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White Book 5

on implementation of Article 5 of the EED in Ukraine

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Foreword

Energy efficiency is a key element in a sustainable economy- leading to an increase in jobs and GDP as well as to the reduction of pollution and securing energy supply. Energy efficiency paves the way to accomplish the greenhouse gas emission reduction target. It improves indoor comfort and provides financial savings on the annual energy bill. Companies can profit from innovative solutions and higher competitiveness as a result of cost savings.

The Energy Efficiency Directive (2012/27/EU) lays the groundwork to fully reach the potential of energy efficiency in the European Union. As a guideline the directive proposes energy efficient measures that each member state transforms into legally binding policies to strengthen its energy efficiency status in all sectors of the economy. With signing the association agreement in 2014, Ukraine, too, needs to transpose the directive in national legislation.

The role model function of public buildings represents an important pillar in achieving energy efficient results. Article 5 of the EED eventually introduces the obligation to renovate 1 % of the building stock of central government. Nevertheless, the transposition of this article in national law shows a variety of possibilities among the member states.

The aim of this document is to provide an in-depth analysis of article 5 of the EED, reviewing European best practices in order to draw a comparison and to choose the best available solution for Ukraine. The document suggests a path and proposes further actions. In the end however, decisions need to be taken to strengthen the energy efficient achievements and the further development.

The transposition of the EED in Ukrainian legislation is one side. Though maintaining the momentum in the implementation process requires the right balance between strict legislation and the Ukrainian reality. Dynamic players need to take actions on the pathway of energy efficiency putting forward its full potential in order to secure a stable and safe energy future for Ukraine.

We are here and ready to support this challenge!

George Cristodorescu

Project Director
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List of abbreviations

BAU
Business as Usual

BPIE
Buildings Performance Institute Europe

BRP
Building Renovation Plan

°C
Degree Celsius

CEA
Central Executive Authorities

CEB
Central Executive Bodies

CO_2
Carbon dioxide

COP
Conference of the Parties

DAS
Data Acquisition Systems

EE
Energy Efficiency

EED
Energy Efficiency Directive

e.g.
For example
(Latin exempli gratia)

EPBD
Energy Performance of Buildings Directive

EPC
Energy Performance Certificate

Please note that EPC can also be used as abbreviation for Energy Performance Contacting. In this report, EPC is used as abbreviation for Energy Performance Certificate.

ESCO
Energy Services Company

EU
European Union

GIS
Geographical Information System

GWh
Gigawatt hour

IPMVP
International Performance Monitoring and Verification Protocol

ISO
International Organization for Standardization

ktoe
kilo tons oil equivalent

kWh
Kilowatt hour

m^2
Square meter

m^3
Cubic meter

M&V
Monitoring and Verification

RES
Renewable Energy Sources

SAEE
State Agency for Energy Efficiency

UAH
Hrywnja

XML
Extensible Markup Language

Definitions

Definitions apply according to Directive 2012/27/EU (EED) and Directive 2010/31/EU (EPBD). Important definitions are listed below.

Excerpt from Article 2 EED, as adopted by Energy Community[1]

1 *Energy efficiency*
means the ratio of output of performance, service, goods or energy, to input of energy.

2 *Energy savings*
means an amount of saved energy determined by measuring and/or estimating consumption before and after implementation of an energy efficiency improvement measure, whilst ensuring normalisation for external conditions that affect energy consumption.

3 *Energy efficiency improvement*
means an increase in energy efficiency as a result of technological, behavioural and/or economic changes.

4 *Energy audit*
means a systematic procedure with the purpose of obtaining adequate knowledge of the existing energy consumption profile of a building or group of buildings, an industrial or commercial operation or installation or a private or public service, identifying and quantifying cost-effective energy savings opportunities, and reporting the findings.

5 *Central government*
means 'all administrative departments whose competence extends over the whole territory of a Contracting Party.

6 *Total useful floor area*
means the floor area of a building or part of a building, where energy is used to condition the indoor climate.

1 Energy Community Secretariat (2016): The Energy Community Legal Framework, Special Edition on Energy Efficiency, *https://www.energy-community.org/dam/jcr:3431ade8-2054-4943-961d-efc22e8ebfd9/EnC_LFEE_2016.pdf* (15.10.2018).

Excerpt from Article 2 EPBD, as adopted by Energy Community

7 *Energy performance certificate*
means a certificate recognised by a Contracting Party or by a legal person designated by it, which indicates the energy performance of a building or building unit, calculated according to a methodology adopted in accordance with Article 3.

Definition according to Directive (EU) 2018/844 amending Directive 2010/31/EU

8 *Building renovation passport*
is explained in Article 19a Feasibility study:
... an optional building renovation passport that is complementary to the energy performance certificates, in order to provide a long-term, step-by-step renovation roadmap for a specific building based on quality criteria, following an energy audit, and outlining relevant measures and renovations that could improve the energy performance.

Definition according to ISO

9 *Energy management system (EnMS)*
Set of interrelated or interacting elements to establish an energy policy and energy objectives, and processes and procedures to achieve those objectives. Definition according to EN ISO 50001 Energy management systems — Requirements with guidance for use 2012 (ISO 50001:2011).

Note the terminology regarding "renovation"

10 *Major renovation*
(EPBD 2010/31/EU)
means the renovation of a building where:
(a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated;
(b) more than 25 % of the surface of the building envelope undergoes renovation.

11 *Deep renovation*
(EED 2012/27/EU)
cost-effective deep renovations which lead to a refurbishment that reduces both the delivered and the final energy consumption of a building by a significant percentage compared with the pre-renovation levels leading to a very high energy performance. Such deep renovations could also be carried out in stages.

12 *Depth of renovation*
According to BPIE (2016[2]), regarding depth of renovation there is no common definition for "deep renovation", "staged renovation" and "deep-staged renovation". However, there are common features among all initiatives, like the will to raise the level of ambition for achieved energy performance, to ensure consistency between short and long term measures and to align the target for the performance of individual buildings with the long term target for the entire building stock.

13 *Building renovation passport*
(BPIE 2016)
according (BPIE 2016): It is a document outlining a long-term (up to 15-20 years) step-by-step renovation roadmap to achieve deep renovation for a specific building. It supports owners with personalised advice on their renovation options and clarifies the renovation stages for all involved parties.

14 *Staged renovation*
(BPIE 2016)
According to BPIE, a staged renovation is a step-by-step building renovation roadmap or a renovation plan with a horizon of up to 15-20 years that, by looking at the building as a whole, suggests the installation of selected measures in a certain order to avoid that at any stage of renovation the installation of additional measures is precluded.

15 *Logbook*
(BPIE 2016)
In addition to the renovation roadmap, the building renovation passport can also include a separate element, a storage space where the building's features and information (e.g. stability, durability, water, installations, humidity, maintenance requirement, etc.) can be collected and regulatory updated, becoming a proper repository of information and data related to a specific building. All this information can be inventoried in a digital register.

2 Mariangiola Fabbri, Maarten De Groote, Oliver Rapf: Building Renovation Passports. Customised roadmaps towards deep renovation and better homes. Published in October 2016 by the Buildings Performance Institute Europe (BPIE). Second Edition (November 2016). *http://bpie.eu/publication/renovation-passports/* (15.10.2018).

1. Introduction

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1.1 Objectives and content of this Whitebook

This Whitebook provides the information base for implementing Article 5 EED in Ukraine.

It is based on:

(*a*) results of stakeholder discussions and workshops held in Kiev;

(*b*) experience, working papers and reports of Ukrainian experts and international consultants;

(*c*) lessons learnt from other European countries.

It compiles information:

(*a*) about the status quo of discussion regarding specific aspects of Article 5 EED implementation (e.g. energy saving target);

(*b*) for immediate action regarding specific aspects of Article 5 EED implementation while having the future changes regarding Long term renovation strategy in mind (e.g. building database);

(*c*) on the need for discussion and further support.

The Whitebook contains the following information:

Chapter 1 explains the objectives of this Whitebook and the motivation of EE-related EU Directives.

Chapter 2 summarizes the legal obligations stipulated by Article 5 EED. It explains relevant links between specific EED articles, and relevant links between EED and EPBD. Moreover, Chapter provides methodological recommendations on approach and energy efficiency measures in case of Ukraine opting for an alternative approach.

Chapter 3 provides examples of EU Member States on Article 5 EED implementation.

Chapter 4 contains main information about specifics features of Article 5 EED implementation.

Chapter 5 presents a summary of recommendations how to proceed.

Chapter 6 contains the list of references used in this Whitebook.

1.2 Motivation and development of EE-related EU Directives

The European Union's energy and climate policy builds on a long history: the Study of the Club of Rome published 1972[3], the Brundtland Report from 1987[4], and the United Nations Framework Convention on Climate Change 1992, which entered into force in 1994. In several Conference of the Parties (COP), CO_2 reduction targets and mechanisms to achieve targets and report on them were agreed.

In 2015, COP 21 resulted in the Paris Agreement signed by 195 countries committing themselves to a long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels. Entering into force was on 4 November 2016[5].

EU regards energy policy as important instrument of climate policy: Beside the Energy Security Strategy and the Integrated Energy Market Strategy, the 2030 Climate and Energy Framework[6] plays a key role for establishing the European Energy Union. In this regard, the Energy Union pursues two main goals: climate protection and a decarbonized economy, and the transition of the energy system by means of research, innovation, and competitiveness. To this end, the European Commission presented several documents on 30th November 2016, among others drafts for revising the Directives 2012/27/EU, 2009/28/EG, and 2010/31/EU, and a draft for a new Governance Regulation[7], stipulating the aligned reporting about achieving energy efficiency and CO_2 reduction targets of Member States.

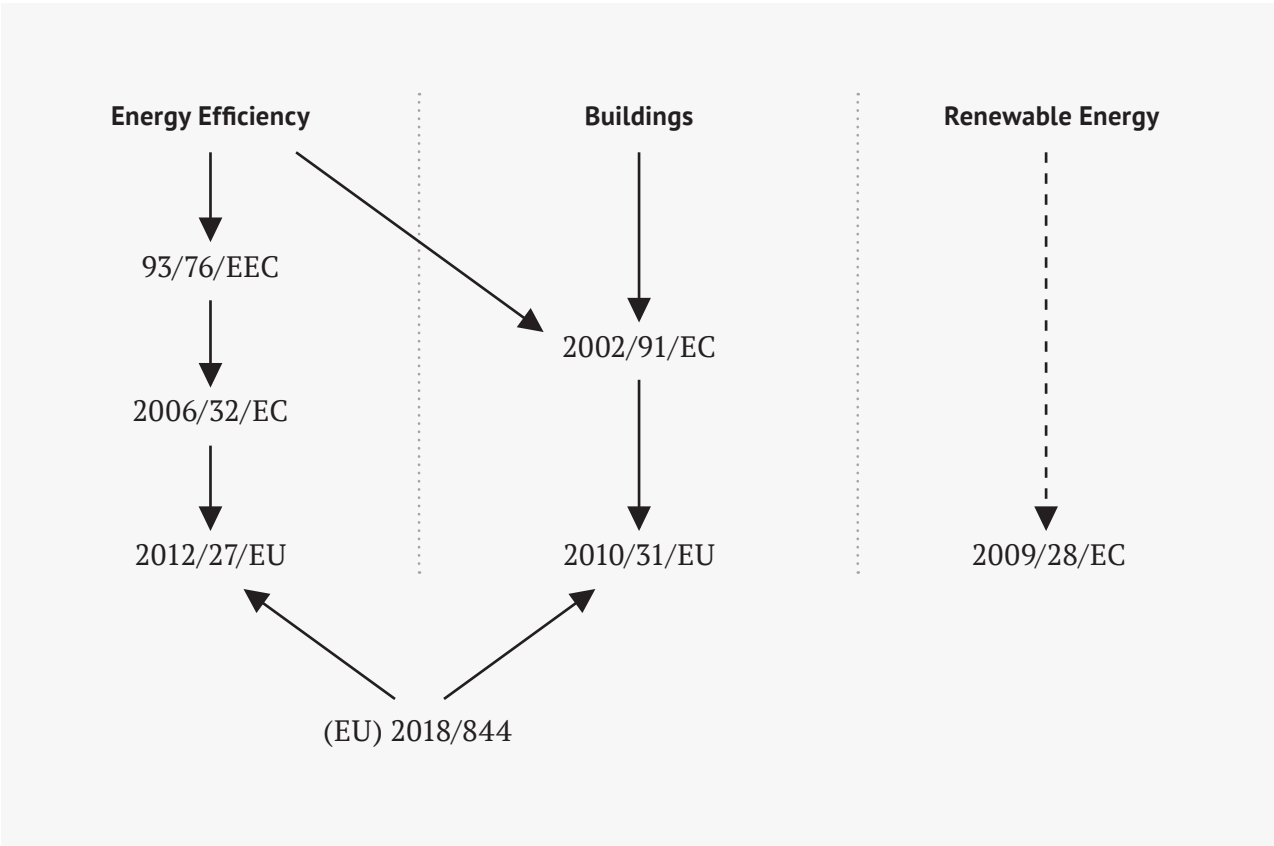
The first European Directive addressing energy efficiency and carbon dioxide reductions was Directive 93/76/EEC. The Directive was very short and general, and evaluation against envisaged targets showed that targets have not been achieved as planned. Therefore, building related provisions were specified in EPBD 2002/91/EC. Due to rather disappointing evaluation results, provisions had to become more specific once again, resulting in three related Directives, focussing on energy efficiency, buildings, and renewable energy sources. Revisions and recasts have always been based on evaluation results regarding achievement of energy efficiency targets and envisaged reductions of carbon dioxide emissions. Directive (EU) 2018/844 amending EPBD 2010/31/EU and EED 2012/27/EU has corrected a few inconsistencies such as moving provisions for the Long term building renovation strategy from Article 4 EED to EPBD as the new Article 2a by stipulating more detailed requirements regarding planning and reporting (overview see *Figure 1*). Reporting obligations as part of the NEEAP remain in Article 4 EED. Member States have to transpose the laws, regulations, and administrative provisions necessary to comply with this Directive by 10 March 2020. EED 2012/27/EU is still under review, but there are no plans to change Article

3 Dennis L. Meadows, Donella H. Meadows, Jorgen Randers, William W. Behrens III: The limits to growth. A report for the Club of Rome's Project on the Predicament of Mankind (1972)
4 Brundtland-Commission: Report of the World Commission on Environment and Development: Our Common Future (1987) *http://www.un-documents.net/our-common-future.pdf* (15.10.2018)
5 COP 21 Paris Agreement *https://ec.europa.eu/clima/policies/international/negotiations/paris_en* (15.10.2018)
6 E2030 Energy Strategy *https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/2030-energy-strategy* (15.10.2018)
7 For more information on the Draft Governance Regulation see: *https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/governance-energy-union* (15.10.2018)

Fernando Cortes / *Shutterstock.com*

5. However, as Article 5 constitutes the renovation strategy of non-residential buildings, it forms part of Article 4 which is strongly related with the new Article 2a EPBD. Although Member States of Energy Community have not yet adopted the amendment, decisions for implementing Article 5 EED should be made in the light of the new development.

Figure 1 Development of EU Directives in the area of energy efficiency and renewable energy sources



The above said explains the existing interfaces between EED and EPBD. The above said also demonstrates that actual energy efficiency improvements and carbon dioxide reductions are extremely important, and therefore reporting about achieving the targets is a high priority action. This is especially reflected by the draft for the new Governance Regulation. Thus, the foundation for effective planning, implementing, monitoring, and reporting must be well designed having the whole picture in mind, in order to ensure smooth procedures in future.

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2. Stipulations regarding Public bodies buildings in EED 2012/27/EU

2.1 **Obligations due to Article 5 EED 2012/27/EU**

In accordance with Article 5 *Exemplary role of public bodies' buildings*, each Member State shall ensure that, as from 1 January 2014, that 3% of the total 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 Directive 2010/31/EU (Default Approach). Thus, the Default Approach builds on the implementation of the EPBD 2010/31/EU, and only building renovation measures are considered eligible energy efficiency improvement measures. Under the default approach, the energy performance and surface of all buildings to which Article 5 applies will need to be specified in a publicly available inventory as set out in Article 5 (5), excluding buildings exempted on the basis of Article 5 (2).

The inventory list shall contain the following data:

(*a*) area of the premises measured in m^2;

(*b*) energy performance of each building or relevant energy consumption data.

EU Member States shall ensure that the central government buildings with the lowest energy efficiency level are the top priority for implementation of energy efficiency measures where they are cost-efficient and technically feasible.

For the purpose of the *Alternative Approach*, Member States may estimate the energy savings that the default approach would generate by using appropriate standard values for the energy consumption of reference central government buildings before and after renovation and according to estimates of the surface of their stock by 2020. The categories of reference central government buildings shall be representative of the stock of such buildings. Under the Alternative Approach, Member States are allowed to implement various economically efficient measures, including organizational measures aimed at changing the behaviour of energy consumers and implementation of energy management systems. Although establishing an inventory of buildings owned and occupied by central government is not mandatory under the Alternative Approach, it should be noted that the best way of ensuring equivalence is to use the inventory referred to in Article 5 (5) as the basis for calculating the 'alternative' target (i.e. expressed in terms of energy saved, and not in terms of renovated

surface), as this will provide greater accuracy than establishing the target on the basis of estimates[8].

Member States selecting the Alternative Approach were required to inform the European Commission by 31 December 2013 of the alternative measures they were planning to implement by indicating the way they would achieve equivalent improvement of energy performance of the buildings owned by central governments.

It is important to note that Article 5 (7) refers to the regional and local level:

Member States shall encourage public bodies, including at regional and local level, and social housing bodies governed by public law, with due regard for their respective competences and administrative set-up, to:

(*a*) adopt an energy efficiency plan, freestanding or as part of a broader climate or environmental plan, containing specific energy saving and efficiency objectives and actions, with a view to following the exemplary role of central government buildings laid down in paragraphs 1, 5 and 6;

(*b*) put in place an energy management system, including energy audits, as part of the implementation of their plan;

(*c*) use, where appropriate, energy service companies, and energy performance contracting to finance renovations and implement plans to maintain or improve energy efficiency in the long term.

In this regard, the way of implementing Article 5 for central government bodies should consider the potential of providing a good example to the local level.

8 Guidance note on Directive 2012/27/EU Article 5
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013SC0445&from=EN

2.2 **Energy Community Acquis**

EED 2012/27/EU is part of the Energy Community Acquis[9]. There are only few adaptations compared with the EU version of the Directive, mainly referring to the energy savings target and dates. The energy saving target of the Energy Community is much lower compared with the target mandatory for EU Member States. Implementation follows either the Default Approach or the Alternative Approach.

9 The Energy Community Legal Framework (May 2016) defines the corresponding obligations for Contracting Parties of the Energy Community, see Special Edition on Energy Efficiency (May 2016)

2.2.1 DEFAULT APPROACH

EED 2012/27/EU as adopted by the Energy Community states in paragraph 1

> *... from 1 December 2017, 1% of the total 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 Directive 2010/31/EU, as incorporated and adapted by the Ministerial Council Decision 2010/02/MC-EnC...*

The 1% rate shall be calculated on the total floor area of buildings with a total useful floor area over 500 m^2 owned and occupied by the central government of the Contracting Party concerned that, on 1 January of each year, do not meet the national minimum energy performance requirements set in application of Article 4 of Directive 2010/31/EU, as incorporated and adapted by the Ministerial Council Decision 2010/02/MC-EnC. That threshold shall be lowered to 250 m^2 as of 1 January 2019.

