work of studies in the electronic form, the right of its reproduction, as well as the right of making this written final work of studies available to the public on the World Wide Web via the Repository of the University of Ljubljana;

10. my consent to publication of my personal data that are included in this written final work of studies and in this declaration, when this written final work of studies is published.

Ljubljana, 27th September, 2017 Author's signature: _____

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Energy is a crucial issue of our time as it is linked with global challenges, such as poverty alleviation, social development, environmental degradation and climate change. Modern society has begun to focus on the more efficient utilization of existing energy supplies to help meet its energy needs. Reddy, Assenza, Assenza, and Hasselmann (2009) believe that, in order to meet growing energy demand, it may be more economical to make efficient use of the existing energy resources, rather than to develop new energy supplies.

Energy and development are interdependent. According to Reddy et al. (2009) more efficient energy use promotes economic development and improves the standard of living. Energy is closely linked to economic opportunity, security and empowerment. Traditional, but unsustainable development models that include increased urbanization, usage of disposable goods and various energy-consuming appliances, high level of energy consumption and car ownership, represent inefficient lifestyle that is still considered as ideals in developing countries (Sarkar & Singh, 2010, p. 1).

Energy efficiency (hereinafter: EE) "is a generic term that refers to using less energy to produce the same amount of services or useful output" (Patterson, 1996). EE is not only connected with reducing energy costs, but it is also recognized as the fastest and a cost-effective way to improve the security of energy supply, conserve natural resources, reduce environmental pollution, and fight against climate change.

EE is at the cornerstone of the European energy policy. It is one of the main targets of the Europe 2020 Strategy for smart, sustainable and inclusive growth, adopted by the European Council in June 2010, as well as in later 2030 climate and energy policy framework, adopted in 2014. Improved EE makes an essential contribution to all major objectives of European Union (hereinafter: EU) climate and energy policies: improved competitiveness, security of supply, sustainability, and transition to a low-carbon economy (European Commission, 2014, p. 8).

Public sector is facing a period of profound challenges in which cost-efficiency and rigorous management are visible imperatives. It is now being challenged to take a collective leadership role in adopting high EE standards and practices that can exemplify and help drive change through all sectors, reduce costs, cut emissions, and mitigate climate change. At its core, public sector EE is synonymous with good public management: when energy is saved, the public funds used to pay for it are also saved (Energy Charter Secretariat, 2008). EE improvements programs can reduce energy-related bills, thus creating fiscal space for social services and critical infrastructure investment priorities (Singh, Limaye, Henderson, & Shi, 2010, p. 15). Effective public sector EE projects produce common benefits that include savings in public sector energy use and costs, dissemination of energy-efficient products and services, as well as the benefit of leadership by example (Energy Charter Secretariat, 2008).

The World Bank estimates that the biggest energy saving potential in the Western Balkans (including Bosnia and Herzegovina) lies in public buildings. Although systematic data on energy consumption in public sector buildings are not available, the estimated savings potential in public buildings is about 35-40% of current energy consumption (World Bank, 2010). Bosnia and Herzegovina (hereinafter: BiH) belongs to developing countries, and the power sector is considered as one of the strongest points in its development. As many other developing countries, BiH has very low EE. According to the data obtained from the Energy Community Report in 2013, BiH energy intensity ratio was 0.58 toe/1,000 USD (tonnes of oil equivalent to one thousand United States dollar), which means that it was significantly higher than the world average of 0.24 and in particular than in the EU-28 (0.11). With the existing level of energy intensity, more than 20% of the national Gross Domestic Product (hereinafter: GDP) is spent on energy, which is a clear indicator that significantly more attention has to be paid to EE in BiH (Municipal Network for Energy Efficiency, n.d.). According to Energy Charter Secretariat (2012), BiH ratified the Energy Charter Treaty and the Protocol on Energy Efficiency and Related Environmental Aspects in 2001 and by ratifying the Protocol, became committed to formulate and implement policies for improving EE and reducing the negative environmental impact of the energy cycle.

The purpose of my master's thesis is to study the concept of EE in public sector as an opportunity to save public money, demonstrate good practices, encourage the dissemination of energy-efficient products and services, and fight against environmental changes. In the view of the fact that BiH belongs to developing countries, with a huge public sector and budget deficit on the one hand and low EE on the other hand, there is a huge potential for EE improvement. The focus is on presenting the tools for EE improvements in public buildings and identifying the main problems and barriers that have to be addressed in order to improve EE in the BiH public sector. In addition, the purpose is to demonstrate how important it is to raise awareness about this issue in my country.

The main research questions in my master's thesis are:

- Why is it important to improve EE in the public sector?
- What are the key tools for EE improvements in public buildings?
- What are the main barriers for EE improvements in the public buildings of BiH?

In this respect, in my master's thesis I aim to achieve the following objectives:

- to study the importance of EE in the public sector;
- to analyze the ways of improving EE in public buildings;
- to analyze the possibilities for financing EE projects of in the public sector;
- to identify the main problems and barriers that have to be addressed in order to improve EE in the public buildings of BiH.

Qualitative research methodology is used in the thesis. In order to explore and understand the concept of EE, energy management and its characteristics in the public sector, I conducted a literature survey of the subject by consulting relevant books, scientific articles, and published reports. A combination of descriptive methods, comparative analysis and critical review is used to analyze legal and institutional framework and indicators related to EE in the public buildings within the EU and BiH. The EU directives – the Directive 2012/27/EU on energy efficiency (hereinafter: Energy Efficiency Directive) and the Directive 2010/31/EU on the energy performance of buildings, as well as the Energy Efficiency Plan, are used to provide information on relevant polices and measures used in the EU for EE improvements in public sector. For the purpose of providing information on EE improvements in BiH, relevant research papers and reports, including Energy Community reports, as well as the BiH National Energy Efficiency Action Plan, are also explored. Primary research is used in order to better understand barriers to and driving forces of EE improvements in the public sector of BiH. The primary research was conducted through interviews that were conducted with representatives of the BiH public institutions, as well as EE experts from international organizations involved in EE improvements in BiH.

The master's thesis consists of six main chapters. The first chapter defines EE and reveals its benefits and indicators. The second chapter gives an insight into the EU legislation in the field of EE with emphasis on the requirements of the EU directives related to EE improvements in public buildings. Third chapter goes deeper into the topic and deals with the importance of EE improvements in public sector, giving an insight into the main barriers that hinder EE improvements in public sector, as well as main driving forces for EE improvements. That chapter further gives an overview of the key tools for EE improvements in public sector, including energy management, energy audit, energy benchmarking, energy certification and an overview of the financial instruments that are used for EE improvements. Chapter four deals with EE improvements in BiH. It gives a brief country overview, including administrative organization, economic background, and energy sector characteristics. That chapter further provides an insight into the framework for EE improvements in BiH. It reveals BiH obligations regarding EE improvements, the state of compliance with the obligations, as well as a draft BiH National Energy Efficiency Action Plan. In addition, that chapter describes the potential for EE improvements in public buildings, as well as targets and planned measures for the public buildings of BiH. Chapter five of the thesis addresses the main barriers and driving forces that are characteristic for EE improvements in the public buildings of BiH. Special attention is given to instruments for financing EE projects in the public sector of BiH. The master's thesis ends with conclusions.

1 ENERGY EFFICIENCY

1.1 The concept and definition of energy efficiency

The concept of EE became strongly popular in 1970s after the oil crisis had led to the realization that the world energy resources might not be enough to keep up with human consumption. Promotion of the efficient energy use in the context of high oil prices became important for reducing energy import dependence. In that period, some countries realized the potential for saving energy. The action in the field of EE policy was revived as a response to rising energy security issues and the commitment to achieve environmental targets set up by the Kyoto Protocol (Filippini, Hunt, & Zoric, 2014, p. 4).

There is no universally accepted definition of EE because defining it is not an easy task. An engineer may define EE in a limiting sense of equipment output, whereas an environmentalist or a politician may have a more broad vision of EE. When defining EE, "it is important to conceptualize energy as an input into the production of desired energy services (e.g., heating, lighting, motion), rather than as an end in itself" (Gillingham, Newell, & Palmer, 2009, p. 1). Accordingly, EE is usualy defined as the energy services provided per unit of energy input.

According to the Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1) "EE means the ratio of output of performance, service, goods or energy, to input of energy." Looking from the other side, according to Patterson (1996, p. 377), EE "refers to using less energy to produce the same service or useful output."

As described by the International Energy Agency (hereinafter: IEA), EE is a way of managing and restraining the growth in energy consumption. Since "the efficiency refers to the ratio of benefits to expenses, EE describes the ratio between the benefits gained and energy used" (Irrek & Thomas, 2008, p. 1). Therefore, the goal of EE is reducing the amount of required energy to perform the same task.

EE includes a number of measures required to reduce energy consumption and not impairing the conditions of life and work. According to the Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1) "EE improvement means an increase in EE as a result of technological, behavioral, and/or economic changes." While saving energy always implies certain sacrifices, efficient use of energy leads to an increase in the quality of life, greater competitiveness, and energy security. Increasing EE results in significant savings in terms of money and better living and working environment. The IEA (2014) suggests that EE is a new energy source ("first fuel in the world") because the investments in EE achieved such a big energy savings that exceed the energy produced from most other energy sources.

1.2 Why is energy efficiency important?

Energy is fundamental to sustained economic growth and crucial for reducing poverty and increasing prosperity. Business development, job creation, and income generation require an adequate energy supply that is both affordable and reliable. On the other hand, energy production and its use significantly affect the environment, causing local and regional pollution, and also issues such as global warming and climate change. Therefore, improving the efficiency of energy consumption is recognized as one of the most important pillars of a modern energy policy positively contributing to both national and international agendas. According to Petterson (1996, p. 377), the importance of EE as a policy objective is linked to commercial and industrial competiveness and energy security benefits, as well as increasingly to environmental benefits such as reducing of carbon dioxide (hereinafter: CO2) emissions.

Some of the most prominent benefits of energy efficiency are presented in Figure 1.

Figure 1. The Benefits of Energy Efficiency

Source: L. Ryan & N. Campbell, *Spreading the Net – The Multiple Benefits of Energy Efficiency Improvements*, 2012.

As presented in Figure 1, there is a wide list of the potential benefits that EE improvements can bring. Those benefits include energy savings, environmental improvement such as reduction of greenhouse gases and other pollutants, energy security, reduced energy costs, increased economy competitiveness, and job creation (Schnapp, 2012). The Energy Efficiency Market Report (IEA, 2013) highlights energy efficiency's place as a major energy resource since EE improvements deliver reductions in energy demand that exceed the output of any other fuel source.

EE constitutes a great opportunity for addressing many of the main European challenges of the 21st century at once. According to the Energy Efficiency Watch (2013, p. 5), EE is represented as a means:

- to mitigate climate change;
- to enable a secure energy supply without relying on imports of fossil fuels;
- to keep energy costs for private households and enterprises at bay;
- to become a technology supplier to the whole world, when efficiency technologies are exported.

According to Singh et al. (2010), EE is a win-win option for national governments that provides benefits to the government, energy consumers, and the environment. EE measures are generally viewed as "no regrets" policies because EE investments are justified with high financial returns. The report by the Energy Efficiency Financial Institution Group (2015, p. 11) further argues that EE investments beside direct energy returns, have significant public benefits that include improvements to a country's fiscal balance, lower emissions, increased employment and energy security.

Looking at the significant unrealized energy demand in the developing world, EE markets offer an opportunity to fundamentally modify the trajectory of energy consumption growth. Many developing countries are trying to improve EE in order to gain the multiple benefits that efficiency can provide in terms of improved air quality, improved electricity systems, poverty alleviation, and greater prosperity for their citizens.

1.3 Indicators of energy efficiency

Taking into consideration that EE is adopted as a worthwhile international goal, it is important that EE can be properly measured and its development tracked over time. However, EE is not an easily defined quantity nor can changes in energy consumption be easily linked to EE improvements. According to Patterson (1996), there is no definitive quantitative measurement of EE. Energy consumption can be measured, but it is not easy to conclude how much would be consumed if we were more or less efficient. Instead, we must rely on a series of indicators to infer changes in EE.

Indicators of energy consumption are widely used in different fields (economy, medicine, etc.) as instruments which provide information to measure the change in a phenomenon or process (Pérez-Lombard, Ortiz, & Velázquez, 2013, p. 241). They are useful to analyze the link of energy and human and economic activity (IEA, 1997a). On the other hand, EE indicators represent tools for identifying and understanding the key drivers of trends, and for prioritizing interventions to control energy consumption growth.

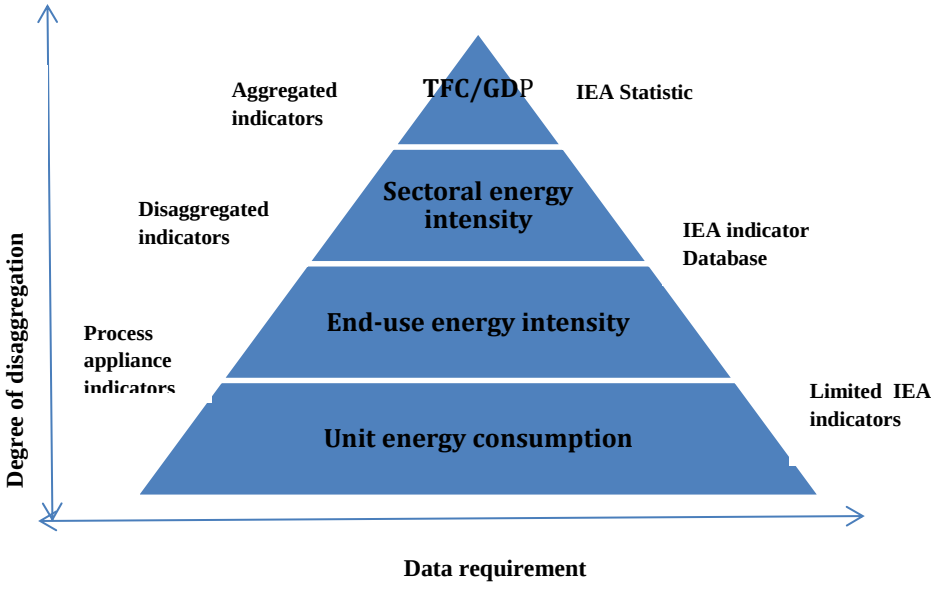
Many governments around the world work hard to improve the EE of their national economies as a way of managing and restraining the growth in energy consumption. However, a number of factors besides EE are also at play in setting the trends in energy

consumption, and they need to be properly understood in order to design practical policy measures. According to Trudeau and Murray (2011), separating different factors that influence energy use is the key purpose of EE indicators. In this respect, EE indicators help policy makers to make informed policy decisions and target the key end-users and behaviors that are driving energy consumption. These indicators provide information on trends in energy consumption and indicate to policy makers where energy savings can be made.

EE is usually approximated by energy intensity. However, European Commission (2000, p. 3) recognizes that changes in energy intensity are a rough estimate indicator for changes in EE since energy intensity also include temperature effects and other effects of economic restructuring. Very similar to this, the IEA (2009, p. 19) outlines that "energy intensity is often taken as a proxy for energy efficiency, although this is not entirely accurate since changes in energy intensity are a function of several factors including the structure of the economy and energy efficiency." Energy intensity is the amount of energy used per unit of activity and is commonly calculated as the ratio of energy use to GDP.

Substantial efforts have been undertaken by a range of international organizations already in early 1990s to develop meaningful ways to measure and monitor EE developments in various sectors and countries. The IEA has been pioneering in the development of EE indicators to study and analyze the main factors that influence energy use. The IEA indicator approach uses a pyramid that shows a hierarchy of energy indicators from the most detailed (at the bottom of the pyramid) to the least detailed (at the top of the pyramid). This hierarchy reveals how different factors such as policies, technological progress, structural reforms, or behavioral changes can be linked to more aggregate quantities, and shows how different changes affect each other.

Figure 2. The IEA Energy Efficiency Indicators Pyramid



Source: IEA, *Energy Efficiency Indicators: Essentials for Policy Making*, 2014a.

As explained by the IEA (2014a), the top row of the pyramid (the most aggregate indicator) is defined as the ratio of total energy consumption to GDP, or another macroeconomic variable, such as population. The second row of pyramid shows energy intensity of each major sector, while other rows represent the subsectors or end users. Aggregate indicators provide a general information on the factors that influence sectoral energy consumption. In order to recognize key drivers of energy consumption, more detailed information is required. Descending down the pyramid requires more data and more complex analysis; however, it also provides a better measure of EE.

With regard to the above discussion on various indicators, Phylipsen (2010) concludes that one EE indicator is not necessarily better than another. In general, the more disaggregated an indicator, the more information it can provide about the drivers underlying its development. However, each indicator has its own message and its own purpose. In order to estimate overall EE improvements, different explanatory data are required for the main end-use sectors (industry, residential, services, and transport), since the sectors are influenced by different underlying factors. According to IEA (2014b), the lack of data for developing proper indicators to measure EE improvement, often prevents countries from transforming declarations into actions. Without the data and EE indicators, it is difficult to optimize EE policies and monitor progress and failures.

As discussed by the IEA (2014a), from an energy policy perspective, it is important to understand the influence of EE improvements on changes in the final energy intensity. In order to understand the impact of EE, a decomposition approach is used to distinguish the impacts of the individual factors that influence energy consumption. According to Phylipsen (2010), changes in each of these factors can distort the message on EE performance and development that could be concluded from observed trends.

2 ENERGY EFFICIENCY AND THE EU

EE is an area where the EU decided to be the world leader. Measures for improving EE are recognized as a means not only for achieving a sustainable energy supply, cutting greenhouse gas (hereinafter: GHG) emissions, improving security of supply and reducing import bills but also for promoting the competitiveness of European economies. According to the European Commission Green Paper of 8 March 2006, "A European strategy for sustainable, competitive and secure energy" (European Commission, 2006a), the goal is to "decouple economic growth from increasing energy consumption," i.e. consuming less and still being more competitive. The Green Paper estimated that the EU holds a potential to achieve a reduction in energy consumption by 20% compared to the projections for 2020 in a cost-effective way.

The resulting Action Plan for Energy Efficiency: Realizing the Potential (European Commission, 2006b) proposed a range of cost-effective measures covering energy performance of equipment and appliances; energy transformation; limiting the costs linked

to transport; financing, incentives and fares; changing behavior and adapting and developing international partnerships. The Action Plan set up an ambitious goal of reducing 20% of primary energy consumption, increasing the share of used renewable energy resource by 20%, and reducing GHG for 20% until 2020. It was intended to mobilize all market actors and transform the internal energy market in a way that would provide EU citizens with the most energy-efficient infrastructure, products and energy systems. These targets were reconfirmed as one of the headline targets of the EUROPE 2020 – A strategy for smart, sustainable and inclusive growth (European Commission, 2010).

In 2006, the Directive 2006/32/EC on energy end-use efficiency and energy services was adopted. Under the Directive, the EU Member States are to achieve a 9% saving in the final energy consumption in the period from 2008 to 2016. In line with this, Member States were required to prepare respective national energy efficiency action plans (NEEAPs) that include different EE measures that would help achieving indicated energy savings. The target set by the Directive was considered as an important first step towards reaching the full EE improvements potential.

When forecasts in 2010 showed that the EU target for EE would not be met, the European Commission responded by developing a new and comprehensive Energy Efficiency Plan 2011 (European Commission, 2011), envisaging new measures that are expected to close this gap. The plan (hereinafter: EE Plan) listed a series of EE policies and measures covering the full energy chain, including energy generation, transmission and distribution, leading role of public sector in EE, building and appliances, industry, and the need to empower the final customer to manage energy consumption.

The EE Plan recognized that greatest energy saving potential lies in buildings and emphases instruments that should initiate the renovation process in buildings as well as measures that should improve energy performance of appliances used in buildings. The EE Plan highlights the importance of public sector in EE improvements, proposing binding target for refurbishment rate of public buildings and EE criteria in public procurements. According to the European Commission (2011), procurement of energy efficient products, buildings, cars and services decreases public sector expenditures and offers improved value for money.

In October 2014, the European Council set the 2030 climate and energy policy framework for the EU setting an ambitious economy-wide domestic target of at least 40% of GHG reduction for 2030 and at least 27% share for renewable energy and energy efficiency. According to the European Commission (2014, p. 13), while Member States are free to choose policies that are suitable to their national energy mix and preferences, those policies should be compatible with further market integration, increased competition and the EU climate and energy objectives. The European Commission (2016, p. 2) states that the 2015 “Paris Agreement vindicates the EU's 2030 approach.” Implementing the 2030 energy and climate framework as agreed by the European Council is a priority in follow-up to the Paris Agreement.

With the intention to encourage a better integration of EE in the national legislative frameworks and the policies, the EU has adopted several directives, which set specific directions for Member States, but also for member countries of the Energy Community of South Eastern Europe[1], such as Bosnia and Herzegovina. In respect of the thesis scope, the most important directives are the Directive 2010/31/EU on the energy performance of buildings and the Directive 2012/27/EU on energy efficiency.

2.1 Directive 2010/31/EU on energy performance of buildings

The Directive 2010/31/EU of the European Parliament and the Council of 19 May 2010 on the energy performance of buildings (hereinafter: Directive on energy performance of buildings) promotes the improvement of energy performance of buildings in the EU, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost effectiveness. According to Directive 2010/31/EU on energy performance of buildings (Official Journal of the European Union, L 153/13), "major renovations of existing buildings, regardless of their size, provide an opportunity to take cost-effective measures to enhance energy performance."

The Directive on energy performance of buildings also gives an important role to public sector. It suggests that Member States should plan measures to support public authorities to improve EE and to implement the recommendations from energy performance certificate as soon as possible.

Directive 2010/31/EU on energy performance of buildings (Official Journal of the European Union, L 153/13), sets requirements for Member States such as:

- Setting of minimum energy performance requirements for new and existing buildings. New buildings must meet EE standards and contain high-efficiency alternative energy systems, while existing buildings, when undergoing major renovation, must improve their energy performance to meet the EU requirements. Public buildings should achieve nearly zero-energy status by 31 December 2018;

- National authorities must ensure regular inspection of heating and air-conditioning systems;

- National authorities must operate an energy performance certification system which is considered as a key policy instrument in reducing energy consumption in buildings. This type of policy instrument rises awareness about energy consumption among the building owners and users, integrates EE information into the real estate market, and by

[1] Albania, Bulgaria, Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Romania, Serbia, Kosovo

publicizing poor performance triggers EE improvements in buildings (Institute for Building Performance, 2011, pp. 2-15).

2.2 Directive 2012/27/EU on energy efficiency

The Directive 2012/27/EU on energy efficiency (hereinafter: Energy Efficiency Directive) was adopted by the European Parliament and the Council on 25 October 2012, repealing Directives 2004/8/EC and 2006/32/EC. This Directive establishes a set of binding measures to help the EU reach its 20% energy efficiency target by year 2020. Under Article 1 of the Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1), all EU countries are required to use energy more efficiently at all stages of the energy chain from its production to its final consumption. Article 1 sets the rules intended to remove barriers that hamper EE in the supply and use of energy, and requires the establishment of indicative national EE targets for 2020. The focus was placed on three measures: a legal obligation to establish energy saving schemes in all Member States, an exemplary role of public sector and major energy savings for consumers.

The Energy Efficiency Directive requires that the rate of building renovation needs to be increased, as the existing building stock represents the sector with the biggest potential for EE improvements. EU countries should set up a roadmap to make the entire buildings sector more energy efficient by 2050 (commercial, public and private households included). Deep renovations are specifically encouraged under Article 4 through the requirements for Member States to establish long-term strategies for the renovations of national building stocks covering all building types.

One of the Energy Efficiency Directive aims is to stimulate stronger incentives for the demand side of EE where public sector should play a vital role. It recognizes public sector as an important driver to stimulate dissemination of energy efficient products, building and services, as well as to trigger behavioral changes in energy consumption by citizens and enterprises.

The main demand from the public sector exemplary initiative and efforts can be divided into two categories:

- exemplary role of public bodies' buildings (Article 5 of the Directive 2012/27/EU on energy efficiency, Official Journal of the European Union, L 315/1);
- purchasing by public bodies (Article 6 of the Directive 2012/27/EU on energy efficiency, Official Journal of the European Union, L 315/1).

The Energy Efficiency Directive introduces a quantified refurbishment target for central government buildings. It requires Member States to "ensure that from 1 January 2014, 3% of the floor area of heated and/or cooled buildings owned and occupied by its central government is renovated each year to meet at least the minimum energy performance

requirements that it has set in application of Article 4 of the Directive 2013/32/EU" (Article 5 of the Directive 2012/27/EU on energy efficiency, Official Journal of the European Union, L 315/1).

Article 6 of the Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1) stipulates that central governments in Member States should procure products, services and buildings with high energy-efficiency performance. This Directive specifies the level of performance these products, services and buildings should have by referring to the criteria established under other EU legislative measures such as the Energy Labelling Directive 2010/30/EU and the Directive on Energy Performance of Buildings.

3 ENERGY EFFICIENCY IN PUBLIC SECTOR

Wherever public money is spent, either for public authorities operations or for the provision of public utilities, there is a huge potential to improve EE. The Energy Charter Secretariat (2008) believes that public sector should use its money and resources wisely and is accountable to the public regarding the use of public funds. In other words, the public expects public sector to set an example to the community in the efficient use of available resources. Energy savings are an important aspect of this. In this context, public sector EE is synonymous for good public management: when energy is saved, the public funds used to pay for it are also saved (Energy Charter Secretariat, 2008).

Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1) also states that "decreasing energy consumption through EE improvement measures can free up public resources for other purposes." As noted by Singh et al. (2010, p. 15), "programs to reduce energy use can reduce energy-related bills, thus creating fiscal space to allow governments to expand social services and meet critical infrastructure investment priorities." Stimulating public procurement of energy efficient products, vehicles, buildings and services can stimulate development of market for energy efficient products and services, and innovations across the EE sector (European PPP Expertise Centre, 2013, p. 2). By virtue of its size, public sector is well-positioned to be a role model of EE measures and create the necessary public awareness. It presents great and untapped energy savings potential, since "government-related facilities are large energy users and government is a large buyer of energy-consuming products and services" (Western Cape Department of Environmental Affairs and Development Planning, 2008, p. 9). Singh et al. (2010, p.1) further argue that public sector has a substantial potential for EE improvements as it represents a significant market in all countries. The common nature and ownership of public buildings, give an opportunity for implementing many projects together and financing at a large scale.

According to the European Court of Auditors (2014), public sector should also have an important role in respect to achieving climate targets. It can influence the magnitude of

energy consumption and GHG emissions by changing the way in which it operates. Through public procurement it can promote environmentally sustainable solutions for the works, goods and services needed. Furthermore, improvement of EE in public sector has a positive impact on other sectors by demonstrating good example to other sectors and stimulating the market of EE goods and services. Besides, it could be said that for governments' climate policies to be credible, it is important that government institutions lead by example. In this way, public sector ought to be on the cutting edge in designing and implementing strategies for achieving climate targets.

The World Bank (2010, p. 23) indicates that EE improvement in public sector often requires the following measures:

- development of a public sector action plan for EE;
- introduction of energy management systems in all public authorities;
- adjustment of public procurement rules and procedures to enable energy service contracting;
- implementation of a public sector EE action plan supported by specialized and well-staffed EE agency;
- establishment of sustainable financing mechanisms for the EE projects in public sector;
- setting up a system for EE data collection and reporting in public sector EE and an appropriate database for EE benchmarking, monitoring and reporting.

3.1 Energy efficiency in public buildings

About one-third of global energy is consumed in buildings for heating, cooling, ventilating, lighting and operating electric and mechanical devices. Because of their high energy consumption, buildings also offer enormous opportunity for energy savings. According to the IEA (2012, p. 328), "buildings account for some 41% of the global energy savings potential by 2035, compared with the industrial sector (24%) and the transport sector (21%)." Overall energy consumption in buildings is expected to grow as countries continue with urbanization and modernization.

Public buildings in general constitute a significant share of the country's total building use. Therefore, by implementing EE improvements in public buildings, governments can exert a powerful influence on the buildings sector, as well as setting an example. Besides, public buildings are used by many members of the public. Therefore, if EE measures and actions in public buildings are properly promoted, this raises awareness amongst the public who spend time in these buildings.

As stated by Singh et al. (2010, p. 15), public buildings, particularly in developing countries, are usually old and have inefficient and poorly maintained equipment, so their potential for EE advantages is large. The Western Cape Department of Environmental Affairs and

Development Planning (2008, p. 9) points out that public sector energy savings potential is significant due to a relatively old buildings and compared with private sector a longer financial horizon and lower requirements for return on investments. It is estimated that "developing countries could save up to 40% of the energy used in public office buildings if energy efficient measures were incorporated" (Institute for Building Efficiency, 2012, p. 53).

The key reasons for governments to engage in EE activities in the buildings they own and operate could be summed up as follows (Limaye & Meyer, 2014, p. 25):

• **Leading by example:** Government policies and regulations that protect the environment and promote sustainable development affect all entities and citizens. To be credible and inspire others, the government must follow and implement its own regulations.

• **Multiplier effect:** Public institutions have an important educational role. EE projects in public buildings provide their users (such as teachers, students, and hospital staff or patients) with an opportunity to learn about importance of EE improvements in their everyday life. Therefore, EE improvement projects in public buildings influence the behavior and lifestyle of building users. According to the Department for Energy & Climate Change (2015, p. 5), leading by example goes even beyond investment projects, numerical targets and building databases. It is vital to generate a spill-over effect and promote building refurbishment and energy-conscious use of buildings among the wider public. This can be done by targeting the behavior of occupants, raising awareness, and communicating savings achieved either through the refurbishment of prominent landmarks or by issuing and displaying Energy Performance Certificates in buildings frequently accessed by the public.

• **Better use of public resources:** Inefficient energy consumption in public sector is a waste of public money since the largest source of public funds are tax payments by citizens and private sector. Energy savings resulting from improved efficiency can be used for capital improvement projects or freeing up budgets for other purposes.

• **Leveraging effect for market creation and transformation:** The public sector's buying power and leadership can provide a powerful stimulation for EE products and services. By supporting EE improvement, the government can trigger suppliers to introduce more EE products and also create more opportunities for the EE services, energy consultants, financing businesses, contractors, and equipment vendors.

3.2 Barriers and challenges to EE improvements in public buildings

Despite enormous energy saving potential, experiences shows that market forces alone are not likely to achieve required saving potential in buildings. The reasons are the barriers that must be overcome in scaling up energy efficiency in buildings. Some of the key barriers include (Feng, 2014):

- financial barriers related to the high cost of gathering reliable data on a building's energy performance, a lack of motivation to invest in EE and limited access to financing;
- a lack of technical capacity needed to design, construct and maintain energy efficient buildings;
- difficulties in coordinating the activities and needs of different stakeholders.

"Split incentive" is also one of the common barriers of EE improvements, and it relates to the condition when costs and benefits of EE investment decisions fall on different actors. According to Eichhammer, Schlomann, and Rohde (2012, p.75) this happens quite often especially in the building sector "due to the opposite interests of landlords (who have to undertake the investment) and tenants (who profit from lower energy bills), or the long payback periods which may be longer than the owner intends to keep a building or the tenant to stay."

Beside the mentioned barriers that are characteristic for EE investments in all types of buildings, several barriers specific to public sector further hold back sustained EE improvements in this sector. The Institute for Building Efficiency (2011, p. 3) says that the most cited barriers in public sector are the "lack of funding and economic incentives for public-sector EE upgrades; limitations or restrictions on non-budgetary spending for EE; unclear procurement rules and legal restrictions; limited staff capacity and lack of prioritization of EE by organizational leadership." Similar to this, as stated by Singh et al. (2010, p. 1), the potential for EE improvements in public sector is significant, but the implementation of EE programs is complicated by many barriers, including lack of commercial orientation, limited incentives to improve EE, rigid budgeting and procurement procedures, and lack of financing mechanisms.