2.2.2 ALTERNATIVE APPROACH

EED 2012/27/EU as adopted by the Energy Community states in paragraph 6

... Contracting Parties may opt for an alternative approach to paragraphs 1 to 5 of this Article, whereby they take other cost-effective measures, including deep renovations and measures for behavioural change of occupants, to achieve, by 2020, an amount of energy savings in eligible buildings owned and occupied by their central government that is at least equivalent to that required in paragraph 1, reported on an annual basis.

The Directive allows the level of energy savings that the 'Default' Approach would generate to be estimated on the basis of standard values:

For the purpose of the alternative approach, Contracting Parties may estimate the energy savings that paragraphs 1 to 4 would generate by using appropriate standard values for the energy consumption of reference central government buildings before and after renovation and according to estimates of the surface of their stock. The categories of reference central government buildings shall be representative of the stock of such buildings.

Opting for the Alternative Approach according to paragraphs 1 to 5 of Article 5 requires to

...notify to Energy Community Secretariat, by 1 January 2017, the alternative measures that they plan to adopt, showing how they would achieve an equivalent improvement in the energy performance of the buildings within the central government estate.

2.3 Links between EED Article 5 and other EED Articles

Under the Alternative Approach of implementing Article 5 Exemplary role of public bodies' buildings, energy management can be among those measures applied to achieve the envisaged energy saving target. In this regard, there is a link between Article 5 and Article 8 *Energy audits and energy management systems*, which is dealt with in another Whitebook. Article 5 can deliver the renovation strategy for governmental buildings and thus can contribute to Article 4 on *Building Renovation Strategies*.

2.4 **Links between EED 2012/27/EU and EPBD 2010/31/EU**

The implementation of Article 5 EED builds on the transposition and implementation of the EPBD:

(*a*) In accordance with Article 5 EED, it has to be ensured that the agreed percentage of total 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 EPBD;

(*b*) also the reference area for calculating the energy saving target refers to the minimum requirements set by Article 4 EPBD: The renovation rate shall be calculated on the total floor area of buildings with more than a certain floor area and a certain type of occupancy, which do not meet the national minimum energy performance requirements set in application of Article 4 EPBD.

2.5 Methodological recommendations on approach and energy efficiency measures in case of Ukraine opting for an alternative approach to implementation of Article 5 of the Directive 2012/27/EU

2.5.1 GENERAL PROVISIONS ON THE ALTERNATIVE APPROACH IN ACCORDANCE WITH THE REQUIREMENTS OF ARTICLE 5 OF DIRECTIVE 2012/27/EU ON ENERGY EFFICIENCY[10]

Public bodies at national, regional and local level should fulfil an exemplary role as regards energy efficiency. The existing building stock represents the single biggest potential sector for energy saving, thus the emphasis within the energy efficiency project was made on repairing these buildings.

Moreover, buildings are very important for achieving the EU's goal of reducing greenhouse gas emissions by 2050 by 80-95% compared to 1990. The buildings owned by public authorities account for a significant proportion of the building stock and these buildings are very noticeable in public life.

It became therefore necessary to set the annual rate of repair of buildings owned by central governments in the EU member states in order to increase the energy efficiency of these buildings.

This pace of repair should have been without prejudice to the obligations with respect to buildings with almost zero energy consumption as provided for in the Directive 2010/31/EU of the European Parliament and the Council dated 19 May 2010 On Energy Performance of Buildings.

General obligations to repair central government buildings in the EU Member States are set out in Directive 2012/27/EU of the European Parliament and of the Council dated 25 October 2012 On Energy Efficiency.

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10 *https://eur-lex.europa.eu/legal-content/HR/ALL/?uri=CELEX%3A52013SC04*

11 Implementing the EU Energy Efficiency Directive: Analysis of Member States plans to implement Article 5: *http://energycoalition.eu*

The Energy Efficiency Directive complements the Directive of Energy Performance of Buildings, requiring Member States to ensure that when existing buildings undergo major renovation their energy performance is upgraded so that they meet minimum energy performance requirements.

The obligation to renovate floor area of central government buildings should apply to the administrative departments whose competence extends over the whole territory of a Member State. When in a given Member State and for a given competence no such relevant administrative department exists that covers the whole territory, the obligation should apply to those administrative departments whose competences cover collectively the whole territory.

The EU Member States may opt for an alternative approach, whereby they take other cost-effective measures, including measures for behavioral change of occupants and putting in place an energy management system.

However, in case of opting for the alternative approach, the EU Member States shall achieve, by 2020, an amount of energy savings at least equivalent to that required within the framework of thermal modernization of 3% of the total floor area of heated and/or cooled buildings.

For the purpose of the alternative approach, Member States may estimate the energy savings by using appropriate standard values for the energy consumption of reference central government buildings before and after renovation and according to estimates of the surface of their stock. The categories of reference central government buildings shall be representative of the stock of such buildings.

Member States opting for the alternative approach shall notify to the Commission, by 31 December 2013, the alternative measures that they plan to adopt, showing how they would achieve an equivalent improvement in the energy performance of the buildings within the central government estate.

2.5.2 EXPERIENCE OF THE EU MEMBER STATES IN IMPLEMENTING ENERGY EFFICIENCY MEASURES CONSIDERED IN CASE OF OPTING FOR AN ALTERNATIVE APPROACH

17 Member States have opted for an alternative approach: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, Ireland, Netherlands, Malta, Poland, Portugal, Slovakia, Spain, Sweden and the United Kingdom. Six Member States that opted for an alternative approach have established inventories of public buildings (Ireland, Croatia, Malta, Slovakia, Portugal and Belgium).

When opting for an alternative approach, the first step is to calculate the potential energy that will be saved after implementation of the respective energy efficient measures.

Table 1[11] contains energy efficiency targets reported by the EU Member States. Based on the indicated values it is possible to analyze the choice of energy efficient measures in the future.

Table 1 Energy efficiency targets reported by the EU Member States

EU Member State	Annual	Total in 2020, [*GWh*]	Total during 2014–2020, [*GWh*]
Austria	—	12	48
Belgium	—	—	—
Croatia	1,3	9,5	38
Czech Republic	—	—	—
Denmark	—	148	610
Finland	-	8,2	34
France	—	707,9	2477
Germany	—	—	—
Ireland	1,3	9,1	36,4
Italy	—	111,9	458,7
Malta	0,08	0,55	2,22
Netherlands	—	60,8	243
Poland	2,12	—	59,36
Portugal	0,6	4,2	16,8
Slovakia	—	13,14	52,7
Sweden	—	20,6	85
United Kingdom	—	163,6	—

It is impossible to check whether the savings declared by the EU Member States are correctly calculated, since there is no possibility to verify, for instance, information about the condition on which the calculation of the savings is based, or data on energy efficiency of their buildings.

Table 2 Examples of typical energy efficiency measures in the EU Member States

Type of measure	Example
Building renovation	• Existing financial schemes for renovation of public buildings • EU funds, for example, the Cohesion Fund • Energy Efficiency Contracts and ESCO
Renewable energy	• Solar installations for own consumption
Introduction of energy management systems	• Appointment in each building of an employee responsible for energy use • Optimization of operations • Measurement of energy and water • Installation of intelligent meters and air conditioners
Audit	• Audit of the time of electrical appliances use
Measures for property rationalization and management	• Reducing the area and its sale or lease • Switching to energy efficient construction • Penalties and bonuses in contracts on asset management with respective companies
Government and stable procurement	• Switching to energy saving devices • Updated lease agreements issued in the form of "Green Lease" contracts
Change in consumer behavior	• Increasing awareness of energy consumers in buildings • A massive campaign on changing the consumer behavior • Redistribution of employees in departments and habitual employee behavior

Table 2 provides several examples of typical energy efficiency measures in the EU Member States[12].

12 *https://ec.europa.eu/energy/en/topics/energy-efficiency-directive/buildings-under-eed*

This study does not contain a complete list of acceptable alternative measures, but highlights several examples, such as deep renovations and measures that lead to a change of the end-users' behavior. Thus, Member States may choose the type of measure they consider most appropriate, with a restriction that they should be carried out in buildings owned and occupied by the central government. In practice, this has led to the fact that most countries provide long lists of alternative measures that are a variety of separate actions, rather than part of a well-structured strategy to reduce energy consumption in central government buildings.

Among the best practices are the combinations of alternative activities planned with available funding for their implementation; for example, Croatia, Italy, Slovakia and Poland use Structural Funds and Merger Funds to fulfill their obligations under Article 5.

Nine countries are planning to achieve the savings through encouraging behavioral changes of end users of central government buildings and raising their awareness. Ireland has launched a large-scale a behavioral change campaign to fulfill its obligations under Article 5.

Although most countries have made commitments to renovate buildings, apart from other measures, only Belgium, Italy and Slovakia have explicitly committed themselves to undertake major renovation of central government buildings. In addition, some included measures aimed at supporting the development of renewable energy, as foreseen in Malta and Poland.

Austria, the Belgian region of Flanders, Finland, France, Malta and the United Kingdom use flexible mechanisms that are also available to countries that have opted for an alternative approach in accordance with the Guidance of the European Commission. In particular, in Austria, Finland and France, the list of buildings to be sold is among the alternative measures, the Belgian region of Flanders plans to "reduce the area" of buildings, Malta generally refers to "redistribution of employees in offices", while the UK takes into account "rationalization of property" in order to set a lower target saving as a priority.

In order to assess the credibility and control the impact of alternative measures, it is necessary to assess the energy savings provided by them. However, among the 17 countries that have opted for an alternative approach, only Austria, Croatia, Ireland and Finland provide a clear figure for savings through individual measures.

Several Member States have implemented the policy measures and actions that have already been planned before the adoption of the Energy Efficiency Directive. This is permissible from the legal point of view, indicating that EU legislation does not always require additional action at the national level.

France will adhere to Article 5 by taking measures already agreed and planned within the framework of "Grenelle de l'environnement". The United Kingdom also plans to use existing schemes that are already in place, such as the UK green commitment, the 2013 UK Carbon Management Plan for Scotland and the Climate Change Strategy for Wales. On the other hand, Finland tends to be planning new measures for central government buildings as a direct consequence of compliance with Article 5 EED.

Table 3 presents a list of key energy efficient measures for each EU Member State with a planned energy savings target (the indicated figures were planned for 2014).

Table 3 A list of key energy efficient measures for each EU Member State with a planned energy energy savings target

EU Member State	**Planned energy efficient measures**	**The level of planned energy savings**, [*GWh*]
Austria	**1.** Renovation of buildings and reduction of area (sale) **2.** Energy service contracting (ESCO) **3.** Energy management, including consumer behavioral changes	12,3
Belgium	*Brussels region* **1.** Using of PLAGE (local action plan for energy management) *Flemish Region* **1.** ESCO **2.** Construction of new energy efficient buildings **3.** Deep renovation of buildings *Walloon Region* **1.** Measures resulting from energy audits conducted under the UREBA program (rational use of energy in public buildings)	0,0028
Croatia	**1.** Energy Saving Program for Public Sector construction 2014-2015 **2.** Energy efficiency of buildings in the public sector in 2016-2020 **3.** Energy management through information systems for measuring energy and water (energy monitoring)	1,4
Czech Republic	**1.** Changing behavior of the end user **2.** Reconstruction of heating systems **3.** Reconstruction of buildings	—
Denmark	**1.** Increasing consumer awareness **2.** Switch to energy saving devices **3.** Switch to energy efficient construction **4.** Optimization of land use **5.** Reconstruction of buildings **6.** Optimization of operations	23,2

The beginning of the table on page 33

EU Member State	**Planned energy efficient measures**	**The level of planned energy savings**, [*GWh*]
Finland	**1.** Fines and bonuses prescribed in contracts with commercial property companies **2.** Increasing consumer awareness **3.** Building renovation **4.** Technical operational guidance and remote energy monitoring **5.** Checking the time of electricity use **6.** Improving the use of space **7.** Extension of the lease term through "*Green Lease*" contracts **8.** Energy efficiency of the Central Government departments in 2014	1,3
France	Existing activities already planned to achieve the "Grenelle de l'Environnement" goals. They include: **1.** Reconstruction of buildings and technical systems **2.** Behavioral changes of energy consumers **3.** Reducing the area and selling buildings	141,4
Germany	**1.** The national "Roadmap for Energy Reconstructi on of Real Estate of the Federal Government" (*ESB*)	—
Ireland	**1.** A large-scale campaign to change the behavior of energy consumers	1,3
Italy	**1.** Renovation of technical systems (*heating, cooling, lighting*) **2.** Reconstruction of the buildings envelopes **3.** Deep renovation	17

The beginning of the table on page 33

EU Member State	**Planned energy efficient measures**	**The level of planned energy savings**, [*GWh*]
Malta	**1.** New energy efficient lighting systems **2.** Smart measuring devices **3.** Energy management systems: air-conditioning and lighting control, regulators, etc. **4.** Replacement of air conditioners with integrated inverter air conditioners **5.** Replacement of fluorescent lamps with LEDs **6.** Constant purchases of appliances and equipment **7.** Solar installations for own consumption **8.** Installation of solar water heaters **9.** Changing behavior of consumers, including redistribution of employees in departments and changing habitual behavior of employees **10.** Insulation of roof and walls / double glazing or window tinting **11.** Other measures included in the "minimum energy efficiency requirements"	0,08
Netherlands	**1.** The Government Buildings Agency will continue to provide 2% energy savings per year through incentive purchases, optimization and installation of power equipment, as well as promotion of ESCOs and energy efficiency contracts **2.** The Ministry of Defense will continue to implement energy efficiency measures through recommendations on energy efficiency	28,7

The beginning of the table on page 33

EU Member State	**Planned energy efficient measures**	**The level of planned energy savings**, [*GWh*]
Poland	**1.** MEPRs implementation **2.** Support for energy efficiency and renewable energy in the public and residential sectors **3.** Awareness raising and thermal modernization projects supported by the National Fund for Environmental Protection and Water Resources Management **4.** The use of renewable energy in buildings used by public organizations **5.** Best practices guide to enhancing energy efficiency on a website	2,1
Portugal	**1.** Appointment of a local energy manager responsible for promoting energy efficiency measures **2.** Contract for provision of energy services **3.** Implementation of an energy efficiency plan	0,6
Slovakia	**1.** Improvement of energy efficiency in buildings (including thermal modernization, as well as renovation of technical building systems) **2.** Energy audit **3.** Change in consumer behavior	1,8
Sweden	–	3,2
United Kingdom	Several existing schemes, such as: **1.** Establishment a Green Government in the UK **2.** Carbon Management Plan for Scotland **3.** Climate change strategy for Wales	63,3

From the list of measures selected by the EU Member States while opting for an alternative approach, as well as taking into account the low level of available public funds for the thermal modernization of government buildings, the priority measures for energy efficiency in Ukraine are as follows: establishment of energy efficiency funds, implementation of energy management and energy monitoring systems, encouraging the conclusion of ESCO contracts, as well as a large-scale campaign to change the behavior of energy consumers in the central government buildings.

2.5.3 RECOMMENDATIONS ON THE INTRODUCTION OF A SYSTEM OF ENERGY MANAGEMENT AND ENERGY MONITORING IN CENTRAL GOVERNMENT BUILDINGS

The main tasks of the energy management system are as follows:

(*a*) maintenance of expenses for energy central government buildings at the minimum possible level (taking into account the existing technical condition), while maintaining the conditions of staying of visitors and staff at the level corresponding to the current normative documents;

(*b*) preparation and implementation of technical and organizational measures to reduce expenses for energy and improve the conditions of stay of visitors and staff;

(*c*) implementation of a system for stimulating of saving of energy resources.

For the successful completion of these tasks, it is necessary to ensure the effective functioning of the following subsystems:

(*a*) monitoring of power consumption;

(*b*) planning of implementation of energy efficiency improvement measures;

(*c*) attraction of sources of energy efficiency improvement measures;

(*d*) control over the efficiency of implementing the energy efficiency improvement measures;

(*e*) training of structural units staff;

(*f*) motivation of saving energy consumption.

Main stages of implementation of energy management and energy monitoring systems in the buildings of the central government institutions.

Stage No. 1

Collection and systematization of available information on buildings of the central government that consume energy resources and are fully financed from the state budget.

These characteristics include in particular:

(*a*) the name and address of the institution;

(*b*) a list of buildings;

(*c*) a list of suppliers of the energy resources;

(*d*) a list of buildings consuming energy resources used by the institution;

(*e*) area and volume of buildings;

(*f*) contractual and actual load on heating, hot water supply, and ventilation;

(*g*) contractual and actual load on electricity consumers;

(*h*) contractual and actual water consumption;

(*i*) contractual and actual consumption of other types of fuel;

(*j*) number of visitors and staff;

(*k*) working hours of the institution;

(*l*) general indicators of energy consumption of the institution;

(*m*) list of points for the input of energy resources and information about the nodes of accounting at these points of input;

(*n*) annual indicators of energy consumption by types of resources.

Stage No. 2

After the formation of the database of main energy resources consumers in the buildings of the central government, a system of energy monitoring as a component of the energy management system shall be introduced.

The system provides for continuous collection and analysis of data on energy consumption, energy characteristics of the buildings and planned or completed works on reconstruction, modernization and major renovation.

Sources of data on energy consumption:

(*a*) directly from nodes of commercial and technical accounting in institutions using automated systems, or with the involvement of staff of the institution;

(*b*) energy suppliers;

(*c*) structural subdivisions and individual institutions/enterprises that pay for energy resources directly.

Maximum periodicity of power consumption monitoring is 1 week subject to manual input. It is allowed to set the frequency of monitoring at 1 month but not longer than within 1 year after the introduction of the energy management system, after which the frequency of monitoring shall be reduced to 1 week or less.

With the use of automated systems, as well as subject to the implementation of measures for energy efficiency improvement of the facility, the maximum periodicity of monitoring shall be 1 day (excluding weekends and holidays).

It is recommended to implement a monitoring system that transmits data from meters and providers in a fully automated manner.

The minimum list of data to be collected during monitoring is as follows:

(*a*) thermal energy (consumption for the period);

(*b*) electricity (consumption for the period);

(*c*) natural gas (consumption for the period);

(*d*) solid fuel (indicating the calorific value);

(*e*) cold and hot water (consumption for the period);

(*f*) the temperature of hot water in the supply and circulation pipelines (average temperature for the period);

(*g*) internal temperature at least in 2 premises of the institution;

(*h*) outside temperature;

(*i*) average daily number of visitors and staff for the period;

(*j*) information on scheduled and unscheduled outages of power supply;

(*k*) information on the efficiency of energy resources accounting units.

Stage No. 3

Based on energy consumption data for previous periods, baseline indicators of energy consumption of objects are determined in accordance with the existing methods. The following indicators are recommended:

For thermal energy and fuel:

(*a*) consumption of heat energy (fuel) for heating for 1 degree-day;

(*b*) consumption of energy / fuel for the needs of hot water supply for 1 business day.

For electricity:

(*a*) consumption of electric energy for 1 working day (in the context of each month).

For cold and hot water and water drainage:

(*a*) water consumption for 1 business day (in the context of each month);

(*b*) temperature of hot water in the supply and circulating pipelines (if available).

After implementation of the daily monitoring, it is possible to allocate the indicator of Electricity consumption for 1 weekend or holiday.