According to the European PPP Expertise Centre (2012, p. 6), challenges for EE investment in public buildings could be summarized in four main groups:

Technical chalengees: These challenges are connected with the fact that owners or users of public building often lack the technical capacities needed for EE improvements. In this context, the challenges are to ensure that public building managers understand methods for monitoring energy consumption and that they are aware of tehnologies, methods and potential for EE improvements.

Economic challenges: Economic challenges are mainly connected with the general problem of demonstrating the cost-effectiveness of EE projects. Low energy prices play an important role in this issue too. Secondly, the budgets of public authorities are planned on an anual basis and in line with the previous year's operating costs, which does not encourage public authorities to reduce energy consumption and costs. Furthermore, EE projects may be considered as uneconomical when energy prices decline.

Budget challenges: Raising funds for investments is often a chalange for public entities since the public funds are not sufficient for the whole investment program. In this situation public entities need to prioritize and often do not see the EE investments as urgency. Additionally, public entities, due to their limited budgets, are considered to have weak credit worthiness. In addition, in the context of recession, banks and lenders have reduced financing flows, and budget strictness becomes imperative in public institutions. In such an environment, EE investments are often considered a luxury, despite growing evidence that investing in EE improvements can significantly decrease operating costs in the long run.

Legal and institutional challenges: Issues related to legal, regulatory or institutional framework may also hamper EE measures or the implementation of EE investments in public buildings. Experience has shown that fragmentation, delay, and gaps in regulatory action have prevented the public sector from providing EE measures in the existing building stock. Czako (2013) claims that some EU Member States report prevailling barriers to EE investments that include legal barriers to the conclusion of service contract as a way of implementing EE investments. This group of challenges also includes the fact that managers in public sector lack the expertise on EE and are not aware of the importance of EE improvements. Furthemore, when the energy tariffs are partly subsidized, incentives to improve EE are limited. According to Gillingham and Sweeney (2012, p. 23), for energy efficient technologies, the issue is not only the cost, but institutional failures, as well as behavioral problems that effect how consumers make decisions that weigh the upfront cost of the technology against future energy savings. Therefore the behavioral issues relating to EE technologies could justify a variety of paternalistic policies that require consumers to purchase energy efficient technologies.

3.3 Driving forces for EE improvements in public buildings

In order to increase the adoption of EE investments and behaviors in buildings, policies and different instruments are necessary to eliminate barriers that discourage the implementation of EE measures. “Beyond removal of barriers, proactive instruments are imperative to give consumers positive reasons to adopt efficient practices” (Schwarz, 2009, p. 6). On the other hand, there are also driving forces that facilitate the implementation of required EE measures in buildings. According to Eichhammer, Schlomann, and Rohde (2012), these are social and psychological factors such as a high environmental awareness, the wish for more comfort, some social “pressure” or a better image, but also general economic conditions in the housing market that can be influenced by policy actors in order to create a general frame which is beneficial for energy efficiency investment.

As defined in Article 2 of the Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1) “policy measure means a regulatory, financial, fiscal, voluntary or information provision instrument formally established and implemented in a Member State to create a supportive framework, requirement or incentive for market actors to provide and purchase energy services and to undertake other EE improvement measures.”

In order to prepare an adequate policy mix, policy makers need to make careful and balanced decisions which measures to support in light of their unique barriers and circumstances on the ground. Lessons from EU and other international experience show that successful EE programs require a mix of policy tools and program instruments to overcome the typical financial, institutional, technical, and behavioral barriers present in most markets (Singh, Limaye, & Hofer, 2014, p. 4). Since there are many barriers to EE improvements, different instruments are needed for removing them.

Eichhammer et al. (2012, p. 75) indicate that an appropriate policy package should both remove the barriers and properly use the driving forces for EE improvements. Instruments in policy package for EE improvements could be classified as:

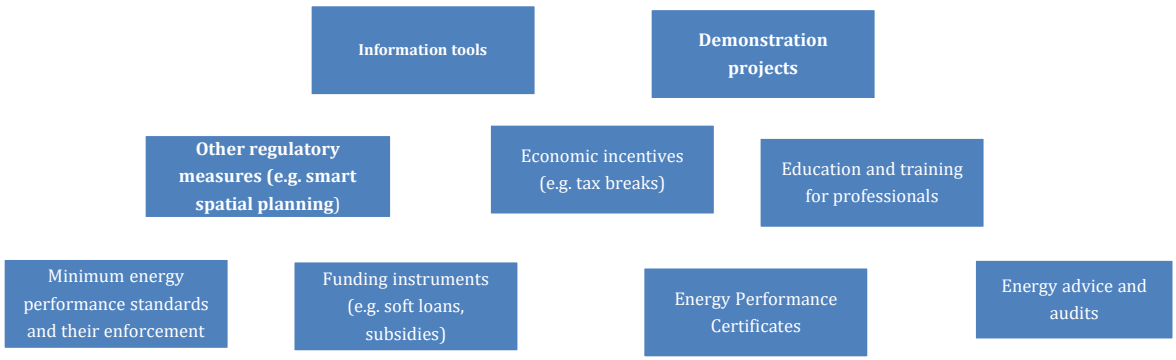
• **Regulatory instruments** that generally define the baseline for the technical EE improvements measures in buildings. These instruments implicitly raise the priority for EE improvements and lower the hampering impacts.

• **Financial and fiscal instruments** are particularly important in the reduction of economic barriers, such as the lack of own capital and the long payback periods of EE investments. They can also improve financial conditions on the housing market.

• **Informational and advisory instruments** can address barriers and driving forces such as information and knowledge deficits, or lack of trust. Such barriers could be tackled with different policy measures, such as labeling and benchmarks, comprehensive measurement of energy consumption, energy audits, awareness rising on the importance of EE improvements and information campaigns regarding the available financial and fiscal support for EE investments in buildings.

According to Phylipsen (2010, p. 11), public sector needs to play an important role in stimulating EE improvements by using a broad range of policy instruments. These instruments include regulatory instruments (standards, obligations), financial instruments (subsides, tax incentives, funding facilities), market-based instruments (energy or carbon pricing, tradable certificates) and informational instruments (raising awareness, training, capacity building, research and development). Elements of the policy package required for EE improvements are presented in Figure 3.

Figure 3. Building Blocks of a Comprehensive Policy Package for the Buildings Sector



Source: Energy Efficiency Watch, *Good Practice way out of energy debt*, 2013.

As presented in Figure 3, the comprehensive policy package required for EE improvements should consist of different instruments and tools (building blocks). It should include regulatory instruments that define standards, baseline, and other incentivizing instruments that should encourage the investor to undertake measures complying with standards (economic incentives, information tools, demonstration projects, energy advice and audits).

Public sector energy management programs can provide an important and motivating example to other energy users. In this respect, public sector can become an important promoter for market transformation. There are many possible approaches for such programs that include promotion of energy-efficient equipment, technology and projects, standards, training, energy audits, common performance or savings targets, and various financing methods (Western Cape Department of Environmental Affairs and Development Planning, 2008, p. 9).

According to the Energy Efficiency Financial Institution Group (2014), the key drivers affecting demand for EE investments in public buildings could be summarized as follows:

- **Rules on public authority accounting, procurement and reporting:** Rules on public procurement are usually rigorous and create barriers to EE investments. Special efforts are needed to facilitate this process. In addition, public sector accounting rules usually record the cost but not the benefit of investment. This limits the opportunities for EE investments to go ahead.

- **Awareness at key decision maker level and leadership:** Energy costs are usually monitored and managed by staff members or specialists that don't have contact with the top management. As such, the potential for energy savings may not be discussed by key decision makers that should consider multi-annual investments in EE. It is important that

political leaders as well as managers in public entities are aware of all benefits of EE improvements and that realized energy savings are properly publicized.

- **Standardization:** It refers to the availability, adoption and common usage of an accepted set of standards for EE investment process. For governments they include comparable methodologies for measuring impacts of EE policies as well as methodologies for developing national Energy Performance Certificates. On the other hand, for business and financiers this includes harmonized methodologies to calculate baseline energy conception as well as measurement, verification and reporting on energy savings achieved.

- **Building regulation, certification and energy performance certificates:** Building regulations should support EE investments in all types of buildings. As such, they must cover both new and existing buildings. Energy performance certificates are mandatory, as specified in the Directive on energy performance of buildings, and they need to be enforced, visible and, through standardization, contain relevant and reliable information for use in the business case for EE investments.

- **Facilitation / Technical assistance:** Public entities are in a position to develop large refurbishment schemes and, as such, develop a pipeline of projects for financing. They could be constrained by a lack of technical expertise for planning and management of projects, as well as a lack of financial resources to pay for the costs of such expertise. In this respect, facilitation and technical assistance are important driving forces for EE investment in public sector.
- **Effective enforcement of regulation:** It is important to develop proper regulatory framework, but also to ensure practical enforcement of regulations with effective and material penalties, as well as effective inspection activities.

3.4 Overview of key tools for EE improvements in public buildings

3.4.1 Energy management

Energy is a cost to most organizations that is growing as a proportion of overall expenditure. All energy-consuming organizations need to manage energy consumption if they want to avoid the impact of price increases on the products or services they provide. The Department for Energy & Climate Change (2015, p. 5) states that the case for investing in EE has never been stronger, and of course the cheapest energy is the energy that organizations don't use.

Energy can be saved in the public sector with the same sound management principles and techniques used in the business for all other key resources. Efficient management practices should control that energy is used rationally, since energy consumption has both costs and impact on the environment. These costs can be controlled and even considerably reduced as

soon as the cost origins become transparent. In many cases, however, reliable data are not available to decision makers. To obtain these data and control energy consumption, efficient energy management practices are required.

According to the Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1) energy management systems are defined as "sets of elements of plans establishing EE objectives and strategies to achieve these objectives." Lackner and Holanek (2007, p. 9) suggest that energy management means structural attention to energy with the objective of continuously reducing energy consumption and maintaining achieved results. "The aim of energy management in buildings is to use the least amount of energy from a source that has the least amount of negative effect on the immediate and long-term health status of people and our planet" (Western Cape Department of Environmental Affairs and Development Planning, 2008, p. 4).

The framework of the Energy Star Seven-Step Guidelines for Energy Management is considered as an effective way for organizations to systematically start energy management and realize energy savings. It is presented in Figure 4.

Figure 4. Energy Management Steps in Buildings

Source: U.S. Environmental Protection Agency, *ENERGY STAR Guidelines for Energy Management*, 2004.

As presented in Figure 4, the launch of an energy management program should start with commitment and a strong policy statement. The energy policy should be developed in step with the organization's strategic goals and in agreement with other policies (quality, production, environment, etc.), vision and mission statements (Natural Resources Canada, 2002). This phase also involves setting up an energy management team.

The second step is to understand energy use in organization by assessing performance. This includes collecting, managing and analyzing data on energy consumption with the aim of

assessing baseline and establishing the target for energy saving. According to the Institute for Building Efficiency (2012, pp. 2-13) organizations that measure energy consumption have been shown to be more likely to improve their EE. Access to reliable data on energy consumption enables good energy management decisions as well as measurement of energy savings from those decisions, thereby overcoming one of the key barriers to EE – the uncertainty of savings. This step also establishes a baseline from which the progress and success of energy management can be measured.

Key approaches for assessing baseline building energy performance in existing buildings include (U.S. Environmental Protection Agency, 2011, p. 11):

- use of available, standardized tools for baseline energy consumption assessments;
- benchmark buildings which involve comparing a building's energy performance to the performance of similar buildings;
- conduct of technical assessments and audits.

Development of an action plan should include technical measures, targets for each building, roles, and resources. The targets should be measurable and verifiable. To ensure that they are realistic, organizations should apply standards that indicate how much energy should be used for a particular application. A regularly updated action plan can serve as a roadmap toward meeting EE goals by systematically improving EE in existing buildings and designing energy-efficient new buildings (U.S. Environmental Protection Agency, 2011, p. 13). After implementation, the action plan progress should be evaluated and results measured. It is also important to recognize the achievements.

In implementing energy management in public buildings, and communicating the actions taken and the results of that action, the public sector demonstrates that action in this area is possible, and that it leads to concrete results (Western Cape Department of Environmental Affairs and Development Planning, 2008, p. 11).

3.4.2 Energy audit

According to the Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1) "energy audits are defined as systematic procedures used to identify, quantify and report existing energy consumption profiles and energy savings opportunities in buildings, industrial or commercial operations or installations, and in private or public services." It represents an integral part of energy management systems. Morvaj, Sučić, Zanki, and Čačić (2010, p. 21) suggest that energy audit is an essential step on the way to control costs and reduce energy consumption by making recommendations for changes in the work process or behavior and recommendations for the application of projects and realization of investments with the potential for improving EE, without compromising the working conditions at the facility.

An energy audit covers a substantially wide range of activities because unlike the energy certification it analyzes and evaluates the user's behavior and the actual energy consumption in the house. In fact, it is recognized that significant opportunities for savings in energy and money are hidden in the area of user's behavior. According to Krarti (2011, pp. 1-2), energy auditing of building can range from a short walk-through of the facility, to a detailed analysis with an hourly computer simulation. In the standard energy audit, building energy systems are comprehensively analyzed. This analysis includes calculation of the baseline for the building energy use and an assessment of energy savings that can be realized by particular EE measures. To develop a baseline energy use and forecast energy savings, standard energy audit uses different tools, such as the degree-day methods and linear regression models.

Public entities usually have a relevant problem in obtaining the consumption data of the buildings (sometimes not existing at all or not available or kept by other bodies asking for special permissions, kept by several departments and not by one referent only, etc). Therefore, it is important that public entities keep real records of the energy (electricity and heating) consumption of their buildings in order to facilitate the work of the auditors (Generation White Paper – Energy Efficiency in Public Buildings, Recommendations for policy makers, n.d.).

The results of the energy audit provide answers to the following questions (Morvaj et al., 2010, p. 21):

- How and where, in the analyzed building, is used energy and water?
- What is efficiency of energy and water consumption in the analyzed building?
- What is the reference energy and water consumption?
- What are the reference costs for energy and water consumption?
- What are the environmental impacts resulting from the use of the building and whether it is in accordance with the relevant laws?
- What measures for improvement of efficiency of energy and water consumption have economic validation and which procedures need to be taken in order to meet legal regulations?

The Energy Efficiency Directive gives energy audits and energy management schemes a substantial role to play in improving EE in the end-use sectors. It requires EU Member States to promote high-quality energy audits in their territories and ensure that their large enterprises and public buildings are subject to regular energy audits. Intended use of energy audits in the Energy Efficiency Directive is identifying, quantifying and reporting current energy consumption, but also providing reliable technical and economic information for planning measures and activities for EE improvements measures that would result with measurable energy savings. The effectiveness of energy audits thus significantly depends

on the adequate implementation of their resulting recommendations, and proper implementation of energy management schemes (Coalition for Energy Savings, 2013).
According to Kolega (2004), it is recommended that the final document of energy audit with the proposal of EE measures should be put a in a visible place in the building so that all employees are familiar with it. Furthermore, it is essential to find effective ways of motivating every employees to facilitate implementation of the proposed EE measures.

3.4.3 Energy benchmarking

The first step in the activities towards increasing EE in public sector is the establishment of a system of managing and monitoring energy consumption. In the business world, benchmarking is known as verification, monitoring and achieving competitive advantages in a particular area (Knežević, Delalić, & Husika, 2008). Often an energy analysis of the selected building doesn't provide all the necessary information on energy efficiency. It is therefore necessary to compare multiple buildings with different indicators that have an impact on EE and show the current situation. Based on these indicators, it is easy to look for the causes and plan a separate action consistent with the observed building.

According to the Natural Resources Canada (2014) a building's energy performance could be compared in several ways:

- against past energy performance;
- against similar buildings within a portfolio;
- against an external data set of comparable buildings;
- against areas in the same building.

When preparing the methodology for benchmarking, special attention should be paid to the choice of comparative indicators. Common indicators are (Knežević, Delalić, & Husika, 2008):

- comparison of buildings with regard to energy consumption per m^2 of the building;
- comparison of buildings with regard to energy consumption per employee;
- comparison of buildings with regard to energy consumption and CO2 emissions;
- comparison of buildings with regard to energy costs per m^2 of surface.

To promote benchmarking analysis, it is necessary to choose stimulating indicators for comparison. This attempts to motivate the management of an organization to use the experience of other organizations in order to reduce energy consumption and costs. Energy benchmarking is most effective when it supports an energy management process that is built on continuous improvements. Collecting and tracking key energy performance indicators informs the planning and implementation of improvements, which in turn can be verified through benchmarking (Natural Resources Canada, 2014).

3.4.4 Energy certification

One of the most important policy instruments that can assist governments in reducing energy consumption in buildings is energy performance certification. According to Article 2 of the Directive 2010/31/EU on energy performance of buildings (Official Journal of the European Union, L 153/13) ”energy performance certificate means a certificate recognized by an EU Member State or by a legal person designated by it, which indicates the energy performance of a building or building unit, calculated according to an adopted methodology.” In most countries, ratings are expressed on a letter scale (e.g., A to G, where A is very efficient and G is very inefficient). It provides decision makers with reliable information on the energy performance of a building, in comparison to other comparable buildings, or in relation to indicated level of energy performance. As such, the energy performance certificate can help in reaching national energy targets. Certification is considered more successful when synchronized and complemented with other instruments that support EE improvements (IEA, 2010).

According to the Directive 2010/31/EU on the energy performance of buildings (Official Journal of the European Union, L 153/13), the buildings occupied by public authority and buildings frequently visited by the public should be subject of energy certification on a regular basis. This Directive also stipulates that public authority should lead by example and should endeavor to implement the recommendations included in the energy performance certificate as soon as possible. The public dissemination of information on energy performance should be enhanced by clearly displaying energy certificates in public buildings.

3.5 Financial instruments for EE improvements

Financing is often determined to be a key barrier to the widespread EE investments. As stated by Singh (2005, p. 12) since typical EE investments have unique characteristics, they tend to fall outside traditional financing programs and thus justify special attention. Financial barriers for public sector represent a critical gap in EE improvement. The European Commission (2013, p. 10) argues that this kind of barriers for EE investments should be urgently addressed, in particular high upfront costs for EE investments, limited access to funds, long repayment period, credit risks, and split incentives between different stakeholders in multi-apartment buildings.

However, international experience shows a wide range of financing options and instruments that are available to address some of the existing market barriers in buildings sector in general. It includes financial instruments such as funds, subsidies, tax incentives, loans, third-party financing, energy performance contracting, contracts guaranteed energy savings and other related contracts that are available in the market from public or private bodies, in order to cover partially or totally the initial project cost for implementing measures to improve energy efficiency. These options range from predominantly public financing to

commercial financing. The chosen model will depend on local market development. Publicly supported, market-based financial mechanisms can help overcome some of EE barriers and help increase investments (Makinson, 2006).

According to Maio, Zinetti, and Janssem (2012, pp. 8, 9), "financial instruments can be divided into two broad categories: conventional and innovative. The conventional financial instruments that have been used since the 1970s' oil crises include: grants and subsidies, loans, and tax incentives. Innovative financial instruments include Energy Supply Obligations (also commonly known as White Certificates) or Energy Performance Contracting." Maio et al. (2012, p. 5) further argue that a combination of different financial instruments may be more effective than single measures over the long-term. Examples include the creation of revolving funds, preferential loans within national programs (e.g. combination of funding originating from capital markets and interest rates subsidized by government) and energy service company (hereinafter: ESCO) business models.

Guertler, Royston, and Wade (2013, p. 27) point out that an important challenge for many finance schemes is to become sustainable. A scheme may succeed, in the short term, but when economic environment change it can face funding uncertainty which could be demotivating for stakeholder engagement. Therefore, a scheme should be able to support itself. This can be either on a revolving basis or by financing through financial markets.

An overview of the most common financial instruments for EE improvements include:

Grants are non-repayable funds commonly disbursed by government department or international organization to a recipient. It can be noted that grants are mostly intended to finance specific projects and that their proper control and monitoring require a certain level of compliance and reporting. According to the Building Performance Institute Europe (2010), grants as economic incentives are generally applied when government asseses that there is a lack of capital on the market needed for EE investments. Grants are targeted to motivate consumers to invest in EE measures.

Singh (2005, p. 15) points out that grants are not addressing the financing barrier per se. This can be an appropriate option where the banking sector is underdeveloped or credit barriers are too high. According to Singh (2005, p. 16) such instruments can also be useful in stimulating the market, providing demonstration case studies and initial project performance data. It can also be developed in combination with other instruments, provided that one instrument does not undermine the other.

Fiscal incentives are way of government encouraging the market actors to invest in EE. They include several measures to lower the taxes paid by consumers investing in the EE of buildings. This kind of measures include tax reductions (individual, corporate and on properties), tax credit and reduced value-added tax (Maio et al., 2012, p. 19). Fiscal benefits are adjusted based on ambition of retrofit and the resulting energy savings.

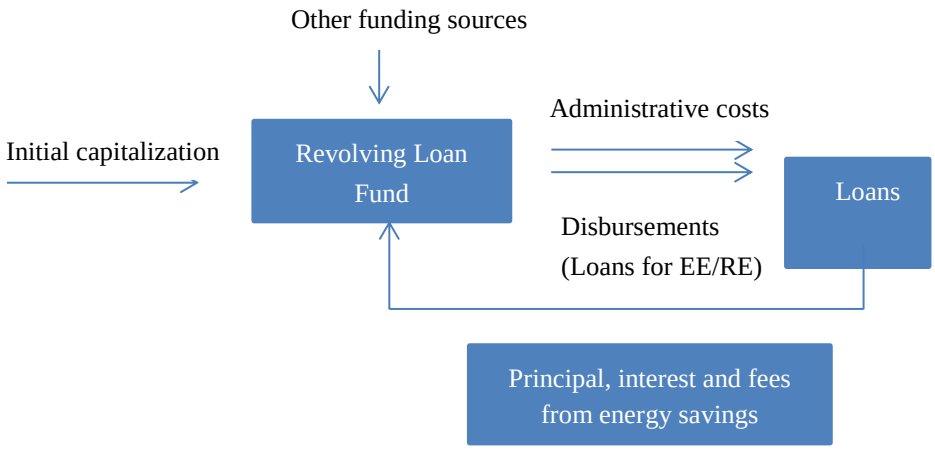
Guarantee programs are frequently used for structuring EE projects. According to Guertler et al. (2013, p. 27), guarantee mechanisms aim to engage financial institutions by supporting and sharing the credit risk of EE investments. In this way, they help financiers to accept the credit risk and act as a catalyst to scale up investments in EE. Guarantee mechanisms are considered as an essential complement to other financing approaches that fill the financial gaps encountered in early stage of EE projects.

Revolving fund is a financing source that funds many specialized projects. Its name comes from the revolving aspect of loan repayment, where the main fund renews from the returns of individual loans, creating the possibility of new loans for new projects. According to Booth, Doris, Knuston, and Regenthal (2011, p. 2), in most cases the interest and fees paid by the borrowers support program administration so that the fund's capital base remains intact. In that manner, this fund becomes an ongoing or "revolving" financial tool.

Most revolving funds programs have a maximum allowable payback period for projects and explicitly state what types of projects are eligible for funding. Revolving fund offers loans for public and private sectors, aiming to cover the initial cost of investment in improving EE.

Figure 5 shows the cash flow in a revolving fund.

Figure 5. Revolving Funding



Source: S. Booth, E. Doris, D. Knuston, & S. Regenthal, *Using Revolving Loan Funds to Finance Energy Savings Performance Contracts in State and Local Agency Applications*, 2011.

As presented in Figure 5, after the initial capitalization, the revolving fund is used for disbursement of loans for EE. As the borrowers repay loans, the money is returned to the revolving fund to make additional loans. Results of energy savings are used for repayment of the revolving fund, including principle, interest and any other fees.

The Western Balkan Investment Framework (2013, p. 29) suggests that funds supplied as loans have the following advantages:

- capital is preserved, since it can be re-lent as soon as loans are partly or fully repaid;
- the "subsidy mentality" of grants is removed.

According to UNDP (2014, p. 18), since EE projects have a positive financial rate of return, realization of these savings and reuse for new investment creates better financially sustainable program than typical budget or donor funding approach. Since the revolving fund has a non-profit character, it may offer funding with a lower cost and longer repayment period with weaker security requirements in comparison to commercial loans.

Soft loans are the loans that are enhanced or "softened," for example with low interest rates and/or interest-free periods at the beginning of the loan term. Many international financing institutions and national governments use soft loans to kick-start the market and to fill the debt gap where local and traditional banking sector actors are not active (Guertler, Royston, & Wade, 2013, p. 11). Financing through soft loans usually involves public-private partnership, where a bank that was financially supported by the government offers loans to its customers with preferential interest rates.

Dedicated credit lines have wide applicability in all buildings segments and tend to provide good leverage. They usually offer long maturities and low costs. Often the promoting financial institutions of dedicated credit lines have strongly defined the development of the sector and continue to develop comprehensive frameworks that simplify procedures and reduce processing times and other transaction costs via a "one-stop" standardized approach, lists of eligible materials and equipment (Energy Efficiency Financial Institutions Group, 2015, p. 24).

Energy performance contracting/third party financing – "Development of the energy services market is often seen as one of the most effective ways of triggering EE measures, particularly in public buildings and industry" (European Commission, 2013, p. 11). This business model is based on the delivery of energy services, often through so-called Energy Performance Contracting. Under the energy performance contracting, the service provider (i.e. ESCO) delivers EE improvements to the client by financing the upfront investment costs and refinancing this through the savings achieved.

The Energy Performance Contract providers deliver a valuable and professional service to commercial and public buildings offering guaranteed savings, turnkey contracts and facilitating the market (Energy Efficiency Financial Institutions Group, 2015, p. 24). The model includes development, implementation and financing of projects aimed at reducing the cost of energy and maintenance required for installing new efficient equipment and optimizing energy systems. Repayment of the investment is provided through the savings over a several-year period. During the repayment of investments in EE, the customer pays the same amount for the cost of energy as they would before the project implementation,

which is divided into an actual (reduced) cost for energy, and the cost to repay the investment. After payback, all the benefits belong to the client.

According to the Institute for Building Efficiency (2012, p. 3), "policies that enable energy performance contracting (EPC) can help create standardized, streamlined, and transparent project development and vendor selection processes that lower the transaction costs for the use of EPCs to retrofit existing buildings." Those policies establish standardized contracts, measurement and verification procedures, as well as transparent lists of energy performance providers. Therefore, energy performance contracting is considered as a financial instrument for EE improvements that address many barriers to EE investments such as high costs, lack of technical capacity and project risks.

Energy efficiency obligation schemes represent mandates given to energy suppliers and/or retailers to achieve a defined amount of energy savings in a given period on the consumer premises. This instrument presumes monitoring and verification of energy savings and can be accompanied by certification (usually referred to as White Certificates). They are deemed as financial instruments due to their leverage effect on investments and creation of additional cash flow. According to Article 7 of the Directive 2012/27/EU on energy efficiency (Official Journal of the European Union, L 315/1), EU countries should set up an energy efficiency obligation scheme. This scheme requires energy companies to achieve yearly savings of 1.5% of annual energy sales to final consumers. In order to reach this target, the companies have to carry out measures that help the final consumers to improve EE.

On-bill financing refers to a financing product that is serviced by or in partnership with utility company for EE or renewable energies retrofits in a building and repaid by the customer on his monthly utility bill (Bell, Nadel, & Hayes, 2011). Advantages of the on-bill financing include the ability to leverage a utility's unique relationship with energy customer to provide convenient access to financing for EE investments. Usually, it allows customers to pay back part, or all of cost of their EE improvements with the money saved on monthly utility bills.

4 ENERGY EFFICIENCY IN BiH

4.1 Brief country overview

BiH occupies a land area of 51,209 km². It is situated on the Balkan Peninsula in the South Eastern Europe. The country is bounded by Croatia, Serbia and Montenegro. It has a short coastline along the Adriatic Sea.

Figure 6. Bosnia and Herzegovina on the Map

Source: Energy Charter, *Bosnia and Herzegovina. Regular Review of Energy Effi ciency Policie*, 2008.

BiH is a mountainous country situated between the European continental and Mediterranean climatic zones, which create three local climatic areas. The northern inland territory has a moderate continental climate, the mountain areas above 700 m have a mountain climate while the south has the Adriatic-Mediterranean climate.

BiH has significant water resources, which should be a key factor in its economic development. Its natural resources include deposits of minerals such as salt, manganese, silver, lead, copper, iron ore, chromium, and coal (Energy Charter Secretariat, 2012).

4.1.1 Administrative organization

BiH emerged in 1991 from the rubble of Yugoslavia and almost immediately fell apart in a devastating war. The Dayton Peace Agreement in 1995 ended the war in BiH. It also gave country a very complicated constitution with a weak state, delaying necessary reforms. BiH has a strongly decentralized governance structure. The constitutional structure includes a state level government (Council of Ministers) and two largely autonomous entities – the Federation of Bosnia and Herzegovina (hereinafter: FBiH) and the Republic of Srpska (hereinafter: RS). The Brcko District was added to the structure in 1999.

Between the two entities, governance structures and budgetary arrangements are starkly asymmetric. While the RS has a centralized governance structure and is divided only into municipalities, the FBiH is divided into 10 cantons, each with its own executive, legislative, and judicial branches of government and further subdivided into municipalities. The country's complex political system poses significant challenges in developing coherent sectoral policies and efficiently confronting emerging development priorities.

4.1.2 Economic background

Before the war, BiH had a relative developed industry. It had a diversified economic structure that was strongly product- and commodity-based. Industrial production (43%), agriculture and forestry (18%), and mining (14%) were important and produced the main part of the GDP. Tourism was also well developed. The war (1992-1995) had a devastating impact on the country's infrastructure that has not been redeveloped since then. According to Energy Charter (2008, p. 12), "during the war, about 45% of its industrial plants, including about 75% of its oil refineries, were destroyed, damaged or plundered. The transport infrastructure suffered similar destruction and approximately 35% of the main roads and 40% of the bridges were damaged or destroyed."

The war caused industrial production to plunge. Industrial output grew at high annual percentage rates from 1995 to 2000 and slowed down after that, but the original starting point was so low that production still remains lower than its 1989 level (Energy Charter, 2008). "The economic recovery began after the 1995 Dayton Peace Agreement. The end of the warfare and the very low level of economic activity during the war caused the GDP to grow dramatically by 54.2% in 1996 with the high growth phase lasting until 1999 before slowing to 3.7% in 2002" (Energy Charter Secretariat, 2012, p. 22). In common with many other countries, construction activity again began to decline since 2008. In 2015, the economy is showing nascent signs of recovery, with the GDP growth around 3%. The World Bank (2016) estimates that the key current economic challenge faced by BiH is the imbalance of the country's economic model: public policies and incentives are skewed towards public sector rather than private sector; consumption rather than investment; and imports rather than exports. Accordingly, BiH needs to unleash the private sector potential while at the same time reducing the footprint of the very large and inefficient public sector.

4.1.3 Energy sector in BiH

Energy sector in BiH is one of the sectors with most prospects, a long history, vast potentials, and many possibilities for development and investment. It is currently subject to reform, reconstruction, and privatization with the aim of inclusion into the European energy markets and the EU. Like other Western Balkans countries, BiH has chosen a way forward in the framework of the 2005 Energy Community Treaty, which expresses a shared commitment to market reforms and the development of a regional energy market.

The main sources of energy in BiH are hydro and thermal power plants that cover 62% of the total primary energy consumption. Besides, significant natural resources in BiH are in coal. BiH also has a significant potential in renewable energy sources, such as wind, solar energy, biomass and geothermal energy. Their utilization potential is 30% higher than the EU average, and the highest in the Balkans (Softić & Glamočić, 2012). Indigenous coal, lignite and hydropower are still dominating sources of primary energy consumption.