Baseline levels (energy characteristics) should be reviewed at least once every six months, or after implementation of measures that affect energy consumption or changes in the mode of operation of the building, and in the event of errors found in the input data used to calculate energy consumption.

Stage No. 4

A general analysis of energy efficiency shall be carried out once a quarter. The operational analysis of the consumption efficiency is performed after the completion of each monitoring cycle (but not less than once a month).

Upon results of the analysis, recommendations shall be provided on:

(*a*) increase of energy consumption efficiency;

(*b*) improvement of microclimate parameters;

(*c*) application of the provision on stimulating efficient energy consumption.

As a result of the analysis, buildings with the worst and best performance indicators of energy consumption shall be identified and their additional analysis is performed to find out the reasons for such a deviation, which may include:

(*a*) inspection of the building and its engineering systems;

(*b*) performance of energy audit;

(*c*) survey of the building staff.

According to the results of primary and secondary analysis, a list of buildings claiming a priority for financing of energy efficiency improvement measures shall be formed.

Stage No. 5

Preparation and implementation of energy efficiency projects, namely:

(*a*) analysis of available sources of measures financing (state budget funds, IFI funds, resources of public unions and organizations, etc.);

(*b*) forming applications for funding;

(*c*) conducting energy audits to refine project indicators (a list of buildings and measures, the sequence of implementation, the formulation of a technical task, etc.);

(*d*) organization and/or assistance of procurement of works, materials and services;

(*e*) control over performed work/provided materials and services, their quality and completeness of materials and equipment.

Stage No. 6

Organization of service maintenance and efficient operation of objects after implementation of measures, namely:

(*a*) conducting training for the staff of the institution and operating personnel;

(*b*) procurement of technical maintenance services;

(*c*) constant monitoring of performance of equipment installed.

2.5.4 RECOMMENDATIONS ON THE INTRODUCTION OF THE ENERGY SERVICE AT THE OBJECTS OF THE CENTRAL GOVERNMENT INSTITUTIONS

Energy service is a complex of technical and organizational energy saving (energy efficient) and other measures aimed at reducing the consumption and/or expenses for the payment of fuel and energy resources and/or housing and utility services in comparison with consumption (expenses) in the absence of such measures.

The concept of the energy service is that energy efficient measures in the buildings of central government institutions are implemented by private investors - energy servicing companies (ESCO), while the payment is made exclusively at the expense of economy (reduction of expenses for utilization of utility services and energy carriers), achieved as a result of implementation of the energy efficient measures.

Budget commitments for the repayment of funds to ESCOs come only after the fact of achieving the savings provided for by the energy service contract. That is, if as a result of energy efficient measures no economy was achieved, the energy services company does not receive the fees. Thus, the energy services company fully assumes the financial risks and responsibility for implementation of the project on energy efficiency improvement.

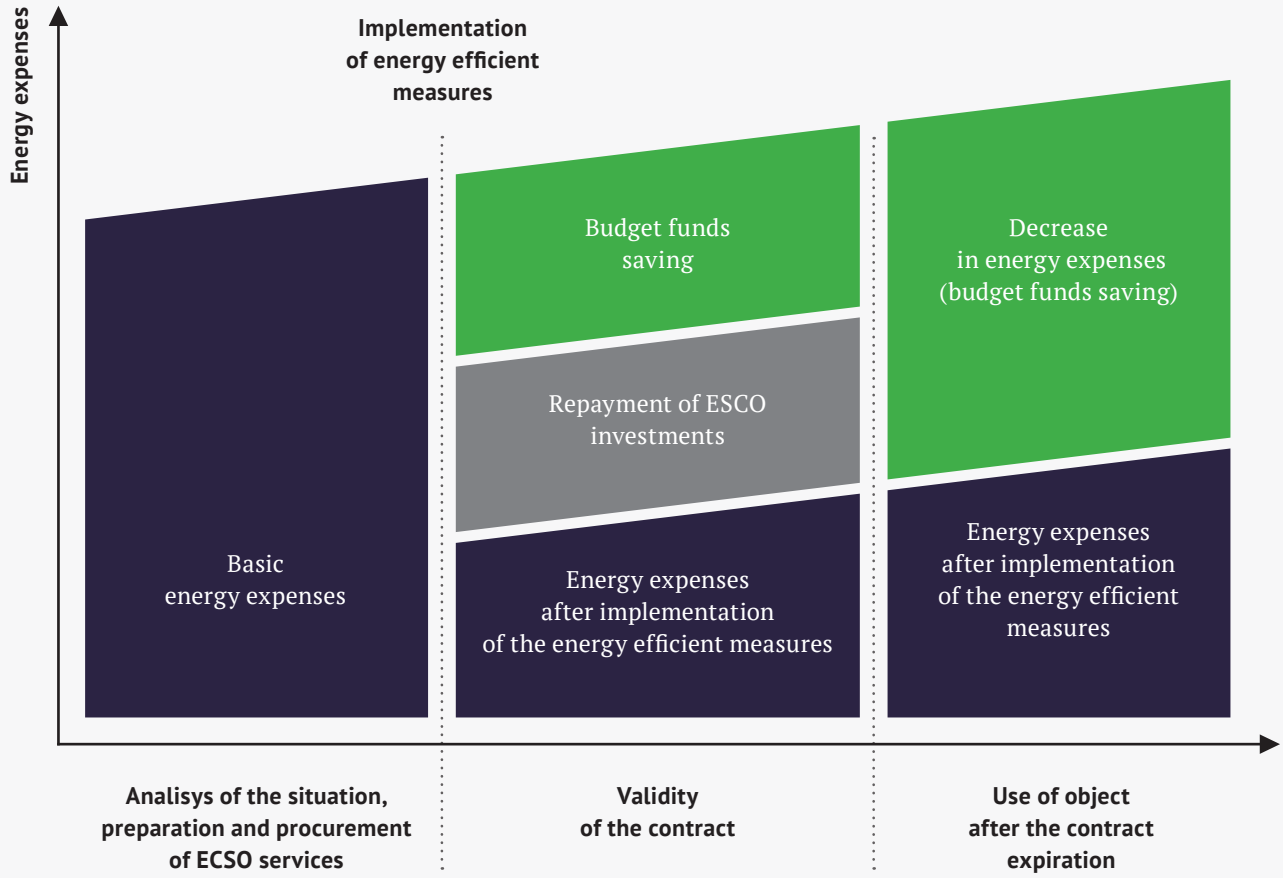
According to the legislation of Ukraine, energy service contracts can be concluded for up to 15 years. During the operation of such an agreement, the expenses of the institution for the payments for fuel and energy resources, as well as housing and utility services does not change. At the same time, the comfort of staying in thermally modernized buildings increases significantly after the implementation of energy efficient measures, i.e. at the beginning of the contract. During the operation of the energy service contract, the customer may receive a benefit in the form of a percentage of the achieved savings (usually 10-20%), and after the completion of the contract, energy costs for the maintenance of the budget institution building are significantly reduced.

A separate issue is the provision of funding for energy efficiency measures. It can be both own funds of the energy service company and the funds raised as loans from banks or other financial institutions, grants or projects of international technical assistance.

There are also models where energy efficiency measures are funded by the customer. From ESCO, in turn, a guarantee is required to achieve an agreed level of energy savings, as well as management of improvements (implemented during the energy service of energy-efficient equipment, materials, etc.).

However, taking into account Ukrainian realities, the lack of experts and budget funds for introduction of energy efficient measures in the objects of the budget sphere, the main advantage of the energy service mechanism is the transfer of financial risks (and attracting investments into an energy efficient project) to ESCO.

Figure 2


Energy expenses
Implementation
of energy efficient
measures
Basic
energy expenses
Budget funds
saving
Repayment of ESCO
investments
Energy expenses
after implementation
of the energy efficient measures
Decrease
in energy expenses
(budget funds saving)
Energy expenses
after implementation
of the energy efficient
measures
Analisys of the situation,
preparation and procurement
of ECSO services
Validity
of the contract
Use of object
after the contract
expiration

The main stages of the implementation of an energy service contract

Stage No. 1

Determination of list of objects and baseline consumption levels

First of all, it is necessary to determine what objects need an increase of the level of energy efficiency and to establish the basic levels of energy consumption.

This will allow to form a database of potential objects of the energy service, according to which ESCOs will be able to estimate the attractiveness of projects. To generalize information on all central government institutions that require the implementation of energy efficient measures, a nationwide system of energy management and energy monitoring can be used.

In addition, the investor himself can initiate the energy service on certain objects. For this purpose, it is recommended that he sends an appropriate letter regarding the intention to implement the energy service to the respective institution.

Stage No. 2

Announcement and conducting the energy service procurement process

At this stage, the following steps should be taken by the customer of the energy service:

(*a*) preparation, coordination, approval and publication of:

1. Changes to the annual procurement plan
2. Announcement of open bidding
3. Tender documentation

(*b*) participation in the tender in accordance with the regulated procedures prescribed by the legislation on public procurement.

Potential executors of the energy service (ESCO) at the same stage:

(*a*) evaluate the potential of energy saving and the feasibility of possible energy efficient measures;

(*b*) carry out calculation of efficiency indicators of energy service contracts and modeling of impact of auction steps on the validity of the contracts and fixed interest rates;

(*c*) submit their tender offers;

(*d*) participate in the tender with a step towards increasing the efficiency of the contract.

The customer determines the winner of the auction by the indicator of the efficiency of the contract. The tender procedure is aimed at the fact that ESCO will offer the highest possible level of cost reduction, the shortest duration of the energy service contract and the smallest fixed percentage of the deduction of savings ESCO. In fact, the indicator of efficiency of the energy service contract is an integral criterion for the three factors mentioned above.

Stage No. 3

Conclusion of an energy service contract with the winner

At this stage, the following steps should be taken by the customer of the energy service:

(*a*) preparation, support and adoption of an act on approval of essential terms of the energy service contract;

(*b*) after making a decision on agreement of the essential terms of the contract, there is a redistribution of expenditures (allocations, assignments, estimates) of the energy service customer;

(*c*) the potential providers of the energy service, for their part, develop, approve and conclude energy service contracts with the customer;

(*d*) preparation of procurement reports;

(*e*) registration of energy service contracts in the bodies of the treasury service.

The energy service contract shall be concluded at the price equal to the product of volume of consumption reduction by the energy service customer of the relevant fuel and energy resources and/or housing and utility services that should be provided by the provider of the energy service for the whole duration of the energy service contract, and corresponding prices (tariffs) that were valid as of the date of announcement of the procedure for the purchase of the energy service, taking into account the fixed percentage of the cost reduction of the customer of the energy service for the payment of the corresponding fuel and energy resources and/or housing and utility services payable to the executor of the energy service.

Stage No. 4

Implementation of energy service measures, which includes the following activities from the side of ESCO

(*a*) obtaining technical specifications, design estimates and project expertise;

(*b*) acquisition of equipment and concluding subcontracting agreements for installation and adjustment works;

(*c*) construction and installation works;

(*d*) technical supervision of the supply and installation of equipment, and the commissioning of facilities;

(*e*) testing of the monitoring system of objects;

(*f*) informing the customer about the list of equipment and materials implemented at the facilities of the energy service with the corresponding registration of temporary storage until the end of the energy service contracts.

Stage No. 5

Measuring and verifying the level of achievement of savings and benefits

This stage includes the creation of systems for measuring and verifying the level of achievement of energy efficiency at the facility and payment under the contract. The result should be the adoption of a plan for measuring and verifying the level of achieved savings and monthly reporting.

The stage provides:

(*a*) development and documenting of a plan for measuring and verifying the object by the customer;

(*b*) data collection, analysis of the reporting results in accordance with the measurement and verification plan for estimating energy savings per month by the executor;

(*c*) payment for the energy service contract and redistribution of budget allocations, if necessary.

In order to stimulate the staff, the heads of the relevant bodies may approve provisions for bonuses for officials responsible for implementation of energy service projects.

Stage No. 6

Completion of energy service contracts

Upon expiration of the energy service contracts (in particular, in cases of early termination), ESCO freely transfers to the owner of the energy service objects all materials and equipment that were formed during the implementation of energy service contracts.

The customer draws up balance of the relevant fixed assets and makes decisions on the models for further management of the implemented energy efficiency technologies.

2.5.5 RECOMMENDATIONS ON THE INTRODUCTION OF INFORMATION MEASURES FOR INCREASING ENERGY EFFICIENCY AT FACILITIES OF THE CENTRAL GOVERNMENT

From the experience of EU Member States, information campaigns have taken their place in many lists of alternative energy efficiency measures at facilities of the central government.

In general, an *information campaign* is, primarily, a measure to carry out an important social and political task.

An information campaign in the context of behavioral changes in energy consumption involves complex and reusable use of PR-tools, as well as promotional materials, within the framework of a single concept and a general plan for influencing the thoughts, attitudes and behavior of people in order to increase the efficiency of energy use in the building.

At the same time, an information campaign is a purposeful, systematically formed and completed set of PR-operations and supporting activities, united by a common strategic plan aimed at solving a specific problem of an organization (the basic subject of PR) and carried out by a technological subject(s) of the PR at a certain stage of the organization's activities.

PR-operation is a separate action of a technological subject of PR, directly aimed at solving a local task in relations with the target public. The *basic subject of PR* is the organization targeted by the Information Campaign to solve the particular problem.

Technological subject of PR is a PR structure that plans and implements the campaign. A technological subject can be internal (own PR service) or external (a PR agency).

An *object of a PR*-campaign is the consciousness and behavior of the target audience members that function within a specific problem situation.

Social and communicative campaigns are preplanned sets of actions aimed at establishing contact with people and encouraging them for certain actions through the use of specific types of information. Almost all kinds of information channels are used in communication campaigns. Organizationally, an information campaign is a set of organizational measures that are implemented simultaneously and consistently according to a single plan.

From the *viewpoint of communication*, an information campaign is a sequence of messages transmitted in a variety of different ways, which is designed for a number of long-term goals.

From a *technological point of view*, an information campaign is systematically organized campaign, based on a program (plan), set of operations, structures and procedures, that provide a solution to a specific problem of organization/person through the management of its public communications. Technological understanding of an information campaign gives grounds for its classification as a class of social and communicative technologies.

An information campaign involves a general concept and action plan.

In general, the algorithm for the *preparation of an information campaign* should look as follows:

(*a*) a general view (the PR tasks are formulated in accordance with the general context of the organization of the campaign, which helps to determine the goals and analyze the current situation from the public viewpoint);

(*b*) intentions and goals (reflecting the specifics of the PR program);

(*c*) target audiences (determination of well-defined groups with whom mutual understanding should be reached);

(*d*) key messages (definition of what is to be transmitted to target audiences, taking into account the knowledge, falsehood and bias they already have);

(*e*) strategy (definition of a general approach, within which a specific tactic is implemented);

(*f*) tactics/activities;

(*g*) schedule (it is important to accurately calculate the time of the campaign);

(*h*) expenses (it is necessary to take into account all expenses, including the time expenses of own employees, estimating them in comparison with the volumes of the work of the invited consultants);

(*i*) control (it is necessary to have a clear control system as part of the program).

The information campaign is designed for a certain period of time and, depending on the scale of the activities, can take from several months to several years. A typical public relations campaign has an annual cycle.

For the effective implementation of such measures, it is advisable to develop an appropriate *communication strategy* that clearly identifies:

(*a*) Target audience;

(*b*) Information messages;

(*c*) Communication channels;

(*d*) Communication activities plan;

(*e*) Monitoring and verifying of the results.

From the point of view of marketing experts, in the planning of information campaigns, the following definition of the target audience is used: a set of existing and potential consumers who are ready to change their priorities in favor of this product or service under the influence of marketing activities.

In the context of increasing the energy efficiency of central government buildings, a more acceptable definition can be applied: a target audience is a set of existing and potential energy consumers who are ready to change their behavioral habits in favor of increasing energy efficiency under the influence of information activities.

In order to determine the *target audience*, one should start with the following classification:

The main target audience (the core) are persons who by their behavior have the greatest influence on the level of consumption of resources in the building. This audience should in the first place be targeted by the main forces of the information campaign.

Consequently, for the implementation of communication measures aimed at increasing the energy efficiency of buildings of the central government, the following *main target audiences* can be identified:

(*a*) staff (permanent employees);

(*b*) visitors and temporary workers;

(*c*) other persons (e.g. service providers).

The definition of key messages is one of the key stages in creating an effective information campaign.

First, key messages should be well-integrated with the basic concepts of the target audiences. The conviction is carried out much easier if the message is consistent with the general position in relation to the subject.

Second, the key messages should be expressed in plain terms.

Thirdly, the key proposal should be repeated throughout the campaign in different ways, but the concept should remain clear and simple.

Repeating key messages increases the chances that it will be heard and noted by the target audiences.

The experience of European countries suggests that, as a prerequisite for the formation of target audiences for the purpose of energy saving, so-called "*factors of privacy*" should be formed:

(*a*) awareness;

(*b*) knowledge;

(*c*) norms of behavior;

(*d*) attitude;

(*e*) self-efficacy.

And further influence on so-called "*favorable factors*":

(*a*) financial resources;

(*b*) technical resources;

(*c*) new skills.

Moreover, these factors are aggravated or weakened by "*strengthening factors*":

(*a*) feedback from colleagues;

(*b*) advice from experts;

(*c*) encouragement and encouragement from the management.

Thus, we can conclude that an efficient information campaign on energy efficiency improvement, through behavioral changes in target audiences, should include the following *mandatory elements*:

(*a*) training;

(*b*) constant information influence;

(*c*) encouragement and motivation.