The BiH energy sector is organized in accordance with the two entities (the FBiH and the RS), which are coordinated on the state level by the Ministry of Foreign Trade and Economic Relations of BiH (hereinafter: MOFTER). The ministries responsible for the energy sector are the Federation Ministry of Energy, Mining and Industry and the Ministry of Industry, Energy and Mining of Republic of Srpska. Those responsible in the field of EE in building sector are the Federation Ministry of Spatial Planning and the Ministry of Physical Planning of the Republic of Srpska. Currently there isn't any national energy policy of BiH. Given the complexity of the constitutional order of BiH and shared responsibility in the field of energy, a comprehensive national energy strategy has not been adopted. Even though it was one of the short-term priorities of the 2008 European Partnership, it has never been developed. It was agreed that the country-wide energy development strategy would be developed once the entities' strategies were adopted. The FBiH has its Strategic Plan and Program for Energy Sector Development in the FBiH (Federation Ministry of Energy, Mining and Industry, 2009) and the RS adopted the Energy Sector Development Strategy of the Republic of Srpska until 2030 (Government of the Republic of Srpska, 2012).

4.2 Energy consumption in BiH and EE indicators

BiH carries the burden that comes with the state and society development, and like many other countries in transition, it has a problem with the disproportionate consumption of energy. On the other hand, BiH has an enormous potential to achieve great progress by applying EE patterns. Although it has large energy resources and is one of the few Balkans countries that exports electricity, its energy supply is not sustainable (Hasovic & Ganic, 2014). Electricity consumption is rising because it is used inefficiently, and using wood and coal as fuel causes air pollution. In this context sustainability would involve "reducing energy consumption, better use of available technology, more efficient use of energy, diversification of access to local or domestic energy sources and reducing energy imports and sustainability from the standpoint of environmental impact" (Softić & Glamočić, 2012, p. 3). The energy sector in BiH is characterized by high energy intensity in comparison with EU countries and the world presented in Table 1.

Table 1. Energy Efficiency Indicators for 2013

Indicator	BiH	EU 28	World
Consumption of energy TPES/Population (toe/capita)	1.69	3.2	1.9
Energy intensity TPES/GDP (toe/1,000 USD)	0.58	0.11	0.24

Source: Energy Community Secretariat. *Annual Implementation Report 2014/2015,* 2015;.International Energy Agency, *Key World Energy Statistics,* 2015; *International energy Agency* , 2016.

Table 1 shows EE indicators – consumption of energy and energy intensity for BiH, the EU-28 and the world in 2013. Energy consumption is calculated as the ratio between total primary energy supply (TPES) and population. This indicator is measured in tonnes of oil equivalent (toe) per person. Energy intensity represents the ratio of TPES to GDP, which is expressed as the ratio of tonnes of oil equivalent per thousand US dollars of GDP. It is evident from Table 1 that BiH consumes around 50% less energy than the average consumption of EU-28 countries and almost 15% less than the world average. On the other side, BiH, consumes a lot of energy per unit of GDP, around five times more than EU countries and two times more than the world average. This suggests that country is very poor on one hand, with a low-income and poorly developed economy, and on the other hand very wasteful one when it comes to the use of energy.

Trends in the main EE indicators for BiH are presented in Table 2.

Table 2. Trends in Energy Efficiency Indicators in BiH in Period 2010–2013

Main data and EE indicators	**2010**	**2011**	**2012**	**2013**
Total final energy consumption (ktoe)	3,837	3,960	3,852	3,534
Energy intensity TPES/GDP (toe/1,000 USD)	0.50	0.55	0.52	0.58

Source: Energy Community Secretariat. *Annual Implementation Report 2014/2015,* 2015.

Table 2 shows the trends in EE indicators in BiH in period 2010–2013. The total final energy consumption that covers all energy supplied to the final consumer for all energy uses is expressed in kilotonnes of oil equivalent (ktoe). It is evident that although the final energy consumption of BiH decreased in 2013 compared to 2012, the energy intensity increased from 0.52 in 2012 to 0.58 in 2013. According to the Energy Community Secretariat (2013), this suggests that BiH's economy is becoming even less competitive, that there is considerable room for energy rationalization and hence stronger EE measures should be implemented.

The energy sector is responsible for more than 70% of the total CO2 emissions in BiH, therefore the potential for reducing GHG emissions is greatest in this sector (Second National Communication of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change, 2013).

4.3 Framework for EE improvements in BiH

4.3.1 BiH obligations regarding EE improvements

Energy policy is one of the EU's most important issues and accordingly the most important issue for all those countries such as BiH that are paving their path towards the EU. In this respect, the state of BiH is signatory of international agreements that, among other things, commit the country to formulate and implement policies for improving EE and reducing the negative environmental impact of the energy cycle. BiH was supposed to create a supportive legal, institutional and financial framework for improvements of EE and to adopt an EE action plan with defined measures and goals. Among the most important contracts are the Agreement on Establishing Energy Community (2005), the Energy Charter Treaty (ECT, 1995, ratified in 2000) and the Protocol on Energy Efficiency and Related Environmental Aspects (2001).

The Energy Community is an international organization dealing with energy policy founded by the Energy Community Treaty, which entered into force in July 2006. The Parties to the Treaty are the European Union and eight Contracting Parties from South East Europe and the Black Sea region: Albania, Bosnia and Herzegovina, Kosovo, Former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia, and Ukraine. Among other things, all the signatories to Treaty have the obligation of transposing the provisions of the EU directives regarding EE into the domestic legislation.

Table 3. Implementation Deadline for the EU Directives on EE in the Energy Community Members

EU directives	**General implementation deadline**
Directive 2012/27/EU on energy efficiency	15 October 2017
Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products	31 December 2011
Directive 2010/31/EU on the energy performance of buildings	30 September 2012
Directive 2006/32/EC on energy end-use efficiency and energy services	31 December 2011

Source: Energy Community, *Energy Community Legal Framework - Special Edition on Energy Efficiency*, 2016.

Table 3 shows implementation deadlines for EE related directives for BiH as an Energy Community member. It is evident that most of the directives should have been implemented by 2012. The deadline is October 2017 only for the Directive 2012/27/EU.

The most important obligations of BiH defined by the above EU directives are as follows:

- The obligation of determining the goals of reducing energy consumption, and the establishment of a regulatory, institutional and financial framework needed to remove barriers to the efficient use of energy (Directive 2006/32/EC on energy end-use efficiency and energy services, Official Journal of the European Union, L 114/64).

- The need for drafting action plans on energy efficiency every three years, and implementation of the plans with the aim of overall reduction in energy consumption by 9% until 2018 (Directive 2006/32/EC on energy end-use efficiency and energy services, Official Journal of the European Union, L 114/64).

- Improving EE in buildings and building units by defining the minimum requirements for the energy performance of buildings in order to achieve optimal levels of energy consumption (Directive 2010/31/EU on the energy performance of buildings, Official Journal of the European Union, L 153/13).

- Determining and laying out goals that will help lower the energy consumption level. As well as regulations within the financial framework that will assist in removing any barriers that stand between the country and efficient energy use (Directive 2006/32/EC on energy end-use efficiency and energy services, Official Journal of the European Union, L 114/64; Directive 2012/27/EU on energy efficiency, Official Journal of the European Union, L 315/1).

The Ministerial Council of the Energy Community has proposed implementation of the Directive 2012/27/EU in each Contracting Party, but with certain modifications. It is recommended that the contracting parties of the Energy Community adopt a requirement goal to retrofit 2% instead of 3% of central government-owned and occupied buildings annually.[2] This also includes establishment of a publicly available inventory of heated and/or cooled central government buildings (Energy Community, 2014).

4.3.2 State of compliance

BiH is significantly lagging behind in meeting the commitments undertaken through signing international treaties and agreements. Implementation of the obligations has been

[2] Recommendation of the Ministerial Council, R/2013/01/MC-EnC on Energy Efficiency, ANNEX 17/11 MC/25-06-2013.

significantly slowed, particularly due to the lack of transparent energy policies, insufficient investment in EE, and slow modernization of legislation. Entity ministries are in charge of developing EE legislation, while the MOFTER participates, coordinates and reports about activities within the Energy Community.

The transposition status for the EE related directives is described as follows (Energy Community, 2015, p. 74):

- **Directive 2006/32/EC**: BiH still fails to comply with this Directive since there is absence of a full package of primary and secondary legislation in each entity and the Brcko District. This is also connected with the prolongation in adoption of a state-level NEEAP and changes in the state-level Law on Public Procurement to include energy efficiency criteria.

  The RS adopted the Law on Energy Efficiency in May 2013. The Law transposed most of the provisions of the Directive 2006/32/EC and contains an obligation for preparing an EE Action Plan; the provisions on introducing EE criteria in public procurement; the EE obligations of energy distributors, operators and users; the provisions related to metering energy consumption, informative billing, and development of an energy services market.

  The FBiH drafted an Energy Efficiency Law, but hasn't adopted it. The draft was adopted by the House of Representatives of the FBiH Parliament in September 2014, but the final adoption by the House of Peoples is still pending since September 2014.

- **Energy Labelling Directive 2010/30/EU**: The RS adopted the Energy Efficiency Law and a rulebook transposing the Directive 2010/30/EU and six Delegated Regulations. The FBiH still fails to comply with this Directive. Corresponding technical regulations were included in the draft Law on Energy Efficiency that is still pending adoption.

- **Energy Performance of Buildings Directive 2010/31/EU**: Although there was some progress in the area of EE in buildings, BiH still does not fully comply with the requirements of this Directive. In the FBiH, the Directive's requirements related to the calculation methodology for minimum energy performance of buildings, energy audits and energy certification of buildings are already transposed through the existing Law on Physical Planning and Land Utilization of FBiH, and in several bylaws. In the FBiH every new building has to have an energy performance certificate when applying for the final permit. Energy performance certificates are the most visible aspect of the new regulation concerning the energy performance of the buildings of FBiH. For existing buildings, energy performance certificates contain cost-effective measures for improving their energy performance. Existing buildings are obliged to get energy certificates in the case of renovations, rental, or sale/purchase. A special emphasis is put on public buildings, which are also obliged to get energy certificate. However, certain provisions

of the Directive still need to be completed, relating to cost-optimal calculations, definition and plans for realization of nearly zero-energy buildings (Oesterretchische Entwicklungs Bank AG, 2015). The RS transposed the key requirements of the Directive through the 2013 Law on Physical Planning and Construction in the RS. It includes provisons on energy performance of buildings (both new and existing), energy certification and energy audits of buildings, requirements for public sector EE improvements). However, still there isn't any secondary legislation that should include the remaining provisions of the Energy Performance of Buildings Directive.

4.3.3 BiH National Action Plan for Energy Efficiency

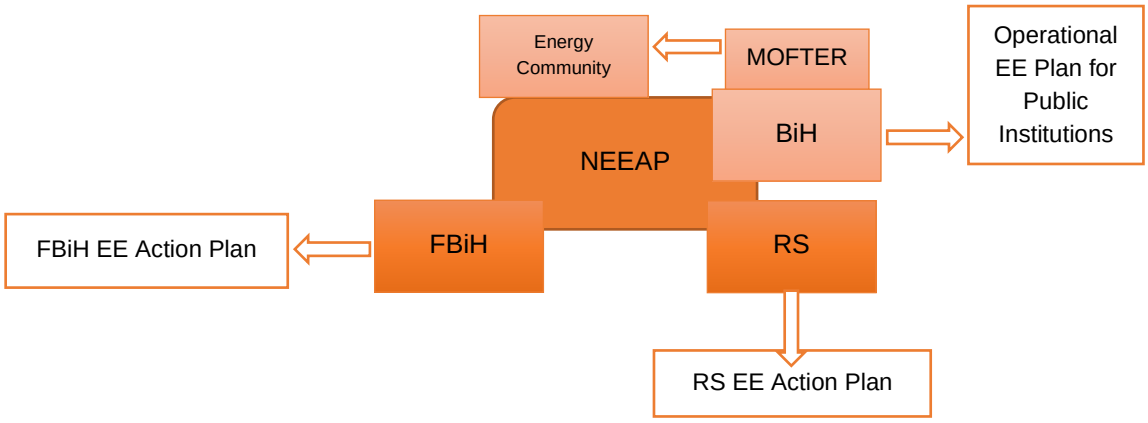
Improvements of EE in BiH, as well as the national objectives for energy savings should be defined by the BiH National Energy Efficiency Action Plan (hereinafter: BiH NEEAP). As a member of the Energy Community, BiH must adopt and aim to achieve an overall national indicative energy savings target of 9% until 2018. The target should be reached by way of energy services and other EE improvement measures. In addition, BiH, like other member states, is obliged to prepare three NEEAPs for the period from 2010 to 2018 in order to cover the entire indicative goal for this period.

The First BiH NEEAP was made in a form recommended by the Working Group of the Energy Community Secretariat but has never been adopted. This document covered the entire 2010–2018 period, providing for the overall goal of 9% until 2018 and the goals for 2012 and 2015. Taking into account the total final energy consumption in 2009, it means that the country should save energy in amount of 12.47 petajoules (PJ) until 2018. Compared to the current average savings of 1.1% annually, this target is considered quite ambitious. The BiH NEEAP contains a list of sectoral programs of EE, as well as horizontal and cross-sectoral measures to establish a comprehensive legal and institutional framework, which should ensure an efficient environment to implement sectoral programs. According to the BiH NEEAP, the highest target for energy savings is set for industrial sector and it amounts to 17% until 2018, followed by commercial sector, where the saving target is 16.8%. However, highest potential in absolute terms can be identified in the buildings sector, given the dominant share of energy consumption in buildings for both the residential and the service sector (Oesterretchische Entwicklungs Bank AG, 2015).

The objectives for EE savings were calculated and based on the available data on energy consumption. However, the lack of reliable energy consumption data was emphasized as a serious problem, which is why the average energy consumption was estimated by using the method of approximations. According to the Audit Office of the Institutions of Federation of Bosnia and Herzegovina (2015), the lack of reliable data on energy consumption has serious implications for the improvements of EE activities since it should be the base for setting the saving targets, defining the priorities and preparing high-quality EE action plan.

Due to the lack of political will, the BiH NEEAP was not adopted as a state level document. The EE Action Plan of the RS was adopted by the RS Government in December 2013, but it did not include reporting on the implementation of measures taken in the previous period (2010–2012), as required by the Directive 2006/32/EC. The RS has also adopted the Operational Plan to Improve Energy Efficiency in central entity authorities in May 2014 (Energy Community Secretariat, 2015, p. 76). The FBiH drafted an EE Action Plan but it hasn't adopted it so far.

Figure 7. BiH NEEAP Coordination



Source: B. Trivanovic, *Status of development of ESCO market and policies in Bosnia and Herzegovina*, 2013.

Figure 7 shows that preparation of the BiH NEEAP and entities' EE action plans requires coordination of the state and entity institutions. The FBiH and the RS should set their own indicative targets regarding the savings on energy consumption and prepare their own EE action plans based on the BiH NEEAP. Once they adopt them, EE action plan development should begin at the local level, the levels of public institutions and large consumers.

The World Bank (2010, p. 43) pointed out that the main reasons for delay in adoption of NEEAP among countries in the Western Balkans are: "(i) a lack of energy data, including EE indicators; (ii) a lack of qualified staff; and (iii) limited government support due to lack of good data; hence, governments are unaware of the extent of the problems they face in the energy sector."

4.4 EE in the public buildings of BiH

4.4.1 Energy savings potential in the public buildings of BiH

As discussed in section 5.3.3, the systematic data on energy consumption by sectors in BiH are not available. This is a serious problem in defining energy saving potentials for building sector as well. However, many relevant studies estimated savings potentials. The World

Bank (2010, p. 21) estimated that the energy savings potential in BiH is highest in the buildings sector (20-60%), followed by industry (10-30%) and the transport sector (8%).

The BiH NEEAP data estimate the overall potential for reduction of final energy consumption in buildings of BiH at 5,11 mil MWh/a (megawatt-hours per year), which would obtain economic savings of EUR 279,3 million per year while the total investment value would reach EUR 2,12 billion (Energy Charter Secretariat, 2012).

High energy consumption in public buildings is mostly connected with low energy standards of the buildings. Public buildings are rather old, and a majority of them were built before the late 1980s with the very weak energy standards. In addition, many buildings were seriously damaged or destroyed during the war and need substantial refurbishment. Having in mind the age of these buildings and the manner of their maintenance (mostly poor), energy consumption for heating in this sector is especially huge. It is around 220 kWh/m^2 (kilowatt-hours per square meter) in public administration and 572 kWh/m^2 in health sector (Ministry of Foreign Trade and Economic Relationship of BiH, 2013). Those amounts are categorized by the EU program of environmental management-EMAS as completely inefficient.