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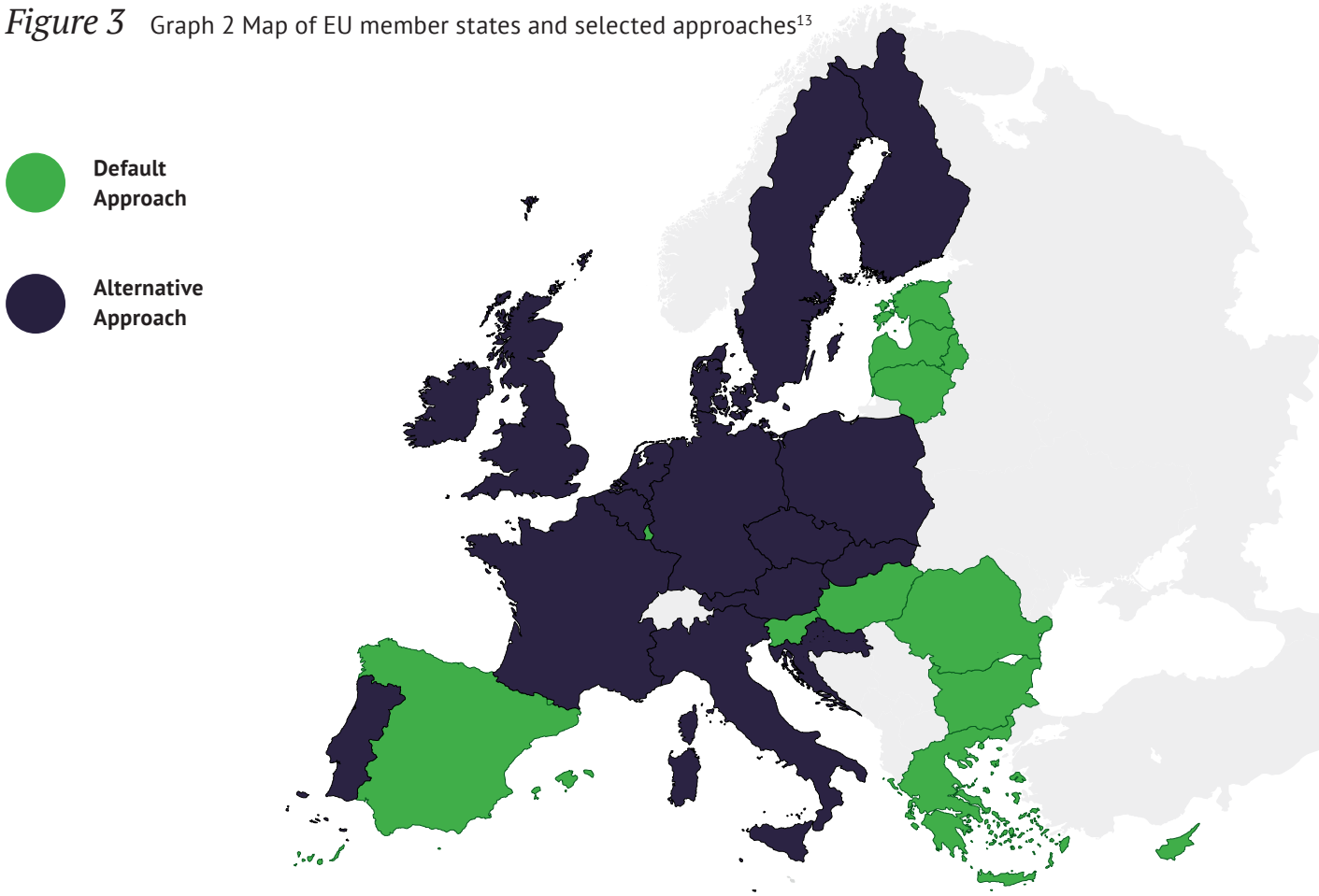
3. Implementation of Article 5 EED in EU Member States

3.1 **Overview**

Figure 3 shows which Member States opted for the *default approach* (11 Member States) and the *alternative approach* (17 Member States)

Figure 3 Graph 2 Map of EU member states and selected approaches[13]



13 Coalition for Energy Savings (2015): Implementing the EU Energy Efficiency Directive: Analysis of Member States plans to implement Article 5 *http://energycoalition.eu/sites/default/files/20150520%20Coalition%20for%20Energy%20Savings%20-%20Article%205%20analysis%20Report.pdf* (15.10.2018)

The majority of EU Member States selected the alternative approach as it ensures more flexibility and allows combining various energy efficiency measures applied to public authorities' buildings.

For the alternative approach, it is not necessary but strictly recommended to prepare the inventory list of central government buildings.

Table 4 shows more information about some countries having chosen the default approach to fulfil their commitment to improve energy efficiency.

Tablet 4 Selected information about some EU Member States following the default approach[14]

	Buildings entered into the Database	**Data on total area of buildings**	**Data on energy consumption/energy performance of buildings**	
			Energy Performance Certificate	*Other energy consumption indicator*
Bulgaria	All central and regional government buildings of the area over 250 m^2	Available for each building	Available for 15% of buildings	Data unavailable
Cyprus	All central and regional government buildings of the area over 500 m^2	Available for each building	Available for 10% of buildings	Information on energy consumption (kW/m^2/year) available for 64% of buildings
Greece	All central and regional government buildings of the area over 500 m^2	Available for each building	Data unavailable	Data unavailable
Latvia	All central and regional government buildings of the area over 500 m^2	Available for each building	Available for 10% of buildings	Information on energy consumption (kW/m^2/year) available for 100% of buildings

14 Coalition for Energy Savings (2015): Implementing the EU Energy Efficiency Directive: Analysis of Member States plans to implement Article 5 *http://energycoalition.eu/sites/default/files/20150520%20Coalition%20for%20Energy%20Savings%20-%20Article%205%20analysis%20Report.pdf* (15.10.2018)

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	Buildings entered into the Database	**Data on total area of buildings**	**Data on energy consumption/energy performance of buildings**	
			Energy Performance Certificate	*Other energy consumption indicator*
Lithuania	All central and regional government buildings of the area over 500 m^2	Available for each building	Available for 60% of buildings	Data unavailable
Estonia	All buildings in state ownership	Available for each building	Available for 10% of buildings	Data unavailable
Hungary	Groups of government buildings by corresponding state authorities	–	Data unavailable	Data unavailable
Luxembourg	All central and regional government buildings of the area over 500 m^2	Available for each building	Available for 30% of buildings	Information on energy consumption ($kW/m^2/year$) available for 28% of buildings

OlegGr / Shutterstock.com

3.2 Examples from EU Member States

Eighteen EU member states have approved and published their inventory lists of public authorities' buildings, as this information is important for planning and monitoring of energy efficiency measures under the alternative approach. Good examples of preparing the inventory lists may be found in the following EU member states.

The following information is taken from the European Commission's website[15] on National Energy Efficiency Action Plans and Annual Reports, from the Ministries in charge for implementing Article 5, and from the Concerted Action EED[16].

3.2.1 SPAIN

The Institute for Energy Saving and Diversification (IDAE), which is a body under the Ministry of Industry and Energy, has designed and developed an IT platform for energy consumption management (PIGEP) for the purpose of inventory. The main objective is to centralize and process energy consumption data for buildings owned by central government agencies.

The inventory was taken during 2013 in cooperation with all interested ministries, based on PIGEP. To fill the Database with data on energy consumption for selected buildings, a responsible energy manager was appointed at the level of each ministry, and an "energy officer" in each building.

Spain integrated its inventory list into the IT-platform SIGEE-AGE for management of energy and property. The task of energy consumption monitoring is assigned to each central government building.

The inventory list contains 2,142 buildings distributed among 12 ministries with the total area of 11,000,000 m^2 (*see Table 5*).

15 *https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive/national-energy-efficiency-action-plans* (15.10.2018)
16 *https://www.ca-eed.eu/Homepage* (17.10.2018)

Table 5 Extract from inventory list of Spain[17]

Ministry	Nº of Building	Surface [m^2]	Electricity [kWh]	Natural gas [kWh]	Diesel oil [kWh]	Propane [kWh]	Total 2016 [kWh]
MAPAMA	33	149.277	10.220.433	925.213	2.038.813	25.346	13.775.404
MAEC	3	6.743	240.996				240.996
MINECO	156	930.878	120.175.371	22.826.483	12.572.901	321.745	155.896.503
MECD	56	374.064	13.854.035	4.977.191	904.489		19.735.715
MEYA	759	1.925.880	126.160.913	15.684.364	9.569.753	29.614	151.444.674
MINETAD	11	295.284	18.972.355	2.800.308	490.908		22.263.571
MFOM	87	213.650	6.541.707	351.647	1.626.464		8.519.817
MINNAFP	395	1.334.474	68.174.789	7.129.179	10.861.868	20.653	86.415.490
MIR	581	5.331.971	279.423.383	109.459.402	152.446.399	11.962.048	553.291.232
M.W511C1A	10	37.807	7.474.326	263.734	1.880		7.739.940
MOR	6	118.628	15.885.332	356.578	1.442.876		17.684.786
M5551	41	338.668	23.901.814	4.933.740	12.594.430	243.179	43.094.723
TOTAL	**2.138**	**11.057.324**	**691.025.453**	**169.707.839**	**204.550.781**	**12.602.618**	**1.080.102.850**

17 *hhttp://www.minetur.gob.es/energia/desarrollo/EficienciaEnergetica/directiva2012/Paginas/actuaciones-transposicion.aspx* (17.10.2018)

This inventory list includes the following data:

(*a*) PaeeAge code the defines each building with a code on the IT-Platform SIGEE-AGE;

(*b*) name of institution that owns the building;

(*c*) information on street, district, avenue, etc.;

(*d*) street name;

(*e*) number of the street where the building is located;

(*f*) municipality;

(*g*) province;

(*h*) total area of the building;

(*i*) energy consumption: electricity, natural gas, diesel fuel, propane, and total energy consumption for the relevant year in kWh;

(*j*) class of energy efficiency indicated in the building certificate.

3.2.2 IRELAND

For the purposes of the Irish Database, the total floor area (TUFA) of each building is calculated. In most cases, this information was available because it was designed for the purpose of development of Building Energy Efficiency Certificates (DEC) as required by Directive 2010/31/EU. TUFA was calculated according to the methodology developed by the Institute of Sustainable Energy of Ireland (SEAI). In particular, the internal area of the floors was calculated, as a rule, by measuring the building plan drawings. For those buildings where floor plans or other drawings are unavailable, ration of 1.25 is applied to the Net Lettable Floor Area (NLFA). The buildings using NLFA and multipliers, rather than the actual calculation of TUFA, are highlighted in the Database in red. Each building is classified as "naturally ventilated" or "air conditioned". This allows calculating the expected energy consumption using standard control values for an alternative approach.

Ireland's first inventory list comprises the buildings that have the following features:

(*a*) total heated/cooled areas above 500 m^2;

(*b*) own and rented buildings;

(*c*) buildings occupied by administrative subdivisions;

(*d*) buildings that do not meet the minimum energy efficiency requirements set by Article 4 of the Directive on energy performance of buildings, that is, old buildings constructed before the publication of Ireland's current building rules on minimum energy saving requirements in non-residential buildings;

(*e*) excluding the buildings defined as protected structures of historic buildings.

One of the additional indicators included into the inventory list was the class of energy performance (DEC Rating) as specified in Article 12 of the EPBD.

In Ireland, the Public Sector Energy Efficiency Strategy is well in place[18].

Table 6 Extract from Ireland's inventory list[19]

Building Name	**Dept/ Organisation**	**County**	**DEC Rating**	**TUFA**, [m^2]	**Building Type**
Kildare Street Agriculture House	DAFM	Dublin	D2	19543	Naturally Ventilated
Hawkins Street Hawkins House	Healt&Children	Dublin	C3	15611	Naturally Ventilated
O'connel Street Upper 9-15	Revenue	Dublin	C1	13682	Naturally Ventilated
St Stephens Gr 50-52	Justice & Equality	Dublin	C3	13040	Naturally Ventilated
Store Street Aras Mhic Dhiarmada	Social Protection	Dublin	D2	12119	Naturally Ventilated
Johnstown Castle Agric Office	DAFM	Wexford	C2	11410	Naturally Ventilated
Sligo College Road	Social Protection	Sligo	C3	11206	Naturally Ventilated
Kilkenny Government Offices	Revenue	Kilkenny	C3	10402	Naturally Ventilated
Limerick Gov Off Sarsfield House	Revenue	Limerick	C3	9954	Naturally Ventilated
Kildare Street 23-28	DJEI	Dublin	D2	9357	Naturally Ventilated
Cork Revenue House	Revenue	Cork	F	9225	Naturally Ventilated

18 *https://www.dccae.gov.ie/en-ie/energy/topics/Energy-Efficiency/national-energy-efficiency-action-plan-(neeap)/Pages/Public-Sector-Energy-Efficiency-Strategy.aspx* (17.10.2018)
19 *https://ec.europa.eu/energy/sites/ener/files/documents/2013_ie_eed_article5_en.pdf* (17.10.2018)

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Building Name	Dept/ Organisation	County	DEC Rating	TUFA, [m^2]	Building Type
Leeson Lane	Transport, Tourism & Sport	Dublin	E1	8120	Naturally Ventilated
Dundalk Gov Off Alphonsus Road	Revenue	Louth	E1	8290	Naturally Ventilated
St Stephens Gr78-81 IveaghHse	DFAT	Dublin	C3	7916	Naturally Ventilated
Longford Government Offices	Social Protection	Longford		7814	Naturally Ventilated
Lansdowne Road 2-8 Lansdowne Hse	Revenue	Dublin	D2	7553	Naturally Ventilated
Roscommon Government Offices	Social Protection	Roscommon	D2	6705	Naturally Ventilated
Kildare House	Oireachtas	Dublin	D2	6647	Naturally Ventilated
Burgh Quay 13-14	Justice & Equality	Dublin	D1	6366	Naturally Ventilated
Nenagh Government Offices	Revenue	Tipperary	C3	6295	Naturally Ventilated

3.2.3 CZECH REPUBLIC

The inventory list contains *975 buildings*.

When forming the inventory list, the following additional data were analysed in addition to the total building area and energy consumption:

(*a*) specific energy consumption per building area;

(*b*) number of employees;

(*c*) working hours in the building;

(*d*) degree-days;

(*e*) energy service development trends;

(*f*) energy supplier and comparison of buildings as a motivation to change the supplier.

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Table 7 Extract from Czech inventory list [20]

Resort/Instituce	Ulice	Číslo popisné	Obec	Plocha [m^2]	Celková roční spotřeba energie [MWh/rok]
Český báňský úřad	Kozí	4	Praha 1	6 194	985
Český báňský úřad	Hřímalého	11	Plzeň	1 130	132
Český báňský úřad	Cejl	13	Brno	737	160
Český báňský úřad	Veleslavínova	18	Ostrava-Moravská Ostrava	1 313	244
Český báňský úřad	U Města Chersonu	1429/7	Most	1 890	304
Český statistický úřad	V Ráji	872	Pardubice	862	90
Český statistický úřad	Repinova	2661	Ostrava	2 943	341
Český statistický úřad	Ke Skalce	1881	Jihlava	804	79
Český statistický úřad	Myslivečkova	914	Hradec Králové	2 767	174
Český statistický úřad	Slovanská alej	2323	Plzeň	4 430	261
Český statistický úřad	Špálova	2684	Ústí nad Labem	2 110	139
Český statistický úřad	Na Padesátém	3268	Praha 10	24 500	4 018
Český statistický úřad	Jezuitská	642	Brno	3 786	454
Český telekomunikační úřad	Tehov	104	Tehov	783	147
Český telekomunikační úřad	Sokolovská	58	Praha	8 556	1 061
Český úřad zeměměřický a katastrální	Pod sídlištěm	1800	Praha	22 544	4 374
Český úřad zeměměřický a katastrální	Čimická	319	Praha	706	134
Energetický regulační úřad	Masarykovo náměstí	5	Jihlava	1 975	298
Kancelář Senátu ČR	Valdštejnské náměstí	17	Praha 1	13 616	2 551
Kancelář Senátu ČR	Valdštejnská ulice	154	Praha 1	4 790	2 551
Kancelář Senátu ČR	Valdštejnská ulice	155	Praha 1	1 232	2 551

20 *https://www.mpo.cz/dokument145673.html* (17.10.2018)

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Resort/Instituce	**Ulice**	**Číslo popisné**	**Obec**	**Plocha** [m^2]	**Celková roční spotřeba energie** [*MWh/rok*]
Kancelář veřejného ochránce práv	Údolní	39	Brno	6 880	1 170
Ministerstvo dopravy	nábřeží Ludvíka Svobody	1222	Praha	47 975	7 273
Ministerstvo financí	Janovského	438	Praha	18 505	3 068
Ministerstvo financí	Voctářova	2145	Praha	9 154	1 754
Ministerstvo financí	Letenská 9	593	Praha	1 282	220
Ministerstvo financí	Legerova	1581	Praha	3 861	626
Ministerstvo financí	Letenská	525	Praha	38 231	2 501
Ministerstvo financí	Dražického náměstí	63	Praha	38 231	2 501
Ministerstvo financí	Josefská	43	Praha	38 231	2 501
Ministerstvo financí	Hybernská	997	Praha	3 834	31
Ministerstvo kultury	Maltézské náměstí	471	Praha 1	6 198	1 338
Ministerstvo kultury	Milady Horákové	220	Praha 6	6 009	1 382
Ministerstvo kultury	Skalní	14	Praha 5	624	80
Ministerstvo obrany	Svatoplukova	84	Brno	3 482	902
Ministerstvo obrany	Kounicova	65	Brno	13 214	3 409
Ministerstvo obrany	Štefánikova	53a	Brno	4 885	821
Ministerstvo obrany	Náměstí	3	Libavá	457	129
Ministerstvo obrany	Náměstí	2	Libavá	576	156
Ministerstvo obrany	Libavá	171	Libavá	685	175
Ministerstvo obrany	Letecká	1	Prostějov	4 654	1 283
Ministerstvo obrany	Letecká	1	Prostějov	2 405	680
Ministerstvo obrany	Letecká	1	Prostějov	4 654	1 283
Ministerstvo obrany	Letecká	1	Prostějov	1 459	423

3.2.4 BULGARIA

The inventory list contains more than 8,000 of the surface area above 250 m^2. In addition to the buildings of the central government, the list contains municipal, state, public buildings, as well as their combinations.

For the formation of the inventory list, the following input data were used:

(*a*) name of institution;

(*b*) address of the building;

(*c*) total area;

(*d*) ownership;

(*e*) designation of the building;

(*f*) year of construction;

(*g*) type of building;

(*h*) facts of inspections (energy audits);

(*i*) availability of the energy performance certificate;

(*j*) class of energy performance;

(*g*) area of heat-insulated elements;

(*h*) brief description of energy efficiency measures;

(*i*) types of renewable energy used in the building;

(*j*) share of renewable energy in the total energy use.

Large amounts of information and lack of training of persons in charge of information provision resulted in the bulky and poor-quality building inventory list.

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3.2.5 FINLAND

The inventory list of central government buildings was a single-time effort, and it was determined that the buildings leased by public institutions shall be deemed a part of central government.

If the areas leased by central government bodies is more than half of the total leased building area it is deemed that the entire building is occupied by the central government.

In total, 237 buildings owned or occupied by the central government have been included into the inventory list. Their total surface area is 884,000 m^2, and annual energy consumption is 178 GWh.

3.3 Comparison and conclusions

Choice of default or alternative approach depends on national conditions. However, a building inventory based on an electronic database is necessary in any case for the effective and cost efficient implementation of Article 5.

Conclusions for the preparation of the inventory list are as follows:

(*a*) it is advisable to form the inventory list on the basis of an IT-Platform (database);

(*b*) an inventory list should comprise a limited amount of data; among other things, they have to comply with market needs (potential investors);

(*c*) it is important to envisage energy performance classes of buildings in the inventory list;

(*d*) the basis for preparation of the list should be the buildings of central governments of the total area of 250 m^2;

(*e*) the group of central government buildings should be clearly defined to enable their further listing;

(*f*) it is important to train the staff that will be responsible for further provision of information;

(*g*) data should be entered or updated once in six months;

(*h*) the list should also include the buildings where a larger half of areas are leased by central government institutions.

The inventory list can serve multiple purposes and, therefore, its scope and targeted use need to be updated by inclusion of additional data, such as, reduction of CO_2 emissions, specific energy consumption per visitor, etc.

Also, inventory lists can be potentially combined with databases of energy audits and building energy certificates.

For the initial stage of data collection on energy and operation characteristics of CEA buildings, the focus should be on the following characteristics:

(*a*) name and address of the building (institution);

(*b*) list of buildings used by the institution and consuming energy resources (group of buildings);

(*c*) list of suppliers of energy resources;

(*d*) heated and total area and volume of buildings;

(*e*) contractual and actual heating, hot water supply and ventilation load;

(*f*) contractual and actual electricity load;

(*g*) contractual and actual water consumption;

(*h*) contractual and actual consumption of other fuels;

(*i*) number of visitors and staff;

(*j*) working hours at the institution;

(*g*) summarized energy consumption data;

(*h*) list of points of input of energy resources and information on metering units at those input points;

(*i*) annual consumption of individual energy resources.