The Ministry of Foreign Trade and Economic Relationship of BiH (2013) further argues that the greatest energy savings in the public buildings of BiH can be achieved by improving central heating, air conditioning and lighting systems, along with introducing measures to renovate building envelopes. A significant increase in the number of new buildings in BiH is also expected, hence new regulations and building codes limiting energy consumption for heating and total energy consumption in new buildings should also bring fast results.

It is important to mention that poor energy management in public institutions in BiH also represents one of the recognized causes of inefficient energy consumption in public buildings. Public institutions generally haven't introduced systematic energy management or used the opportunity to rationalize energy costs with the energy management practices so far. According to the Audit Office of the Institutions of BiH (2015, p. 32) the institutions of BiH, apart from not having in place a strategic approach to improving EE, also don't take actions to ensure efficient use of energy in the buildings they use, thus failing to make an efficient use of budgetary resources for these purposes as well. Due to a lack of comprehensive records on energy consumption, the institutions lost the opportunity to identify energy savings areas.

Taking into consideration the fact that the public sector of BiH is huge, energy costs related to low efficiency of public buildings represent a heavy burden on public budgets. The World Bank (2010) estimates that public sector in the Western Balkan countries, including BiH, spends over EUR 400 million each year in energy costs for their buildings. Saving that money would create a fiscal space for many development priorities.

4.4.2 Targets and planned measures in the public buildings of BiH

The BiH NEEAP includes a list of sectoral EE programs covering the needs of individual sectors and aiming to achieve sectoral goals as well as the horizontal and inter-sectoral measures to establish a comprehensive legal and institutional framework that should provide an efficient environment to implement sectoral programs. Energy savings in buildings are included as one of the key means of attaining the EE target. Efficiency improvements in buildings are expected to most contribute and achieve an annual reduction in energy consumption of 1,900 GWh (gigawatt-hour). To this end, residential buildings are expected to reduce their energy consumption by around 6.5%, while commercial and service sector buildings, including public buildings, are required to reduce energy use by 16.8% by 2018 (Ministry of Foreign Trade and Economic Relationship of Bosnia and Herzegovina, 2008).

Figure 8. Projections of Energy Savings in Commercial and Service Sectors of BiH in Period 2011–2018

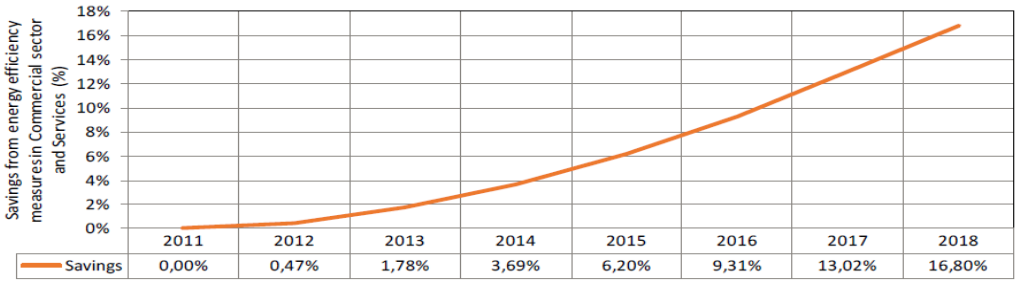


Chart 3: Savings from planned EE measures (%)

Source: Ministry of Foreign Trade and Economic Relationship of Bosnia and Herzegovina, *First National Energy Efficiency Plan for Bosnia and Herzegovina, 2008.*

Figure 8 shows expected savings from the planned EE measures in commercial and service sector in BiH NEEAP. As it is shown, the savings are modelled assuming that in the first period, by the year 2016, there will be slow implementation of EE measures obtaining 9.31% reduction in 2016. After 2016, faster implementation is expected and an increase in savings to 16.8% in 2018.

As the existing energy statistic doesn't allow disaggregation of commercial sector to subsectors, public sector energy savings are included in the total commercial sector. However, it is recommended to start the activities that will enable higher disaggregation of service sector energy consumption, at least to public and commercial services. An appropriate starting point would be introducing building energy management system in public sector comprising building register and an IT system for continuous monitoring of energy consumption.

Table 4 presents a list of the energy saving measures that are planned in the BiH NEEAP for commercial and service sector, including public buildings.

Table 4. Energy Saving Measures Planned in the BiH NEEAP
for Commercial and Service Sectors

Title of energy saving measure	**Energy savings expected in 2018 (GWh)**	**Share in total energy savings from listed measures in %**
Energy efficient electricity use in commercial/public building	22.22	5
Energy efficient heating, air-conditioning and ventilation systems in existing and new low-energy and passive commercial/public buildings	88.88	20
Energy efficient renovation of existing and sustainable construction of new buildings	180.55	40
Building energy management systems BEMS	11.11	2
Integrated generation of renewable energy	36.11	8
Energy efficiency in water supply networks	44.44	10
Integrated cogeneration/ trigeneration systems	19.44	4
Energy efficiency street lighting	44.44	10
Total	447.2	100

Source: Ministry of Foreign Trade and Economic Relations of BiH, *Report on implementation of First National Energy Efficiency plan for 2012. BiH* , 2013.

As shown in Table 4, most of the savings in this sector are expected from energy efficiency renovation of existing and sustainable construction of new buildings (40%), followed by implementation of EE heating, air-conditioning and ventilation systems (20%).

Despite the fact that many projects of EE improvements have taken place in public buildings of BiH, these activities were not on a large scale. Systematic data on undertaken measures and realized savings are still not available.

5 EVALUATIONS OF BARRIERS AND DRIVING FORCES FOR EE IMPROVEMENTS IN PUBLIC BUILDINGS OF BIH

The following section presents an overview of the main barriers and the driving forces that are characteristic for EE improvements of public buildings of BiH. The research was conducted using both primary and secondary data. The primary data were collected through interviews with representatives of the BiH public institutions, as well as EE experts from international organizations involved in EE improvements in BiH. Besides primary data, secondary data based on the survey of relevant reports and studies were also used in order to identify all relevant aspects of the topic.

The interviews were prepared based on a semi-structured questionnaire, which was developed on the basis of an extensive literature review of the Energy Efficiency Financial Institution Group (2014), Feng (2014), Eichhammer, W., Schlomann, B., and Rohde, C. (2012), Institute for Building Efficiency (2011), European PPP Expertise Centre (2012), European Commission (2013), Maio, Zinetti and Janssem (2012), Guertler, P., Royston, S., and Wade, J. (2013), the Building Performance Institute Europe (2010), the Energy Efficiency Financial Institutions Group (2015), and Singh (2005), presented in chapters 3.2., 3.3. and 3.5. The questionnaire can be found in Appendix.

The sample included representatives of public institutions and international organizations that have special responsibilities in overall EE improvements in BiH, as well as public institutions relevant as typical energy end-users that should have implemented EE measures in their own buildings in order to become more energy efficient.

Table 5 provides information regarding the sample, the interview dates, as well as the interview durations. Taking into consideration that few respondents did not agree with citing their names in the thesis, information regarding the respondents is given without mentioning the names.

Table 5. Sample of Respondents

Respondent	**Occupation**	**Institution/organization**	**Date of interview**	**Duration of interview**
Respondent 1	Head of Department of Energy Efficiency in Buildings	Federation Ministry of Physical Planning	September 1, 2016	2 hours
Respondent 2	Expert for energy efficiency	Fond for Environmental Protections of FBiH	September 5, 2016	1 hours
Respondent 3	Senior advisor for energy efficiency	Federation Ministry of Energy, Mining and Industry	September 8, 2016	1 hour
Respondent 4	Senior associate for technical and administrative work	Federation Constitutional Court	September 14, 2016	1 hour
Respondent 5	Associate in the Department for analysis and monitoring of investments and energy efficiency in buildings	Joint Service of the Organ and Bodies of FBiH	September 15, 2016	1,5 hour
Respondent 6	Sector Leader in Energy & Environment Department	UNDP-United Nations Development Program	September 17, 2016	2 hours
Respondent 7	Principal energy efficiency expert	GIZ-Gesellschaft für Internationale Zusammenarbeit GmbH / GFA Consulting Group GmbH	September 2, 2016	2 hours

5.1 Main barriers for EE improvements in public buildings of BiH

Table 6 brings an overview of the survey results on the most important barriers on EE improvements in public sector buildings of BiH. The respondents were asked to describe the most important barriers that hamper EE improvements and to weigh each barrier in accordance with its impact on EE improvements in the public sector buildings of BiH. To identify the importance of each barrier, a 5-point Likert scale was used where 1 represents

"low importance," while 5 represents "high importance" of each barrier. Importance of the barrier presented in Table 6 is average calculated from the answers of all respondents.

Table 6. Barriers for EE Improvements in the Public Sector of BiH

Type of barrier	Importance of the barrier according to respondents' answers
Lack of awareness of importance of EE improvements	4.1
Absence of methods for monitoring energy consumption and analyzing possibilities for energy savings	3.3
Fragmentation, delay and gaps in regulatory actions	4.9
Lack of economic incentives to invest in EE improvements	3.3
Barriers connected with annual budgetary system	3.9
Limited access to financing	4.3
Barriers to conduct service contracts	3.7
Lack of coordination of activities	3.1

According to the respondent's answers, legal barriers that include "fragmentation, delay and gaps in regulatory actions" are considered to have the highest impact on EE improvements of public sector in BiH. The barriers that also have a high importance include "lack of awareness of importance of EE improvements," "limited access to financing," "barriers to conduct service contracts," and "barriers connected with annual budgetary system," while other listed barriers ("absence of methods for monitoring energy consumption and analyzing possibilities for energy savings"; "lack of economic incentives to invest in EE improvements"; and "lack of coordination of activities") are considered as barriers with medium importance. The interview results elaborating these barriers are presented in the following part of the thesis.

Our research has shown that BiH is still struggling with the basic assumptions for EE improvements, which is, according to the respondents' opinion, primarily connected with the incomplete legal framework required for EE improvements. Therefore, the respondents consider that the legal barriers that include **fragmentation, delay and gaps in regulatory actions** have the highest impact on EE improvements of public sector in BiH. According to Respondent 2, even though some steps forward have been made, the development of a complete legal framework for EE improvements and enforcement of laws and bylaws has not taken place in BiH. Effective legislative framework should present government's purpose and intent for EE, define specific and measurable targets, assign responsibility for planning, implementation and monitoring, and provide financing mechanisms.

The FBiH still lacks a law on EE that should define obligations related to EE improvements, with the special attention to the obligations of public institutions. Respondent 1 concludes that the absence of that law represents a serious obstacle to the establishment of systematic improvements of EE. Consequently, the basic policies for EE improvements-the EE Strategy and the EE Action Plan have never been adopted. In the second entity (the RS), although the Law on EE was adopted, important secondary legislation and enforcement of regulations are still missing. Most of the respondents believe that delay in adoption of legislation in the field of EE in BiH is a result of insufficient political interest for EE. According to Respondent 2, "this moreover demonstrates the lack of awareness of the potential benefits of EE improvements in BiH."

5.1.1 Lack of awareness and lack of economic incentives for EE improvements

Lack of awareness of importance of EE improvements is considered as a barrier with high impact on EE improvements in the public sector buildings of BiH. Most of the respondents believe that EE is still considered as a vague and rather unknown concept in public sector, which is a result of low-level environmental awareness on the top management level. Consequently, energy costs are still considered as soft budget constraints in most public institutions in BiH. This barrier is also considered to be closely connected to absence of clear obligations related to EE improvements in public sector buildings in BiH. As stated by Respondent 7, more could be done by better promotion of EE, stressing the benefits of EE improvements, but also by defining a clear obligation for energy savings.

Lack of economic incentives for EE improvements in public institutions is a barrier that is considered as medium important for EE improvements in public sector buildings of BiH. According to Respondent 4, energy costs in the public sector of BiH are usually planned and approved in line with previous years' consumptions, which gives no incentives for planning EE investments and realizing energy savings. Therefore, Respondent 5 concludes that more should be done in order to motivate public institutions to implement EE investments.

5.1.2 Financial barriers

All respondents consider that barriers related to EE financing have a high impact on EE improvements in the public sector buildings of BiH. For this group of barriers the respondents highlighted: limited access to financing, barriers connected with annually budgetary system and barriers to conduct service contracts.

Limited access to financing is considered as a huge obstacle for EE improvements since public institutions in BiH are struggling with limited budgets and even budget deficits in many cases. In such circumstances, the institutions usually have more significant priorities rather than EE investments. Respondent 1 concludes that such an attitude toward EE investments indicates a lack of awareness that EE investments would bring financial savings that could be used for many other development priorities.

According to the respondents' opinions, the fact that BiH doesn't have access to the various EU funds in the field of EE could be seen as a hindrance in comparison to the EU countries that use structural funds for financing EE improvements. Therefore, Respondent 3 concludes that the availability of funding options should be improved through a greater use of banking products for EE financing. However, loan finance for EE improvements in public sector is underdeveloped, which is mostly connected with weak creditworthiness of public institutions. As stated by Respondent 2, since the public budgets are limited and even in some cases in deficit, commercial banks are reluctant to offer financing to public institutions. Therefore, introduction of financing mechanisms that would include debt repayment from the savings in EE improvements is considered an imperative.

Budgetary system in the public sector of BiH that implies annual approval of budgets is also recognized as a barrier for EE investments. According to Respondent 6, without multi-year budgeting, public institutions typically cannot enter into multi-year contracts, since they are not allowed to commit future funding that hasn't yet been appropriated. Besides, current budgetary rules don't allow public institutions to retain savings. Consequently, there is a lack of incentive to implement EE projects. Such rules also constrain the institutions ability to repay loans or enter into multi-year energy performance contracts where the repayments would be derived from energy cost savings in future years. Respondent 6 concludes that "borrowing or contracting over multiple years is often necessary for EE improvements, as it allows public institutions to amortize the higher upfront costs over several years." Some changes in budgeting rules have been made with the introduction of "Program budgeting." However, according to Respondent 2, further work on the legislative and regulatory environment is required in order to ensure contracting of EE investments over multiple years.

Due to the presented legal and financial barriers that are hindering EE improvements in BiH, all respondents agreed that sustainable financing mechanism for EE improvements were not introduced in BiH yet. Availability of specific financial instruments for EE improvements in the public sector of BiH is presented in Table 7.

Table 7. Overview of Financial Instruments Used for EE Improvements in the Public Sector of BIH

Type of financial instrument	Availability	Brief description
Grants	+	Used in both entities. Funded from entity budgets, EE Revolving Fund of FBiH and international organizations.
Dedicated credit lines	+	Funded from international organizations (World Bank and UNDP)
EE revolving fund	-	Recently established in FBiH, but still not operational

As presented in Table 7, all respondents agree that only two financial instruments are used for EE improvements in the public sector buildings of BiH. These are grants and dedicated credit lines funded from international organizations. Other sustainable financing mechanisms haven't yet been developed in BiH.

Our research has shown that grants are financial instruments that were mostly used for financing EE projects in the public sector of BiH in previous years. International organizations, such as USAID, World Bank, and UNDP, as well as few local institutions, such as the Federation Ministry for Physical Planning and the Fund for Environmental Protection of FBiH have been approving grants for EE improvements in public sector buildings in last years. According to Respondent 7, although there was a significant number of EE projects implemented from grant funds in the public sector buildings of BiH, reliable data on the exact number of these projects, the total funds spent, as well as achieved savings are missing. All respondents consider that grants are useful instruments in stimulating EE market and providing demonstration for EE projects. However, they are not considered as sustainable financial mechanism, since the funds used for this are limited and insufficient for all needed EE investments in public sector. Moreover, according to Respondent 1, the problem of grants is that the awareness of importance of EE improvements stays on a very low level because the users don't have to refund this money from their own budget. In this respect, public institutions are not enough connected to EE projects that are financed from the grants.