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4. Implementation of Article 5 of the EED in Ukraine

This chapter deals with specific aspects important for implementation of Article 5 EED and uses the structure of the Ukrainian draft Law on Energy Efficiency to show which details will have to be decided and regulated (*for example, Decision by Cabinet of Ministers of Ukraine, Technical Guideline, etc.*)

4.1 **Default Approach and Alternative Approach**

Article 5 EED requires the central government to achieve energy savings for their own buildings and to report on them on an annual basis.

There are two options:

(*a*) *Default Approach*: renovating 1% of the total useful floor area per year, meeting the minimum energy performance requirements defined according to Article 4 EPBD.

(*b*) *Alternative Approach*: ensuring that the equivalent energy saving compared with the default approach is achieved by means of other cost-effective measures.

This chapter explains both approaches in more detail by comparing the Default Approach with the Alternative Approach along the following topics:

(*a*) setting up a building inventory of heated and/or cooled buildings;

(*b*) determination of energy saving target;

(*c*) types of energy efficiency improvement measures to be implemented;

(*d*) identifying buildings for energy efficiency improvement measures;

(*e*) reporting: Proving the energy savings achieved;

(*f*) role model function;

(*g*) synergies with Article 5 (7).

For each topic, there are suggestions which aspects should be regulated. However, the determination of the appropriate legal instrument is not yet specified.

It finally concludes with a short summary of most important aspects and recommendations how to proceed.

4.1.1 SETTING UP A BUILDING INVENTORY OF HEATED AND/OR COOLED BUILDINGS

Default Approach	Alternative Approach
A building inventory is required and the minimum level of information to be published is specified.	A building inventory is not required but it is strongly recommended. It is suggested to implement the building inventory in any case.

Important aspects to consider:

A well designed building inventory can be used for many purposes, not only for determining the total floor area to be renovated every year and to publish the information required by the EED.

Depending on how the building inventory is set up, it can be useful for developing a renovation strategy, implementing the renovation strategy, and for controlling building comfort and achieved energy savings.

Regarding regulations, there is no difference between Default Approach and the type of Alternative Approach suggested above.

What should be regulated:

(*a*) which buildings to include in the building inventory for determining the energy saving target (1% of the total floor area of heated and/or cooled buildings owned and occupied by its central government);

(*b*) which buildings to include in the building inventory to facilitate a comprehensive renovation strategy (e.g. buildings occupied by the central government);

(*c*) which data to collect for each building, who is responsible for data collection, tools for data collection, procedures for reporting;

(*d*) how to ensure compatible interfaces with other relevant data sources, such as Energy Performance Certificates, energy monitoring databases, etc.

4.1.2 DETERMINATION OF ENERGY SAVING TARGET

Default Approach	Alternative Approach
1% of the total floor area is determined based on the building inventory: The 1% rate shall be calculated on the total floor area of buildings with a total useful floor area over 500 m^2 owned and occupied by the central government of the Contracting Party concerned that, on 1 January of each year, do not meet the national minimum energy performance requirements set in application of Article 4 of Directive 2010/31/EU.	• The equivalent energy savings of the default approach have to be achieved (energy saving target). • The energy saving target can be determined based on the building inventory or based on typical buildings (reference buildings which are representative of the stock of governmental buildings).

Legal requirement for implementing the Alternative Approach:

Determination of the energy saving target and notification to Energy Community, including a description of measures how to achieve the energy saving target (notification).

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4.1.3 TYPES OF ENERGY EFFICIENCY IMPROVEMENT MEASURES TO BE IMPLEMENTED

Default Approach	Alternative Approach
Building renovation measures: 1% of the total floor area of heated and/or cooled buildings owned and occupied by its central government is renovated each year to meet at least the min-imum energy performance requirements that it has set in application of Article 4 of Directive 2010/31/EU.	• In addition to *different types of building renovation* (shallow renovation, major renovation, deep renovation) other measures can be applied such as *Energy Performance Contracting* and Implementation of an *Energy Management System*. • Regarding renovation measures, it is not mandatory to meet the minimum energy performance requirements set in application of Article 4 of Directive 2010/31/EU.

Important aspects to consider regarding the practical implementation of building renovation measures:

Practical implementation creates additional work for staff and additional budget could be necessary. Therefore, it should be checked what is the best way to integrate new processes with existing ones, in order to implement robust procedures which are feasible in the long-run. In the governmental entities, competent staff must be available to develop specifications for calls for tenders, setting up the contracts, supervising the works and commissioning the renovated building. A specialized agency could be entrusted to support them with these tasks (public procurement).

What should be regulated:

(*a*) facility manager / energy manager for each entity of central government, job description and qualification requirements for such position;

(*b*) maintenance and renovation plans for buildings owned and occupied by the government, minimum requirements regarding the content of such plans;

(*c*) procedure for allocating budget to energy efficiency measures, also allowing for staged renovations taking more than a year (implementation of defined measures in a defined sequence).

What should be regulated regarding building renovation measures:

(*a*) whenever possible, additional meters should be installed as part of building renovation works, in order to gradually implement a remote monitoring and control system. To this end, appropriate and feasible requirements should be developed and included in the regulation.

(*b*) random quality checks during carrying out and / or after completion (depending on the type of measure).

Regarding these regulations, there is no difference between Default Approach and Alternative Approach.

Additional regulations recommended for the Alternative Approach:

(*a*) requirements for the implementation of Energy Performance Contracting in public buildings, performance based model contracts including minimum requirements regarding indoor air temperature and air quality.

(*b*) requirements for Implementing Energy Management Systems in public buildings, model procedures.

4.1.4 IDENTIFYING BUILDINGS FOR ENERGY SAVING MEASURES

Default Approach	Alternative Approach
• Buildings are identified by means of Energy Performance Certificates of the buildings listed in the building inventory. • Ideally, Energy Performance Certificates contain detailed recommendations on energy efficiency improvement measures, and how much the building energy performance could be improved. • Based on this information, buildings will be selected for detailed energy audits and renovation planning.	• Based on the information collected for setting up the building inventory, suitable renovation measures can be identified for specific buildings. • Depending on the situation, some buildings might rather qualify for implementing an Energy Management System (e.g. trained staff is available in the respective public entity). Other buildings might benefit most from measures addressing the heating system, because problems are well known and there is no need to identify them by means of an energy audit. Such buildings could be subject to Energy Performance Contracting.

Important aspects to consider regarding Alternative Approach:

It is allowed to take into account buildings taken out of use (demolished, sold, or not used anymore prior to being demolished or sold) due to more intensive use of other buildings as energy saving measure. It is also allowed to take into account new buildings occupied and owned as replacement for specific central government buildings demolished in any of the two previous years. However, these measures will not contribute to developing the energy efficiency market in Ukraine. Therefore, it is recommended to abandon this option.

4.1.5 REPORTING: PROVING THE ENERGY SAVINGS ACHIEVED

Default Approach	Alternative Approach
Issuing an Energy Performance Certificate (EPC) according to EPBD before and after building renovation.	• *Renovations*: EPC before and after building renovation. • *Energy Performance Contracting*: Energy savings to be achieved according to contract • *Implementing an Energy Management System*[21]: Specified indicators, e.g. normalized electricity consumption per year.

What should be regulated:

(*a*) methods of reporting the achieved energy savings;

(*b*) procedure of reporting the achieved energy savings.

The EPC according to EPBD can be used to report on *building renovation measures*. This applies for both, the Default Approach and the Alternative Approach. However, there is the problem that actual indoor temperature is often lower than the standard indoor temperature used for energy performance calculations. In order to make sure that the planned comfort level is achieved, also measured energy data and energy bills should be collected.

For the Alternative Approach, additional specifications are required, namely how to determine energy savings from Energy Performance Contracts, and how to determine energy savings from implementing an Energy Management System. Suggestions are provided below.

21 According to EN ISO 50001 Energy management systems — Requirements with guidance for use 2012 (ISO 50001:2011)

Determining energy savings from Energy Performance Contracts

Savings are eligible in the reporting period covered by the contract: The amount of total energy savings is divided by the years of the contract duration. The annual saving is allocated to each year of the reporting period. The year of starting the contract and ending the contract is included, irrespective of the specific month. In general, it is useful to have standardized model contracts with a specific emphasis on keeping the prescribed comfort level, in order to avoid that energy savings are achieved at the expenses of decreased comfort (lower indoor temperatures that planned).

Determining energy savings from Implementing an Energy Management System

Measures addressing user behaviour resulting in energy savings can be part of an Energy Management System. Checking is also part of an Energy Management System and consists of monitoring, measurement, and analysis.

Measurement can range from collecting data from only utility meters up to complete monitoring and measurement systems connected to a software application capable of consolidating data and delivering automatic analysis. At the beginning, it is suggested to collect data from utility meters and energy bills, and to report the difference compared with the previous year. A procedure has to be defined how to correct the influence of extreme weather conditions and changes in occupancy, in order to generate meaningful information about development of energy performance.

4.1.6 ROLE MODEL FUNCTION

Default Approach	Alternative Approach
Building renovation measures	• Building renovation measures • Energy Performance Contracting • Energy Management System

Important to consider

Governmental buildings have an exemplary role and thus contribute to developing a market for energy efficiency.

4.1.7 SYNERGIES WITH ARTICLE 5 (7)

EED 2012/27/EU as adopted by the Energy Community states in paragraph 7

Contracting Parties shall encourage public bodies, including at regional and local level, and social housing bodies governed by public law, with due regard for their respective competences and administrative set-up, to:

(*a*) *adopt an energy efficiency plan, freestanding or as part of a broader climate or environmental plan, containing specific energy saving and efficiency objectives and actions, with a view to following the exemplary role of central government buildings laid down in paragraphs 1, 5 and 6;*

(*b*) *put in place an energy management system, including energy audits, as part of the implementation of their plan;*

(*c*) *use, where appropriate, energy service companies, and energy performance contracting to finance renovations and implement plans to maintain or improve energy efficiency in the long term*

In view of the statements above, provisions for implementing an Energy Management System and making use of energy service companies and Energy Performance Contracting in addition to building renovation measures will have to be developed, irrespective of the chosen approach (Default Approach or Alternative Approach).

4.1.8 SUMMARY OF COMPARISON

The Default Approach
depends on the availability of the building inventory and on the availability of EPCs. Only building renovation measures account for energy savings.

As only very few EPCs are available, there are basically two options how to proceed:

(*a*) to assume that buildings do not meet minimum energy performance requirements, and all buildings owned and occupied by the central governmental to which article 5 applies are included in the building inventory and used for calculating the 1% rate;

(*b*) to commission Energy Performance Certificates for a large share of buildings (if possible based on a typology approach). However, this option is time consuming and expensive.

Selection of buildings to be renovated can be done based on the following criteria:

(*a*) EPC information (energy rating and recommendations for improving energy efficiency);

(*b*) number of m^2, energy consumption and energy cost (data collected for the building inventory).

For those buildings selected for renovation, EPCs should be issued before and after renovation.

The Alternative Approach
allows for more flexibility regarding energy saving measures. In addition to building renovation measures other cost-effective measures can be taken. It is suggested to concentrate on the implementation of Energy Management Systems and Energy Performance Contracting, as these measures are also required under Article 5(7).

However, building renovation measures are the core element: Energy Performance Contracting is just a method to finance specific renovation measures, and Energy Management also applies procedures to identify building renovation potential and implement renovation measures.

The table 8 below summarizes important aspects to consider when choosing an approach.

Most probably three factors will be critical for the decision:

(*a*) the capacity of responsible entities (e.g. qualification of staff, procedures in place);

(*b*) the available budget;

(*c*) the consistency with previous reporting to Energy Community.

Table 8 Comparison of approaches — overview of important aspects

	Default Approach	Alternative Approach
Flexibility in achieving energy savings	Only renovation measures.	Renovation measures and others such as implementing an Energy Management System, Energy Performance Contracting.
Budget	Renovation to meet minimum requirements needs more upfront investment than shallow renovations.	Mainly low cost measures and third party financing (*Energy Performance Contracting*).
Regulations required	Building inventory and renovation target; etc.	The same as Default Approach and additional regulations.
Exemplary role	Limited to renovation measures	Extended to other measures.
Potential problems	How to deal with missing Energy Performance Certificates.	• Savings from renovations could be too low compared with previous reporting to Energy Community. • Flexibility in achieving energy savings could be a disadvantage in the Ukrainian envi-ronment.
Quick fix possible	Depends on the capacity of responsible entities (*e.g. qualification of staff, procedures in place*).	Depends on the capacity of responsible entities (*e.g. qualification of staff, procedures in place*).

4.1.9 DISCUSSION AND RECOMMENDATIONS

If there is no notification about the Alternative Approach to Energy Community, implementation of Article 5 EED will be under the Default Approach.

If Ukraine opts for the Alternative Approach according to paragraphs 1 to 5 of Article 5 EED, Ukraine will be required to

> *...notify to Energy Community Secretariat, by 1 January 2017, the alternative measures that they plan to adopt, showing how they would achieve an equivalent improvement in the energy performance of the buildings within the central government estate.*

This notification should contain the following elements

(*a*) estimation of energy savings to be achieved according to default approach;

(*b*) description of alternative measures to be adopted;

(*c*) estimation of energy savings by alternative measure.

Article 6 (7) draft Law on Energy Efficiency lists energy management systems, energy service contracts, and thermal modernisation among the permitted energy efficiency measures. This is in line with providing a role model to the regional and local level according to Article 5 (7) EED, it will contribute to develop the market for energy management and energy service contracts, and it will also allow for the Alternative Approach.

If the Default Approach is followed for achieving the energy saving target, some important aspects should be considered regarding the practical implementation of building renovation measures:

(*a*) buildings which are generally in a bad shape and have a high energy consumption will be identified for deep renovation, or will be demolished, if renovation costs exceed cost for a new energy efficient construction.

(*b*) finance required for deep renovation of buildings could exceed annual budgets available for renovation measures. Therefore, it is recommended to develop maintenance and renovation plans for all buildings. This type of plan shows which building components will need repair or will need replacement in the future. Components which need to be replaced anyway (e.g. windows), will be replaced with energy efficient products. Three to five years maintenance and renovation plans are a good basis for developing annual plans for renovation works and for allocating the necessary budget for implementing them (staged renovation).

(*c*) energy efficiency improvement measures addressing the building envelope result in a reduced energy demand, and as a consequence, the required capacity of the heating system will be less (and cheaper). Therefore, when implementing individual measures due to budgetary reasons, the optimal sequence of measures should be considered (staged renovation taking the correct sequence of measures into account).

(*d*) comprehensive renovation works might require moving the staff to another building for some time, or critical works will be carried out in the holiday season when most of the staff is absent.

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4.2 **Energy saving target**

This chapter provides information about developing the method for determining the energy saving target and shows the potential range in which the actual energy saving target could be positioned.

In Article 5 EED it is assumed that EPBD 2002/91/EU and recast 2010/31/EU has been implemented and that EPCs are available for all public buildings. If this is the case, a good basis for determining the energy saving target will be available.

However, the situation is different in Ukraine:

(*a*) minimum requirements are available: 38 kWh/m^3 (heating, cooling, ventilation, hot water), multiply with 2.5 for reference to m^2, this is 95 kWh/m^2). 38 kWh/m^3 is for public buildings with 4-9 floors. This is the major share of public buildings, and therefore this number can be used for first estimations. There is a formula for buildings with fewer than 4 floors;

(*b*) currently, only very few buildings have an EPC;

(*c*) for a few buildings, an energy audit was carried out and an EPC was issued. Analysis shows that metered energy consumption is much lower than energy consumption calculated according to EPBD method. The reason is that boundary conditions given by the calculation method (e.g. operating hours, indoor temperature) often do not correspond with actual conditions. For example, in reality, indoor temperature is usually lower than given by the standardized calculation procedure;

(*d*) FIATU has collected and assessed data from 54 buildings, confirming the situation described above[22];

(*e*) data collection of central governmental buildings started, but there is no complete building inventory or database of governmental buildings yet;

(*f*) publications provide aggregated information about the building stock.

22 According to EN ISO 50001 Energy management systems — Requirements with guidance for use 2012 (ISO 50001:2011)

The status quo described above is the point of departure for developing the method of calculating the energy saving target. Three possible methodological approaches based on a simplified typology are presented in the chapters below.

4.2.1 METHODOLOGICAL APPROACH 1

This approach is based on available information on *energy performance* and *reference area*.

Available information on *energy performance*:

(*a*) *Analysis of data collection by SAEE*: The average of all buildings is 98 kWh/m^2 for annual measured heating energy consumption. This nearly corresponds with the minimum requirement according to EPBD (38k Wh/m^3, approximately 95 kWh/m^2, calculated value). However, actual indoor temperature is often lower than used for the calculation according to standard. Data collection is not yet completed.

(*b*) *Analysis of GIZ energy audits of selected buildings*: Heating energy savings achieved with no-cost and low-cost measures, based on metered consumption, are approximately 20 kWh/m^{2}a. Electricity savings achieved with no-cost and low-cost measures are around 10 kWh/m^{2}a.

In total 30 kWh/m^2 energy savings can be achieved with no-cost and low-cost measures based on metered consumption (*see Table 13*).

Available information on the reference area

The following tables show statistics on the Ukrainian building stock presented in Novoseltsev et al (2013).[23]

Table 9 Total number of m^2 and ownership structure

Total area of building stock	100%	1080 mln m^2
Communal ownership	5.6%	60.48 mln m^2
State ownership	1.4%	15.12 mln m^2
Private ownership	93%	1004.4 mln m^2

Table 10 Share of buildings by construction period

Construction period	**Share of buildings**
Before 1919	4.6%
1919-1945	11.8%
1946-1960	25.1%
1961-1970	24.1%
1971-1980	16.2%
1981-1990	10.8%
after 1991	7.4%

23 Presentation Novoseltsev, Kovalko, Evtukhova (Workshop on the Policies and Schemes for Financing Energy Efficiency in Buildings, Belgrade 18-19 June 2013): Current Status and Perspectives of ESCO Market in Ukraine: Model and Mechanisms for Financing Energy Efficiency in Buildings.

Determination of reference area

Buildings owned by the State: 15,120,000 m^2. It is assumed that none of these buildings complies with the energy minimum requirement. Therefore, 1% renovation rate results in 151,200 m^2 to be used for calculating the annual energy saving target.

Determination of energy saving target

The table 11 below shows a simplified and exemplary calculation of the energy saving target.

The procedure starts from 1 December 2017 and ends by 2020 that is 30 November 2020. Thus, energy savings calculated based on the number of m^2 corresponding to 1% and final energy savings in kWh/m^2a achieved in 2018, 2019, and 2020 are added and represent the energy saving target in GWh.

The usually applied method stipulates that the resulting number of m^2 (corresponding to 1%) must be renovated each year to meet at least the minimum energy performance requirements that it has set in application of Article 4 of Directive 2010/31/EU. This reduces the number basis of m^2 for calculating 1% for the next year. However, due to limited data availability an adapted method might be necessary for Ukraine, and therefore the number of m^2 remains the same during the reporting period.

Table 11 Calculation of annual energy saving target

Buildings owned by the State	15,120,000 m^2
1% to be renovated every year	151,200 m^2
Energy savings per m^2	30 kWh
Annual energy saving target for reference area	4,536,000 kWh
1.12.2017 – 30.11.2018	4.536 GWh
1.12.2018 – 30.11.2019	4.536 GWh
1.12.2019 – 30.11.2020	4.536 GWh
Total	**13.608 GWh**

4.2.2 METHODOLOGICAL APPROACH 2

Methodological approach 2 is based on a *bottom-up* sample compiled by FIATU[24]

Analysis of available building data

FIATU analysed 54 buildings of Central Executive Bodies (CEB) regarding actual (measured, average of 3 years) and baseline (calculated) energy consumption. Due to problems during data collection, a few assumptions had to be made. More information about challenges and criteria for choosing buildings to be included in the sample are provided in the respective report. The summary is shown in the Table below.

Table 12 Results of FIATU's data analysis

	Actual consumption (*measured*)	**Baseline consumption** (*calculated*)
Total area of 54 CEB buildings included in the National Benchmarking [m^2]	219 580,00	219 580,00
Total energy consumption for heating (heat and natural gas) [*kWh*]	19 894 871,00	24 113 593,00
Specific energy consumption for heating needs [kWh/m^2]	90,60	109,82
Specific indicator of annual energy savings for heating needs [kWh/m^2]	0,91	1,10
Total electricity consumption [*kWh*]	16 425 583,00	16 425 583,00

24 FIATU (2017): Benchmarking of CEB buildings using the ICE module "Benchmarking", prepared for GIZ, November 2017

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	Actual consumption (*measured*)	**Baseline consumption** (*calculated*)
Specific electricity consumption [*kWh/m²*]	74,80	74,80
Specific indicator of annual energy savings for electricity [*kWh/m²*]	0,75	0,75
Total consumption of heating energy for hot water supply [*kWh*]	180 322,00	180 322,00
Specific energy consumption for hot water supply [*kWh/m²*]	16,12	16,12
Specific indicator of annual energy savings for hot water supply [*kWh/m²*]	0,16	0,16
Total energy consumption [*kWh*]	36 500 776,00	40 719 498,00
Specific total energy consumption [*kWh/m²*]	181,53	200,74
Specific indicator of annual total energy savings [*kWh/m²*]: 1%	1,82	2,01

Determination of energy saving target

It is suggested to use the specific indicator of annual total energy savings [kWh/m^2] to determine the energy saving target by multiplying the indicator value with the reference area.

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4.2.3 METHODOLOGICAL APPROACH 3

Methodological approach 3 is a *top-down* macroeconomic approach of determining the energy saving target.

Podolets and Diachuk (2017)[25] allocate the following targeted annual energy savings to Central Government administration buildings:

(*a*) *heating energy*
2.55 ktoe = 29,66 GWh[26] (assumption: 55% energy saving compared with status quo)

(*b*) *electricity for cooling*
1.27 GWh (assumption: 55% energy saving compared with status quo)

(*c*) *electricity for lighting*
1.64 GWh (assumption: 80% energy saving compared with status quo)

Assumptions are based on a study carried out by SEVEn Energy demonstrating that the savings described above can be achieved by advanced renovations. Calculation is based on the TIMES-Ukraine macroeconomic model and a case study carried out by SEVEn. Podolets and Diachuk (2017) state in their report that there is a severe lack of data and that the target for Article 5 was only incorporated in the model to be able to perform the overall calculation according to EED requirements. Therefore, the report does not provide transparent information about the technical measures and investment cost the energy savings described above are based on.

25 Roman Podolets, Oleksandr Diachuk: Calculation of the national energy efficiency target until 2020 and 2030 for Ukraine and preparation of the 1st report to the Energy Community according to the Directive 2012/27/EU, Final Report, 2017
26 According to IEA unit converter, *http://episcope.eu/building-typology/country/* (15.10.2018)

4.2.4 DISCUSSION AND RECOMMENDATIONS

The following steps should be carried out in order to estimate the energy savings to be achieved:

(*a*) the total floor used to calculate 1% is the result of identifying those buildings not meeting the national minimum energy performance requirements set in application of Article 4 EPBD;

(*b*) due to lack of information it could be assumed that all buildings included in the inventory at the beginning do not meet the national minimum energy performance requirements set in application of Article 4 EPBD and thus are included in the number basis. Permitted exemptions are taken into account;

(*c*) the resulting number of m^2 corresponding to 1% must be renovated every year to meet at least the minimum energy performance requirements set in application of Article 4 EPBD. This reduces the number basis of m^2 for calculating 1% for the next year;

(*d*) to calculate the energy savings, the final energy demand of buildings before renovation and after renovation has to be determined;

(*e*) the procedure starts from 1 December 2017 and ends by 2020 that is 30 November 2020. Thus, energy savings calculated based on the number of m^2 corresponding to 1% and achieved in 2018, 2019, and 2020 are summed up and represent the energy saving target in GWh.

The estimation of energy savings to be achieved by 2020 must take into account the actual situation in Ukraine. It is the objective to achieve real energy savings reducing the energy costs.

Therefore, the following method is suggested for estimating energy saving targets:

(*a*) analysis of available building data

– analysis of building data collected by SAEE regarding status quo of energy consumption.

– analysis of available building data from energy audits and FIATU's data collection regarding energy consumption and possible energy savings.

(*b*) due to the deviation between measured and calculated energy consumption, determination of energy savings [kWh/m^2a] intends to allow for increasing comfort (actual indoor temperature to correspond with indoor temperature according to standardized calculation). To this end, also electricity savings are included in the saving target, although the minimum requirement does not refer to electricity consumption;

(*c*) determination of energy savings is based on expert's judgement;

(*d*) regarding reference area, data published by Novoseltsev et al. (2013) are used;

(*e*) calculation of energy saving target per year.

Approach 2 developed by FIATU is based on a sample of 54 buildings and therefore, results are considered to be a good basis for elaborating on the Article 5 energy saving target. The suggested energy indicator is an interesting approach for determining the energy saving target. However, the unknown reference area could be a problem, as the energy saving target would increase with a higher reference area. If the reference area presented in approach 1 is correct, the energy saving target according to approach 2 will be in the range of approach 3. This is good in terms of consistency with previous reports to Energy Community, but ambitious regarding implementation.

Regarding the energy saving target, the reference area should be discussed. If exact information about the total number of m^2 of CEB buildings is not available, scenario calculations on the reference area will help to see in what range the energy saving target can be, based on the indicators described in chapter 5.2.2. This will serve to assess the feasibility of implementing energy efficiency measures to achieve the target.

The report prepared by FIATU also contains a list of prioritized buildings for carrying out energy efficiency measures. This list could be used for budget estimations and to start procedures for budget approval, and to proceed with renovation planning.

Article 5 EED allows the level of energy savings that the 'Default' Approach would generate to be estimated on the basis of standard values. Although establishing an inventory of buildings owned and occupied by central government is not mandatory under the Alternative Approach, it should be noted that the best way of ensuring equivalence is to use the inventory referred to in Article 5 (5) as the basis for calculating the 'alternative' target (i.e. expressed in terms of energy saved, and not in terms of renovated surface), as this will provide greater accuracy than establishing the target on the basis of estimates[27].

However, as it will take some time to put the complete building inventory in place, an interim solution based on a very simplified building typology[28] based on building data collected by SAEE and FIATU could be useful to develop a first estimate (see chapter 5.2.1and 5.2.2.). Later on, estimations could be substituted by more accurate calculations based on the building inventory as soon as it is available.

27 Guidance note on Directive 2012/27/EU Article 5 *http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013SC0445&from=EN* (15.10.2018)

28 Examples of building typologies *http://episcope.eu/building-typology/country/* (15.10.2018)

Table 13 Analysis of data based on GIZ energy audits

Building	**MinRegion** *Zhytomyrska 9*	**MinRegion** *Zhytomyrska 9A*	**MinRegion** *Dilova 24*	**SAEE State Agency** *Krakivska 17*
Built	1967	1903	1973	1946
Refurbished	Past decade: replacement of windows, insulation of walls.		Insulation of walls, replacement of windows.	past decade: insulation of walls, new windows, partially LED lighting.
Construction	Massive	Massive	0	Massive
Number of floors	7+1	4	10 (2)	2
Total area [m^2]	2 291	4 766	6 486	1 010
Heated area [m^2]	2 115	4 077	6 173	934
Heated volume [m^2]	6 980	19 602	19 754	2 988
Heating energy source	District heating	District heating	District heating	Individual gas boiler
Building occupants	80	364	400	70
Heating energy metered consumption before renovation [kWh/m^2a]	72,84	121,06	87,40	127,69
Heating energy metered consumption after renovation [kWh/m^2a]	109,55	146,94	134,61	240,41
Heating energy baseline consumption before renovation [kWh/m^2a]	69,67	112,03	91,09	107,99
Heating energy baseline consumption after renovation [kWh/m^2a]				

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Building	**MinRegion** *Zhytomyrska 9*	**MinRegion** *Zhytomyrska 9A*	**MinRegion** *Dilova 24*	**SAEE State Agency** *Krakivska 17*
Electricity metered consumption before renovation [kWh/m^2a]				
Electricity metered consumption after renovation [kWh/m^2a]				
Electricity baseline consumption before renovation [kWh/m^2a]	55,12	123,74	55,22	47,03
Electricity baseline consumption after renovation [kWh/m^2a]	48,58	111,23	46,66	38,68
Real consumption				
Heating energy savings of no-cost and low-cost measures [kWh/m^2a]				
Windows repair	1,76	1,61	0,11	3,03
Automatic door closing mechanism	0	0	0	0,39
Modernization of existing boiler	0	0	0	14,70
Modernisation of individual heating substation	12,03	9,79	7,07	0
Installation of aerators for faucets	0	0,93	0,45	0
Energy monitoring system	1,20	6,25	0,62	1,09

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Building	**MinRegion** *Zhytomyrska 9*	**MinRegion** *Zhytomyrska 9A*	**MinRegion** *Dilova 24*	**SAEE State Agency** *Krakivska 17*
Energy management practices	1,00	1,01	0,47	0,47
Total no-cost and low-cost measures	15,98	19,59	8,71	19,68
Heating energy savings of medium and high-cost measures [kWh/m^2a]				
Flat roof insulation (thermal and hydro insulation)	0	0,81	2,48	0
Insulation of attic floors	0	0	4,56	24,58
Improvement of thermal insulation of outside walls	0	0	0,09	0
Replacement of existing doors	0	0	0,07	0
Replacement of existing windows	2,37	0	2,15	0
Basement celing insulation	2,97	3,51	0,74	0,93
Modernization of heating system	5,28	5,81	3,52	6,22
Insulation of pipes for DHW supply	0,00	0,00	2,07	0
Maintenance and repair of ventilation system	0	1,37	0	0
Total medium and high cost measures	10,63	11,49	15,66	31,72

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Building	**MinRegion** *Zhytomyrska 9*	**MinRegion** *Zhytomyrska 9A*	**MinRegion** *Dilova 24*	**SAEE State Agency** *Krakivska 17*
Total savings heating energy [kWh/m^2a]	26,61	31,09	24,38	51,40
Electricity savings of no-cost and low cost measures [kWh/m^2a]				
Energy monitoring system	1,01	2,81	1,00	0,86
Energy management practices	0,65	1,63	0,38	0,90
Installation of LED lamps	3,09	2,75	3,65	3,53
Installation of motion sensors	0,36	0,23	0	0,58
Control of the period of operation of the electrical equipment	1,35	1,14	2,03	5,93
Installation of aerators for faucets	0	0	0	0,24
Maintenance of air conditioners	1,00	1,74	1,00	2,00
Total no-cost and low-cost measures	7,45	10,29	8,06	14,04
Electricity savings of medium and high-cost measures [kWh/m^2a]				
Installation of external shading on the building south facade	0	0	0,89	0
Heating energy: including hot water				

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4.3 **Database of buildings**

This chapter provides information about the elements needed for establishing the building inventory in the form of an electronic database

(*a*) state bodies falling under Article 5 EED;

(*b*) the method of identifying buildings to be included is explained, data to be collected, requirements for establishing the electronic system, and organisational aspects for operation are described.

4.3.1 LIST OF STATE BODIES OF UKRAINE FALLING UNDER ARTICLE 5 EED

In accordance with Article 1 of the Law of Ukraine On Central Executive Authorities the system of central executive authorities consists of the ministries and other central executive bodies of Ukraine. The system of central executive authorities is an element of the executive power system with the Cabinet of Ministers of Ukraine being the supreme body. Ministries ensure formulation and implementation of the state policy in one or more areas, while other central executive authorities perform separate functions for implementation of the state policy. Powers of the ministries and other central executive authorities are applied within the entire territory of the state. As of the moment of preparation of the document, the system of central executive authorities consists of 68 central executive authorities and the Secretariat of the Cabinet of Ministers of Ukraine.

List of CEAs in Ukraine:

Ministries

1. Ministry of Agricultural Policy and Food of Ukraine
2. Ministry of Interior Affairs of Ukraine
3. Ministry of Ecology and Natural Resources of Ukraine
4. Ministry of Economic Development and Trade of Ukraine
5. Ministry of Energy and Coal Industry of Ukraine
6. Ministry of Foreign Affairs of Ukraine
7. Ministry of Information Policy of Ukraine
8. Ministry of Infrastructure of Ukraine
9. Ministry of Culture of Ukraine
10. Ministry of Youth and Sports of Ukraine
11. Ministry for Temporarily Occupied Territories and Internally Displaced Persons of Ukraine
12. Ministry of Defense of Ukraine
13. Ministry of Education and Science of Ukraine
14. Ministry of Health of Ukraine
15. Ministry of Regional Development, Construction and Housing and Municipal Economy of Ukraine
16. Ministry of Social Policy of Ukraine
17. Ministry of Finance of Ukraine
18. Ministry of Justice of Ukraine

Services

1. State Aviation Service of Ukraine
2. State Archive Service of Ukraine
3. State Audit Service of Ukraine
4. State Treasury Service of Ukraine
5. State Migration Service of Ukraine
6. Administration of the State Border Guard Service of Ukraine
7. State Service of Ukraine for Transport Safety
8. State Service of Ukraine for Safety of Foodstuffs and Consumer Protection
9. State Service of Ukraine for Geodesy, Cartography and Cadaster
10. State Service of Geology and Subsoil of Ukraine
11. State Labor Service of Ukraine
12. State Service of Ukraine for Veterans of Was and Participants of the Antiterrorist Operation
13. State Statistics Service of Ukraine
14. State Service of Ukraine for Medicines and Drug Control
15. State Emergency Service of Ukraine
16. State Service of Financial Monitoring of Ukraine
17. State Service of Export Control of Ukraine
18. State Regulatory Service of Ukraine
19. State Fiscal Service of Ukraine
20. Administration of the State Service of Special Communications and Protection of Information of Ukraine
21. State Service of Education Quality of Ukraine

Agencies

1. State Agency of Motor Roads of Ukraine
2. State Agency of Water Resources of Ukraine
3. State Agency of Energy Efficiency and Energy Saving of Ukraine
4. State Agency of Electronic Governance of Ukraine
5. State Agency of Forestry Resources of Ukraine
6. State Reserve Agency of Ukraine
7. State Fishery Agency of Ukraine
8. State Cinema Agency of Ukraine
9. State Agency of Ukraine for Management of the Exclusion Zone
10. State Space Agency of Ukraine
11. National Agency of Ukraine for Detection, Search and Management of the Assets Obtained through Corruption and Other Crimes
12. State Agency for Infrastructure Projects of Ukraine
13. National Public Service Agency of Ukraine
14. National Agency for Prevention of Corruption

Inspectorates

1. State Architecture and Construction Inspectorate of Ukraine
2. State Ecological Inspectorate of Ukraine
3. State Inspectorate for Nuclear Regulation of Ukraine
4. State Inspectorate for Energy Supervision of Ukraine

CEAs with the special status

1.	Antimonopoly Committee of Ukraine
2.	State Committee for Television and Radio Broadcasting of Ukraine
3.	State Property Fund of Ukraine
4.	National Agency of Ukraine for Prevention of Corruption
5.	National Agency of Ukraine for Detection, Search and Management of the Assets Obtained through Corruption and Other Crimes
6.	Administration of the State Service for Communication and Protection of Information
7.	State Investigation Bureau

Other CEAs

1.	National Police of Ukraine
2.	Ukrainian Institute of National memory
3.	Pension Fund of Ukraine.

Scheme of direction and coordination of CEA activities by the Cabinet of Ministers of Ukraine via relevant members of the Cabinet of Ministers (*through ministries*):

Ministry of Agricultural Policy and Food of Ukraine

1. State Agency of Forestry Resources of Ukraine
2. State Fishery Agency f Ukraine
3. State Service of Ukraine for Food Safety and Consumer Protection
4. State Service of Ukraine for Geodesy, Cartography and Cadaster

Ministry of Interior Affairs of Ukraine

1. National Police of Ukraine
2. Administration of the State Border Guard Service of Ukraine
3. State Migration Service of Ukraine
4. State Emergency Service of Ukraine

Ministry of Ecology and Natural Resources of Ukraine

1. State Ecological Inspectorate of Ukraine
2. State Agency of Ukraine for Management of the Exclusion Zone

3. State Service of Geology and Subsoil of Ukraine

4. State Agency of Water Resources of Ukraine

Ministry of Economic Development and Trade of Ukraine

1. State Service of Export Control of Ukraine

2. State Reserve Agency of Ukraine

3. State Statistics Service of Ukraine

Ministry of Energy and Coal Industry of Ukraine

1. State Inspectorate of Energy Supervision of Ukraine

Ministry of Infrastructure of Ukraine

1. State Aviation Service

2. State Service of Ukraine for Transport Safety

3. State Agency of Motor Roads

4. State Agency of Infrastructure Projects of Ukraine

Ministry of Culture of Ukraine

1. State Cinema Agency of Ukraine

2. Ukrainian Institute of National Memory

Ministry of Education and Science of Ukraine

1. State Service of Education Quality of Ukraine

Ministry of Health of Ukraine

1. State Service of Ukraine for Medicines and Drug Control

Ministry of Regional Development, Construction and Housing and Municipal Economy of Ukraine

1. State Architecture and Construction Inspectorate of Ukraine
2. State Agency of Energy Efficiency and Energy Saving of Ukraine

Ministry of Social Policy of Ukraine

1. State Labor Service of Ukraine
2. State Service of Ukraine for Veterans of War and Participants of the Antiterrorist Operation
3. Pension Fund of Ukraine

Ministry of Finance of Ukraine

1. State Treasury Service of Ukraine
2. State Fiscal Service of Ukraine
3. State Service of Financial Monitoring of Ukraine

Ministry of Justice of Ukraine

1. State Archive Service

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4.3.2 INVENTORY LIST: IDENTIFICATION OF BUILDINGS

The inventory list of buildings serves two purposes:

1. To know the total floor area and energy performance of buildings needed to calculate the energy saving target;

2. To have detailed information about the governmental building stock to plan renovations and follow up the achieved energy savings.

Regarding the first purpose, there is a reference to Directive 2010/31/EU (EPBD) that only those buildings have to be considered which do not meet the minimum energy performance requirements stipulated by the respective law. According to Article 4 EPBD specific types of buildings can be excluded from minimum energy performance requirements by national legislation. In this regard, a cross-check with the provisions of the Law on Energy Efficiency in Buildings is necessary, as these buildings will not be considered for calculating the energy saving target, either. Article 5 EED also names possible exemptions which are specified by the Law on Energy Efficiency.

Regarding the second purpose, it is useful to include as many heated/cooled buildings as possible in the building inventory because this will help determining the economic renovation and energy saving potential and facilitate renovation planning.

Identification of buildings can be done based on existing documentations, such as land registry entries or balance sheets. However, this might be difficult as building units might be defined in a different way than used by the EPBD. For example, what is in the ministries' balance sheets might not be identical with a "building" as defined by EPBD and the respective national legislation. The balance sheets have a fiscal background, and the intention is different from the intention of EPBD. It could be possible that one object in the balance sheet consists of several buildings with an Energy Performance Certificate (EPC) according to EPBD. It could also be possible that one building according to EPBD consists of several objects in the balance sheet (e.g. "dining room").

As EPCs are not yet widely available, the first draft of the inventory list will be based on case by case decisions, taking the exemptions according to Article 4 EPBD and Article 5 EED into account. If there is a wide range of interpretation, the intention of the EU Directives will be examined, and decisions will be made in accordance with the intention of the EU Directives.

Table 14 Examples what to include in the building inventory

Exemptions according to Article 5 EED	Examples what to exclude	Examples what to include
Buildings officially protected as part of a designated environment, or because of their special architectural or historical merit, in so far as compliance with certain minimum energy performance requirements would unacceptably alter their character or appearance.	• Buildings not heated or cooled (buildings not conditioned) • Conditioned buildings officially under monument protection (by law) • Conditioned historic buildings not officially under monument protection (by law) but having a special architecture or historical merit. • *Comment*: Definition of criteria might be necessary, such as: Buildings with a structured façade dating from building periods xx, etc. Definition of criteria must be very clear.	• *Comment*: In this type of building many energy efficiency measures are still possible, such as measures addressing the heating system and electricity consumption for lighting and ventilation. • *Suggested procedure*: Historic buildings are exempt from calculation the energy saving target. However, historic buildings should be included in the building inventory. Based on the data in the building inventory a specific renovation plan for historic buildings can be developed.
Buildings owned by the armed forces or central government and serving national defense purposes, apart from single living quarters or office buildings for the armed forces and other staff employed by national defense authorities.	• Buildings not heated or cooled (buildings not conditioned). • All buildings located on strategic and / or secret sites serving national defense purposes directly such as shelters.	• *Included*: Accommodation for soldiers (barracks), buildings for administration and training (offices and educational buildings).

4.3.3 INVENTORY LIST: IDENTIFICATION OF DATA TO BE COLLECTED

There are two categories of building data to be collected:

1. General information about the building (*can be taken from EPC, if EPC exists*).
2. Monitoring data (*are collected on an annual basis*).

General information documented in the building inventory includes:

(*a*) name, address, coordinates (for geo-referenced presentation) of the building;

(*b*) building use (for example, office, school, hospital)

(*c*) departmental affiliation (control body) of the building;

(*d*) heated and total area of building;

(*e*) heated and total volume of building;

(*f*) technical characteristics of the building: *year of construction, availability of design documentation (BTI passport), number of floors, material of building envelope, thickness.*

(*g*) source of energy provision (energy supply);

(*h*) contractual (normative) load for heating, hot water supply, ventilation;

(*i*) contractual (normative) load on electricity consumers;

(*j*) contractual (normative) water consumption;

(*k*) contractual (normative) consumption of other types of fuel;

(*l*) normative number of visitors, staff and permanent residents;

(*m*) operating mode of the institution;

(*n*) general indicators of energy consumption of the institution;

(*o*) list of points for the input of energy resources and information about metering equipment at these points of input.

General information about the building is updated after renovation measures (e.g. based on the new EPC issued after renovation).

The minimum list of data collected in the course of annual monitoring includes:

(*a*) thermal energy (consumption over the period);

(*b*) electricity (consumption over the period);

(*c*) natural gas (consumption over the period);

(*d*) solid fuel (consumption over the period, indicating calorific value);

(*e*) cold and hot water (consumption over the period);

(*f*) hot water temperature in the supplying and circulating pipelines (average temperature over the period);

(*g*) internal temperature at least in 2 premises of the building;

(*h*) outside temperature;

(*i*) average daily number of visitors and staff over the period;

(*j*) information on planned and non-planned electricity cut off;

(*k*) information on operability of energy metering equipment.

Based on energy consumption data for the previous periods, the baseline indicators of energy consumption of the objects are determined.

The following indicators are recommended:

(*a*) For heat and fuel:

1. Consumption of thermal energy (fuel) for heating per 1 degree-day.
2. Energy/fuel consumption for hot water supply per 1 working day.

(*b*) For electricity:

1. Electricity consumption per 1 working day (with monthly breakdown).

(*c*) For cold and hot water and sewerage:

1. Water consumption per 1 working day (with monthly breakdown).
2. Hot water temperature in the supplying and circulation pipelines (if available).

Energy characteristics should be updated at least once every six months, or after the introduction of measures affecting energy consumption or changes in the mode of operation of the institution, as well as in the case of errors found in the input data used to calculate energy consumption.

Furthermore the following information should be available in the database:

(*a*) list of buildings used by the institution and consuming energy resources (set of buildings);

(*b*) list of suppliers of energy resources and/or housing and utility services.

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4.3.4 METHOD OF DATA COLLECTION

Data collection can be done by means of questionnaires or by entering data in an internet based database. At the beginning it might not be possible to collect all data as listed above. However, when starting the process, it should be clear that the scheme must be sufficiently flexible to cover the full range of requested information in future.

4.3.5 ORGANISATION OF INVENTORY LIST: ELECTRONIC DATABASE

The inventory list should be organised in the form of an electronic database on the basis of an internet based integrated IT Platform containing the characteristics of CEA buildings (the database).

Taking into consideration the scheme of direction and coordination of CEA activities by the Cabinet of Ministers of Ukraine via relevant members of the Cabinet of Ministers (through ministries) it is necessary to ensure submission of information on the CEA objects (buildings) to line ministries that coordinate their activities. The ministries summarize information on the objects (buildings) received from CEAs that coordinate them, summarize information on the objects in their direct possession and enter it into the database. It is necessary to appoint responsible persons in ministries, agencies, inspectorates, etc.

The appointed responsible authority is the administrator of the database and ensures:

(*a*) administration and functional update of the database;

(*b*) monitoring of data entry into the database;

(*c*) calculation of the national energy saving target based on the database indicators;

(*d*) verification of energy consumption indicators in the database;

(*e*) training of persons in charge of data entry into the database;

(*f*) reporting to the Energy Community Secretariat on implementation of Article 5 EED.

4.3.6 SPECIFICATION OF ELECTRONIC DATABASE AND DATA COLLECTION STANDARD

Software tools used for collection of individual building data must be able to communicate with the database.

Basically, there are two options how to go about this problem:

1. To adopt a regulation that a specific software must be used to input data to the database.

2. To adopt a regulation about a specific XML-file representing the interface between any software available on the market and the database.

The second option is more realistic as there are several energy management tools available on the market, they are being improved and updated, and more software tools are being developed. All these tools should be able to communicate easily with the electronic database by means of a standardised XML-file.

Extensible Markup Language (XML) defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. It can be used for the exact specification of data entry fields representing the interface to the database. Stipulated by Government, it will stimulate the competitive development of software tools.

Suggested procedure for developing the standardized XML-file to be stipulated by Government:

(*a*) XML-file is developed by experts;

(*b*) XML-file is authorized and published by Government (e.g. in the form of a Technical Guideline);

(*c*) XML-file is mandatory for software and database developers;

(*d*) it must be guaranteed that data input and reporting is carried out according to standard specification of data fields.

Data entry fields must be exactly specified in order to ensure that reliable data are collected.

Reliable data are needed for decision-making on energy efficiency investments, to meet the requirements set by financing mechanisms, in order to actually release investments. They are necessary for checking the effectiveness of implemented energy efficiency measures to make corrections if necessary, and to meet legal reporting obligations (building inventory/registry).

Example

Energy cost [UAH/m^2] is to be collected. However, which information will be provided:

(*a*) Is it electricity cost?

(*b*) Does it include electric radiators for space heating?

(*c*) Is it just energy cost for district heating?

Does it include hot water for sanitary rooms?

(*d*) Is the reference area m^2 total gross floor area of building?

(*e*) Or m^2 heated area of building?

This example shows that a data collection standard is needed in order to make sure that collected information is reliable and comparable. The development of a standardized XML-file is a method to implement such a data collection standard. Definitions, for example heated area, gross area etc., should be taken from acknowledged technical standards or guidelines.

Manual data input must be possible as interim solution.

It is important to include GIS-coordinates in the data set to be collected to be able to display the building location on a map. Such tools[29] serve as an awareness creation instrument and support the aggregation of similar projects in a neighbourhood to larger projects which benefit from economy of scale.

With regard to the address of a building, a unique identification number will be required if the address is not unique or not sufficiently specific. If currently not available, the XML-file should be developed in a way that it allows for immediate entries and future updates and adaptations.

Table 15 Example of input data fields and XML specification: Location

Input data fields (*Present solution to start with*)	**Input data fields** (*Targeted solution – future*)	**Specification of data input fields / XML**
Address (Problem: some addresses are no unique or not sufficiently specific) GIS-coordinates (To show buildings and their energy performance on a Geographical Information System map)	Unique building identification code. …. according to the National Statistical Office, National Building Registry.	Address: – Street – Number – Postal Code – City – District GIS: Position longitude and latitude Unique building identification code: – NN

This also applies for parameters related with indoor air quality. Even if indoor CO_2 levels are currently not measured, future adaptations should be taken into account.

It will be also necessary to find information in the database, whether a building is part of an Energy Performance Contracting project. If yes, this building will be excluded from all other efforts.

29 Exemplary map *https://app.enerfund.eu/* (15.10.2015)

Table 16 Example of input data fields and XML specification: Indoor air quality

Input data fields	**Specification of data input fields / XML**
Period of measurement	Start/end date [*day, month, year*]
Operational data	Number of occupants per m^2 heated area. Operational schedule (*e.g. 9:00-17:00, 5 times per week, 4 weeks closed in August*)
Indoor climate and indoor air quality	Indoor temperature set point in winter and in summer [*°C*], relative humidity [*%*], $C0_2$ [*ppm*]
Weather data	Heating Degree Days, temperature

Table 17 Example of input data fields and XML specification: Contract with ESCO

Input data fields	**Specification of data input fields / XML**
Type of ownership	Central government, municipality, private person, etc. (*provide options to select*)
Type of building	Office building, multi-unit residential building, mixed-use building, etc. (*provide options to select*)
Type of use and legal basis	E.g., used by the owner or rented; entity of government
Real estate identification	Building is part of a real estate unit with a specific ID
Military use	Yes or No
Religious use	Yes or No
Monument protection	Yes or No
Part of energy contracting project	Start/end date of the contract, energy savings, ESCO

In practice, there are several challenges to cope with, for example:

Many building utilisations are mixed (*e.g. shops and offices in one building; partly rented and partly used by the owner*).

These challenges will become evident during developing and testing the database. Agile software development methods provide appropriate tools to elaborate useful solutions.

Database design must consider useful interfaces with other already existing or planned databases instead of developing multiple parallel solutions. This is especially important concerning the database of energy performance certificates and the database of energy audits.

All types of Software

Energy Audit Software 1
ICE

Energy Audit Software 2
NN

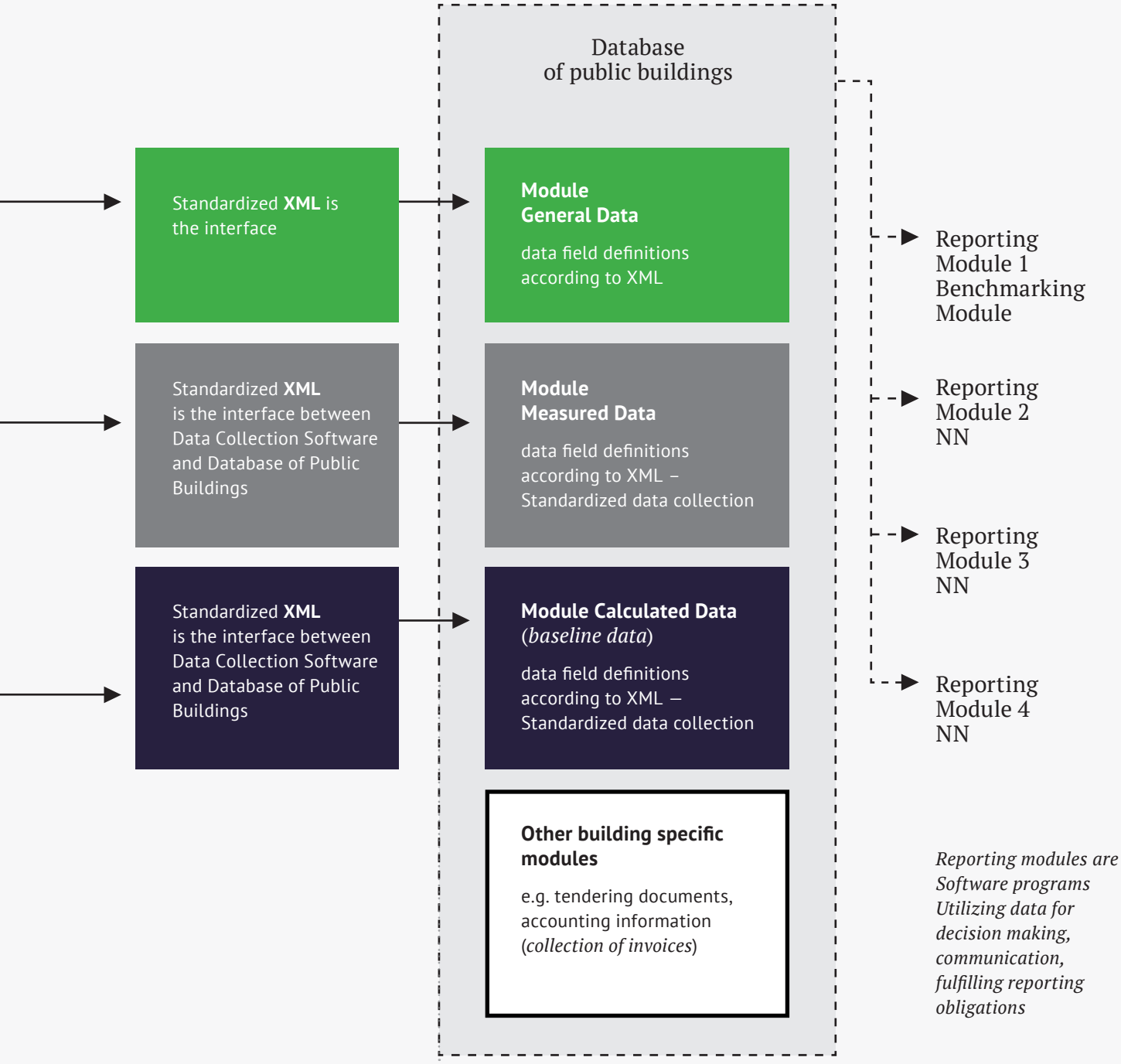
Energy Audit Software 3
NN

EPBD Software 1
EBRD Tool

EPBD Software 2
NN

EPBD Software 3
NN

Figure 4 Possible interfaces between software tools and internet based databases



4.3.7 APPOINTMENT OF PERSONS IN CHARGE OF DATA COLLECTION

CEAs are ordered through the regulatory act of the Cabinet of Ministers of Ukraine to appoint officially the persons in charge of collecting and submitting information on the characteristics of the buildings controlled by CEAs into the database.

By their internal act (for instance, an order), CEAs approve the general system of collection and summarization of the data to be entered into the database.

In the act, CEAs must appoint the persons in charge of collection and summarization of such information, for example:

(*a*) to appoint one person to summarize all information received from all subordinated CEA buildings and enter that information into the database;

(*b*) to appoint persons in charge of collection of information on each building owned or used by the CEA that submits the building information to the person that summarized information;

(*c*) it is possible to appoint one person in charge of data collection from several buildings;

(*d*) it is allowed that one person will be responsible for gathering information on buildings, as well as its summarization and submission to the database.

The persons responsible for gathering and summarizing the information must have knowledge about:

(*a*) the concept of consumption of the fuel and energy resources and energy performance of the building;

(*b*) major reasons for overconsumption of energy resources at the site;

(*c*) principles of operation of energy meters and instructions on collection of readings.

Their tasks and responsibilities are:

(*a*) to observe the efficiency of energy consumption at the site;

(*b*) to collect, transfer and analyse the indicators of consumption of energy resources and internal environment in the premises, as well as any emergency situations;

(*c*) to participate in the control over the maintenance of the engineering systems, as well as other measures related to increasing energy efficiency;

(*d*) to organize monitoring of energy consumption in the subordinated buildings;

(*e*) to prepare proposals for improving the efficiency of energy consumption, maintenance and operation of facilities;

(*f*) to monitor the main trends in the sphere of energy monitoring (dispatching) of energy resources.

4.3.8 APPLICATION OF AUTOMATED SYSTEM FOR DATA COLLECTION AND ASSESSMENT

Whenever possible, an automated system should be approved to monitor energy and water consumption at the CEA subordinate objects.

Acceptable technical solutions must be able to perform the following key tasks of an energy monitoring system:

(*a*) timely detection of cases of over-consumption of energy resources, emergency situations and non-compliance with regulatory conditions for the staying of visitors and staff;

(*b*) collection of data on actual consumption of energy resources;

(*c*) collection of data on the factors that influence the level of consumption of energy resources;

(*d*) collection of data on parameters of internal environment in the buildings;

(*e*) analysis of efficiency of use of energy resources in comparison with similar institutions and normative values;

(*f*) control of efficiency of operation of buildings and engineering systems;

(*g*) determination of the actual level of achieved savings as a result of implementation of measures to improve energy efficiency;

(*h*) preparation of a list of institutions/buildings that require top-priority in-depth analysis and/or implementation of additional measures to improve energy efficiency;

(*i*) creation of the basis for establishment of incentives for economical energy consumption by introducing objective indicators of energy consumption efficiency.

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4.3.9 ALGORITHM FOR FILLING AND USING THE DATABASE

The procedure described below is also shown in *Figure 5*.

The following work steps are carried out to fill the database (*building inventory*) and to make use of the collected data:

1. The Cabinet of Ministers of Ukraine appoints a responsible authority:

(*a*) to establish and administer the CEA building database;

(*b*) ministries and other CEAs to ensure submission of information to the database.

2. The responsible authority to ensure formation and administration of the building database.

3. Based on the collected data, the responsible authority will calculate the energy saving target (in accordance with Article 5 EED).

4. The responsible authority informs the Energy Community Secretariat of the estimated national energy saving target and its achievement.

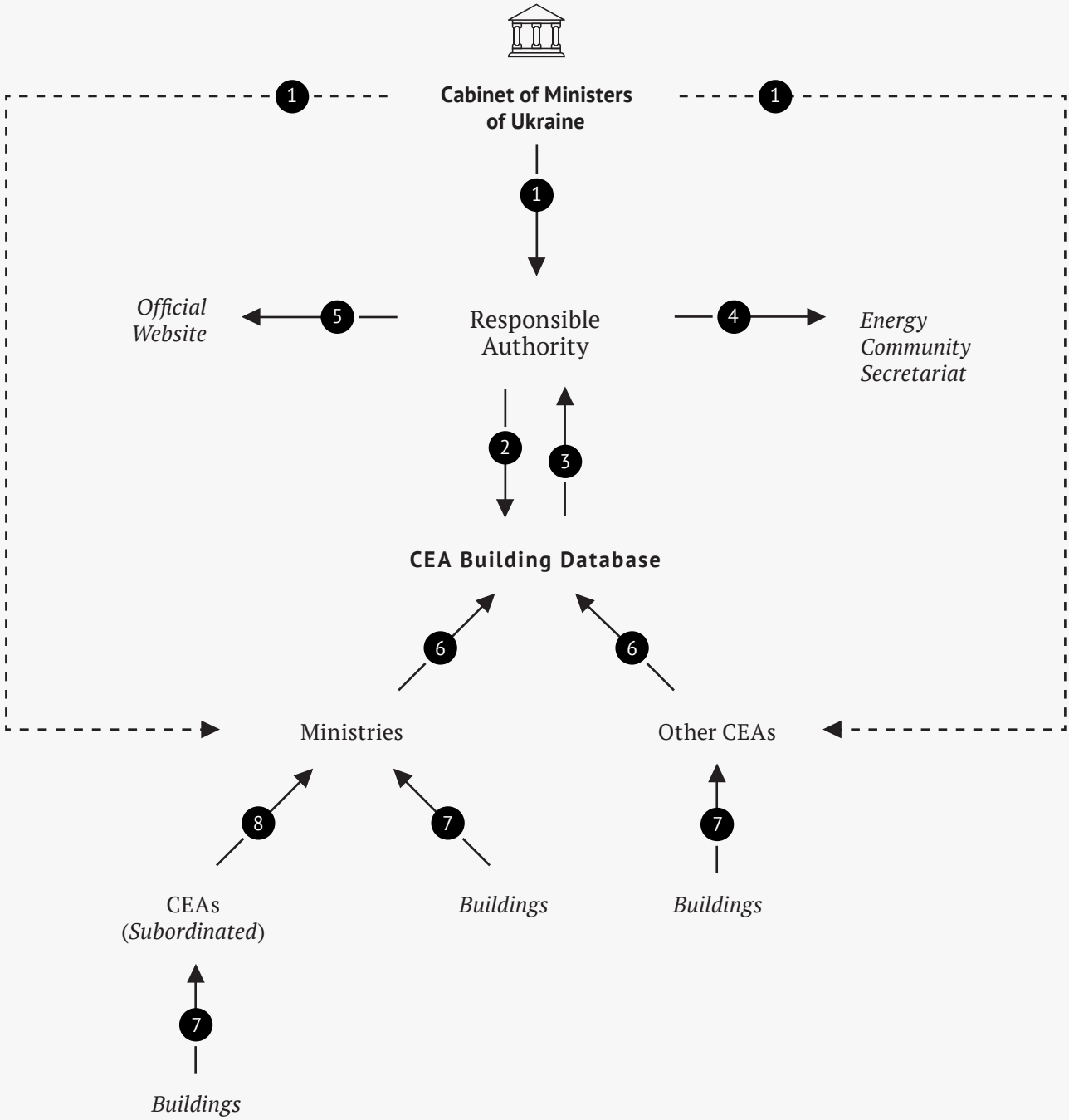
5. The responsible authority places an extract from the building database at the official website in the form of the inventory list of buildings indicating the key figures.

6. Ministries and other CEAs summarize and submit information to the building database according to the set form.

7. Persons in charge of data provision on each building submit information to ministries/other CEAs.

8. The CEAs whose activities are coordinated by relevant ministers submit information to the coordinating ministry.

Figure 5 Discussion and recommendations



4.3.10 DISCUSSION AND RECOMMENDATIONS

Availability and quality of data is crucial for decision making about investments in renovation and for reporting regarding achievement of targets. Exact definition of data entries is a condition, and appointed staff responsible for manual data entries must be trained to choose and enter the correct data.

Random checking will also be necessary to ensure good quality of data and to limit wrong entries. Data quality will improve gradually and systematically with appropriate procedures and support.

Public buildings must display the EPC according to EPBD, therefore all public buildings should have an EPC. Thus, it is evident that EPCs will be an important source of data for the building inventory. Also, energy audits represent an important source of data, and in both cases data quality is a crucial issue. Also, here data quality will improve over time because checking and quality control mechanisms will provide feedback to experts issuing EPCs and conducting energy audits. To ensure quality of EPCs and energy audits, it is important that feedback is linked with sanctions, e.g. the obligation to issue the corrected EPC free of charge, to attend a mandatory training after having issued three faulty EPCs, etc.

The EU-funded project QUALICHeCK developed comprehensive information material and guidelines to ensure quality of EPCs:

(*a*) the QUALICheCK Platform provides information about best practices in Member States and about mistakes which should be avoided[30];

(*b*) source book: Improved compliance of Energy Performance Certificates (EPCs)[31];

(*c*) source Book: Better quality of the works[32].

In addition to ensuring data quality, interfaces between databases must be ensured my means of XML-files, in order to tap the full potential of synergies and avoid duplication of work. Although one single database solution for different purposes (e.g. to comply with Article 5 EED, and to comply with Article 18 EPBD) would be useful, it might be not feasible due to practical and / or political reasons. However, a modular approach with defined interfaces can get close to the ideal solution.

30 *http://qualicheck-platform.eu*
31 *http://qualicheck-platform.eu/wp-content/uploads/2017/02/QUALICHeCK-source-book-EPC.pdf*
32 *http://qualicheck-platform.eu/wp-content/uploads/2017/02/QUALICHeCK-source-book-Works.pdf*

M&V (Monitoring and Verification) according to IPMVP (International Performance Monitoring and Verification Protocol) can be necessary for financing of energy efficiency measures through ESCOs and other financing mechanisms (annual investor disclosure is required). Therefore, it is useful to develop a M&V plan according to IPMVP for defined building types (e.g. large offices, large schools, etc.). When doing so, the trade-off between cost and accuracy must be considered, resulting in low cost solutions with an acceptable degree of accuracy.

At the beginning, data collection can be done manually by filling in templates. Both should be possible, manual meter reads and DAS (data acquisition systems). Over time, a remote monitoring and control system should be implemented gradually. Whenever possible, additional energy meters and sub-meters should be installed (e.g. as a mandatory element of building renovation), in order to achieve more detailed information about the energy consumption patterns of buildings and the related energy saving potential. This strategy is also in line with EPBD 2010/31/EU and amending Directive EU 2018/844 regarding Article 8, 14, and 15 on Technical building systems, Inspection of heating systems, and Inspection of air-conditioning systems.

Data transmission intervals have to be defined (at least monthly, with the option to have a higher resolution). A procedure is necessary how to deal with data transmission errors, and how to detect outliers.

It will be useful to agree on a standard for energy meters regarding range of error/accuracy, quality assurance, etc., and to develop a standardised specification for public procurement. Bulk procurement would make use of economy of scale.

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4.4 Annual plan of energy efficiency measures, including the sources of funding

The renovation strategy for central governmental buildings is a key element of implementing EED Article 5

It shows the way how to actually achieve 1% renovation rate of central governmental buildings or the equivalent amount of energy saving based on a range of economic energy efficiency measures in addition to building renovation measures. It also represents one module of EED Article 4 and thus can provide an important contribution to the comprehensive renovation strategy for the entire Ukrainian building stock.

The renovation strategy for public buildings according to Article 5 EED should be developed in compliance with the structure provided by Article 4 EED. In this way, the renovation strategy will be in line with the strategy to be developed for other sectors.

There are five requirements of Article 4 EED regarding structure and content of the Renovation Strategy, namely:

(*a*) an overview of the national building stock;

(*b*) identification of cost-effective approaches to renovations;

(*c*) policies and measures to stimulate cost-effective deep renovations of buildings;

(*d*) a forward-looking perspective to guide investment decisions;

(*e*) an evidence-based estimate of expected energy savings and wider benefits.

The overall plan of implementing energy efficiency measures in buildings is based on annual plans, as annual plans are necessary from the operational point of view (budget planning and detailed planning of measures). However, annual plans should be based on long term plans, because especially deep renovation of buildings can take more than a year, due to technical and budgetary reasons. Therefore building renovation plans for so-called staged renovations can be important.

This chapter presents an overview of energy efficiency measures which can be part of renovation strategies, building renovation plans and annual plans. It shows how pilot projects can be used to develop procedures and structures for business as usual (BAU) project implementations.

4.4.1 KEY ASPECT: IDENTIFICATION OF ECONOMIC POTENTIAL

Specific buildings need to be identified for specific energy efficiency measures. This can be done based on a building typology or based on the building inventory

Examples

Depending on the specific situation, some buildings might be suitable for implementing an energy management system, because trained staff is available in the respective public entity. Other buildings might benefit most from measures addressing the heating system, because problems are well known and there is no need to identify them by means of an energy audit.

Table 18 Identification of economic renovation potential: overview of required steps and status quo

Step	Comment regarding status quo	Available information
Building stock characterisation	Typology and/or inventory	**1.** *Farinjuk database*: provides the information to assess the economic renovation potential of the public building stock
Economic appraisal of renovation potential	Based on typology on the general level, and on energy audits on the building level	
Identification of energy and non-energy benefits	Can be taken from Argumentarium and existing studies	**2.** *FIATU database*: relates with the building inventory of public buildings and provides the basis for monitoring and evaluation
Quantification of investment requirements and funding sources	Still missing, based on previous steps and based on existing studies	

Based on the information collected for setting up the building inventory, suitable measures can be identified for a certain type of building and for specific buildings. This will facilitate the implementation of pilot programmes which will also help to accelerate market development.

4.4.2 DEEP RENOVATION AND STAGED RENOVATION

UaUsually, deep renovations will be carried out if the building as such is in a bad condition and needs a full range of repair works apart from energy efficiency improvements. In such a case, works will be done taking energy efficiency into account, thus substantially improving the general condition and the energy efficiency of the building at the same time.

Deep renovations can be realised by means of step-by-step long-term (up to 15 or 20 years) renovation roadmaps for a specific building, resulting from an on-site energy audit fulfilling specific quality criteria. The renovation roadmap can be combined with a repository of building-related information (logbook) on aspects such the energy consumption and production, executed maintenance and building plans. This document is also called Building Renovation Passport (see Figure 6).

4.4.3 ALTERNATIVE MEASURES

1. Energy Management Systems

Energy management in public buildings consists of the following elements:

(*a*) conducting energy audits in public buildings;

(*b*) introducing an energy management system in public buildings;

(*c*) implementing energy saving measures identified as a result of the energy audit.

Energy saving measures can be technical measures and non-technical measures (addressing user behaviour).

2. Energy Performance Contracting

A Third-Party invests in identifying and implementing energy efficiency measures with a defined payback period and operates the renovated building for the agreed contract period.

Measures addressing the building envelope have a longer payback period than measures only addressing the heating system. The definition of the envisaged payback period influences the range of energy efficiency measures which can be implemented. Longer payback periods and thus longer contract durations should be preferred in order to facilitate deep renovations.

3. Buildings taken out of use due to more intensive use of other buildings and replacement with new buildings

It is allowed to take into account buildings taken out of use (demolished, sold, or not used anymore prior to being demolished or sold) due to more intensive use of other buildings as energy saving measure.

It is also allowed to take into account new buildings occupied and owned as replacement for specific central government buildings demolished in any of the two previous years. However, these measures will not contribute to developing the energy efficiency market in Ukraine.

4. Individual renovation measures

Measures addressing the building envelope:

(*a*) insulation of ceiling below roof / insulation of roof;

(*b*) exchange of windows;

(*c*) insulation of facade;

(*d*) combination of measures listed above.

Measures addressing the heating / cooling system:

(*a*) hydraulic calibration (hydraulic balancing) of the heating system;

(*b*) exchange of components;

(*c*) exchange of heating system;

(*d*) insulation of heat supply pipes;

(*e*) combination of measures listed above.

Measures addressing hot water consumption:

(*a*) use water saving fixtures;

(*b*) reduce circulation losses;

(*c*) combination of measures listed above.

Measures addressing the lighting system:

(*a*) address user behavior: switch off manually when leaving rooms;

(*b*) deactivate all lighting systems after close of business day, on weekends and holidays;

(*c*) introduce presence detectors and activate/ deactivate automatically based on presence;

(*d*) exchange incandescent lamps for high quality led lamps (taking health aspects into account);

(*e*) combination of measures listed above.

Note

Energy efficiency measures addressing the building envelope result in a reduced energy demand, and as a consequence the capacity of the heating system will be less (and cheaper). When implementing individual measures due to budgetary reasons, the optimal sequence of measures must be considered (renovation carried out in stages – see staged renovation chapter 5.4.2).

Figure 6 Building renovation passport

I. Data gathering at individual building level

1.1. On-site energy audit

(*a*) **By external experts: energy auditors, installers, energy experts** (*in dialogue with building owners or tenants*)

1.2. On-site data gathering

(*a*) **By building owners or tenants**:
- Documentation about executed works
- Energy consumption and production
- Age / characteristics of installed equipment

(*b*) **Automated data**:
- Smart meters
- Renewable energy monitoring systems
- Other monitoring systems (*e.g. Heating systems, CO_2 meters, smoke detectors, etc.*)

II. Processing the data

III. Renovation roadmap

3.1. Renovation roadmap (*deep-staged renovation*)

- Comprehensive audit (*paper or electronic format*)
- Related to national and portfolio renovation roadmap
- Long-term perspective
- Considering individual context
- Systematic renovation in a sensible order and packages

3.2. Building logbook

(*a*) **Inventory of non-dynamic information**
- Relevant individual building related information such as:
- Contacts of building professionals who executed on-site works
- Building plans
- Energy consumption and production
- Government related information (*cadaster, taxes...*)

(*b*) **Interactive tools**
- Benchmark with other buildings
- Monitoring and comparing real energy consumption with design energy consumption
- Alerts in case of unusual consumption patterns — flaws of technical installations
- Guidance through maintenance (*e.g. Semi-automatic request for maintenance*)

(*c*) **Linking building owners (users) to third parties**
- Governments (*e.g. Online helpdesks on taxes, cadaster, etc.*)
- Market actors (*marketplace for qualified building professionals*)

4.4.4 PILOT PROJECTS TO DEVELOP MODEL PROCEDURES

Pilot renovation projects can be used to develop procedures, structures, and guidelines for business as usual (BAU) project implementations.

Examples are shown in the tables below.

Table 19 Important aspects for planning building renovation projects

Phase of a building renovation project	Central government public building	Municipality (Article 5 (7) public building
Initiation	Based on the law.	MoF has to approve.
Preparation	• Project development procedures unclear; there are different streams: – Construction – Energy – Finance • How to bring them together — energy audit as the basis and building renovation plan	• Different procedures depending on the type of municipality. • Lack of resources for project development. • Public procurement.
Implementation	Procedures unclear, similar problems as with Municipalities.	• Who is in charge of project implementation. • How to avoid corruption. • How to ensure proper implementation according to specification.
Evaluation	Clarification of responsibilities and procedures.	Clarification of responsibilities and procedures.

Table 20 Template for documenting the GIZ pilot building renovation project (central government public building)

Phase of renovation project	Short description of procedure	Problems encountered	Role of GIZ	Who would assume this role in BAU process	Training / skills / tools required
			Initiation phase		
Step 1 Identify building to be renovated					
Step 2 Project development					
			Preparation phase		
Step 1 etc.					
			Implementation phase		
Step 1 etc.					
			Evaluation phase		
Step 1 etc.					

4.4.5 DISCUSSION AND RECOMMENDATIONS

Energy efficiency measures can be dealt with at macroeconomic level (e.g. TIMES-Ukraine) and at *building level*, as demonstrated by the GIZ energy audit reports elaborated in 2017.

At the *macroeconomic level*, cost per saved kWh can be defined for specific measures. The lower the cost is the more profitable is the measure. However, this does not necessarily correspond with the energy saving potential. For example: The energy saving potential of insulating the façade is higher than insulating the roof, but for insulating the roof, the cost of conserved kWh is lower. This measure is more profitable than insulating the façade, but insulating the façade results in a higher energy saving.

At the *building level* and looking at individual energy efficiency measures, energy audit reports show that modernization of individual heating substation is most effective and cost efficient.

However, looking at individual measures can be problematic because measures influence each other, and therefore always the building as such should be analysed.

A concept for staged renovation should be developed if the budget is not available to implement all measures at once.

In general, those buildings should be selected

for renovation first, which have never been refurbished until now, or only 40-50 years ago. This means that comprehensive renovation measures will be necessary anyway (repair of façade, change of windows, repair of roof, etc.), and these measures will be upgraded at very low additional cost to meet energy efficiency targets.

FIATU's list of prioritized buildings can serve as a starting point to select buildings for renovation and to crosscheck whether budget is available and projected energy savings can be achieved.

Regarding *Energy Performance Contracting*, the legal framework for implementation is in place. There is control/supervision for large projects, but not for small projects. About 250 buildings are already under Energy Performance Contracting and about 1000 more are to be planned. However, projects are small (about 30,000 EUR) because of high interest rates (15%). The First Annual Report under the Energy Efficiency Directive (November 2017) states that several ESCO projects have been commissioned, and that more are under preparation. It will be useful to know what amount of energy saving is expected per ESCO contract and in total, and what the plans until 2020 are.

Regarding possible sources of financing more clarification is needed.

Ruslan Lytvyn / *Shutterstock.com*

4.5 Monitoring and reporting

According to the draft Law on Energy Efficiency, the responsible authority will monitor the achievement of the energy savings target and will annually submit the consolidated information on the achieved results to the Cabinet of Ministers of Ukraine and to the Secretariat of the Energy Community.

The unified form of the report on the implementation of obligations on improvement of energy efficiency could contain the following information:

(*a*) departmental affiliation of the building;

(*b*) name, address and coordinates of the building;

(*c*) total heated/air-conditioned area;

(*d*) baseline energy consumption and/or energy performance class in the baseline year;

(*e*) estimated level of improvement of energy efficiency (kWh/m^2);

(*f*) actual level of improvement of energy efficiency (kW/m^2);

measures to improve energy efficiency (thermo-modernization, energy management, ESCO, measures to change the culture of energy consumption (behavioural measures).

4.5.1 DISCUSSION AND RECOMMENDATIONS

Monitoring and reporting is closely connected with setting up the electronic database. Automatic reporting modules could be defined which support the responsible authority in generating the requested reports (*see Figure 4*).

5. Summary of recommendations

5.1 Key elements for the successful implementation of Article 5 EED

Transition path: Developing structures and procedures based on pilot projects

Pilot projects should be carried out to gain experience with different aspects of Article 5 implementation. Lessons learnt should be used to set up business as usual procedures.

Quality of collected energy related building data

Reliable information is a condition for decision-making on energy efficiency investments and to meet the requirements set by financing mechanisms, in order to actually release investments. It is also essential for checking the effectiveness of implemented energy efficiency measures to make corrections if necessary. In this way, a positive impact on the national economy is possible.

To ensure quality of collected data, the type of information to be collected must be exactly defined, responsible staff needs to be trained, and procedures to detect errors must be in place.

Financing mechanisms for renovation of public buildings

Financing mechanism for renovation of public buildings of the central government but also for public buildings at the regional and local level according to Article 5 (7) should be identified or developed. An administrative structure including control mechanisms and capacity building for responsible staff will be necessary to manage funds.

Staged renovations and building renovation roadmaps

Due to budgetary and other reasons, it could take more than a year to carry out all the planned renovation measures. In such as case, the concept of staged renovations should be considered which can be implemented based on building renovation roadmaps. Building renovation roadmaps provide the full range of building specific renovation measures in the correct sequence, identifying each renovation step from beginning to the end, and the links between all measures implemented.

Electronic system for Article 5 implementation

Advantages of digitalisation should be used, for example regarding checking and control, and regarding implementation of automatic procedures in order to reduce staff workload.

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