Financing EE projects from dedicated credit lines funded by the World Bank and UNDP recently started in BiH. As stated by Respondent 7, it is expected that using credit lines for financing EE projects should scale up EE improvements in the public sector of BiH. The reason is that much more financial resources will be available than for grants financing. According to Respondent 1, the highest investment at this moment is planned under the project Energy Efficiency in BiH to be financed from a World Bank credit line. Within the project, USD 32 million will be invested in EE improvements of public buildings in BiH.
Our research has shown that sustainable financing mechanisms for EE investments haven't yet been developed in BiH. The respondents found the reasons for it in both legal and financial barriers. According to Respondent 6, in order to facilitate procurement of ESCOs, regulations related to public procurement also need to be adjusted. So far, EE was not included in the Law on Public Procurement of BiH. Furthermore, responsible institutions haven't prepared any guidelines on EE requirements in public procurement nor training in applying EE criteria in public procurement. Respondent 5 concludes that procurement policies are still rigid and encourage lower-cost investments that have much higher operating costs over its lifespan rather then investments that should bring energy savings in the future.

Other important financial instruments, such as revolving fund, fiscal incentives, and soft loans, haven't been used for financing EE projects in the public sector buildings of BiH. Concept and benefits of these instruments are explained in chapter 4.2. Respondent 6

believes that introductions of a revolving fund for EE in FBiH, which is expected in a near future, would scale up EE investments in public sector.

5.1.3 Technical barriers

According to the respondent's opinions, issues related to technical capacities for EE improvements that include **absence of methods for monitoring energy consumption and analyzing possibilities for energy savings** are considered as a barrier of medium importance for EE improvements in the public sector buildings of BiH. According to Respondent 4, many public buildings are connected to district heating networks and are billed for heating on the basis of heated floor area, which provides no incentive to reduce energy use. Therefore, most of the respondents agree that transitioning to consumption-based billing is critical to provide proper consumption signals to public building managers.

International organizations (GIZ and UNDP) give technical assistance to public institutions in BiH that showed interest for improvements of methods for monitoring energy consumption. For instance, one of the aims of the Green Economic Development project of UNDP, that has been active in BiH since 2013, is to institutionalize energy management activities within the public sector buildings of BiH. These activities are in line with the EU, the Energy Community Treaty, and the BiH's obligation to report on current energy consumption and energy savings in accordance with the Energy Efficiency Action Plans. However, most of the respondents still believe that management of public institutions in BiH generally haven't taken adequate and enough activities in order to introduce a systematic energy management in public buildings. According to Respondent 5, creation of a legal obligation to monitor consumption in public buildings, as well as raising awareness about importance of EE improvements, would foster improvements of technical capacity for EE as well.

Lack of coordination of activities between public institutions is also considered as a barrier of medium importance for EE improvements in the public sector buildings of BiH. Since EE is multi-sectoral activity, activities of state, entity and local levels of government as well as other public institutions must be coordinated well. Respondent 7 underlines that the coordination of activities is needed in all segments of EE improvements including: establishment of a legislative framework; strengthening the capacity of institutions; institutionalization of the energy management; implementation of infrastructural measures and raising public awareness about EE. However, the respondents believe that complicated constitution of the country also resulted in a lack of coordination of activities in the field of EE, which hampers overall EE improvements in public sector. Respondent 2 concludes that weak coordination between institutions resulted in the lack of information regarding implemented EE projects and realized energy savings. Monitoring of the achieved savings and sharing such information between institutions is considered of crucial importance for raising public awareness about EE.

5.2 Driving forces for EE improvements in public buildings of BiH

Table 8 brings an overview of the interview results on the most important driving forces for EE improvements in the public sector buildings of BiH. The respondents were asked to describe the most important drivers for EE improvements and to weigh each driver in accordance with its possible impact on EE improvements in the public sector building of BiH. In order to present the respondents' perception on importance of each driver, a 5-point Likert scale was used where 1 represents "low importance," while 5 represents "high importance" of each driver. Importance of the driver according to respondents' answers presented in Table 8 represents an average calculated from the answers of all respondents.

Table 8. Drivers for EE Improvements in the Public Sector of BiH

Type of the driver	**Importance of the driver according to respondents answers**
Standardization (availability and adoption of standards related to measurement, reporting, and verification of energy consumption and energy savings)	3.1
Obligatory measurement, reporting and verification of energy use and energy savings	4.9
Building regulations and certification	3.7
Effective enforcement of regulations (ensured with effective and material penalties)	4.7
Information based instruments	3.9
Use of credit lines	3.3

The respondents believe that the drivers with the highest importance for EE improvements are "legal obligation for measurement, reporting and verification of energy use and energy savings," as well as "effective enforcement of regulations," while drivers with high importance are „building regulations and certifications" and "information based instruments." Other drivers presented in Table 8 ("standardization" and "use of credit lines") are considered as medium important. However, most of the respondents agree that improvements of EE in the public sector of BiH require a set of simultaneously implemented activities on the state, entity and local levels. It is important to mention that most of described driving forces still don't exist in BiH, which is elaborated in the text below.

Respondent 3 highlights that an adequate legal framework is a basic driver for EE improvements. "An adequate legal framework should enable implementation of EE policies

and programs by providing a basis in the law, an EE strategy that is linked to national development objectives, and the resources needed for government action." However, our research has showed that, when looking at the state and entity levels, the **legal framework** remains perhaps the most critical missing element preventing the greater EE improvements. The energy efficiency laws and corresponding bylaws will transpose the provision of EU directives in order to define responsibilities and control overall improvements of EE at the state, regional and/or local levels in BiH. The EE laws will also stipulate the process of development of EE strategy and action plans, as well as development of sustainable financing mechanisms for EE.

Respondent 7 believes that although the legal framework is still incomplete in BiH, the regulations adopted so far have already given some positive results. "A good example is the implementation of the **Energy Efficiency Law in the RS** that resulted in a preparation of model for drafting an action plan for EE in RS municipalities. As a result, all RS municipalities are in the process of developing action plans for EE improvements. Some of the municipalities have already completed action plans and even introduced software for monitoring the implementation."

According to Respondent 1, the implementation of adopted legislation related to EE of buildings of FBiH, such as the **Rulebook on Energy Certification** have also given certain results so far. Accordingly, all new buildings, as well as public buildings under the jurisdiction of FBiH are obliged to have an energy efficiency certificate. However, since a rulebook on energy certifications hasn't been adopted yet by cantons and municipalities, the results have remained limited only on a certain number of buildings.

Respondent 6 underlines that, besides establishing legal framework, it is also necessary to establish a **system of effective enforcement of regulations**, which is still not established in BiH. "This should be done with effective inspection and control activities. Special attention should be given to the introduction of penalties in case of non-performance, but also the incentives in the case of effective implementation of EE measures." The respondents believe that **information-based activities** at the local level and the level of public sector institutions are also highly important driving forces for EE improvements. These include activities on raising awareness and education regarding the importance of EE improvements, as well as the benefits that EE would bring to public sector. A series of activities for the purpose of education about EE, energy-saving potentials and reduction of costs have been carried out by UNDP, GIZ, as well as the Fund for Environmental Protection of FBiH and such fund in the RS. According to Respondent 5, these activities are important because "reaching a certain level of awareness is considered as a precondition for further multidisciplinary action that includes establishment of technical requirements for energy management and establishment of sustainable financing mechanisms."

Due to the fact that the missing data on energy consumption represent an important barrier to EE improvements, **introduction of a system for collecting data on energy consumption and monitoring of energy savings** realized through EE projects are considered as important driving forces for EE improvements. According to Respondent 6, within the UNDP's GEF project, the Energy Management Information System (EMIS) have been introduced in 2,500 public institutions in BiH. This web-based system enables the real-time monitoring and management of energy and water consumption in public-sector buildings. Respondent 4 highlights that all public sector buildings should be required to transition to consumption-based billing. Metering should be the first required step, both to measure actual baseline consumption and to assess expected changes in budgetary provisions resulting from the change in billing practices. In this respect, the **availability and adoption of standards related to measurement, reporting, and verification of energy consumption and energy savings** are also considered as driver for EE improvements.

As the EE project implementation requires financial resources, the respondents find that **the use of credit lines** for EE projects in the public sector of BiH is an important driving force. According to Respondent 6, moving the realization of EE projects from grant to credit lines could be characterized as the end of pilot phase and the beginning of scale-up phase for EE improvements in the public buildings of BiH.

CONCLUSION

BiH is paving its path towards the EU. In that respect, it is a signatory of international agreements that, among other things, commit the country to formulate and implement policies for improving EE and reducing the negative environmental impact of the energy cycle. As many other developing countries, BiH has a very high energy intensity, with the huge potential for improvement. With the improvements of EE, BiH should realize savings in energy and money, reduce negative effects on the environment, create new jobs, and generally achieve economic growth and sustainable development. Therefore, improvements of EE correspond to the development goals of BiH.

Public sector is highlighted as a key contributor in achieving sustainable energy targets. EE improvements in public sector should contribute to reductions in the final energy use and reduction in GHG emissions. On the other side, it should also influence the behavior of citizens and private businesses. For government EE policies to be credible, it is important that public institutions lead by example.

High energy consumption in the public sector of BiH is mostly connected with low energy standards in public buildings as well as weak energy management within public entities. The buildings used by public entities are old and with very low energy performance. The need for their energy improvements is unquestionable. Since the public sector of BiH is huge, energy costs related to low efficiency of public buildings represent a heavy burden on public budgets. Therefore, effective public sector EE projects should reduce energy-related bills and create a fiscal space for many development priorities in BiH. They should also provide the indirect benefits of market leadership, stimulating employment and encouraging the dissemination of energy-efficient products and services.

Improvements of EE in the public buildings of BiH are a great challenge. The requirement for public sector to lead by example in EE improvements entails modification of the overall attitude of BiH public entities. It implies improvement of public accountability in respect of cost-efficiency and rigorous management in public sector that also include improvement of environmental responsibility. Energy efficiency should be considered as an important aspect of this.

Although the activities related to EE improvements in the public building of BiH have begun, it is still difficult to talk about the achieved results. Individual EE projects have realized savings, but due to the lack of a monitoring system, general data on the achieved savings are not available. The research has shown that, without mandatory obligations defined for EE improvements in public buildings, it is hard to expect sufficient results.

BiH lags far behind other Energy Community member countries in meeting the EE requirements. The main barrier hindering EE improvements in BiH is an incomplete legal

framework for EE improvements, which is connected with delays in the transposition of EU directives in a field of EE. Therefore, it become increasingly evident that implementation of EU directives related to EE improvements should not be considered as an obligation for BiH but rather as a roadmap for systematic improvements of EE. Since adequate legal framework represents the main precondition for systematic EE improvement, it could be concluded that EE improvement in BiH is still in the beginning phase. Implementation of EE policies based on EU legislation should stimulate removal of all other barriers that are hampering EE improvements and impeding the realization of many EE benefits.

REFERENCE LIST

1. Audit Office for the Institutions of the Federation of Bosnia and Herzegovina. (2015). *Unapređenje energetske efikasnosti u institucijama FBiH* [Improving energy efficiency in the institutions of FBiH]. Performance audit report number 01/02/03-09-16-1-668/15. Sarajevo: Audit Office for the Institutions of the Federation of Bosnia and Herzegovina.

2. Audit Office of the Institutions of Bosnia and Herzegovina. (2015). *Energetska efikasnost u institucijama BiH* [Energy Efficiency in the Institutions of BiH]. Performance audit report number 01/02/03-09-16-1-668/15. Sarajevo: Audit Office of the Institutions of Bosnia and Herzegovina.

3. Bell, C., Nadel, S., & Hayes, S. (2011). *On-bill Financing for Energy Efficiency Improvements: A Review of Current Program Challenges, Opportunities, and Best Practices.* Washington: American Council for an Energy Efficient Economy.

4. Building Performance Institute Europe. (2010). *Financing Energy Efficiency (EE) in Buildings.* Background Paper. Input to the European Roundtable. Brussels: Building Performance Institute Europe.

5. Booth, S., Doris, E., Knuston, D., & Regenthal, S. (2011). *Using Revolving Loan Funds to Finance Energy Savings Performance Contracts in State and Local Agency Applications*. Colorado: National Renewable Energy Laboratory.

6. Centre for Policy and Governance. (2010). *Izvještaj o politikama energetskog sektora u Bosni i Hercegovini* [Report on the policies of the energy sector in Bosnia and Herzegovina]. Retrieved August 29, 2015, from http://www.cpu.org.ba/media/8267/Izvje%C5%A1taj-o-politikama-energetskog-sektora-u-Bosni-i-Hercegovini.pdf

7. Coalition for Energy Savings. (2013). *EU Energy Efficiency Directive (2012/27/EU) Guidebook for Strong Implementation*. Brussels: Coalitions for Energy Savings.

8. Czakó, V. (2013). *The leading role of the public sector in energy end-use efficiency in the EU: Where do we stand?* Ispra: European Commission Joint Research Centre - Institute for Energy and Transport.

9. Department for Energy & Climate Change. (2015). *A Guide to Financing Energy Efficiency in the Public Sector*. London: Department for Energy & Climate Change.

10. Directive 2006/32/EC on energy end-use efficiency and energy services. *Official Journal of the European Union* L 114/64.

11. Directive 2010/31/EU on energy performance of buildings. *Official Journal of the European Union* L 153/13.

12. Directive 2012/27/EU on energy efficiency. *Official Journal of the European Union* L 315/1.

13. Eichhammer, W., Schlomann, B., & Rohde, C. (2012). *Financing the Energy Efficient Transformation of the Building Sector in the EU*. Lessons from the ODYSSEE-MURE project. Karlsruhe: Fraunhofer ISI.

14. Energy Charter. (2008). *Bosnia and Herzegovina. Regular Review of Energy Effi ciency Policies.* Retrieved August 29, 2015, from http://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-BosniaandHerzegovina_2008_en.pdf

15. Energy Charter Secretariat. (2008). *Energy Efficiency in the Public Sector.* Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects PEEREA. Brussels: Energy Charter Secretariat.

16. Energy Charter Secretariat. (2012). *In-Depth Review of Energy Efficiency Policies and Programmes: Bosnia and Herzegovina.* Brussels: Energy Charter Secretariat.

17. Energy Community Secretariat. (2013). *Annual Implementation Report 2012/2013*. Vienna: Energy Community Secretariat.

18. Energy Community Secretariat. (2015). *Annual Implementation Report 2014/2015*. Vienna: Energy Community Secretariat.

19. Energy Community. (2014). *Impact Assessment of the Energy Efficiency Directive (2012/27/EU) for the Energy Community*. Decision Ware Group in cooperation with Seven Energy. Volume 1. Vienna: Energy Community.

20. Energy Community. (2016). *Energy Community Legal Framework - Special Edition on Energy Efficiency.* Vienna: Energy Community Secretariat.

21. Energy Efficiency Financial Institutions Group. (2014). *Energy Efficiency – the first fuel for the EU Economy. How to drive new finance for energy efficiency investments*. Part 1: Buildings, Interim report. Brussels: European Commission.

22. Energy Efficiency Financial Institutions Group. (2015). *Energy Efficiency – the first fuel for the EU Economy. How to drive new finance for energy efficiency investments.* Final Report Covering Buildings, Industry and SMS's. Brussels: European Commission.

23. Energy Efficiency Watch. (2013). *Good practice ways out of energy debt*. Implementation of energy efficiency policies in EU Member States. Retrieved: September 1, 2015, from http://www.fedarene.org/publications/eew-good-practice-ways-out-of-energy-debt-541

24. European Commission. (2000). *Action Plan to Improve Energy Efficiency in the European Community*. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions. No 247 final. Brussels: European Commission.

25. European Commission. (2006a). *Commission Green Paper of 8 March 2006: "A European strategy for sustainable, competitive and secure energy"*. COM (2006) 105. final – not published in the Official Journal. Brussels: European Commission.

26. European Commission. (2006b). *Action Plan for Energy Efficiency: Realising the Potential*. Communication from the Commission. COM (2006) 545 final. Brussels: European Commission.

27. European Commission. (2010). *EUROPE 2020: A strategy for smart, sustainable and inclusive growth.* Communication from the Commission. COM (2010) 2020 final. Brussels: European Commission.

28. European Commission. (2011). *Energy Efficiency Plan 2011*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM (2011) 109 final. Brussels: European Commission.

29. European Commission. (2013). *Financial support for energy efficiency in buildings*. Report from the Commission to the European Parliament and the Council. COM (2013) 225 final. Brussels: European Commission.

30. European Commission. (2014). *A policy framework for climate and energy in the period from 2020 to 2030*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM (2014) 015 final. Brussels: European Commission.

31. European Commission. (2016). *The Road from Paris: assessing the implications of the Paris Agreement and accompanying the proposal for a Council decision on the signing, on behalf of the European Union, of the Paris agreement adopted under the United Nations Framework Convention on Climate Change.* Communication from the Commission to the European Parliament and the Council. COM (2016) 110 final. Brussels: European Commission.

32. European Court of Auditors. (2014). *How do the EU institutions and bodies calculate, reduce and offset their greenhouse gas emissions?* Special report. Luxemburg: European Court of Auditors.

33. European PPP Expertise Centre. (2012). *Guidance on Energy Efficiency in Public Building.* Luxembourg: European PPP Expertise Centre.

34. European PPP Expertise Centre. (2013). *The Benefits of Energy Efficiency*. Luxembourg: European PPP Expertise Centre.

35. Federation Ministry of Energy, Mining and Industry. (2009). *Strateški plan i program energetskog razvoja Federacije BiH.* [Strategic Plan and Program of the Energy Sector Development of Federation of B&H]. Sarajevo: Federation Ministry of Energy, Mining and Industry.

36. Feng, L. (2014). *Improving energy efficiency in buildings.* Mayoral guidance note no. 3. Energy efficient cities. Energy Sector Management Assistance Program (ESMAP). Knowledge series 019/14. Washington D.C.: World Bank.

37. Filippini, M., Hunt, L.C., Zoric, J. (2014). Impact of energy policy instruments on the estimated level of underlying energy efficiency in the EU residential sector. *Energy Policy*, *69*, 73-81.

38. Generation. (n.d.). *White Paper - Energy Efficiency in Public Buildings, Recommendations for Policy Makers*. Retrieved August 29, 2016, from http://www.powerprogramme.eu/uploads/WhitePaper%20GENERATION%20final.pdf

39. Gillingham, K., Newell, R., & Palmer, K. (2009). *Energy Efficiency Economics and Policy*. Working Paper 15031. Cambridge: National Bureau of Economic Research.

40. Gillingham, K., & Sweeney, J. (2012). Barriers to Implementing Low Carbon Technologies. *Climate Change Economics, 3*(4), 1-25.

41. Governement of the Republic of Srpska. (2012). *Strategija razvoja energetike Republike Srpske do 2030. godine* [Energy Sector Development Strategy of the Republic of Srpska up to 2030]. Retrieved July 17, 2016, from http://www.vladars.net/sr-sp-cyrl/vlada/ministarstva/mper/Documents/nacrt%20strategije%20razvoja%20energetike%20do%202030%20-%20latinica.pdf

42. Guertler, P., Royston, S., & Wade, J. (2013). *Financing energy efficiency in buildings: an international review of best practice and innovation*. Report to World Energy Council. London: Association for the Conservation of Energy.

43. Hasović, Z., & Ganić, E. (2014). Is Bosnia and Herzegovina on a Sustainable Energy Development Path? Sarajevo School of Science and Technology. *Journal of Science and Technology. 2*(1), 205-215.

44. Institute for Building Efficiency. (2011). *EU Public-Sector Experiences with Building Efficiency*. Milwaukee: Johnson Controls, Inc.

45. Institute for Building Efficiency. (2012). *Driving transformation to energy efficient buildings.* Policies and Actions: 2nd Edition. Policies Options. Milwaukee: Johnson Controls, Inc.

46. *International Energy Agency.* Retrieved August 3, 2016, from https://www.iea.org/statistics/statisticssearch/report/?country=EU28&product=indicators&year=2013

47. International Energy Agency. (1997a). *The link between energy and human activity.* Paris: OECD/IEA.

48. International Energy Agency. (1997b). *Indicators of energy use. Understanding the link between energy and human activity*. Paris: OECD/IEA.

49. International Energy Agency. (2009). *Progress with implementing energy efficiency policies in the G8*. Paris: OECD/IEA.

50. International Energy Agency. (2010). *Energy Performance Certification of Buildings. A policy tool to improve energy efficiency.* The IEA Policy Pathway series. Paris: OECD/IEA.

51. International Energy Agency. (2012). *World Energy Outlook.* Paris: OECD/IEA.

52. International Energy Agency. (2013). *Energy Efficiency Market Report*. Paris: OECD/IEA.

53. International Energy Agency. (2014a). *Energy Efficiency Indicators: Essentials for Policy Making*. Paris: OECD/IEA.

54. International Energy Agency. (2014b). *Energy Efficiency Indicators: Fundamentals on Statistics*. Paris: IEA Publishing.

55. International Energy Agency. (2015). *Key World Energy Statistics. Paris: OECD/IEA.*

56. Irrek, W., & Thomas, S. (2008). *Defining Energy Efficiency*. Wuppertal: Wuppertal Institute fur Klima, Umwalt, Energie GmbH.

57. Knežević, A., Delalić, N., & Husika, A. (2008). *Poboljšanje energijske efikasnosti u poslovnim objektima na području Kantona Sarajevo* [Improving energy efficiency in commercial buildings in the Sarajevo Canton]. Sarajevo: Regional education and information centar for sustainable development in South East Europe.

58. Kolega. V. (2004). *Energetski audit zgrada javne namjene – način prikupljanja podataka* [Energy audit of public buildings – Ways of data collection]. *Energija, 54* (1), 107 – 119.

59. Lackner, P., & Holanek, N. (2007). *Step by step guidance for the implementation of energy management.* Vienna: Austrian Energy Agency.

60. Limaye, D., & Meyer, A. (2014). *The Greening of Macedonia's Public Buildings: Financing Options for the National Program for Energy Efficiency in Public Buildings in the Former Yugoslav Republic of Macedonia, 2012-18.* Washington D.C.: World Bank.

61. Krarti. M. (2011). *Energy Audit of Building Systems: An Engineering Approach*. Second Edition. CRC Press. Taylor&Francis Group.

62. Makinson, S. (2006). *Public finance mechanisms to increase investment in energy efficiency.* A report for policymakers and public finance agencies. Basel: Basel Agency for Sustainable Energy.

63. Ministry of Foreign Trade and Economic Relationship of Bosnia and Herzegovina. (2008). *First National Energy Efficiency Plan for Bosnia and Herzegovina. Unpublished manuscript.*

64. Ministry of Foreign Trade and Economic Relationship of Bosnia and Herzegovina. (2013a). *Report on implementation of the First National Energy Efficiency Action Plan for 2012. Bosnia and Herzegovina.* Energy Community. Retrieved January 6, 2016, from https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/2144179/0633975AD1BC7B9CE053C92FA8C06338.PDF

65. Ministry of Foreign Trade and Economic Relationship of Bosnia and Herzegovina. (2013b). *Second National Communication of Bosna and Herzegovina under the United Nations Framework Convention on Climate Change.* Retrieved January 7, 2016, from http://www.unfccc.ba/en/site/upload/PDF_dokumenti/BiH_SNCBiH_BHS-L.pdf

66. Morvaj, Z., Sučić, B., Zanki, V., & Čačić, G. (2010). *Priručnik za provedbu energetskih pregleda zgrada* [Implementation manual for the building energy audits]. Zagreb: UNDP Hrvatska.

67. Natural Resources Canada. (2002). *Energy efficiency planning and management guide*. Office for energy efficiency. Ottawa: Natural Resources Canada.

68. Natural Resources Canada. (2014). *Improve Your Building's Energy Performance: Energy Benchmarking Primer*. Retrieved July 4, 2015 form: http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/BenchmarkPrimer_en.pdf

69. Oesterretchische Entwicklungs Bank AG. (2015). *Energy Efficiency Finance II. TASK 1. Energy Efficiency Potential. Final Country Report: Bosnia and Herzegovina.* Vienna: ALLPLAN GmbH. Retrieved January 16, 2016, from http://www.oe-eb.at/en/osn/DownloadCenter/Studies/Energy-Efficiency-Finance-Bosnia-Herzegovina.pdf

70. Patterson, M.G. (1996). What is energy efficiency? Concepts, indicators and Methodological issues. *Energy Policy, 5*(24), 377-390.

71. Pérez-Lombard, L., Ortiz, J. & Velázquez, D. (2013). Revisiting energy efficiency fundamentals. *Energy Efficiency*, *6*(2), 239–254.

72. Phylipsen, G.J.M. (2010). *Energy Efficiency Indicators: Best practice and potential use in developing country policy making.* Washington D.C.: World Bank.

73. Reddy, S.B., Assenza, G.B., Assenza, D., & Hasselmann, F. (2009). *Energy Efficiency and Climate Change: Conserving Power for a Sustainable Future*. New Delhi: Sage Publications.

74. Ryan, L., & Campbell, N. (2012). *Spreading the Net – The Multiple Benefits of Energy Efficiency Improvements.* Insight series 2012. Paris: OECD/IEA.

75. Sarkar, A., & Singh, J. (2010). Financing energy efficiency in developing countries—lessons learned and remaining challenges. *Energy Policy, 38*(10), 5560-5571.

76. Schnapp, R. (2012). *Energy statistics for energy efficiency indicators. [PowerPoint slides]*. Joint Rosstat—IEA Energy Statistics Workshop. Retrieved 12 December, 2015, from http://www.iea.org/media/workshops/2012/trainingmoscow/Session8Schnapp.pdf

77. Schwarz, V. (2009). *Promoting Energy efficiency in buildings: Lessons Learned from International Experience*. New York: UNDP.

78. Singh, J. (2005). *World Bank GEF energy efficiency portfolio, review and practitioners' handbook*. Washington D.C.: World Bank.

79. Singh, J., Limaye, D. R., Henderson, B., & Shi, X. (2010). *Public Procurement of Energy Efficiency Services, Lessons from International Experience.* Washington D.C.: World Bank.

80. Singh, J., Limaye, D., & Hofer, K. (2014). *Western Balkans - Scaling up energy efficiency in buildings: final report*. Washington D.C.: World Bank.

81. Softić, A., & Glamočić, Lj. (2012). *National background report on Energy for Bosnia and Herzegovina.* WBC-INCO.NET. Retrieved September 5, 2015, from https://danube-inco.net/object/document/10210/attach/0_National_Background_Report_Energy_BiH_2012.pdf

82. Trivanovic. B. (2013). *Status of development of ESCO market and policies in Bosnia and Herzegovina. [PowerPoint slides]*. Ministry of Foreign Trade and Economic Relations of BiH. Retrieved January 12, 2016, from https://www.unece.org/fileadmin/DAM/energy/se/pp/adhoc/EE21_19_GE_April_13/5_BiH_Trivanovic.pdf

83. Trudeau, N., & Murray, I. (2011). *Development of Energy Efficiency Indicators in Russia*. IEA Working paper No. 2011/01. Paris: OECD/IEA.

84. U.S. Environmental Protection Agency. (2004). *ENERGY STAR Guidelines for Energy Management.* Retrieved December 6, 2015, from https://www.energystar.gov/sites/default/files/buildings/tools/Guidelines%20for%20Energy%20Management%206_2013.pdf

85. U.S. Environmental Protection Agency. (2011). *Energy Efficiency in Local Government Operations. A Guide to Developing and Implementing Greenhouse Gas Reduction Programs.* Local Government Climate and Energy Strategy Series. Retrieved March 13, 2016, from http://www3.epa.gov/statelocalclimate/documents/pdf/ee_municipal_operations.pdf

86. Western Balkan Investment Framework. (2013). *Financing Energy Efficiency Investments in the Western Balkan.* Brussels: IFI Coordination Office.

87. Western Cape Department of Environmental Affairs and Development Planning. (2008). *A Guide to Energy Management in Public Buildings.* Retrieved April 30, 2014, from http://www.cityenergy.org.za/uploads/resource_156.pdf

88. World Bank. (2010). *Status of Energy Efficiency in the Western Balkans: a stocktaking report*. Washington D.C.: World Bank.

89. World Bank Group. (2016). *Bosnia and Herzegovina – Overview.* Retrieved September 26, 2016, from http://www.worldbank.org/en/country/bosniaandherzegovina/overview

APPENDIX

APPENDIX: QUESTIONNAIRE FOR PRIMARY RESEARCH

Questioner for master thesis

Title of thesis: ***Improving energy efficiency in public buildings of Bosnia and Herzegovina***
Student: Aida Đozić

1. Introductory questions

1.1. Could you please briefly explain the role of your organization/institution in improvement of energy efficiency (EE) in public sector of BiH?

1.2.What is your role in EE improvement of public institutions of BiH /your organization?

2. The main barriers for EE improvement

2.1.What are in your view the major barriers that hinder the improvement of EE in public sector of BiH?

2.2. Below is a list (in a random order) of relevant barriers for EE improvement in public sector buildings. Could you please weight following barriers in their relation to EE improvement in the public sector of BiH. *(1 is "low" - one of the least important barriers, 5 is "high" - one of the most important barriers).* If the list is missing some of the important barriers for EE improvement in public sector of BiH, please feel free to add it.

- *Lack of awareness of importance of EE improvement on a top management level*
  1 2 3 4 5
- *Absence of methods for monitoring energy consumption and analyze possibilities for energy savings*
  1 2 3 4 5
- *Fragmentation, delay and gaps in regulatory actions*
  1 2 3 4 5
- *Lack of economic incentives to invest in EE improvement (non-commercial orientation)*
  1 2 3 4 5
- *Barriers connected with annual budgetary system where costs are planned according to previous year and where there is no possibility to retain savings*
  1 2 3 4 5
- *Limited access to financing*

1 2 3 4 5

- *Legal barriers to conduct service contracts*
  1 2 3 4 5
- Other: state which one and rate them
  1 2 3 4 5

Comments:

2.3.What policy options should be used in order to overcome these barriers?

3. The main driving forces for EE improvement

3.1. What are the main driving forces for EE improvement in the public sector of BiH?

3.2. Below is a list (in a random order) of relevant driving forces for EE improvement in public sector buildings. Could you please weight following driving forces according to their relation to EE improvement in public sector of BiH. *(1 is "low" - one of the least important driving forces, 5 is "high" - one of the most important driving forces).* If the list is missing some of the important driving forces for EE improvement in public sector of BiH, please feel free to add it.

- Standardization (availability and adoption of standards related to measurement, reporting, and verification of energy consumption and energy savings)
  1 2 3 4 5
- Obligatory measurement, reporting and verification of energy use and energy savings
  1 2 3 4 5
- Building regulations and certification
  1 2 3 4 5
- Effective enforcement of regulations (ensured with effective and material penalties)
  1 2 3 4 5
- Financial incentives (subsidies, tax incentives, loan facilities)
  1 2 3 4 5
- Information based instruments (raising environmental awareness, definition and common understanding of values of energy costs saving training, capacity building,)
  1 2 3 4 5
- Use of international organizations financing funds
  1 2 3 4 5
- Other: state which one and rate them
  1 2 3 4 5

Comments:

2.3. Did some/any of policy options give special results?

4. Financial instruments for EE investments

4.1. Which are the most important financial instruments that are used for financing EE investments in public sector in BiH?

4.2. Below is a list of most common financial instruments that can be used for EE investments. Could you please weight financial instruments for EE investments that are commonly used for investments in EE improvement in the public sector of BiH. *(1 is "low" - one of the least commonly used, 5 is "high" - one of the most commonly used).* If some of presented financial instruments are not used at all, please don't weight it and give a comment about it. If the list is missing some of the important financial instruments that are used please feel free to add it.

- Grants
  1 2 3 4 5
- Dedicated credit lines
  1 2 3 4 5
- Energy efficiency revolving fund
  1 2 3 4 5
- Soft loans
  1 2 3 4 5
- Energy performance contracting/third party financing
  1 2 3 4 5
- Other: state which one and rate them
  1 2 3 4 5

Comments:

4.3. What are the main problems connected to financing of EE investments in public sector of BiH?

Name and position of the interviewee:
Name of the institution: