

GAP ANALYSIS

between the Performance Objectives Set Forth in the Framework Guidelines for Energy Efficiency Standards in Buildings and Current Energy Efficiency Standards and their Implementation

in the Countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation



ACKNOWLEDGEMENTS

This report is prepared in the framework of the project “Enhancing National Capacities to Develop and Implement Energy Efficiency Standards for Buildings in the UNECE Region.”

The report is prepared by the UNECE Secretariat. Nadejda Khamrakulova is the main author. Mohammed Abdul Mujeeb Khan has provided significant contributions. Oleg Dzioubinski, Scott Foster, and Igor Litvinyuk also contributed to this report.

Valuable contributions at various stages of the research and the preparation of the report have been received from the following experts:

- The UNECE Joint Task Force on Energy Efficiency Standards in Buildings;
- The UNECE Group of Experts on Energy Efficiency;
- Participants of the Workshop on Energy Efficiency Standards in Buildings and their Implementation in the UNECE region (Geneva and Chisinau (online), 9 April 2021);
- In particular, the following contributors: Artan Leskoviku (Albania); Ani Rafyan, Andre Ohanian (Armenia); Andrei Miniankou (Belarus); Margalita Arabidze, Natalia Jamburia (Georgia); Mikhail Toropov (Kyrgyzstan); Sergiu Robu (Republic of Moldova); Kostiantyn Gura, Artem Makarov, Dana Galimuk (Ukraine); and Nizomiddin Rahmanov (Uzbekistan).

Contents

List of Tables.....	5
List of Figures	6
Acronyms and Abbreviations.....	7
Signs and Measures.....	8
EXECUTIVE SUMMARY.....	9
INTRODUCTION.....	15
Scope and objective.....	16
Structure	17
Methodology	17
Limitations	18
Response to COVID-19 pandemic.....	19
REFERENCE POINTS.....	20
EXISTING ENERGY EFFICIENCY POLICIES.....	21
SOUTH-EASTERN EUROPE	21
Framework legislation and policy documents	21
Building energy codes	22
Energy performance certification.....	23
Energy pricing measures	23
Promotion of ESCO	24
Awareness programmes.....	24
EASTERN EUROPE AND THE RUSSIAN FEDERATION	29
Framework legislation and policy documents	29
Building energy codes	30
Energy performance certification.....	32
Energy pricing measures	33
Promotion of ESCO	33
Awareness programmes.....	34
THE CAUCASUS.....	38
Framework legislation and policy documents	38
Building energy codes	39
Energy performance certification.....	40
Energy pricing measures	41
Promotion of ESCO	41
Awareness programmes.....	42
CENTRAL ASIA	45
Framework legislation and policy documents	45
Building energy codes	46
Energy performance certification.....	47
Energy pricing measures	47
Promotion of ESCO	48
Awareness programmes.....	49
IMPLEMENTATION OF ENERGY EFFICIENCY STANDARDS.....	52
ENERGY PERFORMANCE OF BUILDINGS	52
South-Eastern Europe	53
Eastern Europe and the Russian Federation	56
The Caucasus.....	58
Central Asia	60
New vs Existing Buildings.....	61

New Buildings	61
Building envelope	61
HVAC	64
Appliances and equipment	66
Lighting.....	68
Existing Buildings	68
Building envelope	69
HVAC.....	75
Appliances and equipment	80
Lighting.....	81
COMPLIANCE MECHANISMS	82
ENFORCEMENT AND ENCOURAGEMENT MECHANISMS	87
Financial incentives.....	87
Penalties for non-compliance	91
INSTITUTIONAL CAPACITY	92
EFFECTIVENESS OF ENERGY EFFICIENCY POLICIES	96
GAP ANALYSIS OF ENERGY EFFICIENCY STANDARDS AND THEIR IMPLEMENTATION IN THE COUNTRIES	102
SWOT ANALYSIS	102
South Eastern Europe.....	103
Eastern Europe and the Russian Federation	104
The Caucasus.....	105
Central Asia	106
CONFORMITY OF ENERGY EFFICIENCY STANDARDS WITH THE FRAMEWORK GUIDELINES	108
Strategic guidance.....	108
Performance-based approach	110
ENERGY EFFICIENCY GAP	114
EXISTING BARRIERS	116
Regulatory and institutional barriers.....	117
Economic barriers.....	118
Behavioural barriers	120
CONCLUSIONS	121
OPPORTUNITIES TO BRIDGE THE GAP	124
BIBLIOGRAPHY	126
ANNEX: COUNTRY PROFILES	132

List of Tables

Table 1. Overview of Building Energy Codes in South Eastern Europe	26
Table 2. Overview of Building Energy Codes in Eastern Europe and in the Russian Federation	36
Table 3. Overview of Building Energy Codes in the Caucasus	43
Table 4. Overview of Building Energy Codes in Central Asia.....	50
Table 5. Minimum Admissible Resistance Value of Heat Transfer of the Building Envelopes of Residential and Public Buildings in Ukraine	63
Table 6. Average Energy Consumption of Residential Buildings in the Caucasus countries.....	72
Table 7. Average Energy Consumption of Residential Buildings in the Central Asian Countries.....	74
Table 8. Compliance Paths of the Building Energy Codes that Regulate Design and Construction of Building.....	84
Table 9. Overview of Requirements for Regular Inspection of Heating and Air Conditioning Systems	85
Table 10. Overview of Energy Performance Monitoring Requirements in the Countries.....	86
Table 11. Presence of Specific Incentives for Compliance with Building Energy Codes	88
Table 12. Presence of Penalties for Non-Compliance with Energy Efficiency Standards in Buildings in the Countries	91
Table 13. Institutions Responsible for Energy Efficiency Policies in South Eastern Europe.....	92
Table 14. Institutions Responsible for Energy Efficiency Policies in Eastern Europe and in the Russian Federation	94
Table 15. Institutions Responsible for Energy Efficiency Policies in the Caucasus.....	95
Table 16. Institutions Responsible for Energy Efficiency Policies in Central Asia	96
Table 17. SWOT Analysis for Countries of South-Eastern Europe.....	103
Table 18. SWOT Analysis for Countries of Eastern Europe and the Russian Federation	104
Table 19. SWOT Analysis for the Caucasus Countries	105
Table 20. SWOT Analysis for the Central Asian Countries	106
Table 21. Overview of Performance-Based Requirements in Building Energy Codes in the Countries	111
Table 22. Overview of Requirements to Identify the Energy Performance Gap in the Countries.....	112
Table 23. Overview of Requirements for Energy Use in Buildings in the Countries.....	113
Table 24. Energy Consumption in South-Eastern Europe, 2018: National Targets vs Actual Energy Consumption (ktoe).....	115
Table 25. Final Energy Consumption in the Countries in 2010 and 2018 (ktoe)	115

List of Figures

Figure 1. Residential Building Consumption, Share of Energy.....	52
Figure 2. Energy Intensity of the Building Sector in 2010-2018.....	53
Figure 3. Primary Energy Consumption and Final Energy Consumption in South Eastern Europe, 2012-2015.....	54
Figure 4. Overview of Primary and Final Energy Consumption Trends in Albania	54
Figure 5. Actual Primary and Final Energy Consumption in Bosnia and Herzegovina	55
Figure 6. Energy Balances in North Macedonia, by years.....	55
Figure 7. Primary and Final Energy Consumption in Serbia, 2016-2018.....	56
Figure 8. Belarus's Largest End-Uses by Sector, 2018	57
Figure 9. Belarus's Residential Energy Consumption by End-Use, 2018	57
Figure 10. The Largest End-Uses by Sector in the republic of Moldova, 2018.....	57
Figure 11. Ukraine's Largest End-Uses by Sector, 2018.....	58
Figure 12. Armenia's Largest End-Uses by Sector, 2018.....	58
Figure 13. Azerbaijan's Largest End-Uses by Sector, 2018	59
Figure 14. Georgia's Largest End-Uses by Sector, 2018.....	59
Figure 15. Kazakhstan's Largest End-Uses by Sector, 2018.....	60
Figure 16. Kyrgyzstan's Largest End-Uses by Sector, 2018	60
Figure 17. Uzbekistan's Largest End-Uses by Sector, 2017.....	61
Figure 18. Components of the Building Envelope.....	62
Figure 19. Estimated Heat Consumption of Residential Buildings in Belarus	71
Figure 20. Specific Prescriptive Technical Requirements in Building Energy Codes.....	83
Figure 21 Level of Compliance with Energy Performance Monitoring in the Countries.....	86
Figure 22. Scheme for Effective Energy Efficiency Policies	97
Figure 23. Assessment of Energy Efficiency Progress in Countries, 2016.....	98
Figure 24. Progress in Energy Efficiency in Serbia over 2010-2017	98
Figure 25. Countries Score in Energy Efficiency in 2019 (out of 100)	99
Figure 26. Overview of Progress in Energy Efficiency in Countries in the Period of 2010-2019.....	100
Figure 27. Regional Overview of Progress in Energy Efficiency in 2010, 2017 and 2019.....	100
Figure 28. Overview of Progress in Energy Efficiency in the Period of 2010-2019, by each indicator	101
Figure 29. Overview of Progress on Building Energy Codes in the Period of 2010-2019.....	101
Figure 30. Overview of Existence of Particular Types of Legislation, Programmes and Policies to Support Investments in Energy Efficiency in the Countries.....	118

Acronyms and Abbreviations

AFD	Agence Française de Développement
EBRD	European Bank for Reconstruction and Development
EE	Energy Efficiency
EEU	Eurasian Economic Union
EPBD	EU Energy Performance of Buildings Directive
EPC	Energy Performance Certification
ESCO	Energy Service Companies
ESMAP	Energy Sector Management Assistance Program
EU	European Union
FEC	Final Energy Consumption
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
HVAC	Heating, Ventilation and Air Conditioning
IEA	International Energy Agency
IFC	International Finance Corporation
INOGATE	Interstate Oil and Gas Transportation to Europe (energy technical assistance programmes funded by the European Union)
IPMVP	International Performance Measurement and Verification Protocol
ISO	International Organization for Standardization
KfW	Kreditanstalt für Wiederaufbau (Reconstruction Credit Institute)
LED	Light-emitting diode
MEPS	Minimal Energy Performance Standards
NAMA	Nationally Appropriate Mitigation Action
NATELI	New Applied Technology Efficiency and Lighting Initiative
NEEAP	National Energy Efficiency Action Plan
NEEP	National Energy Efficiency Programme
NGO	Non-Governmental Organisation
NZEB	Nearly Zero Energy Buildings
PV	Photovoltaics
RISE	Regulatory Indicators for Sustainable Energy
SOCAR	State Oil Company of Azerbaijan Republic
SWOT	Strength-Weakness-Opportunity-Threat
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
VAT	Value-added tax
WB	The World Bank

Currency

EUR	Euro
USD	United States Dollar

Signs and Measures

bcm	Billion cubic meters
°C	degree Celsius
EJ	Exajoule
Gcal	Giga calories
GWh/year	Gigawatt hours per year
KgCE	Kilogram of Coal Equivalent
Ktoe	Kilotonnes of oil equivalent
kW	Kilowatt
kWe	Kilowatt-electric
kWh/m ²	Kilowatt-hours per square meter
kWh/m ² a	Kilowatt-hours per meter square annual
m ²	Square metre
m ³	Cubic metre
Mtce	Megatonne of coal equivalent
Mtoe	Megatonne of oil equivalent
TWh	Terawatt-hour
W	Watt
W/m ² K	Watts per meter square Kelvin
Wh/m ² /degree	Watt hour per square meter per degree Celcius

EXECUTIVE SUMMARY

The UNECE Framework Guidelines for Energy Efficiency Standards in Buildings are the “reference points” in assessment of the situation on current energy efficiency standards and their implementation in the Countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation. The analysis of situation revealed the following:

Framework legislation and policy documents: Framework legislation is developed in the majority of countries in the South-Eastern and Eastern Europe, the Caucasus, and Central Asia, and in the Russian Federation. It includes energy efficiency and energy saving laws. Relevant secondary legislation, energy development strategies and specific energy efficiency programmes were also considered. The countries of South-Eastern Europe incorporated the energy efficiency related EU directives into the legal frameworks. While the energy efficiency framework legislation in the South-Eastern Europe is well developed, the by-laws are less developed. The energy efficiency legislation, related by-laws, norms and standards are quite well developed in Eastern Europe, the Caucasus, Central Asia, and the Russian Federation. The countries of Eastern Europe and the Russian Federation developed a comprehensive legislation on energy efficiency, with some (but not all) laws being recently updated. Most of the countries in the Central Asian region adopted energy efficiency legislation in the late 1990s and recently updated some laws and secondary legislation. However, there are two exceptions. In Azerbaijan and Tajikistan, there is no specific legislation and standards.

Building energy codes have been adopted in most reviewed countries. The countries of South-Eastern Europe transposed the European Union directive on Energy Performance of Buildings, adopted energy performance laws and introduced regulations on minimum performance requirements of buildings. The countries in Eastern Europe and the Russian Federation have adopted the building codes for different types of buildings. The situation in the Caucasus region differs from country to country. In all Central Asian countries the building energy codes are adopted.

Energy performance certification is introduced in some but not all reviewed countries. While the energy performance certification of buildings is mandatory in the countries of South-Eastern Europe, in the countries of Eastern Europe, the Caucasus, Central Asia and in the Russian Federation the situation varies. The requirements for energy performance certification for buildings are specified in the laws on energy performance in buildings in some countries. Energy labelling requirements are introduced in most reviewed countries. Mandatory energy performance monitoring requirements are absent in many reviewed countries.

Energy pricing measures are not introduced in some countries. Low energy prices in the countries lead to absence of a driving force for energy efficiency improvement in buildings. In South-Eastern Europe, the energy prices are still relatively low and cross-subsidised (mainly for households). Currently, the electricity tariffs are higher in Albania and Montenegro. In Belarus, the rates for heating and electricity depends on the type of consumer, use of the building, time and period of use. Energy tariffs were recently increased in Armenia, Ukraine, and Uzbekistan. Low energy prices also make the payback periods for energy efficiency improvements too long to be considered attractive by banks, other financial institutions and general public.

Promotion of ESCO: While in some countries there is no ESCO market, the other countries have a lack of ESCO activities. The energy performance contracts are not implemented in many countries. Activities related to ESCO in the South-Eastern European countries are in their early stages and limited despite the existence of relevant legislation in Albania, Montenegro, and

Serbia. In Serbia, the model contract for ESCO companies was adopted as a secondary legislation and made obligatory for public users. In the past few years, ESCO market is being developed in Ukraine. There is no functional ESCO market in the Caucasus countries. From Central Asia, only Kazakhstan has started introduction of energy performance contracts, however, implementation of this measure remains limited.

Awareness programmes and initiatives to promote energy efficiency among final consumers, as well as specific training courses for energy auditors, inspectors and evaluators exist in many reviewed countries. Information measures and best practices are regularly featured in the NEEAPs and target general public as well as business and industry sectors in the countries of South-Eastern Europe. In the Eastern European and the Caucasus countries, awareness programmes for energy efficiency are being actively implemented. In the Central Asian region, similar activities are also introduced. Despite this, low awareness on the benefits of energy efficiency still exists at the individual level and can preclude the introduction of energy efficiency measures both at individual and community levels. In many countries energy efficiency measures are still seen as high transaction costs, such as time and effort spent investing in them.

Energy consumption is high in all countries. Out of 17 reviewed countries, the residential sector is the largest energy consumer in eleven countries and the second largest in six countries. In South-Eastern Europe, the final energy consumption in buildings is significantly higher than previewed in their national energy efficiency targets. The consumption in the residential sector in the Eastern Europe, Caucasus and Central Asia is very high. In the period from 2010 to 2018, in Azerbaijan and the Republic of Moldova the final energy consumption increased. In Belarus, Georgia, Ukraine, and Uzbekistan the energy consumption slightly reduced.

The situation with new buildings in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation is relatively positive. The construction of new buildings can lead to energy efficient improvements, however, observation of performance-based requirements in the buildings and ensuring the compliance with the building energy codes is required. Very high energy consumption in the existing building stock is a problem in all reviewed countries. Energy consumption has recently increased for heating and cooling in many countries.

Compliance mechanisms: The countries introduced prescriptive technical requirements in their building energy codes. The performance-based requirements for new buildings also exist, however such requirements for the existing buildings are not present in many countries. The energy performance monitoring requirements are present in Albania, Montenegro, North Macedonia, Serbia, Republic of Moldova, Russian Federation, Azerbaijan, Georgia, Kyrgyzstan, and Uzbekistan. They are absent in Bosnia and Herzegovina, Belarus, Ukraine, Armenia, and Kazakhstan. No information is available to assess the situation in Tajikistan and Turkmenistan.

Enforcement and encouragement mechanisms: Financial incentives, such as subsidies, soft loans, tax exemptions or reductions are present in most of the countries. However, specific incentives for improving compliance with building energy codes are absent in some countries. Mandatory regular inspections were introduced as part of enforcement mechanisms. Penalties for non-compliance with building energy codes are absent in many countries.

Institutional capacity: The energy agencies aimed to monitor and implement energy efficiency measures and activities exist in seven countries. Such agencies are not established

in Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, Montenegro, Tajikistan, Turkmenistan, and Uzbekistan.

Effectiveness of existing energy efficiency policies: In the recent years, the frameworks for energy efficiency policies improved slowly. The building codes that embraced policies on energy efficiency slowed in 2017-2019. This is explained by the possibility that most of the actions were taken between 2010 and 2017. Overall, in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia and in the Russian Federation the standards for energy efficiency have been introduced. However, minimum energy performance requirements, energy labelling systems, and carbon pricing seem to lag behind.

The Strength-Weakness-Opportunity-Threat (**SWOT**) **analysis** identified common elements for all reviewed countries. Common strengths include: (i) quite well-developed framework legislation; (ii) building energy codes adopted in almost all countries; (iii) adoption of laws on energy performance in buildings and energy efficiency in buildings; (iv) presence of energy labelling requirements; (v) presence of financial incentives, such as subsidies, soft loans, tax exemption or reductions.

Common weaknesses are: (i) high energy consumption in the residential sector; (ii) lack of ESCO activities in some countries, and absence of ESCO market in the others; (vi) absence of specific incentives for improving compliance with building energy codes and lack of enforcement mechanisms.

Common opportunities present: (i) the operations by dedicated energy agencies to monitor and implement energy efficiency measures and activities; (ii) the introduced mandatory regular inspections; (iii) energy tariffs increases; (iv) further developments in the legislation.

Common risks and threats include: (i) low energy prices in many countries; (ii) absence of mandatory energy performance monitoring requirements; (iii) absence of penalties for non-compliance with building energy codes in many countries.

Conformity of energy efficiency standards with the Framework Guidelines for Energy Efficiency Standards in Buildings: According to the Framework Guidelines, the buildings must be science-based, service-oriented, integrated with the built environment lifecycle, cost effective, using low-carbon technologies, having low energy consumption, performance-monitored and performance-based, safe and healthy. These high standards of buildings should be addressed in the national legislation, which in its turn should be recent and take into account the current trends and modern technologies to enhance energy efficiency in buildings. However, in many reviewed countries the existing energy efficiency standards are not recently adopted or updated and thus cannot reflect the recent requirements and technological advances.

The Framework Guidelines also indicate that buildings, materials and technologies should be assessed over their life cycle in terms of their energy performance. And the energy efficiency standards in buildings are to be outcome-based anchored in energy actually consumed. However, it is not the case for all countries. The countries have different levels of standards addressing the performance of buildings. The existing performance-based requirements in building energy codes are mostly observed in the countries of South-Eastern Europe and Eastern Europe, and in the Russian Federation, while significantly less present in the countries of Central Asia. Such requirements are not present in Georgia.

The Framework Guidelines particularly indicate the building heating and cooling requirements for new buildings and retrofit projects as well as guidance for total primary energy use in

buildings' conditioned spaces, including heating, ventilation, cooling and hot water. However, not all countries introduced performance-based limits directly in their building energy codes. The performance-based requirements for buildings in Albania are in line with the Framework Guidelines. In North Macedonia, the limits of annual consumption for residential and non-residential buildings are higher than those indicated in the Framework Guidelines. In Belarus, the annual consumption requirements for heating and cooling are higher than those indicated in the Framework Guidelines. In the Republic of Moldova, the annual consumption of certain categories of buildings is higher than the indications on energy use in buildings in the Framework Guidelines. In Montenegro and Serbia (sub-region of South-Eastern Europe), as well as in all countries in the Caucasus and Central Asia the requirements based on annual energy consumption are not specified. The indicator for estimating energy consumption of buildings in these countries is the primary energy use for heating, cooling and ventilation.

Existing barriers: A gap between energy efficiency policies potential and effective achievement exists mainly due to barriers affecting those energy efficiency policies and measures. The three main categories of barriers were identified: (i) regulatory and institutional; (ii) economic (financial and market barriers); and (iii) behavioural (awareness, advice and skills).

Regulatory barriers include a lack of secondary legislation and specific norms that make the framework law functional. The institutional barriers include absence of energy agencies in some countries as well as inefficiency of existing institutions in implementing national energy efficiency policies. Economic barriers include a lack of financing for major renovations of residential buildings; limited public financing options; long payback periods for energy efficiency projects as well as low energy prices in some countries. Behavioural barriers are seen in low awareness of energy efficiency benefits at the individual level, lack of a large-scale information campaign in media, perception of high transaction costs for investing in energy efficiency, lack of knowledge on how to incorporate energy efficiency into design and construction of buildings.

Recommendations:

Based on the analysis of this study, several recommendations can be made in order to help bridging the gap between the performance objectives set forth in the Framework Guidelines for Energy Efficiency Standards in Buildings and current energy efficiency standards and their implementation in the countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation.

In line with principles of the Framework Guidelines for Energy Efficiency Standards in Buildings, the following actions should be undertaken in the countries:

Strategic guidance:

- The Governments should develop a comprehensive and long-term building code strategy, gradually increasing its strictness.
- The Governments should ensure the introduction of performance-based approach in the building energy codes and other energy efficiency standards.
- The building energy codes should be frequently evaluated, revised and improved in order to understand the existing strengths and eliminate weaknesses of energy efficiency policy design and implementation.

- Energy efficiency policies should be developed and adjusted to different regional contexts and institutional realities within each country.
- The Governments should set up targets for increasing the share of new high-performant buildings.
- The Governments should set up the ambitious timeline and targets for renovation of the existing buildings.
- The improved energy performance of building components and systems should be a target to improve the energy performance of all buildings.
- Sustainable high-performance construction know-how should be introduced into the curriculum of educational institutions in the countries.
- Awareness of population on energy efficiency benefits need to be raised through the implemented demonstration projects and media campaigns in the countries.

Design and construction:

- The Governments should aim for net-zero energy consumption in new buildings.
- Comprehensive retrofits of existing residential and non-residential buildings should be planned and undertaken to reduce energy requirements and increase energy savings in buildings.
- The minimum energy performance standards should be mandatory for both new and existing buildings in all countries.
- The high costs of energy efficiency technologies may discourage consumers to install them. The Governments should introduce tax exemption or reduction to provide the initial incentive for purchase of energy saving technologies.
- Financial incentives should be introduced to encourage investment in the long-lasting high efficiency improvements.
- The stakeholders in the building sector should be educated on the importance of building energy codes in order to increase support for compliance and effective implementation of the energy efficiency policy.

Management:

- Energy agencies should be established in those countries where they do not exist. An energy agency is an institution playing a crucial role in recognition of energy efficiency as a priority action for the country.
- The baseline data on energy demand should be available to measure the success in implementation of energy efficiency policies.
- The energy performance certification of buildings should be applied as an obligatory measure in all countries. The energy rating for buildings should also be introduced.
- The building energy labels or certificates should be required at the sale or rental of properties.
- The efforts to develop or improve the energy service companies (ESCO) market should be undertaken in all countries.
- Energy pricing should be used as an effective tool for influencing the energy use behaviour. The removal of subsidies to energy use and diversification of pricing measures should be used to enhance the attractiveness of investments in energy efficiency.

- Strong compliance mechanisms and proper monitoring mechanisms should be established to ensure the effective building codes enforcement in the countries.
- Low interest loans for energy efficiency technologies and building constructions and retrofits should be introduced as important instrument in promoting energy efficiency.
- Carefully designed and targeted awareness-raising programmes should be developed to encourage energy efficiency improvements.

INTRODUCTION

“Buildings consume over 70 per cent of the electrical power generated and 40 per cent of primary energy and are responsible for 40 per cent of carbon dioxide emissions from related fuel combustion” (UNECE, 2020). At the same time, in 2018, out of 4.5 trillion USD spent on building construction and renovation, the total amount spent on energy efficiency in buildings counted for USD 139 billion (IEA & UNEP, 2019).

During the last five years, the energy efficiency improvement rate slowed down, and the investment trend mirrored that situation. “An underlying factor was the static energy efficiency policy environment...with little progress made in implementing new efficiency policies or increasing the stringency of existing ones” (IEA & UNEP, 2019).

Different policy instruments can help in addressing the slow progress and improving energy efficiency in the buildings sector. They can be classified into several categories:

- (i) control and regulatory mechanisms aimed at influencing energy performance of buildings (such as building energy codes, appliance standards, procurement regulations, energy efficiency obligations, quotas);
- (ii) regulatory instruments aimed to inform energy users about energy efficiency (such as mandatory labelling and certification programs, mandatory audit programs, utility demand-side management programs);
- (iii) economic and market instruments (such as energy performance contracting, energy efficiency certificate schemes, carbon trading platforms);
- (iv) fiscal instruments aimed to correct energy prices through taxes (such tax reductions or exemptions) or by providing financial support (such as grants, subsidized loans, rebates);
- (v) information and voluntary programs (such as voluntary certification and labelling programs, awareness-raising, education and information campaigns, establishment of energy agencies, awards and competitions, training of building professionals).

The energy efficiency standards in buildings can differ from country to country. One country can have several different standards depending on the entity that adopted them and mechanisms they aim to address.

Building energy codes are the regulatory instruments that specify the minimum energy efficiency standards for the residential and commercial building sectors. By setting up certain standards, they play important role in reducing the long-term energy demands of the buildings sector.

Building energy codes can prescribe energy efficiency characteristics for building technologies. Some building energy codes provide “target energy use levels for a building” (Howard, 1991). The following building technologies and elements are usually included in a building code: (i) building envelope; (ii) heating, ventilation, and air conditioning (HVAC) systems; (iii) appliances; and (iv) lighting.

Despite being a powerful instrument, the building codes are not introduced in many countries. In 2018, only “73 countries of the world adopted mandatory or voluntary building energy codes. Out of them, 41 countries introduced mandatory residential building codes and 51 countries had mandatory non-residential codes; 4 countries had voluntary residential codes and 12 countries had voluntary non-residential codes. Some other countries were in the process of developing the building codes” (IEA&UNEP, 2019).

To improve energy performance of new constructions and existing buildings, the greater adoption and coverage by building codes is required. In addition, building codes themselves should be implemented effectively and improved progressively over time.

In combination with other policy instruments, effective implementation of building energy codes will help reducing the future energy demand. In this case, building energy codes “can support energy cost savings and complementary benefits associated with electricity reliability, air quality improvement, greenhouse gas emission reduction, increased comfort, and economic and social development” (Cox, 2016).

Scope and objective

UNECE is implementing project “Enhancing National Capacities to Develop and Implement Energy Efficiency Standards for Buildings in the UNECE Region.” The project aims to enhance capacity of the UNECE member States to develop and implement energy efficiency standards for buildings. The project is conducted under the auspices of the Joint Task Force on Energy Efficiency Standards in Buildings established under the Committee on Urban Development, Housing and Land Management and the Committee on Sustainable Energy (led by the Group of Experts on Energy Efficiency).

This project builds on UNECE’s previous activities in the area of energy efficiency standards in buildings and further develops the understanding of the status of energy efficiency standards in buildings based on the completed studies. In 2018, a study “Mapping of Existing Energy Efficiency Standards and Technologies in Buildings in the UNECE Region” (UNECE, 2018) was undertaken. In 2019, a study “Mapping of Existing Technologies to Enhance Energy Efficiency in Buildings in the UNECE Region” was conducted.

One of the project activities includes conducting a gap analysis between the performance objectives set forth in the Framework Guidelines for Energy Efficiency Standards in Buildings and current energy efficiency standards and their implementation in the countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation.

The current study builds on both of above mentioned studies and addresses the situation in the following countries: Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia (South-Eastern Europe); Belarus, Republic of Moldova, Ukraine (Eastern Europe); Armenia, Azerbaijan, Georgia (the Caucasus); Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan (Central Asia); and the Russian Federation.

The objective of this study is to identify and analyse gaps between the current energy efficiency standards existing in the countries and the performance objectives set forth in the Framework Guidelines for Energy Efficiency Standards in Buildings. In addition, this study looks at the implementation of energy efficiency standards in these countries and analyse whether the actual situation corresponds to the objectives of the Framework Guidelines for Energy Efficiency Standards in Buildings.

This report aims to highlight gaps between the existing requirements for energy efficiency standards in buildings and enforcement of those standards. It will also identify barriers to adopting and implementing the high-performance standards in buildings in the countries.

Structure

The report consists of the following parts:

Reference points: the UNECE Framework Guidelines for Energy Efficiency Standards in Buildings and the UNECE High Performance Buildings Initiative are considered as “reference points” in assessment of the situation on current energy efficiency standards and their implementation in the Countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation.

Existing Energy Efficiency Policies: this part provides comparative analysis on the existing policies addressing energy efficiency in buildings in the sub-regions of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia. The Russian Federation is analysed together with the countries of Eastern Europe. It provides an overview of (i) framework legislation and policy documents; (ii) building energy codes; (iii) instruments for energy performance certification; (iv) policies and measures for energy pricing; (v) measures for promotion of the energy service companies (ESCO); and (vi) awareness campaigns and programmes.

Implementation of Energy Efficiency Standards: this part outlines trends in implementation of energy efficiency standards in buildings. It particularly looks at the energy consumption trends in the sub-regions and reflects on energy performance of the new and existing residential and non-residential buildings. The focus is on requirements for energy performance in buildings existing in the countries with examples of performance assessments of the (i) building envelopes; (ii) HVAC; (iii) appliances and equipment; and (iv) lighting. This part also analyses the enforcement and encouragement mechanisms existing in the countries to implement their energy efficiency standards. It reviews the institutional capacity to implement energy efficiency policies and analyses the overall effectiveness of the implemented policies.

Gap Analysis of Energy Efficiency Standards and their Implementation in the Countries: this part undertakes Strength-Weakness-Opportunity-Threat (SWOT) analysis to identify the internal and external factors that are favourable and unfavourable for implementation of energy efficiency standards in the sub-regions. It verifies the conformity of existing standards in the countries with the objectives set forth in the Framework Guidelines for Energy Efficiency Standards in Buildings and identifies the gap between the required and actual consumption of buildings in the countries. This part also highlights the regulatory and institutional, economic, and behavioural barriers to adopting and implementing the energy efficiency standards in buildings.

Conclusions are based on the gap analysis of existing energy efficiency standards in buildings and their implementation in the countries. **Recommendations** included in this report focus on priority actions, which countries should undertake to bridge the gap between the performance objectives set forth in the Framework Guidelines for Energy Efficiency Standards in Buildings and their energy efficiency standards in buildings.

This report ends with **Annex** presenting the profiles for each reviewed country.

Methodology

Information and data collected for this study is mainly based on desktop research of internet and printed sources, including the official governmental documents and legal acts, published reports and analytical materials by international organisations and NGOs, academic literature, energy databases and news portals.

The country profiles were prepared for each reviewed country based on the desktop study. Part I: Policies addressing energy efficiency in buildings included (i) framework legislation; (ii) building energy codes; (iii) compliance mechanism; (iv) energy performance certification; (v) energy pricing measures; (vi) financial incentives; (vii) promotion of ESCO; (viii) awareness programmes; (ix) institutions. Part II: Energy performance of new constructions (both residential and non-residential) and Part III: Energy performance of existing buildings (both residential and non-residential) included information and data on (i) design envelope; (ii) heating; (iii) ventilation; (iv) cooling; (v) water heating; (vi) appliances and equipment; (vii) lighting.

The draft country profiles have been distributed to national experts for validation and update. The updates on country profiles have been received from Albania, Armenia, Belarus, Georgia, Kyrgyzstan, Republic of Moldova, Ukraine, and Uzbekistan.

The Chapters of the report present country-related data and information clustered by the sub-regions: South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia. For the purposes of comparative analysis, the Russian Federation is analysed together with countries of Eastern Europe. This comparative gap analysis allowed to identify common needs and trends in the countries as well as specific challenges at the national level.

Furthermore, this report used comparative analysis to identify interrelations and gaps between three components: (i) performance objectives of the Framework Guidelines for Energy Efficiency Standards in Buildings; (ii) the existing energy efficiency standards in the countries; and (iii) the actual energy consumption and implementation of energy efficiency standards in the countries.

Limitations

The scope of the study is limited to evaluating data and information made available from the desktop research.

The country profiles are based on publicly available information. While information for part I (policies addressing energy efficiency in buildings) was relatively accessible and available, the data and specific information for part II (energy performance of new residential and non-residential buildings) and part III (energy performance of existing residential and non-residential buildings) remain scarce. Some additional data is available at the national level and required translation from the national languages.

The draft profiles were distributed to representatives of each reviewed country. Out of seventeen profiles prepared for this report, the responses from the governmental representatives of seven countries were received. The provided updates to the country profiles were also reflected in the relevant chapters of this report.

Despite these limitations, the authors of the report believe that information compiled from different countries would enable exchanges between the countries on effectiveness of existing energy efficiency standards in buildings and requirements for update of their standards or development of the new ones.

Response to COVID-19 pandemic

Globally, the slow rate of energy efficiency improvement was observed over the last few years. The coronavirus pandemic is causing global economic crisis and “adds a new layer of uncertainty.” This crisis and “triggered changes to behaviour and markets” and “threatens to delay investments by businesses and households in more efficient technologies” (IEA, 2020).

According to the IEA assessment, there was “a partial shift in energy demand from commercial to residential buildings, as social distancing and teleworking reduced the use of commercial buildings and increased activities that use energy at home.”

Pandemic-related issues now crowd the national agendas and are changing the perceived priorities. “Current forecasts suggest the pandemic has dampened growth expectations for the buildings and construction sector” (IEA, 2020).

The “governments at all levels are operating in a context of radical uncertainty.” The investments in energy efficiency worldwide were expected to drop, as countries focused to tackle the economic recession that was set off due to the pandemic (OECD, 2020).

From one side, future prospects may not be so positive. “If the economic recession deepens, households and businesses may reduce spending on building upgrades, which will slow technical efficiency improvements.” (IEA, 2020).

At the same time, the crisis may also provide significant opportunities for sustainable recovery and energy system transition in which energy efficiency will play an integral role. The buildings sector can become “the primary target for energy efficiency stimulus spending announcements...In some regions, the scale of this investment could be large enough to significantly boost technical efficiency” (IEA, 2020).

An urgent need for progress across the 2030 Agenda for Sustainable Development also remains. Therefore, the work on buildings remains vital to the global future. Transforming the built environment can drive sustainability and deliver quality of life in the broadest terms. It can also impact the priorities of the world’s responses to crises across environmental, social, health, and economic facets, and can be a leading force defining the society that emerges from today’s chaos.

So far, the response to this need has been mixed. Some countries have not yet committed to additional spending on energy efficiency, while others continued their engagement or renewed their commitments under previous agreements and programmes related to energy efficiency.

Going forward, the countries in the UNECE region must align their policies and focus on energy efficiency financing to keep up with the progress and the momentum. Shifting to dramatically higher performance standards for new and existing buildings can make a major contribution to the transition to sustainability. All stakeholders involved in the energy efficiency area need to engage and implement a vision for high-performance buildings to deliver a developing and sustainable global society.

REFERENCE POINTS

The reference points address to an idea which helps to understand or make a judgement about another situation. In order to identify gaps in energy efficiency standards in countries, one has to refer to certain concepts that represent guidance and provide possibility to learn about the factors needed to achieve future objectives. The Framework Guidelines for Energy Efficiency Standards in Buildings as well as the High Performance Buildings Initiative can serve as reference points in assessment of the situation on current energy efficiency standards and their implementation in the countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation.

The concepts set forth in the **Framework Guidelines for Energy Efficiency Standards in Buildings**¹ (ECE/ENERGY/GE.6/2020/4) represent a principles-based performance guidance for building energy standards that is outcome-based, anchored in energy actually consumed, and that is designed to project a vision of holistically designed and operated, ultra-high-performance buildings as part of an integrated sustainable energy system.

The energy required by buildings can be reduced to a level that can be supplied largely, perhaps exclusively, by non-carbon-based energy. Limiting building heating and cooling requirements to 15 kWh/m²a in new builds and to 25 kWh/m²a for retrofit projects (final energy in conditioned space) each reduces energy needs sufficiently to permit renewable energy or zero carbon sources to meet most or all of the remaining space conditioning energy requirements. Total primary energy use in buildings' conditioned spaces, including heating, ventilation, cooling and hot water, can be limited to 45 kWh/m²a or, including plug-in loads (appliances), to 90 kWh/m²a. Over time with improvements in technology and materials and with enhanced connections to the built environment, these targets could be improved further.

The principles required for an era of truly sustainable buildings emerge from building science, materials science, digital science, information and communication technology and more. They reflect accumulated lessons learned and best practices of building owners, designers, engineers, builders, managers, policy makers, and more. The principles shift the building industry paradigm from fragmented and serial to holistic and integrated. The principles cannot be prescriptive because of the vast diversity of circumstances and conditions experienced around the world. Rather, the principles provide guidance for planners, builders, and the entire building delivery and management chain as elements of innovative sustainability strategy.

UNECE launched the **High Performance Buildings Initiative**² to deploy its Framework Guidelines for Energy Efficiency Standards in Buildings and its Geneva UN Charter on Sustainable Housing with the aim of accelerating the transformation of the world's building stock. The initiative focuses on capacity development and impact in the field, developing the intellectual, material and financial resources to educate, advocate and advise for transformation to high performance buildings; and the outreach required to create a worldwide urban shift to truly sustainable buildings. The ultimate objective is to improve health and quality of life within the built environment while simultaneously decarbonizing building-related energy requirements.

¹ In 2017, the Joint Task Force on Energy Efficiency Standards in Buildings developed the Framework Guidelines for Energy Efficiency Standards in Buildings (ECE/ENERGY/GE.6/2017/4). During its seventh session on 22-23 September 2020, the Joint Task Force on Energy Efficiency Standards in Buildings reviewed and adopted the Updated Framework Guidelines for Energy Efficiency Standards in Buildings (ECE/ENERGY/GE.6/2020/4), available at: https://unece.org/fileadmin/DAM/energy/se/pdfs/geee/geee7_Sept2020/ECE_ENERGY_GE.6_2020_4e.pdf

² https://unece.org/sites/default/files/2020-12/HPBI_Leaflet_2020_1.pdf

EXISTING ENERGY EFFICIENCY POLICIES

Energy efficiency policy is a set of strategies, legislation, regulations, measures, programmes that together stimulate energy efficiency improvement (IEA).

SOUTH-EASTERN EUROPE

Framework legislation and policy documents

The South East European countries are the members of the Energy Community which in its turn works to extend the EU internal energy market to this region. Since 2009 they countries have incorporated various energy efficiency related EU directives into the legal frameworks. The EU Energy Performance of Buildings Directive (EPBD-2010/31/EU) sets minimum energy performance requirements for new and existing buildings. The Framework Energy Labelling Regulation (FELR-EU/2017/1369) creates a framework for labelling and providing consumer information on energy consumption for energy-related products. “Implementation of these provisions has made progress in the region but much work is still needed as implementation scores range between 30 and 60 percent” (EU, 2019).

The energy efficiency law adopted in 2015 in **Albania** is in compliance with the EU Directive 2006/32/EC. In 2016, Albania adopted the law on energy performance of buildings which includes the minimum requirements for energy performance of buildings, as well as the performance certification of buildings. Furthermore, in accordance with these two laws a number of bylaws have been adopted recently, including on regulation for categories, conditions, and qualifications requirements for the certification of energy managers (2019); energy audits and energy services (2019); approval the methodology to calculate cost-optimal levels of minimum energy performance for buildings and building elements, and minimum performance requirements for energy of buildings and building elements (2020).

The National Energy Efficiency Action Plan (NEEAP) was defined for a period of 2010-2018, this was followed by the 2nd and 3rd NEEAPs for the period of 2017-2020 (adopted in 2017). The law on indication by labelling and standard product information of the consumption of energy and other resources by household appliances was adopted in 2009 and is in accordance with the EU Directive 92/75/EEC.

In **Bosnia and Herzegovina**, the law on “Efficient Use of Energy” and the law on the “Use of Renewable Energy Sources and Efficient Cogeneration” were adopted in 2013 in the Republika Srpska. Additionally, the Republika Srpska adopted the Energy Development Strategy until 2030. The Law on “Efficient Use of Energy” and the NEEAP for 2016-2018 were adopted in 2017 in the Federation of Bosnia and Herzegovina. Moreover, the Law on “Use of Renewable Energy Sources and Efficient Cogeneration” was adopted in 2013.

The law on “Efficient Use of Energy” (adopted in 2014), replaced the previous law on energy efficiency in **Montenegro**. It introduced the obligations regarding energy performance of buildings, including energy audits, minimum energy efficiency requirements and energy performance certification. The provisions of this law and the relevant secondary legislation acts represent the transposition of the requirements of the EU Energy Performance of Buildings Directive. The Energy Policy of Montenegro until 2030 (adopted in March 2011) included key strategic objectives and priorities in the energy sector, majority of which are related to energy efficiency. Montenegro has adopted four National Energy Efficiency Action Plans as follows:

the 1st NEEAP for 2010-2012; the 2nd NEEAP for 2013-2015; the 3rd NEEAP for 2016-2018; and the 4th NEEAP for 2019-2021.

The energy law was adopted in **North Macedonia** in 2011 and last amended in 2013. The country adopted the Energy Efficiency Strategy and its first NEEAP in 2010. The same year, the Strategy for Energy Development in the Republic of Macedonia until 2030 was adopted. The 2nd and 3rd NEEAPs were adopted respectively in 2014 and 2017. The Parliament of North Macedonia adopted a comprehensive law on energy efficiency, transposing the EU Energy Efficiency Directive, Energy Performance of Buildings Directive, Regulation on Labelling of energy related products, and the Directive on Eco-design of energy related products.

Serbia adopted the law on “Efficient Use of Energy” in 2013. Moreover, the NEEAPs were adopted as follows: the 1st NEEAP for 2010-12; the 2nd NEEAP for 2013-15; and the 3rd NEEAP for 2016-2018. The Energy Sector Development Strategy for the period until 2025 with projections until 2030 was adopted in 2016.

Overall, the framework legislation regarding energy efficiency is present in South-Eastern Europe, which includes laws, secondary legislation, and national energy efficiency action plans (NEEAPs).

Building energy codes

Albania adopted a law in November 2015, which transposed many of the requirements of Directive 2012/27/EU (the “Energy Efficiency Directive”). The law on the Energy Performance of Buildings transposed Directive 2010/31/EU (the “Energy Performance of Buildings Directive”). In November 2016 the Energy Performance Law was adopted. The strictness of building energy codes in Albania is mixed (mandatory and voluntary) and is applicable for apartments, single family houses, commercial and public buildings. The performance-based requirements for new building are 55 kWh/m²a and for existing buildings (after substantial refurbishment) is 80 kWh/m²a (UNECE, 2018).

In **Bosnia and Herzegovina**, the regulation on minimum energy performance of buildings is present in the Republika Srpska since 2015, while for the Federation of Bosnia and Herzegovina is in adoption procedure. According to Energy Charter, the implementation progressed in the Federation of Bosnia and Herzegovina with the adoption of rulebooks for energy performance requirements of buildings and regular inspections of heating and air conditioning systems in November 2019. Building energy codes are mandatory and are classified according to the national classification of building codes for residential buildings (apartment building and individual family house), non-residential buildings (administrative building, for education, social and health), and commercial buildings (for sports and recreation, tourism and restaurant/hotel). The maximum transmittance and maximum permissible values for annual heat energy required per m³ of useful surface of the building (kWh/m²a) are defined depending on the shape factor (geometry of the building), climatic zone and the purpose of the building are specified and same for new buildings and major renovations (EU, 2019).

The main regulatory document related to building energy codes in **Montenegro** (official Gazette of Montenegro 75/15) sets the rules on minimum energy requirements for energy efficiency of buildings, the guidelines for energy efficiency certification of buildings and energy audits of buildings. The building energy codes are mandatory and applicable to single family houses, apartment blocks, commercial (hotels, recreational facilities, cultural etc), public buildings (schools, kindergartens, universities, hospitals, etc) and buildings defined as

others (that are heated on temperature above 12°C, have area more than 50 m² and are not under cultural heritage).

In **North Macedonia**, the national classification of buildings covered by energy codes for certification purposes includes residential and non-residential buildings. The strictness for building energy codes is mixed (both voluntary and mandatory). The minimum consumption class for residential sector “C class” is 100 kWh/m²a, for public sector minimum is “C class” of 150 kWh/m²a. The mandatory class for public sector is minimum “D class” after substantial refurbishment (UNECE, 2018).

In **Serbia**, the rulebook on energy efficiency in buildings specifies the energy performance and manners of calculating thermal properties in numerous types of buildings. These include residential single apartment, residential with multiple apartments, administrative and commercial, education and cultural, health and social care, tourism and hospitality, sports and recreation, mixed purpose buildings. The national classification of buildings covered by energy codes includes A+, A, B, C, D, E, F, G with a mixed (both voluntary and mandatory) strictness. Moreover, the energy class of the new building should not be lower than class “C”. The class of energy consumption of existing buildings should be upgraded by at least one class after reconstruction.

Energy performance certification

The energy performance certification (EPC) of buildings is mandatory for public buildings and new non-residential buildings in **Albania** (the EPC refers to total primary energy).

The EPC is mandatory for existing residential and non-residential (after substantial refurbishment in both cases) as well as for new residential and non-residential buildings in **Bosnia and Herzegovina**.

The EPC is mandatory for all types of buildings in **Montenegro**, including new and existing residential and non-residential buildings. However, EPC is not carried out in practice due to the lack of national software for calculating. At the same time, this was expected in the framework of the Energy Efficiency Programme in Public Buildings project phase II which was implemented between 2012-2020 in Montenegro. The project was funded by the German Development Bank KfW and reconstructed 28 educational facilities (ECS, 2018).

Similarly, EPC is not functioning in **North Macedonia** even though there exists a mixed (both voluntary and mandatory) strictness for EPC covering both new and existing residential and non-residential buildings.

Serbia has defined EPC according to the total primary energy with mixed strictness (both mandatory and voluntary) for buildings.

A national registry database for EPC exists in Bosnia and Herzegovina and Serbia, however is missing in Albania, Montenegro and North Macedonia.

Energy pricing measures

The major reasons for slow energy efficiency uptake in the South-Eastern Europe were identified as the low and cross-subsidised energy prices (mainly for households) coupled with late or non-payment of energy bills that had a significant impact on energy efficiency investments. The incentive for consumers to invest in energy efficiency measures were not

significant due to the high upfront investment cost and low financial savings compared to the cost of energy actually paid for electricity. Furthermore, the gas prices were generally lower than EU market values, especially for residential consumers in the region. Overall, the low and non-reflective, regulated tariffs were considered a serious barrier to energy efficiency improvement (ECS, 2012).

Currently, the electricity tariffs are more expensive in Albania and Montenegro. Montenegro had the highest household electricity prices (10.32 euro cents/kWh) while the prices for industry were the highest in Albania at 12.5 euro cents/kWh. Montenegro remains the only country in the region where end-consumer prices for households are not regulated.

Promotion of ESCO

Many countries in the region have planned or already introduced measures to foster energy performance contracting and energy service companies (ESCOs). The promotion of ESCO is part of the framework legislation in countries as follows:

- In Albania included in new energy efficiency law,
- In North Macedonia new articles introduced in the updated Energy Law, and included Rulebook on energy performance contracting,
- In Montenegro included in the Rulebook on energy performance contracting,
- In Serbia are provided through provisions in the new Law on rational use of energy.

Overall, the activities related to ESCO are in early stages and limited despite existence of relevant legislation in **Albania, Montenegro and Serbia**. Previous attempts to establish public private ESCOs in **North Macedonia** failed. Companies that work on project-based financing model are limited and usually enter into direct agreement with municipality which results in issues with money pay back due to the low municipality financial viability. To overcome this, countries need to clearly specify the financing methods that would not only guarantee the project development to implement energy efficiency measures but also support monitoring, inspection and verification of the systems for sustainability (Acuner *et al.*).

The development of legal framework for implementation of ESCO and models of energy performance contracts in buildings, water supply and public lighting in **Montenegro** was supported by the Regional Energy Efficiency Programme (ECS, 2018). This initiative for the Western Balkans provides technical assistance, policy support and financing instruments for creation of a sustainable market for energy efficiency. It supports energy efficiency investments in both private and public sectors. The project is funded by the EU in cooperation with Energy Community.

In **Serbia**, the model contract for ESCO companies was developed and adopted as a secondary legislation and made obligatory for public users. In 2019, there were more than 15 ESCO street lighting projects in Serbia (UNECE, 2019).

Awareness programmes

Information measures and best practices were regularly featured in the NEEAPs that targeted the general public as well as business and industry sectors. In **Albania**, the NEEAP included energy advice network which served as a tool to provide advice to energy end users, education and training for professionals and managers of public buildings. The NEEAP of **North Macedonia** included a provision for nationwide awareness campaign and trainings for commercial and public buildings. **Montenegro** developed training modules (capacity building plan) for public sector, local authorities, large energy users as well as private sector along with

set-up of info centers for residential and service sector. **Serbia** developed a comprehensive programme of information, guidance and training for policy makers, and local authorities (representatives and advisors).

In **Bosnia and Herzegovina**, with support from UNDP, campaigns for energy efficiency in buildings were implemented. Non-governmental organizations also provide information to general public on energy efficiency. For example, the Regional Energy and Information Center held annual summer school dedicated to energy efficiency and renewable energy promotion. Consulting companies in collaboration with the UNDP, GIZ, and USAID carried out seminar programmes on the efficient use of energy sources.

North Macedonia carried out a campaign titled “Energy Mathematics” that provided households with practical examples on how to save energy. The campaign included billboards displays, flyers, and TV broadcast.

The Ministry of Mining and Energy of **Serbia** is a regular participant in events explaining relevant policies on energy efficiency. The Ministry also maintains information regarding energy efficiency on their website for citizens and investors. Local self-government units (in accordance with the Law on Housing and Maintenance of Buildings) required to provide advisory assistance to improve the energy efficiency of buildings to the citizens and housing communities.

<i>Table 1. Overview of Building Energy Codes in South Eastern Europe</i>					
	Albania	Bosnia and Herzegovina	Montenegro	North Macedonia	Serbia
Coverage	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings • Other buildings that are heated on temperature above 12° C, has area more than 50 m2 and are not under cultural heritage. 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings
Strictness	<ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • Energy use for heating, cooling, hot water, lighting, ventilation. 	<ul style="list-style-type: none"> • Mandatory • The values are the same as for new buildings and major renovations. • The maximum transmittance for buildings on the climate zone, use of the building and the shape factor of the building (geometry of buildings) 	<ul style="list-style-type: none"> • Mandatory • Energy classes are defined within the EEPPB II project 	<ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • The national classification of buildings covered by the energy codes include residential and non-residential for the means of certification. 	<ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • Energy use for: required thermal energy for heating • National classification of buildings covered by the energy codes: A+, A, B, C, D, E, F, G.
Main regulatory documents	<ul style="list-style-type: none"> • Energy Building Code dated January 16, 2003; • The Law No. 8937, dated 12.09.2002 “On Conservation of Thermal Heat in Buildings”; • Energy performance on building law dated November 2016. 	<ul style="list-style-type: none"> • The law on energy efficiency in the Federation of B&H (Federal official Gazette, 22/17); • The law on construction in the Republika Srpska; • The Regulation of the minimum energy efficiency of buildings in the Federation of B&H and Republika Srpska; • The Regulation of minimum of energy performance of buildings in Republika Srpska (2015); • The Regulation of minimum of energy performance of buildings in Federation of B&H currently is in the adoption procedure. 	<ul style="list-style-type: none"> • The Law on efficient use of energy (official Gazette of Montenegro, 57/14); • Guidelines for energy efficiency certification of buildings (official Gazette of Montenegro 75/15); • Guidelines for energy audits of buildings (official Gazette of Montenegro 75/15); • Secondary regulation for EPBD implementation: five rulebooks are adopted in 2013 and updated in 2015. 	<ul style="list-style-type: none"> • The Law on Energy dated 2011; • The Law on Construction; • The Law on spatial and urban planning; • Rulebook on energy audits 2013; • Rulebook for energy characteristics of buildings 2013; • Rulebook for information; • System for monitoring and management of energy consumption at legal entities in public sector 2015; • Energy efficiency strategy for 2010-2020. 	<ul style="list-style-type: none"> • The law on planning and construction (No. 72/2009, 81/2009, 145/2014); • Rulebook on energy performance of buildings (No. 61/2011); • Rulebook on conditions, contents and manner of issuing certificates on energy performance of buildings (No. 69/2012); • Energy certification of buildings (2012), mandatory.

<p>Performance-based requirements</p>	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system (mainly in the non-residential sector) • Design position and orientation of buildings • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Thermal bridge • No use of IPMVP • No mandatory requirement to assess post-construction requirement of the thermal bridge • No mandatory requirement for air tightness testing; • Performance-based requirements: energy efficient development systems • Values of the performance-based requirements: new buildings: 55 kwh/m2a, existing buildings: 80 kwh/m2a 	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system (mainly in the non-residential sector) • Design position and orientation of buildings • Indoor and outdoor climatic conditions • Thermal bridge • Energy use for heating, cooling, hot water, ventilation • Use of EN ISO or EN standards, other technical requirements following the adoption of the EU standards such as EPB from 2017 (EN ISO 52000) • Use of IPMVP 	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Design position and orientation of buildings • Thermal bridges • Electricity for the pumps and fans and Electricity for appliances and equipment • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Energy use for heating, cooling, hot water, lighting, ventilation. • Software used for compliance verification: ENSI, Knauf, etc. • Performance-based requirements for buildings do not exist at this moment. • Total primary energy use 	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Design position and orientation of buildings • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Thermal bridge • Energy use for heating, cooling, hot water • No software used for compliance verification • The national classification of buildings for the needs of energy audits includes: residential sector min "C class" 100 kWh/m2 annual consumption, public sector min "C class" 150 kWh/m2 annual consumption. Mandatory for public sector min "D class" after substantial refurbishment 	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Design position and orientation of buildings • Thermal bridges • No software used for compliance verification • The energy class of the new building shall not be lower than class "C" or higher. The class of energy consumption of existing buildings should be upgraded to at least one class after reconstruction.
<p>Prescriptive requirements</p>	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Specified thermal comfort levels for winter and summer • Solar gains (G-values) • Air-tightness • Ventilation or air quality • Ventilation for summer 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Solar gains (G-values) • Air-tightness • Ventilation or air quality • External solar protections • Thermal bridge • The U values for external walls, 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Air-tightness • Ventilation or air quality • External solar protections • Artificial lighting system, lighting density • Boiler/AC system 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Air-tightness • Solar gains (G-values) • Ventilation or air quality • External solar protections • Daylighting requirements • Boiler/AC system 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Specified thermal comfort levels for winter and summer • Solar gains (G-values) • Air-tightness • Ventilation or air quality • External solar protections

	<p>comfort</p> <ul style="list-style-type: none"> • Daylighting requirements • Artificial lighting system, lighting density • Boiler/AC system • Renewables 	<p>floor, roof and windows depends of designed temperature of buildings and climatic zone.</p> <ul style="list-style-type: none"> • Partial use of individual energy metering and control units 	<ul style="list-style-type: none"> • Renewables • Thermal bridges 	<ul style="list-style-type: none"> • Renewables • Thermal bridge 	<ul style="list-style-type: none"> • Periodic transmittance and time lag of walls and roof • Solar absorbance of external surfaces (e.g. cool paintings for roofs and streets) • Daylighting requirements • Thermal bridges • No requirement for use of individual energy metering and control units
--	---	--	---	--	---

EASTERN EUROPE AND THE RUSSIAN FEDERATION

Framework legislation and policy documents

The law of the Republic of **Belarus** “On Energy Saving” (adopted in 2015) is the fundamental legal act that regulates relations in the field of energy savings and energy efficiency in Belarus. This includes setting indicators in the field of energy saving, conducting energy audits, setting norms for the consumption of fuel and energy resources as well as technical regulation, standardization, assessment and implementation of energy savings programs.

The Resolution of the Council of Ministers on Comprehensive Programme for the Design, Construction and Reconstruction of Energy-Efficient Houses for 2009-2010 and until 2020 was adopted in 2009. It specifies that systems for heat recovery from the ventilation of buildings should be installed in all newly constructed buildings by 2020. It also included a comprehensive programme, which specified that at least 60 per cent of the total constructed housing stock in Belarus shall be built in energy efficiency way from 2015 onwards. The Decree of the President dated 2019 “On Improving Energy Efficiency of Multi-Apartment Residential Buildings” provides for creation of conditions for attracting a wide range of funding sources, including funds of homeowners, local budgets, other sources, including international financial organizations, for the purpose of thermal modernization of apartment buildings. The conceptual goal of the Decree is voluntary involvement of owners of residential and non-residential premises, members of developers' organizations in the processes of improving energy efficiency of housing and creating conditions for participation of the citizens and legal entities in the implementation of measures aimed at the efficient and rational use of thermal energy. The Decree provides an opportunity for residents to carry out thermal modernization of a residential building with payment by instalments during up to 10 years and up to 50 per cent state subsidy.

The Law No. 139 on Energy Efficiency in the **Republic of Moldova** is in accordance with Directive 2012/27/EU and Directive 2009/125/EC. It aims to create the legal framework necessary to promote and improve energy efficiency through implementation of energy efficiency action plans, and development of energy services market.

The Law on Dwellings (No.75 adopted in 2015) has specific provision related to energy performance of buildings with reference to ventilation, cooling and lighting of the legislation. The targets related to energy efficiency in the Energy Strategy of the Republic of Moldova until 2030 (regulation No.102 of 2013) included rehabilitation of 10 per cent of public building stock and reduction of energy consumption of buildings by 20 per cent from the 2009 level.

The National Energy Efficiency Program (NEEP) was adopted for a period of 2011-2020, and the National Energy Efficiency Action Plans (NEEAP) for 2013-2015, and 2016-2018. The most recent NEEAP 2019-2021 (G.D. No. 698 of 2019) aims to facilitate energy efficient retrofits of public buildings with cumulative savings of 58 ktoe by end of 2021 and energy efficient retrofits of multi-apartment residential buildings, in frame of a separate programme by the end of 2021 with average annual savings of 83,6 ktoe (cumulative savings of 193,6 ktoe by the end of 2021) The NEEP and NEEAPs were designed in accordance with the country's commitments under the Energy Community Treaty. National Programme on Energy Efficiency 2011-2020 aimed a reduction of 20 per cent of the overall primary energy consumption by 2020 compared to 2009 levels.

The law on energy labelling of energy-related products (Law No. 44 as of 2014) is being supported by the Regulation 1003/2014, which establishes a set of labelling requirements for household tumble driers, air conditioners, domestic ovens and range hoods, electrical lamps and luminaries, household washing machines, household dishwashers, household refrigerating

appliances and TV sets. The law on eco-design requirements applicable for energy-related products (Law No. 151 as of 2016) is being supported by the Regulation 750/2016 which establishes requirements for equipments, such as household dishwashers and air conditioners. The law on Energy Performance of Buildings (Law No. 128 adopted in 2014) includes timeline for nearly zero-energy buildings (after June 2019 for new public buildings and after June 2021 for all new buildings).

The law on energy savings (adopted in July 1994) in **Ukraine** established the grounds for energy savings in the country. The NEEAP (adopted in 2015) specified the target of energy savings of 9 per cent in 2020 (compared with average domestic final consumption during 2005-2009). Later the NEEAP was adjusted, and new energy efficiency targets were adopted in accordance with the Article 3 of EU Energy Efficiency Directive (in 2020 primary and final energy consumption in Ukraine should not exceed respectively 101.316 mln toe and 55.507 mln toe).³

The energy saving measures for residential sector under the NEEAP included energy audits and certification schemes, energy labelling, renovation of buildings, financial support for households and establishment of the Energy Efficiency Fund. The law on energy efficiency in buildings (adopted in June 2017) is in line with the EU Directive 2010/31/EU on energy performance of buildings.

The minimum energy performance standards and labelling for household refrigerators, freezers in Ukraine have been enacted in line with the European Commission Eco-design Regulation 643/2009. The draft order on approval of requirements for nearly-zero energy buildings is under consideration by the government. The draft national energy efficiency targets and NEEAP till 2030 are submitted to the government as of January 2021. This draft Government Order has been elaborated by the State Agency on Energy Efficiency and Energy Saving of Ukraine in cooperation with international experts, specialists from the Energy Community Secretariat. Proposed targets are set according to the Energy Efficiency Directive approach and the EU implementation for the year 2030 – the primary energy consumption should not exceed 91 468 thousand tonnes in 2030; the final energy consumption is 50 446 thousand tonnes of oil equivalent.

In 2013, the Ministry of Energy of the **Russian Federation** developed the State Programme on Energy Efficiency and Energy Sector Development for the 2013-2020 period. Under this programme, there is a sub-programme for energy savings and energy efficiency improvement targets. The Law on Energy Conservation and Increase of Energy Efficiency (2011) established the mandatory energy labelling scheme. The Federal Program for Energy Savings and Energy Efficiency for the period until 2020 allocates 9.5 trillion Rubbles to regional energy savings programs, with a goal to reduce the energy intensity of the country's GDP by 13.5 per cent by 2020, while also establishing government guarantees for certain projects (IEA, 2020). The Energy Conservation and Energy Efficiency Increase law of 2009 includes regulations for building energy efficiency standards, energy audits, and energy services contracts.

Building energy codes

The energy consumption parameters defined in **Belarus** for space heating in new buildings are of maximum limit of 60 kWh/m² (with natural ventilation) or 40 kWh/m² (with mechanical insulation). A comprehensive programme for design, construction and renovation of energy-efficient buildings was developed by the government in 2009 to reduce the energy used for space heating and ventilation to the levels defined above.

³ <https://zakon.rada.gov.ua/laws/show/1228-2015-%D1%80#Text>

In terms of specific energy consumption for heating and ventilation during the heating period, multi-storeyed residential buildings should consume 30-48 kWh/m²/year, thus, corresponding to energy efficiency class B. The norm for residential buildings without heat recovery in ventilation is 96 kWh/m²a if the building has 1-3 storeys, and 48 kWh/m²a if the building has 12 and more storeys. Achievement of A and A + classes is possible only with use of a forced ventilation system in the building with the recovery of thermal energy from the air removed from the buildings. For individual residential houses it is 108 kWh/m²a; for kindergartens is 38 kWh/m²a; for schools is 37 kWh/m²a; for clinics and hospitals is 35 kWh/m²a; for administrative (public) buildings is 36 kWh/m²a (ARCEE, 2013).

The categorization of residential and public buildings depends on the annual consumption in accordance with the norms and standards as A+ (very high energy efficiency), A, B, C, D, E and F (very low energy efficiency). For buildings in class “D”, the activities for heat loss reduction are recommended to implement. The recommended measure for class “E” is modernization of engineering equipment in the building, whereas class “G” needs to undergo modernization of engineering equipment as well as thermal insulation. The mandatory performance requirements of the building envelopes are defined in the “Construction norms CH 2.04.02-2020 Buildings and structures. Energy Efficiency”. (UNECE, 2018).

The construction norms and standards in the **Republic of Moldova** are mostly dated back to the Soviet times. The Ministry of Regional Development and Construction was working on a roadmap to update the building codes. The introduction of minimum energy performance requirements is expected to bring more than 30 per cent savings. Under the National Energy Efficiency Programme, constructions subject to major renovation (25 per cent of the value or area of the building envelope) need to adhere to the new minimum requirements (PNNL, 2018).

The Law on energy performance of buildings in Moldova (adopted July 2014) is in accordance with the Directive 2010/31/EC. Buildings are classified into classes from “A” (outstanding) to “G” with mixed strictness (both voluntary and mandatory). Moreover, all new buildings after 2012 must be NZEB - the buildings with a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources produced on-site or nearby.

Ukraine has updated and strengthened its building energy code (DBN) V.2.6-31 “Thermal insulation of buildings” (PNNL, 2018). These codes apply to new and existing (after substantial refurbishment) non-residential and residential buildings which include single family houses, apartment blocks and public buildings. The strictness is mixed (both voluntary and mandatory). The classification is done as class “A” to “G”, and these standards exist since 2017. Furthermore, there exists a mandatory requirement to assess post-construction requirement of the thermal bridge (UNECE, 2018).

In 2020, the Concept of the state policy in energy efficiency of buildings was adopted.⁴ This document approved the National Plan for NZEB with a target that all new buildings should be NZEB after 2028.

50 regions of the **Russian Federation** implemented their own building codes in accordance with federal building standards between 1995 to 2004. These regions established their own requirements for calculating a buildings energy consumption and compliance with local code. Local enforcement agencies mandated auditing and some offered incentives for exemplary performance. The Russian Federation has an extensive classification of the building energy codes (A++, A+, A, B+, B, C+, C, C-, D, E). These codes apply to new and existing (after substantial refurbishment) non-residential and residential buildings, which include single

⁴ <https://zakon.rada.gov.ua/laws/show/88-2020-%D1%80#n172>

family houses, apartment blocks, commercial and public buildings. The strictness is mixed (both voluntary and mandatory). There is also a mandatory requirement to assess post-construction requirement of the thermal bridge along with the use of International Performance Measurement and Verification Protocol (IPMVP).

The Federal Law on Energy Efficiency of the Russian Federation established requirements to update building codes on energy efficiency standards for new buildings at least once every five years. The law also introduced mandatory labeling of buildings and established a target for reducing energy consumption in public buildings annually by 3 per cent. The Ministry for Regional Development establishes and specifies requirements for the construction sector, building technologies and materials. It also required reduction of energy consumption in new buildings by at least 15 per cent in 2011-2015, by 30 per cent in 2016-2019, and by 40 per cent from 2020 (SWP, 2013).

Energy performance certification

There is no system of energy performance certification (EPC) in **Belarus** and hence no national registry database for EPC. However, there is a system of classification of buildings by an indicator of specific consumption of thermal energy on heating and ventilation.

The Resolution No. 216 of the Council of Ministers (2016) approves the procedure for organizing and conducting energy surveys (energy audits) mandatory for legal entities with an annual consumption of fuel and energy resources of 1.5 thousand tons of fuel equivalent and more. Energy certification is obligatory in the design development and commissioning stage and optional in the maintenance stage of buildings.

The law on energy performance of buildings in the **Republic of Moldova** is the main legislative document related to EPC. Regulation on the procedure for certification of the energy performance of buildings and of building units (Government Decision No. 896/2016) introduced the EU standards. The relevant documents include CP E.04.05-2006 Design of thermal protection for buildings; CP E.04.02-2003 Technical implementation rules for exterior/interior thermal insulation of buildings; CP E.04.02-2003 Technical implementation rules for exterior/interior thermal insulation of buildings with fine plaster on insulation; CP G.04.02-2003 Regulation on energy audits of existing buildings and the heating and domestic hot water. NCM M.01.02:2016 on Energy Performance of Buildings, Methodology for calculation of the Energy Performance of Buildings presents the methodology and conversion factors for energy units for calculation of the energy performance of buildings.

The regulation GD 884 officially introduced energy audit from 2012. This regulation sets the requirements with regards to minimum criteria and provides a list of energy efficiency indicators. Earlier (in 2003), a normative document on the regulation on energy audits of existing buildings and the heating and domestic hot water, provided a basis for conducting energy audit of existing buildings.

The energy performance certification in **Ukraine** is under development. Under the projects on energy efficiency over 50 municipalities in Ukraine were part of a benchmarking system for energy performance of buildings. This comprised a dataset of 2000 municipal buildings and compared the energy performance, allowing each municipality to better plan and prioritize renovation activities (UNEP, 2019). Ukraine adopted the Law on Energy Performance of Buildings implementing EU EBPD. EPC is mandatory for the specific buildings.

A mandatory EPC exists in the **Russian Federation** and covers the existing apartment blocks, commercial and public buildings as well as new residential buildings. A national registry database exists for the energy performance certification.

Energy pricing measures

In **Belarus**, the Council of Ministers sets the energy tariffs for residential users, while the Ministry of Antimonopoly Regulation and Trade sets it for industrial users. The Ministry of Antimonopoly Regulation and Trade is responsible for the state policy in the sphere of antimonopoly activities and competition fostering, tariff policy, regulates the prices (tariffs) for goods (works, services) within its competence. The tariffs are set region-wise. The energy tariff rates depend on the type of consumer and the time and period of use (day/night and heating/non-heating season).

Household consumers in **Ukraine** prior to 2015 paid only 12 per cent of the cost recovery prices for natural gas. There was an increase in energy prices to cost-recovery levels in Ukraine to promote energy efficiency. In the second quarter of 2015, natural gas prices for households and district heating tariffs increased on average 285 per cent and 67 per cent, respectively. The increased prices created strong incentives for consumers to use energy more efficiently. As a result, it led to two third reduction in household's natural gas consumption in 2014-2015. An expanded social security safety net system was rolled out for low-income households to protect them from the increased energy prices (PNNL, 2018). A few price increases has happened since then. Since 2020, all utility subsidies for low-income householded are monetized.

In 2020, the price of natural gas was equivalent to 0.012 USD per kWh for households and 0.016 USD per kWh for businesses. These rates include taxes, fees and other components of the gas bill. For households, the price was calculated using 30,000 kWh annual consumption. For businesses, the rate was based on consumption of 1,000,000 kWh per year (GPP portal).

Promotion of ESCO

Energy service companies (ESCOs) do not exist in **Belarus** at present, but recently a number of steps have been taken in the country to create favourable conditions for development of energy service activities. In 2018-2019, the EU4Energy Governance Programme, jointly with the Department for Energy Efficiency of the State Standardization Committee and other stakeholders, carried out the study on support to development of legislative and regulatory basis for providing energy efficiency services. It included the revision of existing legal framework, the situation with the provision of energy services and the activities of energy service companies. In December 2020, the Department for Energy Efficiency of the State Standardization Committee submitted to the Government of the Republic of Belarus a draft resolution of the Council of Ministers of the Republic of Belarus "On Approval of the Concept of Development of Energy Service Activities in the Republic of Belarus". The purpose of the concept is to create conditions for the development of energy service activities in Belarus. This concept analyses the main global trends in the development of energy service activities as well as the specifics of the formation and development of energy service activities in Belarus, mechanisms and tools for its implementation, taking into account the national legislation. It also includes assessment of the energy service market for the near future and the Plan for amending the existing regulatory legal acts to ensure the development of energy service activities.

The Law on Energy Efficiency in the **Republic of Moldova** provided basic conditions to promote ESCO. The NEEAP for the period of 2019-2021 also provides basic conditions to promote ESCO and energy performance contracts.

However, the existing policy, legal, regulatory, awareness and information barriers influenced the situation and prevented the ESCO market from its development. ESCOs either provide energy audit services or offer audits and technical solution for a fee. These companies do not provide both technical and financial solution, and there is limited experience with energy

performance contracts. Energy service providers frequently do not enter into public-private partnership with the municipal sector due to their limited payment ability.

Over the past few years there have been significant developments with regards to ESCO market in **Ukraine**. Two laws were adopted (i) on the introduction of new investment opportunities, guaranteeing the rights and legal interests of business entities for large-scale energy modernization No. 327-VIII dated April 9, 2015; and (ii) on introduction of the changes to the Budget Code of Ukraine regarding new investment opportunities, guaranteeing the rights and legal interests of business entities for large-scale energy modernization No. 328-VIII dated April 9, 2015. They set the legal framework for ESCO and defined the procurement procedures and assessment criteria for buildings retrofits. The EU has provided funds for training experts on energy services contracting. In 2016, the government launched a large-scale promotion campaign for ESCO. The first ESCO contract in the public sector was signed in 2016 too (PNNL, 2018).

Energy efficiency retrofits for buildings by ESCO under the energy performance contracts were also introduced in Ukraine in 2016. The first 20 energy performance contracts were concluded in five regions of country. Currently, the energy performance contracts are applicable mostly for public buildings. As of January 2021, more than 1251 tender procedures have been started; about 550 energy performance contracts have been signed with a total price up to 1.25 billion UAH (equivalent to 44.8 million USD).

There are almost no state measures in the **Russian Federation** supporting the commercial ESCO sector. Financing of projects is done through direct loans to customers, ESCO's own funds, or the customers themselves. The provision for direct loan financing for energy efficiency projects of ESCOs is rare (FNC, 2012). A limited number of energy service companies and regional centres for energy efficiency exist in the country. The Russian Energy Agency is involved in supporting the implementation of energy service projects as well as in selection and preparation of energy service projects in various regions.

Awareness programmes

Public awareness on energy efficiency in **Belarus** is relatively high, as information is regularly shared through media campaigns, information sessions, publications, international and national exhibitions, forums and conferences educational seminars and other information dissemination approaches (IEA, 2015). There are permanent exhibitions in numerous cities and educational institutions dedicated to energy savings in Belarus. Moreover, there are educational programmes such as competitions, energy marathons in schools and courses dedicated to energy efficient technologies, energy savings and energy management in higher educational institutes (ECSa, 2013).

The annual national competition "Energomarathon" held in Belarus is aimed at attracting wide public attention to energy conservation issues, fostering a culture of energy consumption, developing the skills of rational energy consumption and respect for the environment in school and college students. More than 3.5 thousand students from more than 500 different educational institutions (preschool educational institutions, secondary educational institutions, vocational schools) from all over the republic participate in the competition annually.⁵

Numerous awareness programmes related to energy services and energy performance of buildings are a part of the NEEAP for the period of 2019-2021 in the **Republic of Moldova**. This includes conducting training courses for energy management systems, energy auditors,

⁵ As indicated by government sources

inspectors and evaluators; publishing articles and brochures on energy services, regular inspection of heating and air conditioning systems, energy performance for end-users.

The government of **Ukraine** launched a website to inform households and public utilities about energy prices, energy subsidies and best practices in energy efficiency (PNNL, 2018).

Table 2. Overview of Building Energy Codes in Eastern Europe and in the Russian Federation

	Belarus	Republic of Moldova	Ukraine	Russian Federation
Coverage	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings 	<ul style="list-style-type: none"> • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Public buildings 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • existing non-residential • Single family houses • Apartment blocks • Public buildings: hotels, trade enterprises, buildings and facilities of educational institutions, pre-school institutions, health care institutions 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family • Apartment blocks • Commercial buildings • Public buildings
Strictness	<ul style="list-style-type: none"> • Mandatory • There is a power classification of buildings by consumption of thermal energy on heating and ventilation, classes G - A+. • An indicator for reference to a certain class - specific annual consumption of thermal energy on heating and ventilation • It is not allowed to design new buildings if the requirements for buildings do not correspond to classes A +, A or B. • Types of energy considered in building codes and regulations: use of energy for heating 	<ul style="list-style-type: none"> • Mixed: both voluntary and mandatory) • Types of energy considered in building codes and regulations: energy use for heating, cooling, hot water, lighting, ventilation. • Law on energy performance of buildings (2014) transposes the Directive 2010/31/EC. Energy class – system of measurement from "A" to "G" for specifying of energy efficiency of the building. In case of classification of buildings with very outstanding energy performance, the class "A" can be subdivided into sub-classes. 	<ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • National classification of buildings covered in building energy codes: A, B, C, D, E, F and G. • Types of energy considered in building codes and regulations: energy use for heating, cooling, hot water, ventilation. Total primary energy use. 	<ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • National classification of buildings covered in building energy code: A++, A+, A, B+, B, C+, C, C-, D, E. • Types of energy considered in building codes and regulations: energy use for heating, cooling, hot water, lighting, ventilation. Total primary energy use
Main regulatory documents	<ul style="list-style-type: none"> • The Building Code: “Repair, renovation and restoration of residential and public buildings and facilities” (NBS 1.04.02-02), dated September 2002; • The Technical Code of Applied Practice 45-2.04-196.2010 (02250) “Thermal protection of buildings; • The Technical Code of Applied Practice No. 45- 2.04-43-2006 (02250) “Thermal Engineering Building design standards.” 	<ul style="list-style-type: none"> • Law on Energy Performance of Buildings (2014); • Law on energy efficiency nr 140 from 2012; transposes Directive 32/2010 on energy performance of the buildings; • Building Code (NCM M.01.04: 2016) "Methodology for calculating cost-optimal levels, minimum energy performance requirements for buildings and their components" (heating component and domestic hot water preparation); • NCM E.04.03-2008 Energy conservation in building. 	<ul style="list-style-type: none"> • DBN.2.6-31 (state building codes) dated 2006; the document concerns buildings; • DSTU B A.2.2-8 (state standards of Ukraine) dated 2010; the document concerns engineering systems. 	<ul style="list-style-type: none"> • Federal law No. 261-FZ “On energy saving and energy efficiency improvement” – 23.11.2009; • GOST R 56828.18-2017 GOST R 51388-99 Energy Saving; • Government resolution No. 18 of 25 January 2011; • Government resolution No. 452 of 16 May 2014.

Performance-based requirements	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Design position and orientation of buildings • Passive solar systems & solar protection • Indoor and outdoor climatic conditions • Thermal bridge • Mechanical and natural ventilation • Air-conditioning system(s) • Built-in lighting system (mainly in the non-residential sector) • Partial set of CEN EPB standards, a subset of ISO standards EPB • No software for compliance checking • Technical Code on Thermal protection of buildings defines norms for annual consumption of heat for different types of buildings. 	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system (mainly in the non-residential sector) • Design position and orientation of buildings • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Thermal bridge • Full set of CEN EPB standards • Energy efficient development systems <p>Details/values of the performance-based requirements: After year 2021, all new buildings must be NZEB Class A = 50 kWh/m²a; B=99 kWh/m²a.</p>	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system (mainly in the non-residential sector) • Design position and orientation of buildings • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Thermal bridge • Use of Energy Performance in Buildings (EPB) standards (2017) • No software used for compliance verification: No • Mandatory requirement to assess post-construction requirement of the thermal bridge 	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system • Design position and orientation of buildings • Indoor and outdoor climatic conditions • Thermal bridge • Use of IPMVP • Software used for compliance verification • Mandatory requirement to assess post-construction requirement of the thermal bridge
Prescriptive requirements	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Specified thermal comfort levels for winter and summer • Air-tightness • Ventilation or air quality • The requirements for daylight • Artificial lighting system, lighting density • Thermal bridges • Solar gains (G-values) • Buildings mandatory equipment with individual energy metering and control units 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Specified thermal comfort levels for winter and summer • Ventilation or air quality • Boiler/AC system • Renewables • buildings partial equipment with individual energy metering and control units (approximate share of equipped buildings in the country) • The main legislative documents relating to EPC: Law Nr. 128 of 11.07.2014 on Energy performance of the buildings 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Specified thermal comfort levels for winter and summer • Solar gains (G-values) • Air-tightness • Ventilation or air quality • External solar protections • Solar absorbance of external surfaces • Artificial lighting system, lighting density • Boiler/AC system • Renewables • Thermal bridges 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Air-tightness • Ventilation or air quality • Daylighting requirements • Artificial lighting system, lighting density • Boiler/AC system • Specified thermal comfort levels for summer • Solar gains (G-values) • Thermal bridge • Buildings mandatory equipment with individual energy metering and control units

THE CAUCASUS

Framework legislation and policy documents

The law on energy saving and renewable energy (adopted in 2004; with amendments in 2016 and 2017) was the initial law that specified the principles and mechanisms for implementation of national policy on energy conservation in **Armenia**. The European Neighbourhood Policy action plan was approved two years later in 2006 and, supported the harmonization of Armenian legislation, norms and standards. Energy efficiency standards in accordance with the EU criteria were transposed, the revision of the Building Code and the transposition of the EU Energy Performance in Buildings Directive was made through a national Technical Regulation on Building Energy Efficiency. In 2007, the National Programme on Energy Saving and Renewable Energy was adopted and set specific targets for improvement of energy efficiency in buildings. The implementation of the National Programme was done through the NEEAP, which specified steps to meet the goals of the programme as well as monitor the performance. The NEEAPs were implemented in three stages from 2011-2013, 2014-2016 and 2017-2020. The assessment of the first NEEAP (2010-2013) in 2014 presented a success with the target of 3.3 per cent reduction in baseline energy consumption of 2010 being outperformed and higher savings achieved than targeted (8.6 per cent overall energy saving compared to baseline energy consumption of 2010). The action plan included capacity buildings programs, financial assistance to energy efficiency measures, introduction of regular energy statistics among others. The National Energy Security Concept (adopted in 2013) emphasized on investments in building energy efficiency by state and public investors. In 2018, the Government of Armenia introduced a resolution on “Establishing technical regulations on energy saving and energy efficiency in new residential apartment buildings, as well as in facilities under construction (reconstructed) at the expense of state funds”, which came into force in October 2019.

The energy efficiency legislation in **Azerbaijan** is not developed. Most national programmes that directly or indirectly involve energy efficiency improvements were launched before 2010. The law on the Use of Energy Resources (adopted in 1996) introduced the basic elements for the promotion of energy efficiency. This law, however, did not specify the implementation of the proposed energy efficiency policy. Furthermore, the lack of supporting regulations is one of the reasons for low adoption of energy efficiency measures. Further developments in terms of strategy, action plans and legislation are needed in Azerbaijan.

The energy legislation which includes energy efficiency doesn't specify clear targets, the NEEAPs are also not adopted. The State Programme of Technical Regulation, Standardization and Conformity Assessment System Development aims to improve energy efficiency, obtain energy savings, improve the environment and resource efficiency and develop national standards on the basis of regional standards.

The Ministry of Energy of the Republic of Azerbaijan with the assistance of EU4Energy Programme, developed a draft law on Energy Savings and Energy Efficiency in 2017. This draft law includes several energy efficiency measures and provisions, such as setting up energy auditing, energy management, energy efficiency in buildings, energy efficiency services, efficiency in production, transmission and distribution etc. The draft law was under consideration by relevant government authorities as of 2019.

Since 2019, within the framework of the EU4Energy programme, the development of the NEEAP has been started. In addition, a draft review of Azerbaijan's energy efficiency policy was made by the Energy Charter. Currently, the development of secondary legislative acts is being discussed with international organisations (MoE Azerbaijan website).

On 21 May 2020, **Georgia** adopted the law on Energy Efficiency in accordance with the Energy Efficiency Directive 2012/27/EU, and the law on Energy Efficiency of Buildings in accordance with Energy Performance of Buildings Directive 2010/31/EU. The NEEAP for the period of 2019-2020, developed by the Ministry of Economy and Sustainable Development, includes the activities to be carried out to achieve the national energy efficiency targets. The law on energy efficiency of buildings not only aims to improve the energy efficiency of buildings but also promotes reasonable use of energy resources. The minimum energy efficiency requirement for both existing and new buildings is under development by the Government and is expected to be completed by June 2021. The details of the requirement for the energy efficiency of heating systems, hot water supply, air conditioning and ventilation will be determined by the Government under this law. Regular inspection of heating and air conditioning systems in buildings are obliged under the legislation (“detailed instructions for the inspection will be determined by the Government”). Moreover, the Government aims to adopt rules of certification of energy efficiency in buildings. These certificates will be necessary for new and existing buildings if they are being sold or leased. The Energy Strategy for 2020-2030 (finalized in 2019) includes a section dedicated to energy efficiency.

The law on Energy Labelling (adopted in 2019) is in accordance with the 2010/30/EU Directive and the Regulation (EU) 2017/1369, and aims to provide standard and additional information on energy consumption indicators of the product placed on the Georgian market and/or put into operation in Georgia, as well as standard information and additional information on the product, which will allow consumers to further reduce energy and other resource consumption. Additionally, the purpose of this law is to ensure compliance of the energy consumer product placed on the Georgian market and/or put into operation in Georgia with the requirements defined by this Law and other relevant technical regulations. The Energy and Climate Integrated Plan is being drafted, which will set the targets for 2030 in five dimensions, such as energy efficiency, energy security and internal energy market, decarbonization, research, innovation and competitiveness to achieve the committed targets.⁶

Moreover, the Georgian Space Planning Architectural and Construction Activity Code (enacted in 2019) includes a general article No 87 on Building’s Energy Efficiency.

Overall, the basic framework legislation for energy efficiency exists in the Caucasus region. Armenia and, most recently, Georgia adopted laws on energy efficiency, whereas in Azerbaijan a draft law is under consideration. NEEAPs have been developed in Armenia and Georgia. Information on the adoption of NEEAP in Azerbaijan is not available. Overall, NEEAP is a requirement for Georgia under their Energy Community obligations but is voluntary for both Armenia and Azerbaijan.

Building energy codes

Armenia joined the international standard system on thermal performance of buildings in 2004, which took into account the requirements of the EU-relevant documents. In 2016, Armenia introduced a mandatory building energy code with the adoption of a new regulation on thermal protection of buildings (RACN 24-01-2016), which was developed based on the Building Energy Code of the Russian Federation from 2003 (updated in 2012) with application of some methodologies and approaches of the EU standards, such as EN 15217:2007; EN15316-1:2007; EN15603-1:2007; ISO 16818:2008; and ISO 23045-2008. It linked building envelope components and heat losses with established energy limits, considering differences in climatic conditions. It also included a requirement for issuing a building energy passport and energy efficiency label with energy efficiency classes. It also includes a requirement for issuing

⁶ As indicated by government sources

a building energy passport and an energy efficiency label/certificate with defined energy efficiency classes.

The following building codes are currently into force in Armenia: (i) EE building Code - "Thermal Protection of Buildings" 24-01-2016 RACN; (ii) RACN II-7.02-95 "Construction thermophysics of building envelope"; (iii) RACN II-7.01-2011 "Construction Climatology."

Furthermore, the construction norms on "Artificial and Natural Lighting" RACN 22-03-2017 have been adopted in 2017, which enforce mandatory requirements for buildings and structures of various purposes (as well as outdoor working sites, outdoor sites of industrial and agricultural organizations, railroads within the working sites, outdoor/street lighting of cities and urban and rural settlements, design, reconstruction, capital renovation and operation of road tunnels).

The general design and reporting requirements for building envelopes are specified in **Azerbaijan**, however, there are no minimum energy performance requirements for buildings. The law on the Use of Energy Resources, once adopted, will require the implementation of the following policy instruments in line with the EU standards: (i) minimum energy performance requirements for new and renovated buildings; (ii) energy performance certification scheme; (iii) compulsory energy audit and designating energy managers for buildings (except residential) with a total construction area of more than 10.000 square metres.

In **Georgia**, there are no effective mandatory or indicative energy efficiency standards in the building codes. The codes dating back to the Soviet times for the thermal engineering of buildings are implemented on a voluntary basis. In 2013, the Government began the procedure of setting up a working group to develop medium- and long-term energy strategy. The Ministry of Economy and Sustainable Development is developing codes for the structural design of buildings (Eurocodes) in cooperation with GIZ (German International Cooperation Agency) and IBC (being translated by USAID, EPI project). At the same time, the Ministry is working on the implementation of the Eurocodes. The Spatial Planning and Construction Code, which is being developed, also reflects on construction as a built-in environment. No effective mandatory energy efficiency standards in the building code exist in Georgia, and therefore, housing stock in the country is a major source of excessive energy losses.

Energy performance certification

Energy efficiency standards and labelling framework for buildings sector technology has made significant progress in **Armenia**, but some gaps remain. Under the EU4Energy programme, a detailed report with recommendations to accelerate the adoption of the minimum energy performance standards and labels for five priority product groups was submitted in 2018. Armenia is expected to commence implementing standards for a range of energy-using technology from 2021, as part of its Eurasian Economic Union membership.

The law on the Use of Energy Resources (adopted in 1996) in **Azerbaijan**, included mandatory state certification of energy-intensive equipment (both new and in operation). The documents used in Azerbaijan as a normative base for solving issues of energy performance certification of buildings include: (i) EN 15217: Energy performance of buildings - Methods for expressing energy performance and for energy certification of buildings, 2005; (ii) Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the Energy Performance of Buildings (recast); (iii) SNIP 23-02-2003 "Thermal performance of the buildings", Moscow, 2012; (iv) EN ISO 13790: Energy performance of buildings – Calculation of energy use for space heating and cooling; (v) EN 16247:2014 European Standard Energy audits - Part 2: Buildings. European Committee for Standardization (Akbarova, 2018).

The draft law on energy efficiency stipulates the development of minimum energy performance requirements for new or renovated buildings in Azerbaijan, which currently doesn't exist. Official statistical data on energy performance of buildings is absent. The Energy Charter Secretariat proposed to estimate energy consumption in the buildings sector based on available data for the residential and service sectors, as together they cover the energy consumption of buildings, including heating, cooling and appliances (ECS, 2019).

The law on energy efficiency in buildings in **Georgia** creates a legal basis for the introduction of a mandatory system to issue Energy Performance Certifications (EPCs) for buildings. This law requires the adoption of the national methodology for calculating the energy performance of buildings and the establishment of minimum energy performance requirements for buildings or building units and building elements before June 30, 2021. Currently, both normative acts are being developed. According to this law, the EPC will be mandatory for new buildings or new building units in (i) existing buildings that are sold or rented/leased; (ii) existing building units that are sold or rented/leased; (iii) buildings with total useful area more than 500m² that are occupied by public authority and frequently visited by the public. From 2026, the threshold of 500 m² will be lowered to 250 m².

Energy pricing measures

The energy pricing falls under the purview of various ministries and agencies in the countries. In **Armenia**, the Public Services Regulatory Commission is the regulatory body for tariffs (electricity, thermal energy and natural gas). The tariffs have increased by 94-112 per cent for electricity and 250 per cent for natural gas within the period of 2007-2017. According to the GIZ report, households spent an average of 20 per cent of their total expenditure on tariffs for electricity, heating and hot water and in some cases reaches up to 50 per cent for low-income households during winter months (GIZ, 2019). The relatively high level of household energy consumption – primarily in the form of natural gas – translates into significant end-user costs.

The electricity tariffs in **Azerbaijan** have remained relatively stable during the same period with only three major changes in tariff rates and structure. The Tariff Council is responsible for calculation and approval of energy tariffs, however after the adoption of the draft law on the regulator, the Energy Regulatory Agency will take this responsibility. The most recent changes include introduction of inclining block tariffs for residential consumers.

The **Georgian** National Energy and Water Supply Regulatory Commission sets tariffs for electricity and natural gas in Georgia. “Regulated tariffs are based on supply/distribution costs and approximately total 8-11 US cents/kWh depending on the voltage.” Georgia has introduced rigid step tariffs in 3 blocks (consumption up to 100 kWh, between 101 to 300 kWh and above 301 kWh) to promote the rational use of electricity and provide additional guarantees for social protection (C2E2, 2015).

Promotion of ESCO

Currently, **Armenia, Azerbaijan and Georgia** do not have a fully functional ESCO market and promotion activities related to ESCO are little to none. The Neighbourhood Investment Platform Initiative in Armenia aims to engage with the existing ESCOs in the country to provide on-site training in energy audits, engineering design and latest technologies for improvement of energy efficiency in buildings as well as measurement and verification of savings. Building-level solutions for systematic upgrading and retrofitting of buildings will be prioritized under the programme, and participation of local authorities as co-financiers is foreseen for multi-apartment buildings for socially vulnerable households.

Awareness programmes

There are numerous awareness programmes for energy efficiency in the Caucasus region. Training programmes under the Residential Energy Efficiency for Low Income Households project were used for raising awareness among households in **Armenia**. The project was successfully implemented, and a post training survey found 71 per cent of participants had initiated energy efficiency measures (IEA Armenia, 2020).

Additional donor efforts have addressed the project “Regulatory Framework to Promote Energy Efficiency in the Countries of Eurasian Economic Union” supported by the Russian Federation and UNDP which aims to harmonize standards and labelling regulations in countries of the Eurasian Economic Union.

However, there is no mandatory requirement to promote energy efficient products in Armenia. Green procurement is promoted through public awareness raising campaigns under the different projects or institutions. Despite the existence of an institutional mechanism to assure the control for implementation of such requirements, the obligatory requirements are not established in that framework. The topic of energy efficiency in buildings is not sufficiently covered in the curriculum of technical schools and universities.

In **Azerbaijan**, several activities to raise energy savings awareness have been implemented under the framework of INOGATE Programme in collaboration with Ministry of Industry and Energy. Moreover, training activities have been carried out by State Agency on Alternative and Renewable Energy Sources (IEA, 2015). INOGATE jointly with the Azerbaijan University of Architecture and Construction developed educational materials on energy efficiency in buildings.

Georgia has organized various activities related to awareness programmes of energy efficiency. The Energy Efficiency training week in Tbilisi was held in 2017 organized by the IEA, the Ministry of Energy of Georgia and the EU4Energy. USAID organized a seminar on energy efficient stove design techniques in 2008.

The Energy Strategy 2020-2030 finalized in October 2019, among its measure and initiatives, aims (i) to adopt rules for energy audits and energy management systems; (ii) raise the qualifications of energy auditors and service providers; and (iii) improve the level of knowledge and experience in energy efficiency among entrepreneurs working in industry and trade, as well as among final consumers of energy in government organisations.

The USAID-funded programme, New Applied Technology Efficiency and Lighting Initiative (NATELI), assisted the officials and representatives of educational and health-care institutions and residential buildings in getting knowledge on possible energy saving opportunities. Between 2009 and 2011, Winrock International (via NATELI) conducted energy audits and trained a group of auditors. Winrock is also operating the energy bus, which travels around Georgia showcasing small-scale energy efficiency equipment and building materials (C2E2, 2015).

Such initiative provides information on suppliers and financing options for energy efficiency and renewable energy projects. The Energy Efficiency Centre in Georgia also holds energy efficiency seminars for energy managers from various ministries and agencies to raise their awareness on cost-efficient and environmentally sound energy-saving technologies, including presenting case studies of energy audits of government buildings.

Table 3. Overview of Building Energy Codes in the Caucasus

	Armenia	Azerbaijan	Georgia
Coverage	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Commercial • Public buildings 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Apartment blocks • Commercial • Public buildings 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential <p>Except for the following buildings:</p> <ul style="list-style-type: none"> • Buildings with status of cultural heritage monuments, • Buildings used as places of worship/religious activities, • Temporary buildings with use of 2 years or less, • Industrial sites, • Workshops and non-residential agricultural buildings with low energy demand, • Stand-alone buildings with a total useful floor area of less than 50 m².
Strictness	<ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • The building stock is divided into five categories depending on their volume, significance, importance and complexity, as well as the safety of citizens and the environment. 1) low-risk objects: category I; 2) objects of medium risk: category II; 3) objects of medium risk: category III; 4) high-risk objects: category IV; 5) objects with the highest degree of risk: category V • Mandatory measures to ensure EE of buildings (at the expense of public funds) • Indicators for assessing EE and energy consumption in building codes have not yet established. • Energy use for: heating, cooling, hot water, lighting, ventilation. 	<ul style="list-style-type: none"> • Voluntary 	<ul style="list-style-type: none"> • Voluntary • Performance-based requirements in building energy codes: new buildings • Energy levels are considered in building codes • Energy use for: heating, cooling, hot water, lighting, ventilation. • Non-renewable primary energy use
Main regulatory documents	<ul style="list-style-type: none"> • Law on Standardization, AL-21-N (08.02.2012); • Law on Technical Regulation, AL-19-N (08.02.2012); • Energy Law, AI-148 (07.03.2001) (Amendments 2016, 2017); • Law on Energy Saving and Renewable Energy, AL-122 (2004) (Amendments 2016, 2017); • Energy Security Concept of the RA, 2013; • Second National Energy Efficiency Action Plan (02.02.2017); • Technical regulation on ES and EE in residential multi-apartment buildings under construction as well as in 	<ul style="list-style-type: none"> • A draft law “Efficient Use of Energy Resources and Energy Efficiency” is in the process of adoption with the support of Energy Charter • Adraft a law “Energy Efficiency in Buildings” is planned afterwards; • There is currently applied regulative document named as “Urban Planning and Building codes”; • Decree of the Cabinet of Ministries “The rules of increasing energy efficiency of construction facilities and economized use of energy resources” has been remaining in force since 2014. 	<ul style="list-style-type: none"> • The Law on Energy Efficiency of Buildings (21.05.2020) (in accordance with energy performance of buildings Directive 2010/31/EU); • Secondary legislation remains to be adopted, but six by-laws (methodology for energy performance calculation, certification rules, Regulation on inspection of heating and air-conditioning systems, Regulation on minimum energy performance requirements for buildings, report on heating and cooling systems, alternative measures of regularity compliance inspection) have been prepared for adoption by the Government.

	objects being constructed (reconstructed, repaired) at the expense of state means (12.04.2018).		<ul style="list-style-type: none"> • The Government will determine the minimum requirements of energy efficiency no later than June 30, 2021; • Georgian Space Planning, Architectural and Construction Activity Code, (enacted on June 3, 2019) includes a general article No 87 on Building's Energy Efficiency.
Performance-based requirements	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness (“Ventilation for buildings - Calculation methods for the determination of air flow rates in buildings including infiltration” - AST EN 15242-2014) • Air-conditioning system(s) • Space heating system and hot water supply units • Mechanical and natural ventilation • Built-in lighting system (mainly in the non-residential sector) • Design position and orientation of buildings • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Thermal bridge • No software used for compliance verification • No mandatory requirement to assess post-construction requirement of the thermal bridge • No mandatory requirement for air tightness testing 	<ul style="list-style-type: none"> • New buildings • Existing buildings • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system (mainly in the non-residential sector) • Design position and orientation of buildings • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Thermal bridge • No energy levels are considered in building codes; the subset of ISO EPB standards; • The use of IPMVP. 	<ul style="list-style-type: none"> • No elements, which must be taken into account for the calculation of the energy performance of a building • The subset of ISO EPB standards: Directive 2010/31/EU on Energy Performance of Buildings (EPBD). • No use of IPMVP • No software used for compliance verification • No existing standards for determining the energy characteristics of the buildings in operation • No mandatory requirement to assess post-construction requirement of the thermal bridge • No mandatory requirement for air tightness testing
Prescriptive requirements	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Air-tightness • Solar gains (G-values) • Ventilation or air quality • Ventilation for summer comfort • Daylighting requirements • Periodic transmittance and time lag of walls and roof • Artificial lighting system, lighting density • Boiler/AC system 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Air-tightness • Ventilation or air quality • Daylighting requirements • Artificial lighting system, lighting density • Boiler/AC system • Renewables • Individual energy metering and control units not applied in existing buildings, but it is planned to be implemented in new buildings • No mandatory requirement 	<ul style="list-style-type: none"> • When the law enters into force, the relevant regulations will be adopted and detailed information will be available; • Requirements for mandatory regular inspection of heating and AC systems • Mandatory requirement for individual energy metering and control units

CENTRAL ASIA

Framework legislation and policy documents

The law on Energy Conservation and Energy Efficiency (adopted in 2012) in **Kazakhstan** provided the basis for energy efficiency related mechanisms, such as energy efficiency requirements for new and retrofitted buildings, energy management, equipment standards, energy audits, financial support for energy efficiency activities, long-term energy efficiency agreements, and information support. Additionally, there are several energy efficiency regulatory acts. These include the Comprehensive Energy Conservation Plan to 2015, the 2020 state program on energy saving, as well as the act on Approval of Energy Efficiency Requirements to Predesign and Design Documentation on Buildings, Constructions and Facilities. Overall, Kazakhstan established a developed and comprehensive regulatory framework to implement its energy efficiency policies. Introduction of energy-saving technologies is a key priority in the concept on the transition of Kazakhstan to green economy.

In addition, the integrated Energy-Savings and Energy Efficiency Plan for Astana described the energy efficiency priorities for the city between 2016-2020.

The framework legislation related to energy efficiency in **Kyrgyzstan** dates to 1996 with the adoption of national law on energy. This law envisaged the role of energy efficiency and energy conservation in the development of national energy programmes. The law was amended several times, the latest amendment was introduced in January 2015.

In 1998, the law on Energy Conservation was adopted (with latest amendment in July 2019) and aimed to increase energy efficiency in the energy sector from production to transmission. The promotion and development of incentives for energy efficiency were one of the priority directions in the Programme on Transition of the Kyrgyz Republic to Sustainable Development for 2013-2017.

The National Sustainable Development Strategy for 2018-2040 includes scaling-up of energy savings and energy-efficiency programs for the existing building stock and net-zero-energy buildings (NZEBs) for new construction. The Energy Efficiency in Buildings Law 137 (adopted in 2011 and amended in June 2019) governs the energy performance of buildings in the Kyrgyz Republic during design and construction (for new buildings) as well as for major renovations (existing buildings). It is aligned with the EU best practices and based on key requirements of the EU's Energy Performance in Building Directive (EPBD). The minimum energy performance requirements for new and renovated buildings, energy performance certification and awareness raising are part of this law.

The law on Energy Savings (adopted in 2002) in **Tajikistan** outlined the basics of the energy saving and energy efficiency policy. This law was replaced by the law on Energy Savings and Energy Efficiency in 2013. The new law includes mechanisms, such as labelling and energy passports. A Presidential decree on additional measures on the economical use of energy and energy savings was adopted in 2009. Additional regulatory acts related to energy efficiency include the acts on energy passports for industrial energy consumers; a list of indicators on energy efficiency; methods of monitoring the compliance with energy production efficiency requirements.

The energy saving and energy efficiency legislation is under development in **Turkmenistan**. The Draft Energy Strategy for 2030 includes provisions related to improving energy efficiency of municipal services and industry and the modernization of heat supply, implementation of energy efficiency measures in the housing and industrial sectors.

Uzbekistan adopted the law on Rational Energy Use in 1997, which provided a general framework related to energy efficiency. A resolution on Further Development of Renewable Energy and Energy Efficiency in the period of 2017-2025 was adopted in 2016. Moreover, the strategy for the transition to a green economy for the period of 2019-2030 was adopted and aims to improve energy efficiency, rational consumption and conservation of natural resources. In particular, this strategy aims to implement state programs to improve the energy efficiency of buildings, including the reconstruction of multi-storey residential buildings, as well as buildings of individual housing stock.

Building energy codes

Kazakhstan introduced mandatory norms on thermal efficiency of buildings in 2004 (SNiP 2.04-21-2004 Energy consumption and thermal protection of civil buildings). The country adopted new building energy codes in 2012. They included energy efficiency parameters for new, upgraded and retrofitted buildings as well as determination of energy efficiency classes for all buildings. No schedule to improve the energy efficiency of new buildings further was developed. The building codes are mandatory for new and existing (after substantial refurbishment) residential and non-residential buildings. The national classification is done as class A++ to E.

In 2018, **Kyrgyzstan** introduced a system of regulatory documents in construction for single apartment residential buildings, which includes a brief detail on energy performance. The other relevant documents also include SNiP 23-01:2013: “Building Heat Engineering (Thermal Protection of Buildings)”; SP 23-101-2013: “Design of Thermal Protection of Buildings”; Method for Calculating the Energy Efficiency of Buildings and Determining Energy Efficiency Class for Energy Certification of Buildings (Gosstroy order, 26.05.2013); Methodical instructions for conducting periodic monitoring of the energy efficiency of boilers, heating systems of buildings, and hot water supply of buildings (Gosstroy order 26.05.2013); as well as the Guide to the settlement application for energy certification of buildings (Gosstroy order 26.05.2013).

In **Tajikistan**, “the energy efficiency on new and existing buildings has been on the Government agenda since the adoption of the “Concept for the Development of the Fuel and Energy Sector for the period of 2003-2015.” The technical codes for building regulations were adopted in 2005 (Residential Buildings Code). Between 2004 and 2009, additional guidelines and standards on specific aspects of construction were adopted. The building norms and regulations (SNiPs) are obligatory (UNECE, 2011).

The main regulatory document in **Turkmenistan** is the Building Code SP 50.13330.2012 (updated version of SNiP 23-02-2003) on Thermal Performance of Buildings (adopted in 2012). Additional related documents are the following (i) Guidance on the Design of Energy-Efficient Residential Buildings for SNT 2.08.01-15; (ii) Guidance for the Design of Energy-Efficient Roofs and Roofing for the SNT 2.03.10-01; (iii) Guidance for the SNT 2.01.03-17 on Thermal Building Engineering.

The Government of **Uzbekistan** revised ten building codes and adopted the new versions in 2011 related to energy efficiency. According to the revised building codes, energy consumption for space heating is 30 to 40 per cent down from the earlier level. Uzbekistan has mandatory performance based requirements in buildings energy codes (for new and existing residential and non-residential buildings).

Energy performance certification

There is currently no provision for energy performance certification in **Kazakhstan**. However, energy consumption norms exist for various industrial products, energy metering requirements, mandatory energy audits, energy data reporting and ban on inefficient equipment turnover (incandescent lamps).

Energy audits of buildings in the service sector (such as hospitals, schools and kindergarten) are carried out regularly in **Kyrgyzstan**.

The law on Energy Performance of Buildings established a legal basis for evaluation of energy efficiency and reduction of energy consumption in buildings in Kyrgyzstan. This law obliged residential, public, administrative and multifunctional non-industrial buildings owners to prepare energy passports and energy certificates for the buildings. The provisions of this law are applicable to only new buildings and private house above 150m². However, very few buildings are certified due to the absence of certified energy efficiency specialists in Kyrgyzstan (World Bank, 2019b).

In **Tajikistan**, the Government intended to “introduce energy efficiency standards and labels” (ECS, 2013b). Asian Development Bank also recommended to develop and adopt the “guidelines and requirements issuing the building certificate, like the installation of insulation systems in residential buildings” in the country (ADB, 2016).

The regulation on the rules and procedure for conducting energy audits in residential buildings in **Turkmenistan** was under review (UNECE, 2018). No information is available on further developments in this area.

Uzbekistan has mandatory requirement for energy performance certification covering new and existing (after substantial refurbishment) residential and non-residential buildings. The national registry database for EPC also exists.

Energy pricing measures

The mid-term energy tariff policy for 2014-2017 in **Kyrgyzstan** scheduled gradual price increases to achieve cost-reflective electricity and heat tariffs by end of 2017. However, the recovery was only 63 per cent of the real costs as of June 2017 for electricity tariffs for households.

Electricity tariffs for residential consumers in Kyrgyzstan are as follows: consuming less than 700 kWh/month - 0.77 Som/kWh (equivalent to less than 0.01 USD/kWh); consuming more than 700 kWh/month - 2.16 Som/kWh (equivalent to 0.03 USD/kWh) and other consumers: 2.24 Som/kWh (equivalent to approximately 0.03 USD/kWh).

The residential district heat (DH) and hot water tariffs for the period 2020-2022 for residential consumers are 1134.76 Som/Gcal (equivalent to 13.40 USD/Gcal); hot water: 981.76 Som/Gcal, 64.38 Som/m³, 309.03 Som/person/month – equivalent to 11.59 USD/Gcal, 0.76 USD/m³, 3.65/person/month). All other consumers, including public institutions pay as follows: for DH: 1695.1 Som/Gcal (equivalent to 20.02 USD/Gcal); for hot water 1965.1 Som/Gcal (equivalent to 23.21 USD/Gcal) / 97.19 Som/m³ (equivalent to 1.15 USD/m³)

The natural gas cost is pegged to the US dollar rate and makes 0.23 USD/m³ and 0.28 USD/m³ for residential and other consumers respectively. In national currency tariff for residential consumers changed from 13.8 Som/m³ (equivalent to 0.16 USD/m³) in the beginning of 2015

to 18.06 Som/m³ (equivalent to 0.21 USD/m³) in the end of 2020. For other consumer the tariff changed from 16.57 Som to 21.79 Som (equivalent to 0.20 and 0.26 USD) for the same period.

The Decree of the Government on approval of the medium-term tariff policy for electric and thermal energy for 2020-2022 (Decree no. 188, of March 2020) was updated, but the policy and the tariffs in general were saved as before. The current policy does not preview further increase of tariffs for electricity and heat.

The electricity prices in **Tajikistan** were increased by 15 per cent in 2014 and this was the third price rise since 2010. Even after this increase, the World Bank report of 2015 shows that heat and electricity tariffs were well below cost recovery levels. This led to a lack of funding for ongoing maintenance and capital improvements - both in the heating and electricity sectors - and exacerbated the poor operating and financial performance of companies in the sector. "Electricity tariffs for budget and residential customers are set as a rising block tariff. Tariffs for electricity consumption in excess of 2.5 kW are set at twice the base rate for residential and budget subscribers in order to discourage the use of large electric boilers. However, the tariff structure had one unintended consequence: homes are often heated with individual radiators (each less than 2.5 kW) placed in each room, as this is cheaper than implementing a more efficient electricity-based system for the entire building" (World Bank, 2015a).

The government of **Turkmenistan** provides energy free of charge up to a certain limit. Before 2013, the free limit included 35 kWh/person per month of electricity consumption, after 2013 the limit was reduced to 25 kWh/person per month. The free commodities include gasoline, natural gas, drinking water and electricity. Above the limit, the electricity was priced at 0.0042 USD/kWh and natural gas at USD 7 per 1000 m³ including VAT (C2E2, 2015).

In 2015, the residential energy prices in **Uzbekistan** were very low. From November 2016, the cost of one kWh of electricity increased to 250 soums (equivalent to 0.02 USD). As of June 2019, another increase was implemented making the electricity tariff to 280 soums. The quotas for the consumption of electricity and gas were introduced for the first time in the country as an experiment. The Yunusabad district of Tashkent became a pilot area of the project. From 2019, the benchmark quota of electricity consumption is 300 kWh per month per household, the benchmark quota of gas consumption is 1,000 m³ per month per household during the heating season and 250 m³ per month per household in other cases. "For the consumption volumes being within the limits of these quotas, the payment is executed at the rates established by the state, and for the consumption volumes exceeding the quotas the payment is executed by using the coefficient of 1.2." According to the results of the pilot project, the Ministry of Finance, the Ministry of Economy, and the Ministry of Energy had to prepare the proposals for the further introduction of the benchmark quotas throughout the country.⁷

In 2020, the Government of Uzbekistan has approved the introduction of differentiated tariffs for electricity as of 2022. The population will pay for electricity depending on the time of the day they use it.

Promotion of ESCO

The only country in the region which started the introduction of energy performance contracts is **Kazakhstan**, as stated in the Address of the First President (Kazakhstan 2050 strategy, Step 59). However, the implementation of this remains limited, despite legislative amendments aimed to improve energy service contracts. Only eight energy service contracts were concluded

⁷ Based on reporting from the local sources in November 2018, when the Government of Uzbekistan approved the resolution "On the Phased Change of Prices and Tariffs for Fuel and Energy Resources"

between 2015 and 2018. The complicated process of investment return for ESCOs has been identified as the key reason for limited use of energy service schemes (KazEnergy, 2019).

In **Kyrgyzstan**, there were some projects in the period of 2004-2006 promoting ESCO. Development of ESCO was mentioned in the Program on Energy Conservation and Energy Efficiency Policy for 2015–2017, but no practical result was achieved. At least one ESCO was created in 2004, but doesn't exist from 2006.

No ESCO promotion mechanism exists in **Tajikistan, Turkmenistan, and Uzbekistan**.

Awareness programmes

In **Kyrgyzstan**, a project financed by EBRD and supported by the government in 2009-2015 provided energy efficiency education and training. For the purposes of improving energy efficiency, seminars were held on the renovation of space heating systems in hospitals, schools and kindergartens. Energy public awareness program was also implemented in the framework of the project financed by the Asian development Bank.

The UN facilitated multiple dialogues in **Tajikistan** intended to create a platform for exchange of experience, best practices and knowledge on energy efficiency in buildings and to promote further collaboration in this area (UN, 2017).

Seminars, workshops, conferences and training components on energy efficiency were conducted as part of the World Bank and UNDP-GEF projects in **Uzbekistan**. In 2019, “Uzenergoinspeksiya” held twelve training workshops across the country, with over 500 industrial enterprises; four press conferences, as well as meetings to promote reduced energy intensity and improved energy efficiency. It also distributed information, including posters on energy efficiency and saving resources. Promotional videos were broadcasted, TV and radio broadcasts were prepared, announcements were published in mass media and on social media (MoE Uzbekistan).

No information is available on specific awareness programmes and initiatives conducted in **Kazakhstan and Turkemenistan**.

Table 4. Overview of Building Energy Codes in Central Asia

	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Coverage	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Apartment blocks • Commercial • Public buildings 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Public, administrative and multifunctional buildings 	<ul style="list-style-type: none"> • New residential • New commercial • Renovated buildings in residential sector • Renovated buildings in commercial sector 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings 	<ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings
Strictness	<ul style="list-style-type: none"> • Mandatory • National classification of buildings in the building code of 2012: A++; A+; A; B+; B; C+; C; C-; D; E. • Requirements for the assessment of energy efficiency and energy consumption exist but not really implemented. • Energy use for heating, ventilation. 	<ul style="list-style-type: none"> • Mandatory • The minimum energy efficiency requirements for buildings do not apply to: (i) individual residential buildings, the total area of which does not exceed 150 square meters; (ii) buildings designed for religious rites, rituals and ceremonies; (iii) buildings that, in accordance with legislation, are assigned to cultural heritage sites ; (iv) temporary objects of non-capital construction; (v) holiday homes; (vi) buildings of auxiliary use. 	<ul style="list-style-type: none"> • The technical codes for building regulations were adopted in 2005 (Residential Buildings Code). • Between 2004 and 2009, additional guidelines and standards on specific aspects of construction were adopted. • The building norms and regulations (SNIps) are obligatory. 	<ul style="list-style-type: none"> • Mandatory • Energy saving is a requirement of the new SNT 2.01.03 "Building heat engineering" 	<ul style="list-style-type: none"> • Mandatory • Energy use for heating, cooling, hot water, lighting, ventilation.
Main regulatory documents	<ul style="list-style-type: none"> • The Law of "On energy saving and energy efficiency" dated January, 2012; • SN 2.04-21-2004 " Thermal protection and energy consumption of civil buildings"; • SN RK-2.04-04-2011 " Thermal protection of buildings". 	<ul style="list-style-type: none"> • SNIp 23-01:2013, "Building Heat Engineering (Thermal Protection of Buildings)" • SP 23-101-2013, "Design of Thermal Protection of Buildings" • Method for Calculating the Energy Efficiency of Buildings, Determining Energy Efficiency Class for Energy Certification of Buildings (Gosstroy order, 26.05.2013) • Methodical instructions for conducting periodic monitoring of the energy efficiency of boilers, heating systems of buildings, and hot water supply of buildings (Gosstroy order 26.05.2013) 	<ul style="list-style-type: none"> • Residential Buildings Code (2005); • Town Planning Code (2008); • The Agency for Construction organizes a yearly revision of the existing SNIps with the participation of industry players. 	<ul style="list-style-type: none"> • SNT 2.08.01-15 on "Residential buildings"; • SNT 2.01.03-17 on "Thermal building engineering"; • SNT 2.03.10-01 on "Roofs and roofing" • Guidance on the Design of Energy-Efficient Residential Buildings for SNT 2.08.01-15 "Residential Buildings"; • Guidance for the Design of Energy-Efficient Roofs and Roofing for the SNT 2.03.10-01 "Roofs and Roofing"; • Guidance for the SNT 2.01.03-17 "Thermal Building Engineering. 	<ul style="list-style-type: none"> • The Uniform Building Regulations of the Republic of Uzbekistan (Part 1) (Annex No. 3 to the Decision of the Cabinet of Ministers of the Republic of Uzbekistan on August 20, 2013, No. 229); • Rules of organization of works on the improvement of settlements taking into account modern architectural and town-planning requirements (as of March 2009); • KMK 2.01.12-2000 Norms of energy consumption for heating ventilation and air conditioning of buildings and structures.

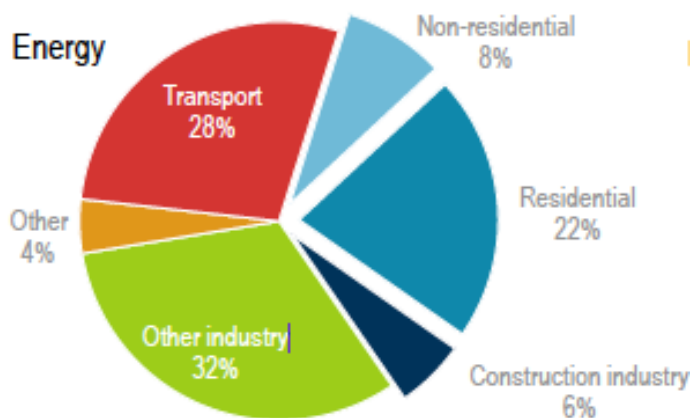
		<ul style="list-style-type: none"> • Guide to the settlement application for energy certification of buildings (Gostroy order 26.05.2013). 			
Performance-based requirements	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Design position and orientation of buildings • Indoor and outdoor climatic conditions • Thermal bridge • No software for compliance verification • No mandatory requirement to assess post-construction requirement of the thermal bridge • No mandatory requirement for air tightness testing. 	<ul style="list-style-type: none"> • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system • Passive solar systems and solar protection • Passive cooling • No software for compliance verification 		<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Space heating system • Air-conditioning system(s) • Mechanical and natural ventilation • Design position and orientation of buildings • Indoor and outdoor climatic conditions • Thermal bridge • Energy use for heating, cooling, hot water, ventilation. • No software for compliance verification • The primary indicator for estimating the energy consumption of buildings is the primary energy consumption for heating, cooling and ventilation. • Total primary energy use. 	<ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system (mainly in the non-residential sector) • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Thermal bridge • Use of Energy Performance in Buildings standards (2017) • Use of software used for compliance verification • Total primary energy use.
Prescriptive requirements	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Specified thermal comfort levels for winter and summer • Air-tightness • Ventilation or air quality • The requirements for daylight • Thermal bridges • District heating and other external heating system, buildings are equipped with mandatory individual energy metering and control units 	<ul style="list-style-type: none"> • Thermal insulation • Ventilation or air quality • Daylighting requirements • Boiler/AC system • Specified thermal comfort levels for summer and winter • Solar gains (G-values) • Artificial lighting system, lighting density 		<ul style="list-style-type: none"> • Specified thermal comfort levels for winter and summer • Ventilation • Thermal bridges • Requirements for mandatory regular inspection of heating and AC systems • No requirement for use of individual energy metering and control units 	<ul style="list-style-type: none"> • Thermal insulation (including U-values for walls, floor, roof and windows) • Specified thermal comfort levels for winter and summer • Solar gains (G-values) • Air-tightness • Ventilation or air quality • External solar protections • Ventilation for summer comfort • Solar absorbance of ext-l surfaces • The requirements for daylight • Artificial lighting system, lighting density • Boiler/AC system • Requirement for mandatory individual energy metering and control units.

IMPLEMENTATION OF ENERGY EFFICIENCY STANDARDS

ENERGY PERFORMANCE OF BUILDINGS

Globally, buildings and construction sector accounted for 36 per cent of final energy use (IEA & UNEP, 2019). Fig. 1 below indicates that residential buildings consumption share of energy is 22 per cent, while non-residential buildings consume 8 per cent.

Figure 1. Residential Building Consumption, Share of Energy



Source: 2019 Global Status Report for Buildings and Construction: Towards a zero-emission, efficient and resilient buildings and construction sector, IEA & UNEP.

The energy performance of a building indicates the amount of energy actually consumed (or estimated to be necessary) to meet the different needs associated with a standard use of the building, including heating, cooling, lighting and provision of hot water. The ISO52000-1:2017 standard identifies energy performance as being “calculated with data for the building after construction (prior to or during operation) and standard use data set.”

The performance of a building may depend on various factors. Indirect use of energy depends on climate and the applied energy efficient technologies and contributes up to 25 per cent of total energy use. Factors influencing consumption of energy may also include changes in population, as well as variations on how buildings are constructed and used. The particular choice of building materials may influence the energy performance of buildings. However, the “environmental impacts of different building materials and designs depend on a number of factors...offering an advantage in terms of carbon storage and potential energy recovery” (Urge-Vorsatz *et al.*, 2012).

While energy performance is site and case dependent, the optimal solutions to reducing energy consumption include energy efficient building designs, a wise choice of building materials, and renewable energy sources use (Urge-Vorsatz *et al.*, 2012). Overall, the life cycle approach will help identifying the optimal total amount of energy required to provide energy services in buildings.

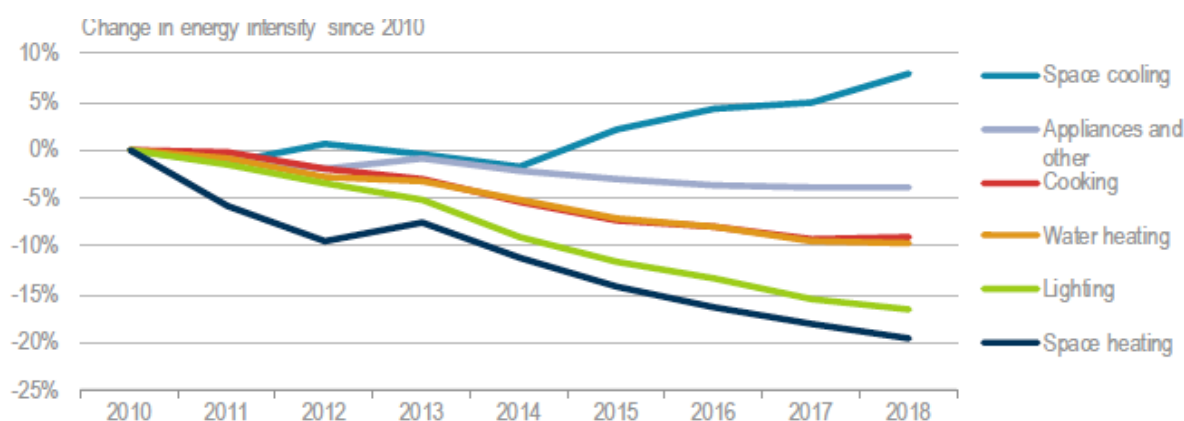
The total energy demand in buildings continues to increase despite the existing trends in improvements in the building envelopes (better insulation and windows), the performance of building energy systems (in heating, cooling and ventilation) and the components (cooking equipment and appliances).

Globally, the final energy use in buildings grew from 118 EJ in 2010 to around 128 EJ in 2019. Final energy consumption, being a total energy consumed by end users in households, industry and agriculture, excludes energy used by the energy sector.

The “final energy consumption in residential buildings made up more than 70 per cent of the global total in 2018...Consumption in residential buildings rose more than 5 EJ during the period of 2010-2018, and 3 EJ in non-residential buildings.” (IEA, 2019)

In the period of 2010-2018, a trend in energy intensity of the building sector shows significant reductions in average space heating (up to 20 per cent), lighting (up to 17 per cent), space and water heating but increase in space cooling, especially in countries with hot climate (Fig. 2).

Figure 2. Energy Intensity of the Building Sector in 2010-2018



Source: 2019 Global Status Report for Buildings and Construction: Towards a zero-emission, efficient and resilient buildings and construction sector, IEA & UNEP.

This study will further explore the trends in energy performance of buildings in the countries of South Eastern Europe, Eastern Europe, the Caucasus, Central Asia and in the Russian Federation.

South-Eastern Europe

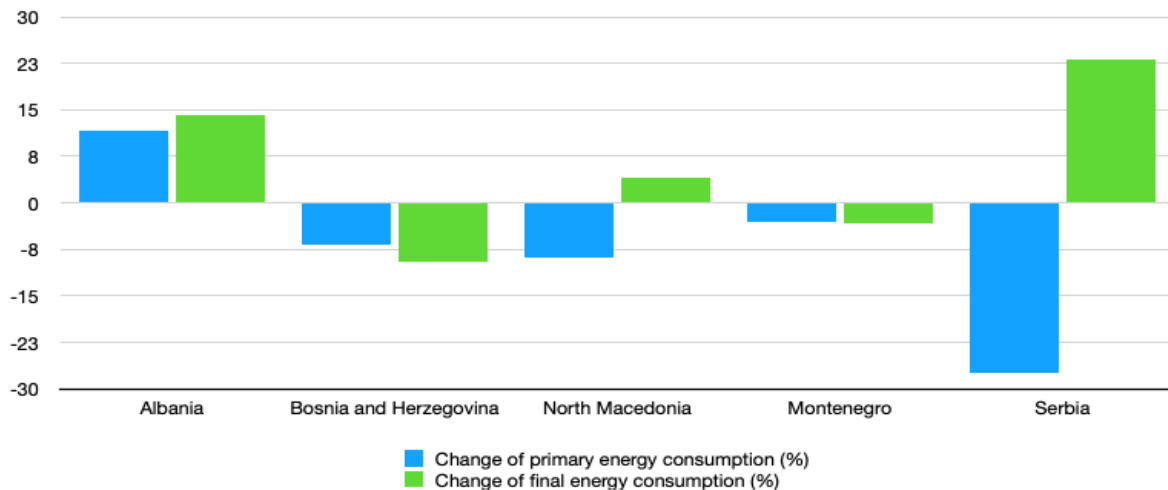
The South-Eastern European countries emerged from the energy intensive economies and power systems heavily reliant on fossil fuels. They made significant progress over the last 15 years in reducing energy intensity. Despite this progress, their level of energy intensity remains three times more than in the countries of the European Union (EU, 2019).

As indicated in Fig. 3 below, between 2012 and 2015, in the countries of South-Eastern Europe the following changes occurred (EU, 2018):

- In Albania, the final energy consumption reduced by 14.1 percent to 2.1 Mtoe. In 2015, the residential sector was the second largest energy-consuming sector, at 26 per cent of final energy consumption.
- In Bosnia and Herzegovina, the final energy consumption reduced by 9.6 per cent to 4.4 Mtoe. The overall energy savings target between 2010 and 2018 were 9 per cent. In 2015, residential was the largest energy-consuming sector with a 50 per cent share in final energy consumption.
- North Macedonia increased its final energy consumption by 4 per cent to 1.9 Mtoe. In 2015, the residential sector was the second largest energy-consuming sector, at 28 per cent of final energy consumption.

- Montenegro reduced its final energy consumption by 3.3 per cent to 0.71 Mtoe. Despite the slight increase in 2015, the country's energy consumption followed a downward trend. In 2015, Montenegro achieved 2.3 per cent of energy savings while the target by 2018 was 9 per cent. In Montenegro, the residential was the largest energy-consuming sector, representing a 37 per cent share in final energy consumption.
- Between 2012 and 2015, Serbia increased its final energy consumption by 1.4 per cent to 8.8 Mtoe. Despite this increase in energy consumption, the country managed to accomplish 4.4 per cent of energy savings between 2010 and 2015. In 2015, residential was the largest energy-consuming sector, representing a 32 per cent share of final energy consumption.

Figure 3. Primary Energy Consumption and Final Energy Consumption in South Eastern Europe, 2012-2015

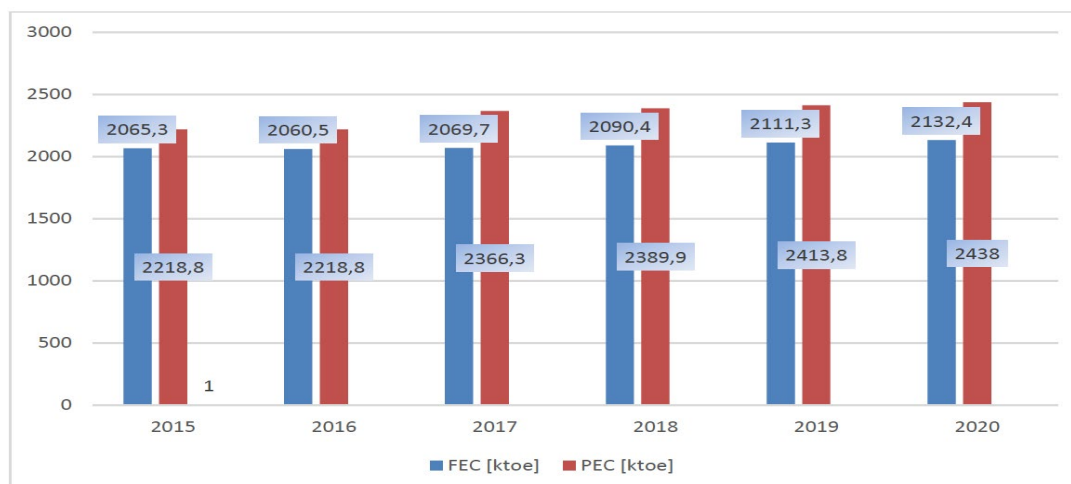


Source: Guide on Good Practice in Energy Efficiency for Central and South Eastern Europe, EU, 2018

The more recent estimates include higher potential energy savings of 10-35 per cent for households and 35-40 percent in the public sector in these countries (EU, 2019).

In **Albania**, the primary energy consumption increased up to 2,289.9 ktoe in 2018 comparing to 2218,8 ktoe in 2015. The increase is also observed in the final energy consumption from 2065.3 ktoe in 2015 to 2094.4 ktoe in 2018 (see Fig. 4). The calculated consumption for building sector is 10.7 ktoe in 2018, and projected of 37.4 ktoe for 2020.

Figure 4. Overview of Primary and Final Energy Consumption Trends in Albania

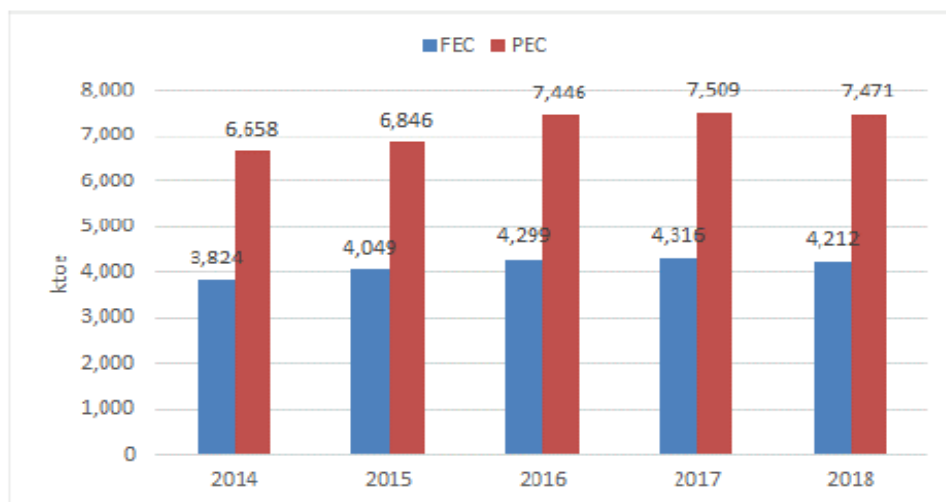


PEC-primary energy consumption; FEC-final energy consumption

Source: Agency for Energy Efficiency, Albania, Second Annual Report under the Energy Efficiency Directive, 2020

In **Bosnia and Herzegovina**, the primary energy consumption in 2018 was 7,471 ktoe, while in 2015 it was 6,846 ktoe. Final energy consumption increased to 4,212 ktoe in 2018 from 4,049 ktoe in 2015 (Fig.5). The highest figures for both primary and final energy consumption are observed in 2017. The building sector remains the largest energy consumer with 2,203 ktoe in 2015 and reduced consumption of 1,719 ktoe in 2018.

Figure 5. Actual Primary and Final Energy Consumption in Bosnia and Herzegovina

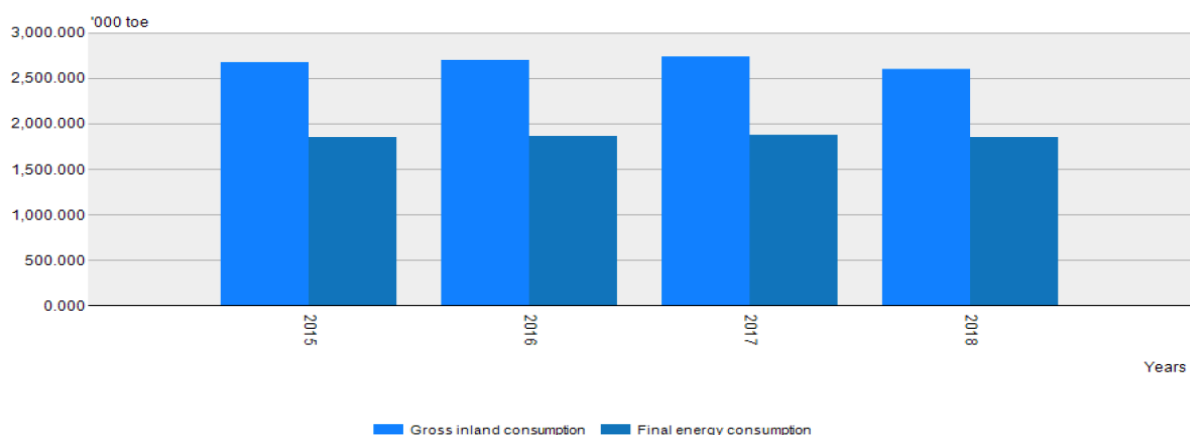


PEC-primary energy consumption; FEC-final energy consumption

Source: Ministry of Foreign Trade and Economic Relations, Bosnia and Herzegovina, Fourth Annual Report under the Energy Efficiency Directive, 2020

In **North Macedonia**, the total primary energy consumption in 2018 was 2599 ktoe comparing to previous years where consumption was at the slightly higher level. Fig. 6 indicates that the total final energy consumption in 2018 was 1853 ktoe. The building sector consumed 484 ktoe (the second largest energy-consuming sector).

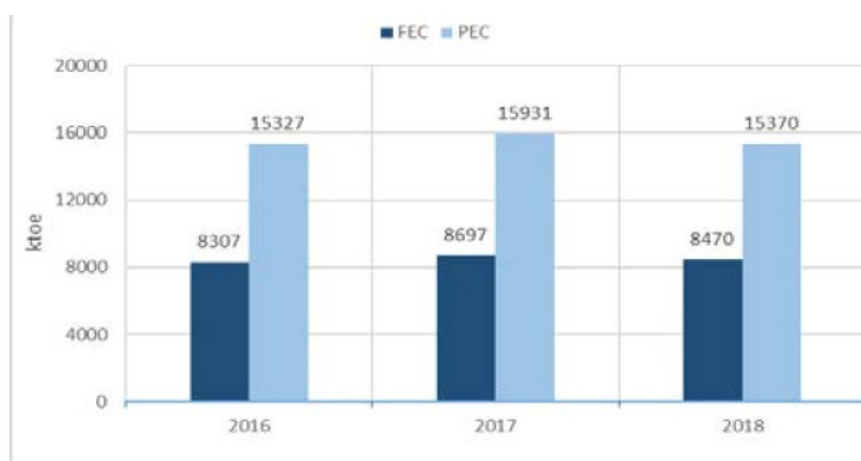
Figure 6. Energy Balances in North Macedonia, by years



Source: Ministry of Economy, North Macedonia, Fourth Annual Report under the Energy Efficiency Directive, 2020

In **Serbia**, primary energy consumption was reduced about 13 per cent in the period from 2010-2014 while in the period from 2014-2018 there was the increase resulting with growth of 15 per cent. Final energy consumption decreased by 2 per cent in the period 2010-2018. More precisely, FEC was reduced in the period 2012-2014 while in the period 2015-2018 there was some increase following growth of economic activities (Fig 7).

Figure 7. Primary and Final Energy Consumption in Serbia, 2016-2018



PEC-primary energy consumption; FEC-final energy consumption

Source: Ministry of Mining and Energy, Serbia, Fourth Annual Report under the Energy Efficiency Directive, 2020

Eastern Europe and the Russian Federation

In 2013, in **Belarus**, energy consumption in the residential sector amounted to 11.433 Mtoe. Residential buildings are characterized by the following specific energy consumption parameters: total specific energy consumption 25.7 kgCE/m² (209.9 kWh/m²), including electricity 3.22 kgCE/m²; heat 13.72 kgCE/m², space heating 7.72 kgCE/m²; domestic hot water 155 kgCE/person); and natural gas 8.76 kgCE/m² (C2E2, 2015).

According to the IEA, final energy consumption in the residential sector was 5305 Ktoe in 2013 and 5196 Ktoe in 2018.

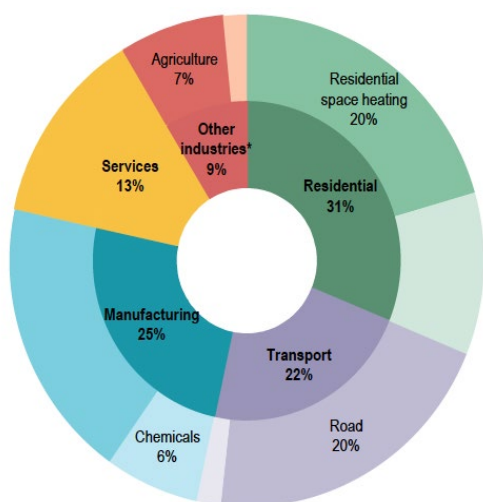
In 2015, the National Statistical Committee of Belarus conducted a sample survey of households on energy consumption. According to the results of the survey, the average annual power consumption in the residential sector per unit area was 248.5 kWh/m², of which 147.1 kWh/m² for heating, 44.2 kWh/m² for hot water, 32.3 kWh/m² for cooking, 24.9 kWh/m² for domestic appliances and lighting. In the structure of energy consumption by purpose of use, heating accounted for 59.2 per cent, hot water for 17.8 per cent, cooking for 13 per cent, household appliances and lighting for 10 per cent.⁸

In 2018, the residential sector is still the largest energy consumer, at 31 per cent of the final energy consumption (Fig. 8). The residential space heating accounts for up to 20 per cent of the energy use.

According to the IEA assessment, space heating accounts for 66 per cent of total residential energy consumption by end use in Belarus. It is followed by energy use for water heating (17 per cent), residential appliances (10 per cent) and cooking (7 per cent) (see Fig. 9).

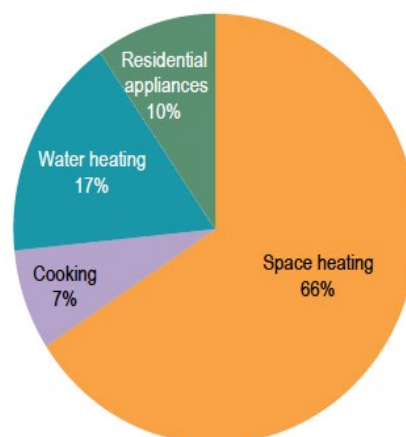
⁸ As indicated by government sources

Figure 8. Belarus's Largest End-Uses by Sector, 2018



Source: IEA, Energy Efficiency Indicators Highlights, 2020

Figure 9. Belarus's Residential Energy Consumption by End-Use, 2018



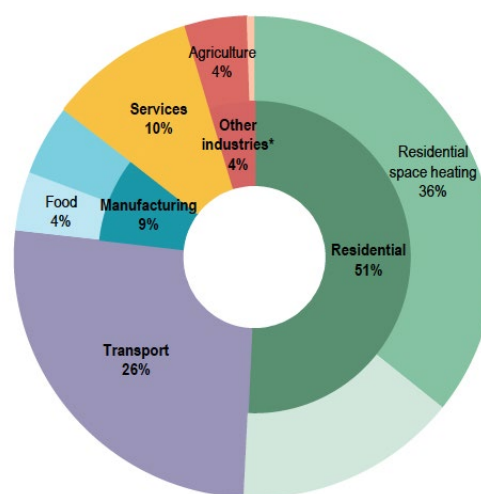
Source: IEA, Energy Efficiency Indicators Highlights, 2020

In the **Republic of Moldova**, between 2012 and 2015, the primary energy supply was reduced by 31 per cent to 2.4 Mtoe, and its final energy consumption by 12 per cent to 2.1 Mtoe. The country's overall energy savings target between 2013 and 2020 is 9 per cent. 1.6 per cent of energy savings was achieved by 2016.

Figure 10. The Largest End-Uses by Sector in the republic of Moldova, 2018

In 2015, residential was the biggest energy-consuming sector, representing a 43 per cent share of final energy consumption. Primary energy intensity significantly decreased by 41.1 per cent from 2012 to 2015 (EU, 2018).

In 2018, the residential sector continued to be the largest consumer of energy (Fig. 10), at 51 per cent of total final energy consumption. 36 per cent of the consumption falls on the residential space heating (IEA, 2020). The space heating account at 70 per cent of the total residential energy consumption.

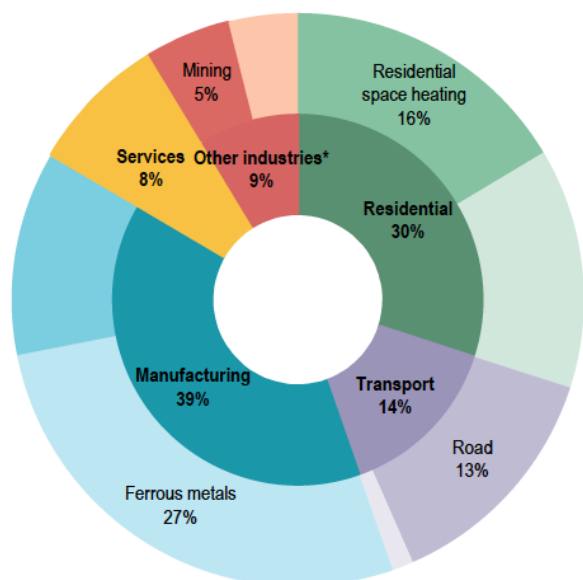


Source: IEA, Energy Efficiency Indicators Highlights, 2020

Total final energy consumption in the **Russian Federation** saw varying levels of decline. In 2015, the proportion of total final energy consumed by the residential sector was approximately 30 per cent. Energy consumption patterns of the residential sector also varies. Petroleum products account for less than 10 per cent of the final energy consumption. The natural gas use accounts for 30 per cent of the residential sector final energy consumption, and the use of electricity ranges between 10 per cent to 20 per cent in 2008 and 2015 (Hao Yu *et al*, 2019).

Ukraine, between 2012 and 2015, reduced its primary energy supply by 26.4 per cent to 90.1 Mtoe, and its final energy consumption by 30.5 per cent to 50.8 Mtoe.

Figure 11. Ukraine's Largest End-Uses by Sector, 2018



In 2015, residential sector was the second largest energy-consuming sector, at 30 per cent of final energy consumption. Primary energy intensity decreased between 2012 and 2015, along with a contraction of GDP in 2014 and 2015 due to the economic crisis (EU, 2018). According to the State Statistics Service of Ukraine, in 2015, residential sector was the largest energy-consuming sector, at 32.6 per cent of final energy consumption.

In 2018, residential sector was the second largest energy consumer (Fig. 11), at 30 per cent of total final energy consumption, where 16 per cent falls on residential space heating (IEA).

Source: IEA, *Energy Efficiency Indicators Highlights*, 2020

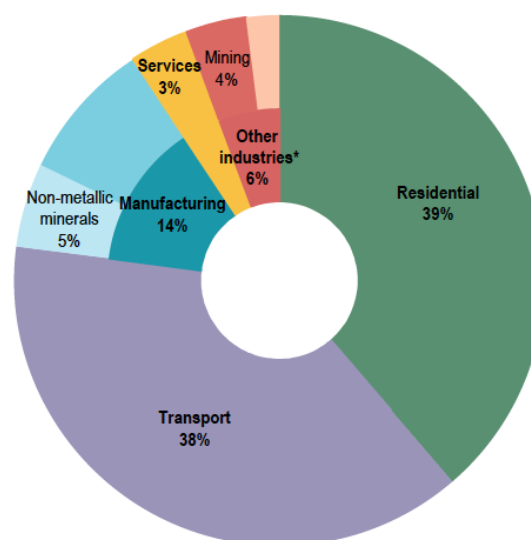
According to the State Statistics Service of Ukraine, in 2018, residential sector was the largest energy consumer, at 32.4 per cent of total final energy consumption.⁹

The Caucasus

In **Armenia**, in 2015, the overall technical energy efficiency potential in the housing sector was estimated at 0.9 Mtce; and in the public and commercial buildings sector at 0.2 Mtce. Total energy saving potential in buildings was estimated as exceeding 1 Mtce (C2E2, 2015).

Figure 12. Armenia's Largest End-Uses by Sector, 2018

In 2018, the largest energy-consuming sector in Armenia is the building sector (Fig. 12) that “account for nearly 40 per cent of the country’s total electricity demand and more than 25 per cent of its gas demand. Estimated energy-saving potential ranges from 40 per cent to 60 per cent across residential, public and commercial buildings, depending on interventions” (Armenia IEA, 2020).

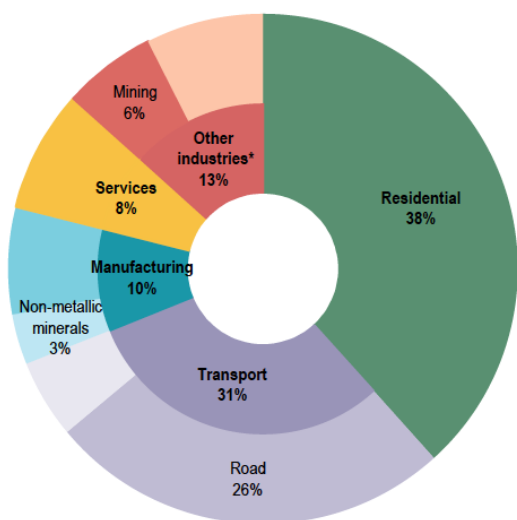


Azerbaijan's total final consumption in 2018, excluding transformation sector, was 9.2 Mtoe. As shown on the Fig. 13, the residential sector is the largest final consumer with 3.3 Mtoe in 2018 (Azerbaijan IEA, 2020).

Source: IEA, *Energy Efficiency Indicators Highlights*, 2020

⁹ As indicated by government sources

Figure 13. Azerbaijan's Largest End-Uses by Sector, 2018



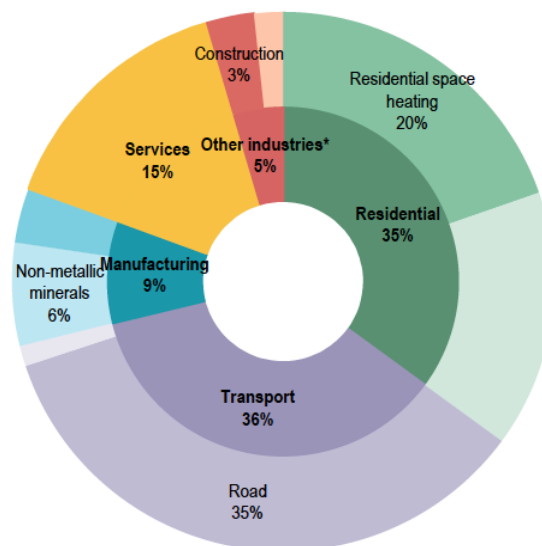
In 2015, multifamily buildings in Azerbaijan accounted for 54 per cent of the urban living stock. Public and commercial buildings used mostly electricity (68 per cent) and natural gas (23 per cent). The total energy saving potential in buildings was estimated at almost 4 Mtce, including 3 Mtce in residential buildings and 1 Mtce in public and commercial buildings” (C2E2, 2015).

«From 2000 to 2015, the total final energy consumption in **Georgia** has been multiplied by 1.5.»

Source: IEA, Energy Efficiency Indicators Highlights, 2020

As of 2018, the residential sector of Georgia is the second largest final consumer of energy after transport (EU4ENERGY Georgia, 2020). Fig.14 shows that transport is just 1 per cent higher than residential sector, which account for 35 per cent of final energy consumption. The residential space heating accounts particular 20 per cent of the final consumption. Currently the households are the first consumers of natural gas (IEA, 2020).

Figure 14. Georgia's Largest End-Uses by Sector, 2018



The residential electricity consumers were divided into three categories. The first category covered consumers whose average monthly consumption varies between 5 and 100 kWh (36 per cent of such customers in Tbilisi). Households in the second category consumed 100-300 kWh/month on average (10 per cent). Households in the third category were those consumers, who have locked up and temporarily uninhabited flats, and consume less than 5 kWh/month of energy (14 per cent).

Source: IEA, Energy Efficiency Indicators Highlights, 2020

Residential energy consumption by end-use (based on 2018 data from IEA) dominates by the heating (around 56 per cent), then follows by energy use for cooking (18 per cent), use of appliances (around 13 per cent) and water heating (12 per cent). Space cooling accounts only 1 per cent of the total energy consumption in the residential sector (IEA Georgia, 2020).

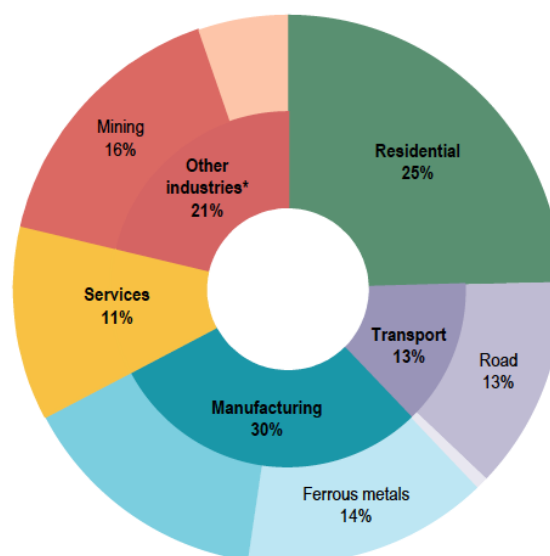
Central Asia

Figure 15. Kazakhstan's Largest End-Uses by Sector, 2018

In **Kazakhstan**, the total final energy consumption, excluding transformation processes, amounts to 42 Mtoe in 2018.

Fig. 15 shows that residential sector is the second largest final energy consumer, at 11 Mtoe (IEA Kazakhstan2020). Oil and coal together form over 50 per cent of the final consumption (EU4ENERGY Kazakhstan, 2020).

Kyrgyzstan's total primary energy supply was 3.9 Mtoe in 2015 and reached 4.6 Mtoe in 2018.

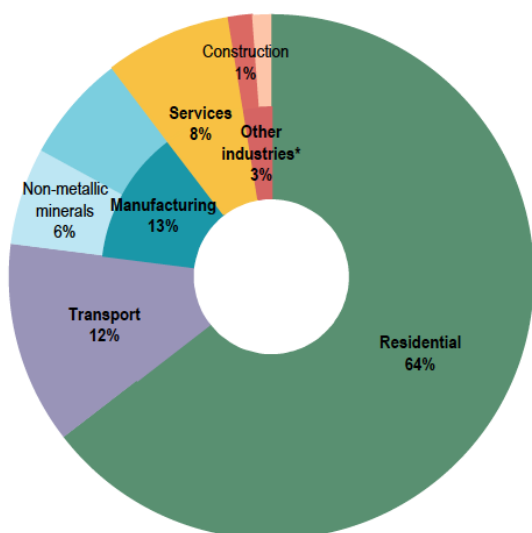


Source : IEA, Energy Efficiency Indicators Highlights, 2020

Total final consumption was 4.2 Mtoe in 2018, and is growing rapidly (additional 72 per cent since 2008)” (IEA Kyrgyzstan, 2020)

In 2014, the residential sector represented 36 per cent of the total final energy consumption and was the primary largest final energy consumer. In 2015, 95 per cent of heat energy was consumed by municipal and residential buildings (IEA Kyrgyzstan, 2020).

Figure 16. Kyrgyzstan's Largest End-Uses by Sector, 2018



In 2018, the residential sector consumption grew significantly representing 64 per cent of total final energy consumption (Fig. 16).

According to the ADB assessment, energy intensity in **Tajikistan** is significantly higher than the world average. Energy efficiency potential in Tajikistan is assessed by the Ministry of Energy and Industry at 30 per cent reduction in power consumption (ADB, 2013).

In Tajikistan, the buildings sector (including residential, public and commercial buildings) is a large energy user, while data for actual energy consumption is not available (C2E2, 2015).

Source : IEA, Energy Efficiency Indicators Highlights, 2020

Turkmenistan is self-sufficient in terms of energy production. “The total production of all electric energy producing facilities is 21 billion kWh, also 140 per cent of own requirements” (Worlddata website). Earlier, the energy consumption in Turkmenistan’s “residential sector amounted to 1.96 Mtoe, electricity consumption to 4.374 million kWh, heat consumption to 1.355 thousand Gcal and natural gas consumption to 1.079 billion m³” (C2E2, 2015).

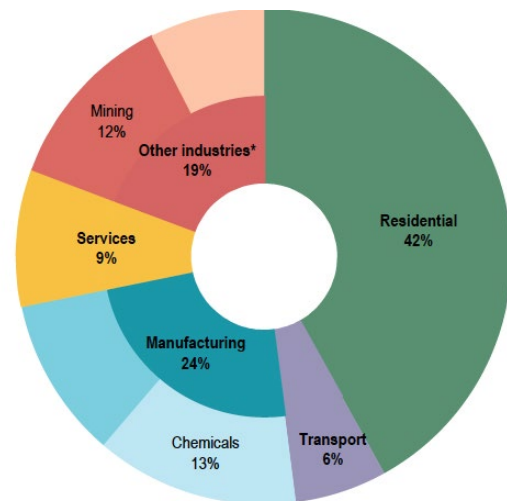
Residential buildings in Turkmenistan include private housing with individual space heating and domestic hot water supply from gas or electric boilers (80 per cent of total housing stock).

The other 20 per cent of housing include apartment buildings with access to district heating and hot water supply from district boilers.

Figure 17. Uzbekistan's Largest End-Uses by Sector, 2017

In **Uzbekistan**, the total final energy consumption was 29.5 Mtoe in 2018. The residential sector is the largest consumer (Fig. 17), with a share of more than 40 per cent (IEA Uzbekistan, 2020).

Earlier, the building sector, including residential, public and commercial buildings, was responsible for 55 per cent of the end-use energy consumption. Buildings were responsible for 75 per cent of final heat consumption, 26 per cent of final electricity consumption, 64 per cent of final natural gas consumption (C2E2, 2015).



Source : IEA, Energy Efficiency Indicators Highlights, 2020

New vs Existing Buildings

The main energetic function of a building is to provide thermal comfort. It is important to keep this in mind when thinking of a building construction, renovation and operation. Up to 75 per cent of reduction in the gross energy requirements can be achieved in the new buildings in most countries of the world. Up to 50 per cent of reductions in the energy use can be achieved in the existing buildings (Urge-Vorsatz *et al.*, 2012).

A choice between construction of a new building or renovation of an existing one depends on situation and various factors. During construction of a new building it is possible to avoid using the energy-intensive materials. The environmental gains of a new construction can be significantly higher as new buildings can reduce their energy requirements for operation or meet them entirely through the use of renewable energy sources.

However, sometimes refurbishment of an existing building can offer more energy savings compared to a new construction if to look at the total life cycle of energy use (Urge-Vorsatz *et al.*, 2012). For existing buildings, the largest use of energy is during the operation phase. Therefore, the good insulation material and improved building technology is required.

This study will look in more details at the energy performance of new constructions and the existing buildings in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia, and the Russian Federation.

New Buildings

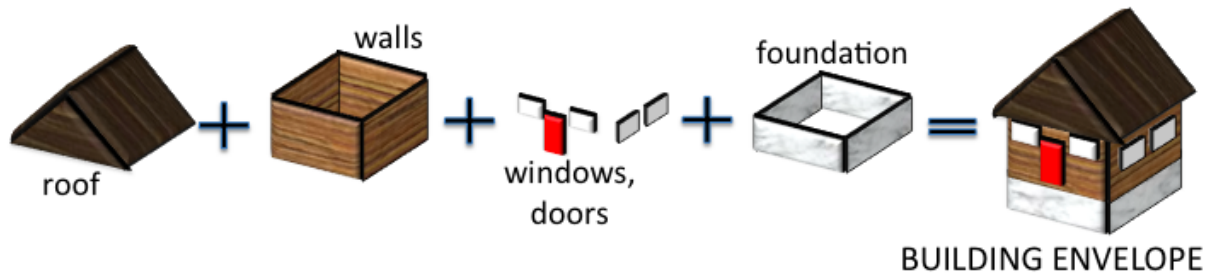
Using the potential for energy savings within the building sector can bring significant benefits to the economies and overall energy security of the countries (Economidou *et al.*, 2011). By ensuring that new buildings are energy efficient, one can realise a number of benefits including lower energy bills and reduced greenhouse gas emissions.

Building envelope

The concept of a building envelope relates to design and construction of the exterior of the house. To be precise, the building envelope is the physical barrier between the exterior and interior environments enclosing a structure (Hagentoft, 2001).

Building envelope (Fig. 18) is comprised of several components and systems that protect the interior space from the environmental effects such as precipitation, wind, temperature, humidity, and ultraviolet radiation (Donev *et al.*, 2018). The building envelope of a house consists of its roof, walls, sub floor, exterior doors and windows.

Figure 18. Components of the Building Envelope



Source : Energy Education-Building envelope

A good building envelope involves using exterior wall materials and designs that are climate-appropriate, structurally sound and aesthetically pleasing. These three elements are the key factors in constructing the building envelope.

Improving building envelope of houses is one of the best ways to get better energy efficiency. This part of the study will provide examples of requirements for building envelopes in new constructions and their implementation in several countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia.

There is a common approach in almost all countries of Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation to “include typical energy efficient measures, like modern insulation and glazing, for new construction for multi-family residential and public buildings. These requirements are reflected in country-specific laws on energy efficiency” (UNECE, 2019).

According to a recent evaluation of energy performance of buildings in **Albania**, almost 80 per cent of the new buildings (constructed less than 5 years) have no drafty doors or windows. The new buildings, constructed more than 5 years, represent the highest percentage of dwellings with full insulation, at around 39-43 per cent. The new buildings also represent the highest percentage of dwellings with double-glazed windows, around 75 per cent. Dwellings in new buildings, built mainly over the last five years, represent the dwellings in the best conditions in terms of insulation, presence of double-glazing windows, lack of mold, and draft-proof windows and doors (EDEN Center, 2018).

Examples from the energy performance assessment conducted by the GIZ in **Belarus** include residential buildings in different cities:

- The 16-storey residential building constructed in Minsk in 2011 with 126 flats has compact and favorable surface to volume ratio of 0.3. The local planners indicated a heat demand of 39,5 kWh/m²a for the entire building. The recalculated energy demand ranges from 43 kWh/m²-a for a flat in the middle up to 83 kWh/m²a for the shared space; and the entire building is calculated with 56 kWh/m²a. The increased values, compared to the heat demand given by the local planner might be due to the increased indoor temperatures of approx. 23°C compared to the assumed 20°C. Outside of the building, in particular not properly installed windows, missing or damaged sealing and sealing foam which is not properly covered. The insulation between heated and unheated areas is insufficient in the common spaces.

- The apartment building in Gomel' is a 9-storey high-rise with 108 flats, built in 2012. The heated areas of the building is 5.733 m² while the thermal envelope is 7.638 m². The surface to volume ratio is 0,5. According to survey and metering results, the average indoor temperature is around 23,5° which would lead to a calculated energy demand of 95 kWh/m²a, or 102 kWh/m²a, if use the increased thermal bridges at windows.
- The building in the city of Solnechny, constructed in 2005, offers 36 flats on 9 storeys. The heated area is 3.789 m² and the thermal envelope is 4.037 m². The surface to volume ratio is 0,4 which is a rather favourable value and indicates a compact building. The calculated heat demand by the planner has been given with 19,8 kWh/m²a which is in stark contrast to the values recalculated by the project experts. The recalculated values range from 54 kWh/m²a for an apartment in the middle of the building with an orientation to the south up to 90 kWh/m²a, if to consider the entire building and assume that the staircase is outside the heated volume. The quality of installation of windows differed from room to room. This caused additional energy losses and in some cases led to problems with mold near the windows (GIZ, 2016).

The National Technical Standard has set the thermal performance in the **Republic of Moldova** (U value) for new buildings as follows: external wall: 0.4 W/m²K; flat roof: 0.3 W/m²K; windows: 2.56 W/m²K. The new standards that are implemented as of 2011 based on the regulation for Energy performance in buildings: external wall: 0.32 W/m²K; flat roof: 0.2 W/m²K; windows: 1.5 W/m²K.

The minimum admissible resistance value of heat transfer of the building envelopes of residential and public buildings (Table 5) in **Ukraine** is set up for outside walls, coatings, translucent buildings envelopes and external doors.

Table 5. Minimum Admissible Resistance Value of Heat Transfer of the Building Envelopes of Residential and Public Buildings in Ukraine

Item No.	The type of the building envelope	The values of $R_{q, min}$, m ² K/W, for Ukraine temperature zones	
		I	II
1	Outside walls	3.3	2.8
2	Combined coatings	6.00	5.5
3	The coatings of heated attics (technical storeys) and attic type coatings	4.95	4.5
4	Attic coatings of non-heated attics	4.95	4.5
5	Coatings over driveways and non-heated ones	3.75	3.3
6	Translucent building envelopes	0.75	0.6
7	External doors	0.6	0.5

Source : Envelope Life Cycle Costing of Energy-Efficient Buildings in Ukraine, International Journal of Innovative Technology and Exploring Engineering, 2019

In **Georgia**, the large variations in energy performance of newly constructed buildings derives due to the absence of the mandatory energy efficiency standards as well as approved use of the Technical Regulations of Member-states of the European Union and the Organization for Economic Cooperation and Development for construction activities.

However, also many developments with better energy performance, significantly exceeding legal minimum requirements.

Thermal transmittance (U value) value of building envelope: floor -0.2 W/m²K ; external walls - 0.74 W/m²K; roof - 0.7 W/m²K; windows: 2.85 W/m²K.

Within the framework of the WB/ESMAP project the the technical design solutions and recommendations for the energy efficiency retrofitting of the residential buildings were developed. Thermal transmittance the U values for the building envelope components were defined in line with the developed regulation on the minimum energy performance requirements (not adopted yet) and constituted for the Climate zone-2 as it follows: floor: U value 0.38 W/m²K; external walls: 0.38 W/m²K; roof: 0.3 W/m²K; windows & external doors: 0.3 W/m²K (World Bank, 2020a).

High energy efficiency standards were implemented in several public buildings that have undergone the energy efficiency rehabilitation. The thermal transmittance U values of the building envelope components of the above buildings constituted as follows: floor: 0.25 W/m²K; external walls: 0.33W/m²K; roof: 0.207 W/m²K; windows: 1.6 W/m²K.

In 2013 in **Kyrgyzstan**, the standards were revised towards increasing the energy efficiency classes of buildings from 5 to 7, which is in line with the EU Directives on Energy Efficiency in Buildings: 2002/91/EC and 2010/31/EC. In accordance with the building codes, the thermal requirements for multi-apartment buildings, depending on the number of storeys, ranged from 64 to 78 kWh/m². Monitoring showed that in 2014, 92 per cent of new building projects in Kyrgyzstan comply with new building codes (Rodina *et al.*, 2015).

The more recent assessment by the World Bank indicates that requirements for U-value of building structures for new buildings (not specified for residential or non-residential) include: external walls - 0.32 W/m²K; windows in external walls and doors - 1.5 W/m²K; flat roof: 0.20 W/m²K; ceiling with vertical thermal flow - 0.2.-1.70 W/m²K (World Bank, 2019).

HVAC

There are several types of systems used to provide heat in a building. Some heating systems share components with the building's cooling equipment, and some systems provide both heating and cooling. The broader term HVAC - heating, ventilation, and air-conditioning - describes the overall climate control system in a building.

No matter what HVAC system is used, the purpose is to tap the thermal energy from a fuel source and transfer it to living spaces to maintain a comfortable ambient temperature. “Different approaches to the design of building heat supply systems depend largely on the availability of energy resources, fuel prices, infrastructure, technological development, and relevant energy policy” (UNECE, 2019). Some buildings have more than one heating system, such as when an addition or finished basement is heated by a different system than the rest of the house.

Heat supply system technology is in a transition phase in the countries of the UNECE region (UNECE, 2019). Some examples of requirements for heating and hot water supply in new buildings in the Eastern European, Caucasus, Central Asian countries and the Russian Federation are illustrated below.

In **Belarus**, in the framework of the UNDP/GEF project, several buildings were constructed. The specific consumption of heat energy for heating and ventilation for the design operating conditions of the two buildings of the project was less than 25 kWh/m²a (which corresponded to class A+), and in the third building was less than 15kWh/m²a, which corresponded to the passive house standard.

The country's first energy-efficient building in Minsk had apartments equipped with a mechanical supply and exhaust ventilation system with heat recovery from exhaust air. The supply air is supplied through the air ducts to the living rooms, and the exhaust vents are located

in the kitchens and bathrooms. The ventilation units are located in the loggias. The building has been in operation since 2007. More than 70 per cent of the apartments use for ventilation the systems installed during the construction.

Energy efficient buildings in Minsk, Grodno and Mogilev built under the UNDP/GEF project had apartments equipped with a mechanical supply and exhaust ventilation system with heat recovery from the exhaust air. The supply air is supplied through the air ducts to the living rooms, and the exhaust vents are located in the kitchens and bathrooms. The ventilation units were located in the loggias. The buildings have been in operation since 2017. More than 50 per cent of the apartments used for ventilation the systems installed during construction.

In **Ukraine**, in the recent years, the individual heating units have been massively installed at multi-apartment and public buildings to regulate the heat demand and perform localized hot water preparation for the consumers, actively using electrical boilers for this purpose (KT Energy, 2020).

In the **Russian Federation**, the required heating energy intensity for new multistorey buildings is 77 kWh/m²a. About 78 per cent of heat consumption is generated by district heating. The remaining 22 per cent is produced by individual boilers, gas heaters, and traditional stoves. Demand for both district heating systems technologies and individual boilers is still expected to grow (PNNL, 2012).

In **Georgia**, on the contrary, the option for central heating systems is non-existent in newly constructed buildings (World Bank, 2020a).

As indicated in the draft National Sustainable Energy Action Plan of **Azerbaijan**, 166 heat sources were created in Baku and in regions of the country, 271 gasification projects were completed, heating systems were restored in 1828 residential buildings and 350 educational and medical buildings. “As a result of the work performed, the efficiency of heat supply has been significantly improved. Compared to 2011, the production of heat increased by 1.9 times in 2016 and amounted to 1235 thousand Gcal, the loss of heat energy decreased by 4.5 per cent, the gas consumption for the production of 1 Gcal of heat energy decreased by 5.9 m³/Gcal, and thus conditionally saved 7.4 million m³ of natural gas” (NSEAP, 2019).

The average space heat demand for multi-family apartment buildings in **Kyrgyzstan** (constructed after 2004) was 100-110 kWh/m²a (World Bank, 2015b).

For ventilation, air conditioning and cooling there are “modern building engineering systems that have a variable operating mode (ability to change parameters or characteristics during the operation of the system), allowing for the reduction of designed parameters of fresh-air, heating, cooling... These parameters must be optimally set to maintain proper ambient climate conditions, and to ensure efficient energy consumption” (UNECE, 2019).

In **Belarus**, the newly constructed multi-resident buildings in Minsk are equipped with a mechanical ventilation system which includes a heat exchanger. Supply air is provided in the living rooms while the exhaust air vents are located in kitchens and bathrooms. 64 per cent of the residents of those buildings didn't use other ventilation systems than the one installed, other used fans or classical ventilation through windows and doors to improve air ventilation and circulation. On the contrary, in city of Gomel', in the more recently constructed buildings the flats were not equipped with a ventilation system (GIZ, 2016).

In the **Russian Federation**, the use of air conditioning and ventilation has increased in recent years. The particular factors contributed to that rise: growing incomes and demand for comfort in buildings, and hotter summers in recent years. As the new legislation mandates

improvements in energy efficiency, there was an increased demand for HVAC equipment and controls (PNNL, 2012).

Appliances and equipment

The amount of electricity used by household appliances and other devices has increased nearly 3 per cent per year since 2010. “While energy policies have led to efficiency gains, especially for major household goods such as refrigerators and televisions, small appliances and plug-load devices globally are not aligned with the Sustainable Development Scenario, which requires that total energy consumption fall 40 per cent by 2025” (IEA Appliances, 2020).

This section provides examples of energy efficiency policies and their requirements for appliances and equipment in some countries of the South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation.

In **Montenegro**, as of June 2018, the energy efficiency labelling bylaws had been adopted for six groups of products. The rulebooks regulating the labelling of these product groups entered into force on 1 January 2017 for refrigerating appliances, televisions, dishwashers, lamps and luminaries; and on 30 June 2017 for washing machines and air-conditioners.

From 1 July 2018, the rulebooks regulating requirements for non-directional household lamps, fluorescent lamps and electric motors entered into force. From 1 January 2019, the rulebooks regulating requirements for directional lamps, LED lamps and related equipment; household washing machines; household tumble driers; household dishwashers; household refrigerating appliances; air conditioners and comfort fans; televisions; simple set-top boxes; external power supplies; electrical and electronic office; water pumps; glandless standalone circulators; and fans (ECS, 2018).

In the **Russian Federation**, the energy efficiency markings are based on the Order of the Ministry of Industry and Trade No 357, which contains rules for determining energy efficiency class of goods by producers and importers. It concerns: principal household energy-consuming appliances (such as TVs, refrigerators, washers) since 1 January 2011; computers, electronic devices and office hardware (such as fax machines, copiers) since 1 January 2012; and other goods (such as lifts used for the transportation of people, heating appliances) from 1 January 2013. “A” rating is considered the most energy efficient, while “G” rating is the least efficient. Additional A+ and A++ and A+++ classes can be assigned to extremely energy efficient items.

The energy efficiency class of appliance or equipment must be specified in the technical documentation attached to the product, on markings and on labels. Final definition of the energy efficiency class is the responsibility of producers and importers of the product (FINPro, 2014).

In **Belarus**, as of 2018, the national requirements on energy efficiency and energy labelling are implemented for a range of electrical appliances. The energy efficiency and energy labelling requirements are applicable to:

- cooling household devices, such as refrigerators, freezers and their combinations;
- electrical ovens, hobs;
- air conditioners with capacity up to 12 kW;
- dishwashers;
- washing machines;
- drying machines;

- non-directional household lamps, fluorescent lamps without integrated ballast, high intensity discharge lamps;
- household and office equipment such as cooktops, toasters, fryers, electrically operated knives, foodmills, coffee machines; printers; scanners; monitors; multimedia projectors; broadcasting receivers; video tape recorders; video recorder cameras; sound-recording devices; audio amplifiers; home theater systems; electric musical instruments; other equipment for sound and image record and playback;
- TV sets and TV monitors (as of 1 January 2019);
- microwave ovens (as of 1 January 2019).

The national regulations in Belarus require confirmation of the compliance of products with the established requirements for energy efficiency. Depending on the specific product category, a declaration of certificate of conformity should be obtained.

Since 2014, in the **Republic of Moldova**, energy labels are mandatory for 11 categories of household electrical products, including refrigerators, dishwashers, air conditioners, TV sets, ovens and kitchen hoods, water heating installations, enclosure heating installations, electric lamps and luminaires, washing machines, dryers, and vacuum cleaners (EEA, 2020).

Ukraine has developed a number of national standards and requirements for appliances. The key driver behind this legislation is Ukraine's initiative for deeper integration with the EU. In accordance with European Directive 2010/30/EC, Ukraine has implemented a system of energy standards and labels for household electric equipment. In 2008, the government approved technical regulation on energy efficiency for freezers. In 2013, energy labeling for freezers and washers was adopted. In 2015 it was also introduced for lamps and dishwashers. The government aims to include similar regulations for air conditioners, household tumble dryers, vacuum cleaners, and TVs (PNNL, 2018). Implementation of the energy labeling system is an important direction within National Energy Action Plan and EU-Ukraine Association Agreement (SAEE, 2017).

In **Azerbaijan**, there is no primary and secondary legislation on energy-related products. Once adopted, the law on the use of energy resources will require the implementation of policy instruments on energy labelling, and ecodesign requirements.

There is no information on energy savings that would be a result of the introduction of the ecodesign and energy labelling requirements but the energy savings are likely to be significant for all products. As indicated, in the recent assessment, potential energy savings from the introduction of minimum energy performance standards for residential refrigerators in Azerbaijan can include 0.44 TWh of annual electricity savings in 2030; and 2.4 TWh of cumulative electricity saving in 2030. Potential energy savings from the introduction of minimum energy performance standards for room air conditioners in Azerbaijan are to be 0.18 TWh of annual electricity savings in 2030; and 1.0 TWh of cumulative electricity saving in 2030 (UEAA, 2019).

Uzbekistan introduced mandatory requirement for energy marking and information on energy efficiency class in technical documentation and labels of home appliances as of January 2016. The decision was adopted based on the Resolution No. 8 of the Cabinet of Ministers of Uzbekistan "On additional measures to reduce production costs and reduce the cost of production in industry" (22 January 2015) which introduced a list of household electrical appliances imported and sold on the territory of country, which are subject to the requirement for mandatory energy marking and certification on the corresponding class of energy efficiency (from 9 April 2015). In line with it, the home appliances should have labels of energy efficiency of classes from A to G, where class A is the most energy efficient device, while G is the lowest. Similar to other reviewed countries, the marks should be included in technical documentation

of home appliances and their labels. The requirement is applied to refrigerators and freezers, household and laundering washing machines, air conditioners and fans, household electric ranges, microwave ovens, dishwashers, TVs, electric water heaters, heating electrical appliances, monitors, and lamps. Uzbekistan banned import and sales of home appliances, which have no information on the class of energy efficiency.

Lighting

Energy efficiency in the lighting sector provides with the required illumination level of the lighting scheme for the application it has been designed for, while consuming the least amount of energy. Energy efficient lighting can save electricity while maintaining good quality and light. Certain progress is being done by countries under the review to ensure energy efficiency standards for lighting.

For example, **Azerbaijan** has begun promoting energy efficient lighting. A proposal to Parliament to consider the minimum energy performance standards for lamps is aimed to prepare mandatory labels for lamps. Energy efficiency awareness raising campaigns through media and school programmes have been conducted in some cities. Baku planned to establish CFL collection points and to build a recycling facility for electronic waste. According to the UNFCCC report, “energy efficiency could be improved through application of efficient lighting...in commercial and residential sectors,” and replacement of traditional incandescents light bulbs with LED ones would help reduce energy consumption by 15-30 million kWh (UNFCCC, 2014).

Potential energy savings from the introduction of the minimum energy performance standards for lighting in Azerbaijan «include 0.16 TWh of annual electricity savings in 2030; and 2.1 TWh of cumulative electricity saving in 2030» (UEAA, 2019).

In the **Republic of Moldova**, in accordance with their National Energy Efficiency Action Plan 2013-2015 the increase of 20 per cent on customs duty was introduced for incandescent lamps and zero customs duty regime for efficient lamps (NEEAP 2013-2015).

Another example includes energy efficiency law in the **Russian Federation**, which in 2011 introduced a ban on the sale of incandescent bulbs of 100 watts and higher and later included a ban on all incandescent bulbs (PNNL, 2012).

In accordance with the plan of measures to improve energy efficiency of buildings and structures in the Russian Federation, the government approved the priority requirements for energy efficiency of buildings and structures, providing for the mandatory use of energy efficient lighting and individual heating units with automatic weather control from January 2018 during construction, reconstruction, and major repairs (Alekseev *et al.*, 2019).

Existing Buildings

Buildings are at the centre of our lives, and therefore the need for better quality of buildings is increasing. While new buildings are being constructed, the need for restoration and renovation of the existing buildings gains much more importance (Kogalniceanu, 2011). Retrofitting to high energy efficiency standards is possible and often environmentally desirable (Urge-Vorsatz *et al.*, 2012).

Building envelope

Residential buildings

South Eastern Europe

In **Albania**, the residential buildings constructed between 1983 and 1992 are considered problematic, as only 17 per cent of them have full insulation. Dwellings older than 60 years have very poor insulation, around 40 per cent of them lacking insulation completely. Buildings constructed 36-60 years ago and more represent 65 per cent of buildings with single-glazed windows (EDEN Center, 2018).

Over 85 per cent of buildings in **Bosnia and Herzegovina** are characterized by poor energy performance with a high coefficient of heat transfer of external heat layer, resulting in the inefficient end-use and estimated 30 per cent of energy loss (Zagora *et al.*, 2017).

On average, buildings in Bosnia and Herzegovina consumed more than 200 kWh/m²a, while households consume as much as 350 kWh/m²a (Mehinović & Strik, 2014).

In **Montenegro**, the analysis of energy consumption by households and data concerning the existing building stock revealed that the average energy consumption of residential buildings is decreased from 178 kWh/m²a in 2011 to 161 kWh/m²a in 2016. According to the Energy Charter assessment, this was partially achieved by introduction of the minimum energy performance requirements for new buildings in 2013 (ECS, 2018).

In **Serbia**, the residential buildings constructed before 1970 have almost no thermal insulation. Buildings constructed before 1980 have an unsatisfactory thermal insulation. And over 75 per cent of the building stock was constructed before 1980. For these buildings the largest energy savings are possible, up to 80 per cent (Acuner & Onaygil, 2015).

Residential buildings represent the biggest part of national building stock, and more than 90 per cent of them are single family houses. 59 per cent of these residential buildings are older constructions and characterized by excessive energy consumption, due to the absence or poor thermal insulation, or due to inefficient doors and windows (Nikolic *et al.*, 2020). The average energy consumption in residential buildings in Serbia was over 150 kWh/m²a (Šumarac, *et al.*, 2010).

The single-family ground floor houses in Serbia, built between 1946 and 1970, are made in a massive construction system with façade walls of 38 cm solid brick, plastered on both sides. The foundation floor construction is a concrete slab on the filling, with no thermal insulation. The windows are wooden two single pane sashes in wide casements, additionally equipped with external blinds. U-values for building original thermal envelope elements are for external walls: 0.97 W/m²K; windows: 3.5 W/m²K; ground floor: 1.7 W/m²K; roof: 2.65 W/m²K.

The construction of single-family house with two floors was massive between 1971 and 1980. These buildings are with 38 cm brick façade walls and concrete floors; the windows are wooden double sashed with single panes and wooden roller blinds. U-values for building original thermal envelope elements are for external walls: 0.97 W/m²K; windows: 2.8 W/m²K; ground floor: 1.48 W/m²K; roof: 2.65 W/m²K.

Additionally, the single-family houses with two floors, built between 1981 and 1990, have the façade walls are of 38 cm solid brick, plastered on both sides. Their minimal thermal insulation is installed in the key elements of the thermal envelope, including 5 cm insulation in the

external walls and 10 cm thermal insulation in the floor construction to the unheated attic. U-values for building original thermal envelope elements are for external walls: 0.5 W/m²K; windows: 2.8 W/m²K; ground floor: 1.48 W/m²K; roof: 0.32 W/m²K (Manić *et al.*, 2019).

Eastern Europe and Russian Federation

In **Belarus**, the standard building types, so-called ‘khrushchovka’, denominates the buildings of the first generation of constructed in the period of 1950s-1960s. At that time, little or no attention was paid to energy performance characteristics of the building, and energy efficiency was not considered. These buildings were constructed according to the Soviet norms and are characterized by high energy consumption. The average heat energy consumption in these buildings is usually between 150–200 kWh/m²a (ARCEE, 2013).

The difference in energy consumption between old constructed buildings and newer ones is quite visible. While building constructed in the 1990s consumes on average 150-200 kWh/m²a, the newer buildings consume on average 60 kWh/m²a (EaPGreen, 2016).

However, not all relatively recent constructions are more energy efficient in Belarus. For example, the residential building in Lida was constructed in 2000. The evaluated building had four storeys. The heated area was 1,432 m² and the thermal envelope was 2,650 m². Resulting from the complicated architecture and subsequent heat losses, the building final heat demand was calculated as 123 kWh/m²a. As per GIZ assessment, “thermal bridges contribute 19 kWh/m²a to the total heat losses, while windows and external walls 66 kWh/m²a. These represent 46 per cent of the total heat loss, followed by ventilation loss representing 29 per cent of the total losses. Additionally, losses due to thermal bridges, windows and external walls represent 66 per cent of the total transmission losses” (GIZ, 2016).

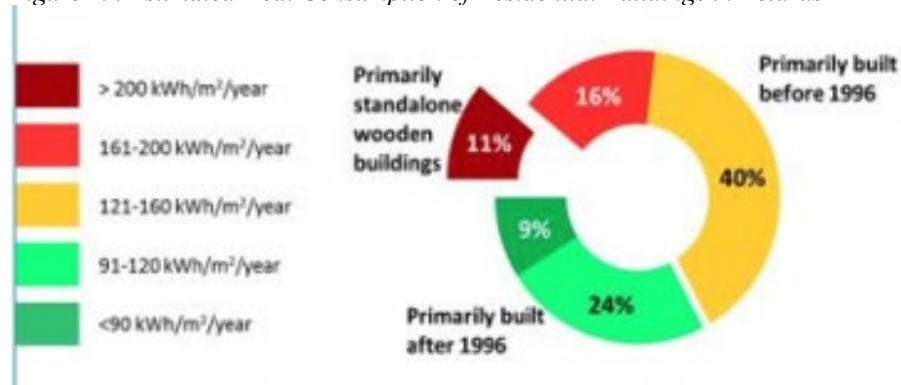
Another building in Minsk was refurbished in 2011. The heated area of the building was 3,055 m² and the thermal envelope was 3,905 m². The surface to volume ratio of the building is 0.5. The final heat demand of the building was calculated at 104 kWh/m²a when the external walls to the balconies were not insulated or 98 kWh/m²a if they were insulated. However, during the insulation, the windows were not replaced (GIZ, 2016).

According to World Bank conclusions (Fig. 19), around 11 per cent of residential building consume more than 200 kWh/m²a; a majority of existing buildings, around 40 per cent, consume 121-160 kWh/m²a; and only 9 per cent of buildings consume less than 90 kWh/m²a (World Bank, 2015c).

In the **Republic of Moldova**, the average share of spending for heating ranges from 15 to 50 per cent of the total household expenditures. Certain projects were implemented to increase energy efficiency of existing buildings by building envelope renovation and upgrading heating systems. It demonstrated that the potential for reducing energy consumption in existing buildings is about 30-50 per cent and may even reach 70 per cent in some cases.

The National Technical Standard has set the thermal performance (U value) for existing buildings of 15-30 years old as follows: external wall: 1-1.2 W/m²K; flat roof: 1.2 W/m²K; windows: 2.8-3.5 W/m²K.

Figure 19. Estimated Heat Consumption of Residential Buildings in Belarus



Source: Belarus: Scaling Up Energy Efficiency Retrofit of Residential and Public Buildings, World Bank, 2015

In **Ukraine**, there is still a large share of buildings with inefficient envelope, which corresponds to about 85 per cent of the buildings that were constructed during the Soviet time.

The energy savings potential in buildings and district heating include 2.3 bcm of natural gas for retrofits of multistorey buildings; and 4.7 bcm for retrofits of individual buildings (PNNL, 2018).

According to IEA, in the **Russian Federation**, the deep energy efficiency renovation in multistorey residential buildings could reduce energy consumption of these buildings by 50 per cent (IEA, 2014).

The Caucasus

According to an assessment in **Armenia**, the existing residential building stock includes:

- Most of Armenia's 19,195 buildings were built during the Soviet era, 35 to 60 years ago, where 73 per cent of all apartment buildings that are stone buildings were constructed in 1940s-1960s. Stone block apartment buildings have at least 3 or up to 5 upper floors and a basement. That type of apartment buildings is made from masonry of classical metric perforated stones. The standard thickness of the outdoor wall is 40-50 cm,. The walls have exterior lime-cement render with paint finish or generally exposed masonry. Additional, thermal insulation is almost not practiced at all. The heat energy consumption of that type of residential buildings varies from 150 to 180 kWh/m²a.
- Around 23% of the overall number of apartment buildings in Armenia is built with concrete prefabricated panels. All of these buildings were constructed in urban areas during the 60's, 70's and 80's The heat energy consumption of such residential concrete panel buildings varies from 140 to 210 kWh/m²a. Exterior walls have a thickness of approximately 35 cm. No insulation layer is present in these buildings.
- 6 per cent of the overall number of apartment buildings is constructed with monolithic concrete or concrete frame in the period from 1970s until now. Additional thermal insulation in these buildings is almost not practiced (OeEB,2013).

As an example of recently undertaken efforts, the thermal retrofit of a multi-apartment panel building in Yerevan reduced energy consumption from 178 kWh/m² to 74 kWh/m² (by 58 per cent) after thermal rehabilitation of the building façade (GIZ, 2019).

The energy saving potential in the residential sector in **Azerbaijan** was estimated about 6,732 kWh (UNECE, 2013).

The average energy consumption of residential buildings varied from 204 kWh/m²a in 2013 to 276 kWh/m²a in 2017. According to IEA, no minimum energy performance requirements were introduced for new or renovated buildings.

The total average energy consumption decreased by almost 20 per cent. This reduction was the result of (i) overall installation of natural gas and electricity meters; (ii) demolition of old and emergency low-rise housing stock and construction of new and comfortable housing instead, demolition of houses and withdrawal of territories for state needs for the implementation of infrastructure projects and the resettlement of residents in newly constructed buildings; (iii) actual application of new technologies, such as new construction materials, efficient boilers and windows, in the construction of new buildings and in the retrofitting of existing buildings (IEA Azerbaijan, 2020).

In **Georgia**, a large share of the housing stock was constructed between 1960 and 1990 in accordance with the Soviet standards and has very low thermal efficiency. It was made out of concrete blocks or panels which resulted in an increased share of the housing stock deteriorating. The standard thickness of the walls is 40-50 cm, usually without any thermal insulation. The main problem in buildings made of concrete panel is the “thermal bridges”. Buildings are of poor quality due to improper design and assembly. About 60 per cent of windows and doors in the block buildings in Tbilisi are of old, wooden construction and have to be replaced.

In Tbilisi, about 60-65 per cent of buildings are apartments, 20-25 per cent are individual houses, and the rest are a mixed kind of flat. In other cities, 40-45 per cent are apartments and about 40 per cent are individual houses. Energy demand for heating of buildings is in the range of 200-410 kWh/m²a (USAID, 2008).

According to USAID evaluation, the “majority of buildings built in Georgia have a thermal resistance that fluctuates between $R = 0.62-0.78$ (m². 0C .W-1); the higher the R-value is, the greater the insulation power is. If Georgia increased the R value to 2.1, it would eliminate half of the thermal losses of buildings...however, increasing Georgian buildings’ thermal resistance up to an average of $R=1.62$ is absolutely enough to significantly reduce thermal losses” (USAID, 2008).

Based on the above information, one can conclude that energy consumption of buildings in the Caucasus countries remains high and varies between 150 and 400 kWh/m²a depending on the type and years of construction of the residential building (Table 6).

Table 6. Average Energy Consumption of Residential Buildings in the Caucasus countries

Average energy consumption	Armenia	Azerbaijan	Georgia
	<i>Varies from 150 to 210 kWh/m²a</i>	<i>Varies from 204 to 276 kWh/m²a</i>	<i>Varies from 200 to 410 kWh/m²a</i>

Central Asia

In **Kazakhstan**, as per Energy Charter assessment, the consumption of heat by residential buildings equaled to 273 kWh/m²a (ECS, 2014). The estimates on thermal and technical characteristics of 70 per cent of buildings, especially those ones constructed between 1950s and 1980s, didn’t meet modern requirements.

32 per cent of the housing stock consists of the apartment blocks in need of various kinds of renovations, including repair of facades, roofs, tightening joints of wall panels. 2 per cent of

the housing stock is in an emergency state and requires demolition as it's unsuitable for further use (ECS, 2014).

In Nur-Sultan, old constructions represent approximately 20 per cent of the residential buildings, while 80 per cent has been built in the recent decade. Old apartment buildings have usually 9 floors, while new residential constructions have usually 12-16 floors (Astana, ESMAP, 2017).

In Almaty, the consumption of residential and public buildings amounted to 250 kWh/m²a (Almaty, ESMAP, 2017).

In order to explore energy efficiency potential, the energy audit of 586 residential building have been conducted across the country. The reports indicated that most buildings had high potential for energy efficiency improvement, since majority of them “had poor insulation properties, heating pipes were uninsulated, automated heat supply stations were absent, among many other deficiencies. In Kazakhstan, despite its more severe climatic conditions, walls have poorer insulation properties, with U value of 0.85-1.2 W/m²K” (Kerimray *et al*, 2017).

In **Kyrgyzstan**, the modern construction is characterized by excessive consumption of energy resources, “with the use of construction structures and materials that are ineffective in terms of energy consumption, as well as the use of projects of buildings and residential buildings with high heat losses, and low quality of construction work” (Arkhangelskaya, 2014).

In **Tajikistan**, the energy audits indicate that there is a significant energy saving potential in residential buildings, estimated between 30 to 40 per cent (UNECE, 2017a).

According to USAID, the majority of existing buildings in Dushanbe did not conform to the modern insulation standards. Results from the pilot project in Tajikistan indicated that based on thermal characteristics of the building's envelope, the requirement for heat energy of the building was estimated as 148 kWh/m²a. The coefficient of heat transmission (U value) was 1.49, whereas existing norms stipulated that U-value of residential building's envelope should be 0.65 (USAID, 2012).

The estimation from the Copenhagen Centre on Energy Efficiency indicates that specific energy use for space heating should be between 203 and 220 kWh/m², taking into account inefficient space heating systems, poor windows and the poor energy performance of building envelopes (with lack of insulation). “In multifamily buildings in Dushanbe, where electricity is used for space heating, specific energy use was assessed at close to 140 kWh/m²a, with underconsumption during winter peaks. For single-family houses with less efficient space-heating systems it should be much higher, close to 220-244 kWh/m²a” (C2E2, 2015).

In **Turkmenistan**, the majority of residential buildings were constructed between 1960 and 1991, with four to nine storeys and walls made of brick or cement panels. The residential sector is considered a major electricity consumer, at 29 per cent, including around 15 per cent consumed by the urban population and 14 per cent - by the rural population. Average specific energy consumption per square meter of residential floor space is 36.21 kWh/m² (C2E2, 2015).

In **Uzbekistan**, the use of obsolete heat-insulation materials, inadequate engineering designs and inefficient heat supply systems led to the energy consumption in buildings 2-2.5 times higher than in most developed countries. For example, in 2011 energy consumption by living space was 423 kWh/m²a. Nearly 50 per cent of heat loss is due to inefficient windows, doors, ceilings and walls, which led to energy consumption of 320 to 690 kWh/m²a (UNECE, 2015).

The most effective way to improve energy efficiency of residential buildings in Uzbekistan is the use of modern construction solutions using thermal insulation materials. The use of proper heat-insulating materials can lead to energy savings of more than 70 per cent. In the conditions of Uzbekistan, three main directions can be distinguished to improve the thermal insulation properties of enclosing structures: (i) use of basalt fiber for heat insulation; (ii) insulation of external walls through the use of polymeric materials (foamed polyurethane foam, expanded polystyrene); (iii) application of new building materials with low thermal conductivity, such as foam concrete and aerated concrete (EESJ, 2019).

Based on the above information, one can conclude that energy consumption of buildings in the Central Asian countries remains high. Examples from a few countries show that it varies between 140 and 423 kWh/m²a (Table 7).

Table 7. Average Energy Consumption of Residential Buildings in the Central Asian Countries

Average energy consumption	Kazakhstan	Tajikistan	Uzbekistan
	Varies from 250-273 kWh/m ² a	Varies from 140-240 kWh/m ² a	Varies from 320-423 kWh/m ² a

Non-residential buildings

Public buildings in **Bosnia and Herzegovina** are rather old, and majority of them were built before the late 1980s with very weak energy standards (Dozic, 2017).

In the **Republic of Moldova**, approximately 90 per cent of the building stock, including institutional buildings, needs a major retrofit to implement basic energy efficiency measures as such:

- Wall insulation with mineral wool, with saving potential 50 per cent;
- Windows replacement, with saving potential 14 per cent;
- Implementation of individual heating substation for buildings connected to district heating, with savings potential 10 per cent;
- Implementation of new internal heating systems (two pipes, thermostats), with savings potential 15 per cent.

Energy saving potential in **Ukraine** by retrofits of public buildings is 0.3 bcm of natural gas (PNNL,2018). According to the NEEAP, the energy saving potential in pre-school facilities is 66.6 per cent against the current energy consumption and in secondary schools this indicator is 61.7 per cent. This result can be achieved through 100 per cent energy efficient modernization of buildings, replacement of windows and automation in buildings belonging to public facilities. Technical potential of energy efficiency in preschool and secondary education facilities is 712.5 ktoe. Potential reduction of total energy consumption is 104.4 ktoe by 2020 (Draft NEEAP).

In **Armenia**, the energy saving potential by thermal insulation of municipal buildings was estimated at 0.67 million GCal (USAID, 2007). The projects implemented by Armenia Renewable Resource and Energy Efficiency Fund, included energy efficiency improvements carried out on 124 public and social buildings. The results included average energy savings of more than 50 per cent. According to IEA, these efforts translated into energy savings of 540 million kWh and 145 tonnes of CO₂ emissions (IEA Armenia, 2020).

In **Azerbaijan**, the renovation measures of six buildings, undertaken in the framework of the NAMA project, included the insulation of the building envelope, roof and basement and the installation of new efficient windows and lighting. The energy audit conducted after those measures revealed 50 per cent energy saving potential as a result of the thermal renovation of

existing public buildings (IEA Azerbaijan, 2020). Another example includes the UNDP project in the framework of which six office buildings of the state oil company SOCAR in Sumgayit and two settlements near Baku were upgraded in 2017. Their energy consumption was reduced by 30 per cent.

In **Georgia**, majority of buildings in Tbilisi were constructed between 1960 and 1990, and approximately 10-15 per cent of them are in poor condition. While the energy efficiency potential of building stock is large, there is no building energy code in place, and therefore there is a lack of energy performance regulations for new construction.

In **Kazakhstan**, the municipal buildings in Nur-Sultan account for 7 per cent of the building stock in the city. Municipal buildings are the largest energy consumer per square meter among the entire building stock in the city - 290 kWh/m². Public buildings in Nur-Sultan have 50 per cent energy savings potential (Astana ESMAP, 2017).

In **Kyrgyzstan**, approximately 70-88 per cent of energy use in public buildings can be attributed to space heating. Electricity is used for space heating in 60 per cent of all public buildings. The overall energy savings potential for implementation of energy efficiency measures amounts to 50–60 per cent of total energy consumption, or 500 GWh/year (World Bank, 2019).

Most public buildings in **Tajikistan** are characterized by low energy efficiency due to (i) poor technical conditions, (ii) insufficient thermal insulation of outside walls, top and first floors, and (iii) high air permeability through windows and doors. The internal heating systems of buildings connected to district heating systems or boiler houses are in poor condition, which leads to uneven heating within buildings, and thus contributes to underheating (UNECE, 2017a).

HVAC

The heating requirements depend on climate conditions. In cold moderate climates the residential buildings may use more energy for heating. In moderate climate regions the heating loads may significantly decrease “due to the combined effect of advanced knowhow in building construction, building insulation performance, and an increase in internal heat loads.” The impact of warming depends on several factors, such as “fuel and conversion efficiencies for heating fuels and power generation, building design, efficiency, and operation” (Urge-Vorsatz *et al.*, 2012).

The choices about cooling technology also prove to be increasingly important. It depends on income, building design, culture, and external temperature. A stock of residential, municipal or commercial buildings can even be designed to be non-air-conditioned and use only ceiling fans to provide thermal comfort. This translates to a lower energy usage for cooling in such buildings.

At the same time, changes in summer temperatures tend to increase the load on electricity systems used for cooling, and therefore increase the need for power generation capacity. The increases in electricity demand for air conditioning and cooling, however, may be “outweighed by reductions in the need for heating energy up to 2050, while warming is moderate and no thermally advanced buildings are considered” (Urge-Vorsatz *et al.*, 2012).

The examples of requirements for heating and hot water supply as well as air conditioning and cooling in the existing buildings in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia and in the Russian Federation are provided below.

Residential buildings

South-Eastern Europe

In **Albania**, a stove is the most typical heating system, used by 63.3 per cent of population, followed by electric heaters at 8.5 per cent and air heat pumps at 6 per cent. Only 3.2 per cent of the private households have district heating (Simaku, 2017). Biomass is also used for heating in 12 per cent of households (EDEN Center, 2018).

In **Bosnia and Herzegovina**, the average energy consumption for heating in residential buildings is 200 kWh/m²a (OeEB, 2015). According to the Energy Charter assessment, the district heating systems are used only for space heating, but not for supply of hot water (ECS, 2012).

In **Montenegro**, the residential buildings are heated and cooled by individual systems such as air conditioners, including air source heat pumps, individual boilers for apartments or houses and biomass stoves (ECS, 2018).

Electricity and wood are the most typical energy sources used for heating and hot water production. The households' hot water is produced using an electric boiler. 54 per cent of households are also equipped with mechanical cooling systems. Most of the cooling units are reversible, thus they can also be used for heating (REC, 2015).

In **North Macedonia**, most of the heating systems in the residential buildings are inefficient. Heating is typically provided by three sources: 64 per cent by biomass, 25 per cent by electricity, and only 9 per cent by district heating (latter only in Skopje) (World Bank, 2019a).

In **Serbia**, most multi-family buildings are connected to district heating. Some apartments have built-in electrical storage devices for water heating of 50 to 80 liters with electric water heaters with individual power of 2 kWe. In buildings constructed after 2010, there are distribution pipelines installed in corridors outside the living space and calorimeter housed in the floor cabinet for each apartment. After 2005, a number of newly constructed buildings were also connected to the gas distribution network, and gas boilers were installed in each of these buildings for space heating and hot water (EU, 2020).

The energy consumption for heating and cooling in buildings is high. Majority of Serbian district heating network is supplied by gas, 71 per cent of which is imported (BPIE, 2018). Biomass is also used for heating, followed by coal. Solar and geothermal sources are negligible (REC, 2015).

In residential buildings, the net heat demand for domestic hot water is 10 kWh/m²a for single-family houses and 20 kWh/m²a for multi-family houses on the basis of heated floor area. Around 27 per cent of households use air conditioning systems, while at least 20 per cent of households have space-cooling systems (REC, 2015).

Eastern Europe and the Russian Federation

In **Belarus**, the energy consumption for space heating and water heating in multifamily buildings depends on the building's age and type. For buildings constructed before 1993, specific energy consumption was 230 kWh/m²a; for buildings constructed after 2009 130 kWh/m²a. For energy-efficient buildings it was set at 70 kWh/m²a (C2E2, 2015).

Three types of heat supply and provision exist in Belarus, including district heating, individual natural gas boilers, and individual wood and coal boilers and stoves. While urban households

are mostly served by district heating systems (80 per cent of urban households), the rural households use individual boilers and stoves (around 85 per cent of rural households). District heating supplies heat and hot water to 61 per cent of the households (World Bank, 2015c).

In the **Republic of Moldova**, around 95 per cent of population of Chisinau have access to district heating. In the other cities, only a few residential consumers have access to district heating, as it is mainly supplied to public buildings. After district heating was cut off in most cities, the individual heating systems were installed and are operating with different fuels.

In 2020, according to a study carried out in Chisinau, a public or building heated from district heating network has the annual energy consumption of thermal energy of 112 kWh/m²a. For buildings that use natural gas the consumption was 157 kWh/m²a, at an average efficiency of boiler of 92 per cent. For buildings heated from biomass - 235 kWh/m²a. The efficiency of the boilers was 75 per cent.

According to IEA estimations, about 43 per cent of households in **Ukraine** are connected to district heating networks. The remaining households have individual heat supply systems, such as individual gas and electric boilers. Additional heat is produced by autonomous and individual boilers for 25 per cent of households and the rest - by stoves (IEA, 2015).

Natural gas still remains dominant for district heating, while use of biomass for heating is growing. “Ongoing district heating energy efficiency projects aim to balance current reduced heat loads with existing heat generation and transportation facilities, further centralise district heating and upgrade major technological equipment” (KT-Energy, 2020).

Implementing energy efficiency in residential buildings in Ukraine can substantially reduce district heating costs. Replacing windows and exterior doors, installing more efficient insulation in roofs and external walls, glazing balconies, and installing heat-cost allocators can reduce energy consumption and lead up to 40 per cent reduction in end-use energy consumption (World Bank, 2012).

In the **Russian Federation**, the specific consumption of heat energy in residential apartment buildings increased by 4 per cent and amounted to 0.222 Gcal. For high-rise multi-family buildings, it was 229 kWh/m²a. Some estimates indicate that rehabilitating existing housing stock can reduce the energy intensity to 151 kWh/m²a (Meshcheryakova, 2018).

A small percentage of the buildings constructed after 2000 are in compliance with new thermal insulation standards and meet modern thermal performance and heat efficiency requirements. However, most existing buildings have much lower parameters of space heating efficiency (PNNL, 2012).

Buildings constructed before 1990 are with hot water energy intensity between 0.08 and 0.18 Gcal/m²a. By renovating these buildings the intensity of 0.06 to 0.08 Gcal/m²a can be achieved. Buildings constructed between 1990 and 2000 achieve between 0.04 to 0.06 Gcal/m²a (PNNL, 2012).

The Caucasus

In **Armenia**, the district heating is not widely used because the existing facilities are in critical condition. This happened due to a lack of maintenance and damage sustained in the 1988 earthquake. For individual space heating around 70 per cent of population uses natural gas, 23 per cent uses electricity and a minor percentage uses firewood (OeEB, 2013a).

According to IEA and based on the household survey, less than 40 per cent of households claimed to be “comfortable” in winter, nearly half are merely “close to comfortable” and more than 9 per cent indicated the “hardly cope”. The survey results also indicate that discomfort due to insufficiently heated houses is more prevalent in other cities and villages than in the capital (IEA Armenia, 2020). The Integrated Living Conditions Survey in Armenia concluded that the households in Armenia used natural gas (40.2 per cent); wood (35.9 per cent); and electricity (18.5 per cent) for heating (GIZ, 2019).

For water heating, in rural areas, during the heating season, 62 per cent of households used natural gas, 22 per cent heated with wood, 10 per cent used electricity (GIZ, 2019).

The residential buildings have a higher heat energy demand due to poor insulation and building aging. According to UNDP, the average heating energy demand in multi-apartment residential buildings is 185 kWh/m²a. However, with cost-effective energy efficiency improvements the energy use can be reduced by 40 per cent (UNDP, 2014).

According to IEA, 10 per cent of the population in Yerevan has an air conditioning unit. In other cities this figure is up to 5 per cent only. However, cooling is one of the fastest-growing sources of the energy demand in the country resulting from recent increases in average temperatures (IEA Armenia, 2020).

In **Azerbaijan**, a share of district heating in the residential sector is low. Only 2.6 per cent of residential buildings have access to district heating services (IEA Azerbaijan, 2020). Residents mostly use natural gas for space heating and cooking due to its cheap price. The gas fired mini-boilers called "combi-systems" are popular in Baku. They are used for both surface heating and hot water supply. In rural areas, wood, kerosene, and electricity are used for heating (OeEB, 2013b).

According to the Copenhagen Centre on Energy Efficiency, the average energy consumption in the multifamily building estimated at 209 kWh/m²a, while the economic energy saving potential in residential retrofits can be yielded in natural gas (75 per cent) and electricity (25 per cent).

After the collapse of the Soviet Union, the district heating was abandoned and individual heating and air conditioning systems were introduced in apartment buildings and houses in **Georgia** (OeEB, 2015). The district heating network in Tbilisi and other cities is not used due to fuel shortages and lack of maintenance of the distribution network.

Natural gas, electricity, and biomass are used for heating and hot water supply (OeEB, 2015). Fuel wood is used in rural areas in places where there is no gas distribution network (USAID, 2008).

The level of specific energy consumption for space heating in Tbilisi buildings varied between 125 kWh/m²a according to the USAID and 160 kWh/m²a (around 140 kWh/m²a in apartment buildings and 180 kWh/m²a in private housing). Overall, space heating is responsible for about 70-80 per cent of residential energy consumption.

Central Asia

In **Kazakhstan**, based on the IEA data assessment, energy consumption per floor space was 241 kWh/m²a. Consumption of district heating is the highest among buildings energy services with an average of 185 kWh/m²a. Consumption of hot water in buildings is at an average of 67 kWh/m²a (Kerimray *et al.*, 2016).

According to Energy Charter assessment, majority of existing housing stock consists of apartment blocks with central heating based on boiler houses. Thermal modernization of housing stock will allow a reduction of up to 20 per cent of consumed heat (ECS, 2014).

The residential sector is the main consumer of district heat (57 per cent of total heat) in Nur-Sultan. All its residents are connected to electricity network and most of the multi-storey residential buildings are linked to the district heating system (Astana ESMAP, 2017). However, due to cold weather, poor insulation and waste of energy, Nur-Sultan has high heat consumption per square meter.

In Almaty, the residential sector is also the main consumer of district heat - 63 per cent of total heat (Almaty ESMAP, 2017). Not all buildings there are connected to the district heating system. Single-family houses have individual heating systems based on natural gas.

Overall, rural households in Kazakhstan have lower access to district heating and gas network and are usually heated by coal or wood. In urban and suburban areas, some households have access to district heating or network natural gas (Howie & Atakhanova, 2017).

In **Kyrgyzstan**, the average space heat demand for residential buildings constructed between 1940 and 1960s is 100-143 kWh/m²a; and for buildings constructed between 1960 and 1980s is 130-143 kWh/m²a. The specific demand for hot water in residential buildings in Bishkek is on average 50 kWh/m²a (World Bank, 2015b).

In **Tajikistan**, the data on connection to heating system vary. According to USAID assessment, around “67 per cent of the city buildings are connected to the central heating grid, yet the real number is only 52 per cent, of which according to the most optimistic estimation only 15-25 per cent is heated from the grid” (USAID, 2012). According to UNEP-DTU, around 1 per cent of residential consumers have access to district heating (C2E2, 2015).

The World Bank indicates that single-family houses in urban areas are heated using coal, electricity and wood. Apartment buildings in the cities use mostly electricity for heating. Rural dwellings are mostly heated by coal, electricity, wood, dry dung, and cotton stalks (World Bank, 2014).

In **Turkmenistan**, around “60 per cent of the urban population has access to pipeline water supply round the clock, while others only for six to eight hours a day. Specific water consumption per person is 323 litres/day, and the minimum consumption limit is 250 litres/day” (C2E2, 2015).

In **Uzbekistan**, about 43 per cent of the housing stock is provided with district heating, “yet the operational lifespan of most district heating systems has been exceeded, challenging the ability to ensure stable central heating and hot water supply” (UNECE, 2015).

Two thirds of residential energy consumption is related to space heating. Average total energy consumption for space heating of the whole buildings stock was 0.121 Wh/m²/degree days of the heat supply season, 0.035-0.065 Wh/m²/degree days for multifamily buildings, and 0.136 Wh/m²/degree days for single-family houses (C2E2, 2015).

Average energy consumption for domestic hot water per household is 807 kgce/year due to a large size of households and inefficient water heating equipment. In multifamily houses, energy consumption for hot water purposes is 80 to 100 kgce/m²a (C2E2, 2015).

One of the options in increasing energy efficiency of buildings in Uzbekistan can be use of modern technologies of public services, for example, introducing a “closed” domestic hot water

system and use of an independent heating system in heat supply systems. According to preliminary calculations, this will lead to the saving natural gas up to 62.59 million m³/year, and electricity up to 17128.53 thousand kWh/year (EESJ, 2019).

Non-residential buildings

Energy consumption for heating in the non-residential buildings in **Bosnia and Herzegovina** is large and equivalent to 220 kWh/m²a in public administration and 572 kWh/m²a in health sector (Dozic, 2017).

Commercial buildings in **Montenegro** are usually equipped with a district heating system based on light fuel oil, electricity, coal or biomass (ECS, 2018).

In **Azerbaijan**, the standards for quality of ventilation in public buildings, such as schools, are established but not for energy efficiency of equipment (Kolar & Rzayeva, 2013).

The vast majority of public buildings in the **Republic of Moldova** are under-heated and use 60-70 per cent less energy than required to ensure thermal comfort of 20-22°C (GCF, UNDP). Consequently, the average energy consumption for heating of public buildings is 80-100 kWh/m²a.

The **Russian Federation** has the world's largest district heating infrastructure, with 70 per cent of water boilers and 66 per cent of district heating networks constructed before 1990. Therefore, the average heat boiler efficiency is around 73 per cent (PNNL, 2012). The average heat intensity of existing buildings was 229 kWh/m²a. For new buildings, it is around 77 kWh/m²a, while retrofitted buildings averaged 151 kWh/m²a. (Millhone, 2010).

In **Kazakhstan**, the municipal buildings in the cities have high heat consumption - between 200 kWh/m²a and 250 kWh/m²a (World Bank, 2018). Heating accounts for 84 per cent of the energy consumed in public buildings in Nur-Sultan. All public buildings are connected to the district heating network (Astana ESMAP, 2017).

In **Kyrgyzstan**, the specific heat demand in non-residential buildings was 30-66 kWh/m³/year for educational buildings; 36-40 kWh/m³/year for health facilities; and 45-50 kWh/m³/year – for administrative buildings (World Bank, 2015b).

Appliances and equipment

The growing use and rapid turnover of household electronics is an emerging problem that comes on top of the energy use of traditional household appliances (Urge-Vorsatz *et al.*, 2012).

According to IEA, the “electricity consumption by household appliances continues to increase. It reached over 3 000 TWh in 2019 and accounted for 15 per cent of global final electricity demand, or one-quarter of electricity used in buildings. Demand is driven by rising ownership of connected plug-load devices... Mandatory Energy Performance Standards cover one-third of the energy used, mainly for large household appliances, but smaller plug loads, including consumer electronics, are less well regulated” (IEA Appliances, 2020).

This study will look at some examples of energy performance of appliances and equipment in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia and in the Russian Federation.

In the countries of South-Eastern Europe the regulatory measures are being implemented. They transpose the EU Directives 2006/32/EC, 2010/30/EU and 2010/31/EU.

For example, **Albania** introduced mandatory labelling of appliances in 2009, but the enforcement is required through ensuring the minimum performance standards and market monitoring (Kogalniceanu, 2011).

In **Bosnia and Herzegovina**, modern appliances, such as refrigerators, freezers, ovens, stoves, and washing machines, use significantly less energy than older models. However, due to low electricity prices, energy efficiency is not the primary driving force for replacement of existing electric appliances (OeEB, 2015).

In **Serbia**, the products that consume electricity must have the prescribed energy labels. This is primarily related to home appliances, such as washers and dryers, dishwashers, refrigerators, televisions, air conditioners, electric lamps and light fixtures. These products consume at least one-fifth of the total amount of electricity that households need (SCEE website).

The Russian Federation also adopted standards and labels for a number of appliances. However, the list of “products subject to energy labelling is relatively narrow, excluding electric kettles, coffee machines, irons, vacuum cleaners, gas ovens, audio equipment, computers, and other household and office devices, which account for a significant proportion of total energy demand of the building sector” (IEA, 2014).

In **Armenia**, the device ownership and usage levels are relatively low. Most households have stoves, refrigerators, washing machines and TVs. However, fewer households own microwaves and dishwashers. Computers are existing in approximately three-quarters of households (IEA Armenia, 2020).

Armenia has introduced energy labels (labels scale: A to G) in line with the EU regulations, however, only for refrigerators/freezers, washing machines and air conditioners. Armenia has committed to introduce other EU-based energy labels in the coming years, however, has also agreed to introduce energy labels as defined by the EurAsian Economic Union (EEU).

In **Azerbaijan**, replacement of appliances with the most efficient models can potentially save 0.206 Mtce. According to IEA, the use of some appliances increased significantly in the period of 2010-2018. For example, use of dishwashers increased 200 per cent; use of computers increased almost 140 per cent. The refrigerators and TVs use did not increase much (IEA Azerbaijan, 2020).

Lighting

IEA assessed that in 2019 the “LED sales reached a critical milestone, achieving a record number of sales of more than 10 billion units, including both light sources (bulbs, tubes, modules) and luminaires” (IEA Lighting, 2020).

In recent years, **Armenia** has made considerable progress in converting to LED lighting. However, precise data on LED use is currently not available.

In **Georgia**, efficient lighting has the potential for significant energy tariff reductions. According to the National Energy Efficiency Action Plan (2019-2020), there is a large market potential for implementation of energy performance contracting in public sector lighting – with potentially over EUR 90 million in investment required and typical internal rate of return of over 30 per cent. Specific steps will need to be taken to establish this market.

In the **Russian Federation**, the efforts to phase out inefficient lightbulbs have been undertaken. The Federal Law No. 261-FZ prohibits production, importation and sales of incandescent bulbs

of 100 watts or more. It additionally prohibits purchase of incandescent bulbs of any capacity used for lighting for public needs (IEA, 2014).

The requirements connected with lighting in residential and municipal buildings in **Kazakhstan** are defined by the construction codes (SNiP RK 2.04-05-2002 "Natural and artificial lighting"). It particularly defines that the most economic gas discharge lamps with luminous efficiency not less than 55 lm/W should be used for general artificial lighting of internal spaces (ECS, 2014). As an example of the implemented actions to enhance energy efficiency, in Nur-Sultan, around 20 schools changed their lighting system to LEDs (Astana ESMAP, 2017).

According to the World Bank, in **Tajikistan**, electricity and candles are the main sources of lighting in both urban and rural areas. In winter during unstable electricity supply, households use lanterns that work on batteries and can be recharged using electricity when it is available. In rural areas, some households have generators to supplement system-supplied electricity for lighting and television (World Bank, 2014).

COMPLIANCE MECHANISMS

Building energy codes serve as a major policy tool for reducing the required amount of energy for heating, cooling, water heating, and lighting in the building. Existing practices in many countries show that building energy codes are of two major types:

- prescriptive codes, which set separate energy performance levels for major envelope and equipment components; as well as
- overall performance-based codes requiring that a building's predicted energy demand or energy cost is equal to or lower than a baseline target that has been specified by the code (Urge-Vorsatz *et al.*, 2012).

According to the IEA, the prescriptive building energy codes set minimum energy performance requirements for each building component and include permissible levels of heat loss for windows, roofs and walls, efficiency levels for heating, cooling and lighting equipment (IEA, 2013). In other words, such codes offer a prescriptive compliance path set performance requirements (Evans *et al.*, 2017) and specify the required minimum or maximum values for discrete components or features of a building (Evans *et al.*, 2014).

Most building energy codes focus on the prescriptive path because of its ease of application. As it offers a possibility for designers and builders to easily determine what they need to do to comply with prescriptive requirements and validate compliance (Evans *et al.*, 2014). Such standards are simple to follow and assess.

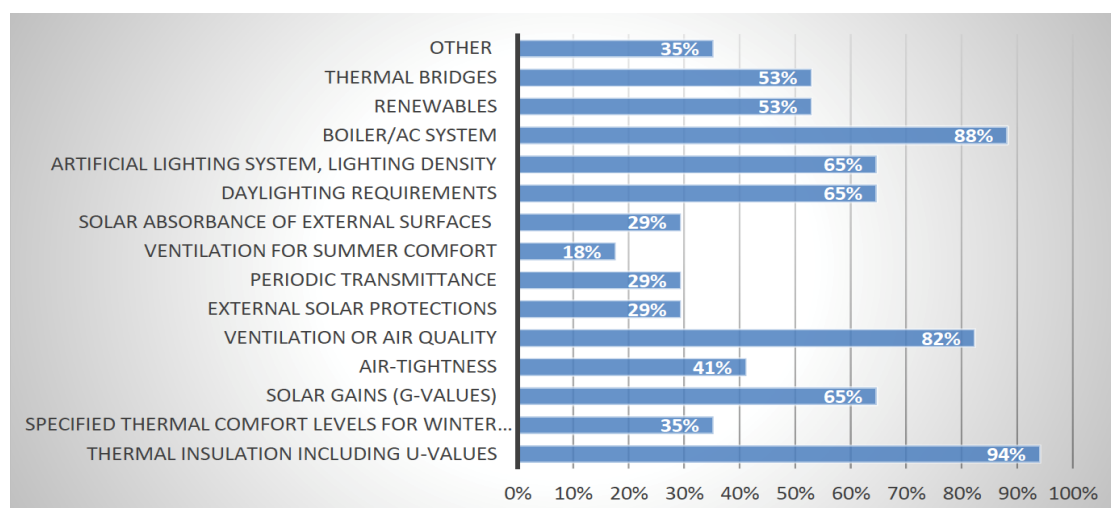
The prescriptive method sets requirements for a thermal value (U-value) for windows, roofs or walls; include efficiency values for technical installation, ventilation, orientation of buildings, solar gains, the number and size of windows. "To comply with a prescriptive standard, each part of a building must meet its specific value. A simple version of a prescriptive building energy code set thermal values for the essential 5–10 building parts. In the most complicated systems, energy efficiency requirements are set for all parts of building and installations, including heating installation, cooling units, pumps, fans, and lighting. In some cases, these requirements are even adjusted according to size of the equipment or the size or percentage of windows based on floor area or the outer wall" (UNECE, 2018)

However, prescriptive codes have limitations. They limit flexibility in design and "they do not address issues such as building geometry as a function of volume or floor area" (Evans *et al.*, 2014).

The countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and the Russian Federation introduced prescriptive technical requirements in their building energy codes.

According to the UNECE study, “a large majority of the UNECE countries have requirements for thermal insulation including U-values (94 per cent), followed by boiler/AC system (88 per cent) and ventilation or air quality (82 per cent). Lighting density, daylighting and solar gains (G-values) are equally distributed (65 per cent) with both renewables and thermal bridges representing 53 per cent” (Fig 20).

Figure 20. Specific Prescriptive Technical Requirements in Building Energy Codes



Source: Mapping of Existing Energy Efficiency Standards and Technologies in Buildings in the UNECE Region, UNECE, 2018

To demonstrate compliance with building energy codes, developers can follow one or more compliance paths (IEA, 2013) and thus make implementation mechanisms more robust.

For example, a simple trade-off compliance path also exists and is similar to the prescriptive one but allows some substitution among code components. Such approach allows more flexibility in compensating between energy requirements of building envelope components when prescriptive requirements can't be met. This method can be used if a building exceeds prescriptive window-to- exterior wall area allowance or if the designer prefers the reduced insulation levels for any of the building envelope components (Evans *et al.*, 2014).

Another path - a simulated performance compliance - relies on building energy simulation software to simulate energy use in a designed building, which is compared either to a reference building or to a specified requirement. However, implementation of building energy codes that rely on such path requires adequate training to ensure that software is used properly, and that buildings' actual characteristics correspond to the simulated ones.

Performance standards are usually more complicated but allow a designer to vary building characteristics and comply with the overall requirements. Such codes require the overall building to be considered as one single system. «Factors to consider in the calculation methodology include: the building form and orientation; daylight, solar gains and shading; the share of glazed areas; building inertia; thermal bridges; natural and mechanical ventilation; indoor comfort; internal loads from appliances, equipment and occupants; the performance of different building components and equipment; and the use of renewable energy sources and automatic controls” (UNECE, 2018).

The performance path for compliance allows designers more flexibility in that one energy-saving measure can be traded for another. “If, for example, the wall insulation does not meet the prescriptive requirements in the code, yet the HVAC system exceeds the prescriptive requirements, then the applicant can demonstrate compliance of the whole building with the code using a performance equivalency method” (Evans *et al.*, 2014). This approach is more commonly used by countries, however, it does not regulate actual building energy use as different similar buildings would not necessarily have the same anticipated energy use.

Some authors argue also for the outcomes-based approach which focuses on the energy used during the operation of the building rather than building design specifications. This approach is based on actual energy usage of the building. Contrary to prescriptive approach, here if building is supposed to use some amount of energy but uses more than that, it fails to comply with an outcomes-based approach. It is, however, more difficult to comply with the outcome-based building energy code as building simulation software may not capture the effects of occupant behavior (consumption of energy) and thus it is more difficult to design a building determining what amount of energy the building should use.

Many countries actually offer several paths for building energy code compliance to ensure that different types of users can ensure compliance, including those who need design flexibility, and those who prefer to avoid complexity of conducting high-quality building simulation (Evans *et al.*, 2017). Depending on the compliance path (Table 8), some implementation mechanisms might be more important in one country than others.

In the UNECE region,¹⁰ according to the survey on building energy codes, “90 per cent of respondents confirmed the existence of performance-based requirements for new buildings, followed by 77 per cent for existing buildings and 33 per cent for energy efficiency development systems” (UNECE, 2018).

Table 8. Compliance Paths of the Building Energy Codes that Regulate Design and Construction of Building

	Prescriptive	Simple trade-off	Simulated performance
Compliance path	Specifies minimum or maximum values for discrete components or features of a building	Compliance of envelope with the code is demonstrated using simulation software	Compliance of whole building with the code is demonstrated using energy simulation software

To help countries with building energy code compliance, the complementary policies can serve as an effective mechanism. They can include workforce development initiatives as well as benchmarking and disclosure, audit, and retro-commissioning policies.

The requirements for regular inspection of heating and air conditioning systems included in the building energy codes can serve as an example of such policy. According to the UNECE survey, 66 per cent of respondents from its all member States indicated that such mandatory requirement was included in their country’s building energy code (UNECE, 2018).

The situation with these requirements differs in the countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation. For example, in Montenegro, North Macedonia, and Serbia the inspection is required and mandatory for heating and air conditioning systems, while in Albania and in Bosnia and Herzegovina it is not. The situation in the Eastern European countries differs from country to country: in the Republic of Moldova the regular inspection is required for both systems, while in Belarus and in the Russian Federation it is required only for heating systems. In the Caucasus countries, only in

¹⁰ UNECE region consists of 56 member States.

Azerbaijan there is no requirements for regular inspection, while in Armenia it is mandatory for heating systems. The building energy codes in the Central Asian region require regular inspection for heating and air conditioning systems in Turkmenistan and Uzbekistan, and periodic monitoring of boilers, heating systems and hot water supply in Kyrgyzstan (Table 9).

Table 9. Overview of Requirements for Regular Inspection of Heating and Air Conditioning Systems

Country	Requirement for regular inspection	Inspection of heating systems	Inspection of AC systems
<i>South-Eastern Europe</i>			
Albania	No	-	-
Bosnia and Herzegovina	No	-	-
Montenegro	Yes	x	x
North Macedonia	Yes	x	x
Serbia	Yes	x	x
<i>Eastern Europe and the Russian Federation</i>			
Belarus	Yes	x	-
Republic of Moldova	Yes	x	x
Russian Federation	Yes	x	-
Ukraine	No	-	-
<i>The Caucasus</i>			
Armenia	Yes	x	-
Azerbaijan	No	-	-
Georgia ¹¹	Yes	x	x
<i>Central Asia</i>			
Kazakhstan	No	-	-
Kyrgyzstan	Yes	x	-
Tajikistan	<i>No data</i>	-	-
Turkmenistan	Yes	x	x
Uzbekistan	Yes	x	x

Source: Mapping of Existing Energy Efficiency Standards and Technologies in Buildings in the UNECE Region, 2018

The energy performance monitoring measures energy efficiency actions, assesses the relevant impact of individual actions and holds entities responsible for their actions and (i) confirms the activity measuring integrity; (ii) identifies non-compliance and convincing all involved parties that compliance is a better outcome than non-compliance; (iii) allows putting in place adequate controls and thus minimize the level of non-compliance; (iv) allows collecting data to measure the effectiveness of energy efficiency standards in the countries (OECD/IEA, 2010). Different categories can benefit from it, including actual consumers, businesses and policy makers.

Table 10 shows the situation in the countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation with regards to energy performance monitoring requirements.

The level of compliance with energy performance monitoring contained in building energy codes (Fig. 21) was assessed by the UNECE survey in 2018. According to its results, “9 per cent of respondents thought that energy performance monitoring was fully compliant, while high and medium level of compliance equally received 36 per cent each. 18 per cent of respondents considered that monitoring in their country was not compliant with the requirements set in country’s building energy code” (UNECE, 2018).

¹¹ Once the secondary legislative act on energy performance monitoring requirements is enforced, the monitoring will become mandatory.

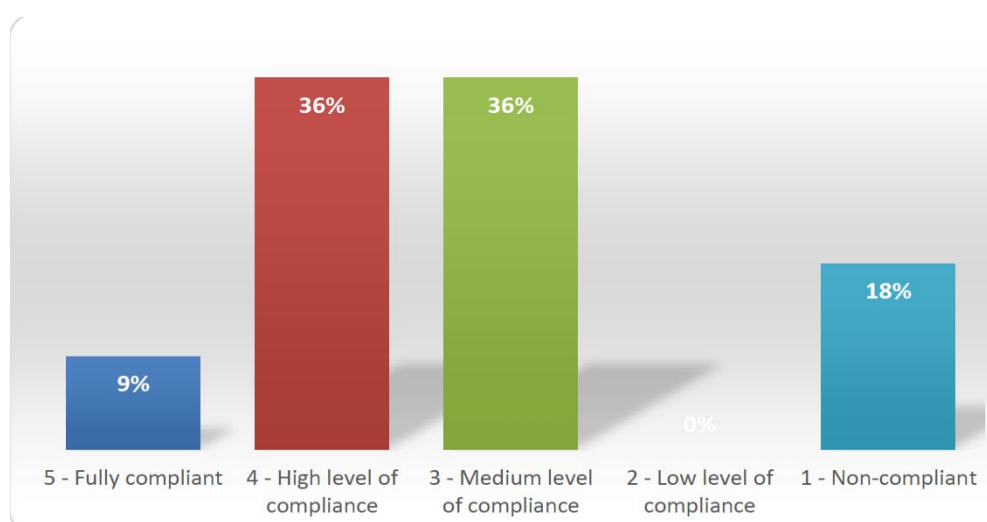
Table 10. Overview of Energy Performance Monitoring Requirements in the Countries

Country	Energy performance monitoring requirements	Mandatory monitoring
<i>South-Eastern Europe</i>		
Albania	Yes	-
Bosnia and Herzegovina	No	-
Montenegro	Yes	x
North Macedonia	Yes	-
Serbia	Yes	x
<i>Eastern Europe and the Russian Federation</i>		
Belarus	Yes	-
Republic of Moldova	Yes	-
Russian Federation	Yes	x
Ukraine	No	-
<i>The Caucasus</i>		
Armenia	No	-
Azerbaijan	Yes	-
Georgia	Yes	-
<i>Central Asia</i>		
Kazakhstan	No	-
Kyrgyzstan	Yes	x
Tajikistan	<i>No data</i>	-
Turkmenistan	<i>No data</i>	-
Uzbekistan	Yes	x

Source: Mapping of Existing Energy Efficiency Standards and Technologies in Buildings in the UNECE Region, UNECE, 2018

The full potential for energy savings from building codes is not always achieved, in part because compliance and enforcement mechanisms are not complete. The next chapter of report will look in more details on the enforcement of energy efficiency standards in buildings.

Figure 21 Level of Compliance with Energy Performance Monitoring in the Countries



Source: Mapping of Existing Energy Efficiency Standards and Technologies in Buildings in the UNECE Region, UNECE, 2018

ENFORCEMENT AND ENCOURAGEMENT MECHANISMS

Enforcement mechanisms ensure compliance by establishing penalties for non-compliance. Encouragement mechanisms provide rewards and incentives for compliance with regulations. Both approaches can be used in combination of a carrot-and-stick approach. Each country decides on the mechanism which is more appropriate for their situation.

Financial incentives

“Some countries have specific policy packages and incentives that complement or motivate compliance with building codes. Such mechanisms can include green loan programs, financial schemes and incentives, and public incentives including tax credits” (UNECE, 2018). Depending on country’s decision, they may include (i) tax measures; (ii) rebates, grants, and performance-based incentives; as well as (iii) loan programs, guarantees, and credit enhancements.

Tax measures can include the following: (i) corporate income tax incentives that are the tax deductions for use of energy efficiency technologies; (ii) personal income tax incentives that are tax deductions based on personal investment in energy efficiency technology; (iii) property tax incentives that are applicable when energy efficiency technologies are implemented to improve a quality of a property; (iv) sales or value-added tax incentives that reduce those taxes for energy efficiency technologies for both individuals and businesses.

In addition to tax measures, rebates, grants, and performance-based incentives can be designed to support energy efficiency actions and technology deployment.

- (i) Rebates are often funded through utility customer payments and used for energy efficiency home improvement and construction, and appliances.
- (ii) Grants are provided by governments and/or other institutions and can fund research and development, feasibility studies, system demonstration, installation, and operation. Grants can also be combined with subsidized loans to support energy efficiency enhancement.
- (iii) Performance-based incentives are funded through utility customer payments and support building energy efficiency upgrades based on overall energy saving.

Loan programmes, loan guarantees, and credit enhancements can support energy efficiency deployment.

- (i) Subsidized revolving loans reduce loan interest rates for energy efficiency technologies by providing a loan loss reserve fund or similar mechanism that serves as a form of insurance in the event of loan failure.
- (ii) Mortgage-related loan programs include property related programs with funding for energy efficiency improvements that are paid back over time by commercial and residential property owners. In this case, mortgage loans for energy efficient homes can also allow higher debt to income because the mortgages assume future energy savings for the homeowner.
- (iii) Credit enhancements reduce credit risk associated with energy efficiency investments through interest rate buy-downs and reserve accounts.
- (iv) Loan guarantees, used as credit enhancement incentives, support reduced loan interest rates by providing assurance to a lender that loans will be fully or partially repaid even if borrower fails.

The results of the earlier UNECE assessment indicate (Table 11) that only Armenia, Georgia, Montenegro and Uzbekistan provide specific incentives for improving compliance with their building energy codes (UNECE 2018).

Table 11. Presence of Specific Incentives for Compliance with Building Energy Codes

Country	Presence of a specific incentive
<i>South-Eastern Europe</i>	
Albania	No
Bosnia and Herzegovina	No
Montenegro	Yes
North Macedonia	No
Serbia	No
<i>Eastern Europe and the Russian Federation</i>	
Belarus	No
Republic of Moldova	No
Russian Federation	No
Ukraine	No
<i>The Caucasus</i>	
Armenia	Yes
Azerbaijan	No
Georgia	Yes
<i>Central Asia</i>	
Kazakhstan	No
Kyrgyzstan	<i>No data</i>
Tajikistan	<i>No data</i>
Turkmenistan	No
Uzbekistan	Yes

Source: Mapping of Existing Energy Efficiency Standards and Technologies in Buildings in the UNECE Region, UNECE, 2018

South-Eastern Europe

In **Bosnia and Herzegovina**, the Green Economic Development programme for 2014-2018 (adopted in the Federation of Bosnia and Herzegovina) provided co-financing of energy efficiency projects. These funds were allocated to buildings owned by the public sector where the end user contributed to at least 50 per cent of the project value. Moreover, the Environment Protection Fund allocated a total of 9.1 million Bosnian Marks (equivalent to 5.35 million USD) for energy efficiency projects. Subsidies and incentives are available as non-refundable financing from the budget spending programme with allocation criteria “Current transfers to other levels of government and Funds for the projects of thermal insulation of buildings aims at energy savings”. The Environmental Protection and Energy Efficiency Fund, in the Republic of Srpska, oversees fundraising activities, implementation and development of projects and programmes in conservation, protection and sustainable use of environment, energy efficiency, and renewable energy.

Montenegro does not have a dedicated fund to provide sustainable financing to projects that focus on the improvement of energy efficiency of final consumers. Hence, financial support for such projects is limited. Moreover, financial incentives in the form of tax measures to promote energy efficient technologies or products is also not established (ECS, 2018).

Eco Fund was established by the Decision of the Government of Montenegro in November 2018 with the purpose to act as a central national institution for financing and providing technical support to projects / programmes in the field of the environment, climate change and energy (Eco Fund website).

The Ministry of Economy of **North Macedonia** provided subsidies up to 50 per cent (or maximum up to 500 Euro per installation) for replacement of inefficient windows with energy efficient ones.

In **Serbia**, in 2012 the former Ministry of Environment, Mining and Spatial Planning granted funds of up to 1.3 billion Serbian Dinar (equivalent to 13,344,136 USD) to tenants for rehabilitation of existing buildings (MCU).

Eastern Europe and the Russian Federation

Energy efficiency market mechanisms and economic incentive programmes in **Bosnia and Herzegovina** include federal subsidies and grants, soft lending with 50 per cent interest subsidy, subsidies for buildings retrofits, taxation and pricing policies.

In **Belarus**, in the structure of financing of the State Programme on Energy Saving for 2016-2020, about 75 per cent are non-budgetary sources, such as own funds of organizations, loans and other sources. Similar approaches are laid down in the State Programme on Energy Saving for 2021-2025. It is estimated that implementation of the set of measures to achieve the target indicators of the State Programme for the next 5 years will require about 320-360 million US dollars annually.¹²

In the **Republic of Moldova**, the economic incentive programmes for energy efficiency included subsidies for building retrofits and installation of building-level meters, voluntary agreements, taxation and pricing policies, as well as varying heat rates depending on presence of heat meters.

The Energy Efficiency Fund was established in 2012, which financed projects in public lighting, rehabilitation of heating and domestic hot water source and distribution systems as well as energy saving measures, such as thermal insulation of walls and roofs, replacement of windows and exterior doors. Additionally, the EBRD in cooperation with Moldovan banks established the Moldovan Residential Energy-Efficiency Financing Facility to support energy efficiency investments in the residential sector with a loan of EUR 35 million (EBRD website).

The **Ukrainian** government has been implementing the “Warm Loan Programme” since 2014. This programme subsidizes 20 to 35 per cent of investment costs for individual households and 40 to 70 per cent of investment costs for multi-apartment residents, if they intended to invest in energy efficiency for their properties. Approximately USD 117 million have been reimbursed from the national budget since October 2018. The Cabinet of Ministers prolonged the Programme for 2021 (SAEE website & Yang *et al.*, 2019). The Ukrainian Energy Efficiency Fund was established in 2017. It is eligible for Home Owner Associations (multy-dwelling buildings).

The **Russian Federation** established the Fund for Assistance to the Housing and Public Utilities Reform, which covered 10 per cent of the costs aimed at increasing energy efficiency in the apartment buildings (Alekseev *et al.*, 2019). Tax incentives and benefits are provided to industry for replacement of inefficient equipment. The resolution on Subsidies for Regional Programmes for Energy Saving and Energy Efficiency was also adopted in 2011.

The Caucasus

In **Armenia**, with regards to the residential sector, loans by credit lines are established by EBRD, IFC, GGF, AFD and KfW. They offer to finance energy efficiency investments and

¹² As indicated by government sources

integrated renewable energy solutions (mostly solar water heaters and PV panels) in private households. This market is growing, especially considering the integration with mortgage lending. When the consumer seeks to borrow for purchasing real estate or renovation, the special energy efficiency mortgage or renovation loan product is usually available at more affordable terms or with cash-back option. The product is designed in a way that allocate the funds as quickly as possible. Most of them specify “white product lists” to help the loan officers to assess the eligibility of applications and reduce processing time. Some of these loans are packaged with incentives, such as lower interest rates or grant money back (returning cash back to the borrower after the energy efficiency is verified).

The government of **Azerbaijan** introduced resolutions (No. 112 and No. 113) that exempt custom duties and VAT on import of energy efficient equipment and technology (Huseynova, 2015).

Similarly, **Georgia** has introduced basic energy efficiency market mechanisms and economic incentive programmes such as taxation, pricing policies, bond financing in the building sector. According to the law of Georgia on energy efficiency of buildings, with the aim to promote activities for improving the energy performance of buildings, the Government of Georgia ensures the following: (i) development and distribution of information, methodological materials and guidelines on the energy performance of buildings, on energy performance certificates and inspection reports, on cost-effective ways to improve the energy performance of buildings, and on available financial instruments to the owners and tenants of buildings; (ii) public information and relevant guidance on training, certification and accreditation for experts involved in activities related to the energy performance of buildings; (iii) reflecting measures within their national plans to support public authorities to implement the recommendations included in the energy performance certificate issued for buildings under their ownership; (iv) drawing up and updating every three years a list of existing measures and instruments, including those of a financial nature, which promote the improvement of the energy performance of buildings and support implementation of this law.¹³

Central Asia

Kazakhstan provides basic energy efficiency market mechanisms and economic incentive programmes, including emissions trading, subsidies for buildings retrofits, building-level meters installation, voluntary agreements, taxation and pricing policies, and variable heat charges.

In **Kyrgyzstan** there is a lack of financial resources allocated for large-scale energy efficiency rehabilitation projects in the public buildings sector. The “funds allocated to the renovation of buildings usually do not include measures for improving energy efficiency and most renovation programs entail replacing only windows, lighting and heating systems. Building operators can tap into different funding sources for building renovation, such as municipal or regional budgets and central government funds (partly through the Community Development and Investment Agency of the Kyrgyz Republic, ARIS)” (World Bank, 2019b).

There is no determined strategy or practice on support of energy efficiency measures introduction. Some incentives can be provided by international organisations, such as grants or preferential loans for introduction of energy efficient measures. Some governmental plans and decrees declare the provision of incentives (for example, a Decree “On approval of the Action Plan for 2019 for the implementation of the Plan of the Government of the Kyrgyz Republic for 2019-2023).

¹³ As indicated by government sources

Energy efficiency market mechanisms and economic incentive programmes in **Tajikistan** include government procurement rules, soft loans (including microfinance), pricing and taxation policies (C2E2, 2015).

Energy efficiency market mechanisms and economic incentive programmes in the buildings sector in **Uzbekistan** include subsidies for buildings renovation and building-level meter installation, taxation and pricing policies. The law on Rational Energy Use also introduces public co-financing for energy efficiency programmes, setting up an inter-sectorial energy efficiency fund.

Penalties for non-compliance

Penalties for non-compliance with building energy codes (the “disincentives”) can include occupancy and construction permissions (for example, if the building does not comply with the code, then the construction entity is refused permission for occupancy or construction); as well as fines for noncompliance.

Assessment of enforcement mechanisms in the countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia and in the Russian Federation indicate that refusal for occupancy or construction permit is introduced in Bosnia and Herzegovina, Georgia, Montenegro, North Macedonia, Russian Federation, Serbia, and Turkmenistan. Fines for noncompliance with the energy efficiency standards are applicable in Albania, Armenia, Georgia, Montenegro, and Uzbekistan. The assessment, however, doesn’t have available information on the situation in Kyrgyzstan and Tajikistan (Table 12).

Table 12. Presence of Penalties for Non-Compliance with Energy Efficiency Standards in Buildings in the Countries

Country	Refusal for occupancy or construction permit	Fines for non-compliance
<i>South-Eastern Europe</i>		
Albania	No	Yes
Bosnia and Herzegovina	Yes	No
Montenegro	Yes	Yes
North Macedonia	Yes	No
Serbia	Yes	No
<i>Eastern Europe and the Russian Federation</i>		
Belarus	No	No
Republic of Moldova	No	No
Russian Federation	Yes	No
Ukraine	No	No
<i>The Caucasus</i>		
Armenia	No	Yes
Azerbaijan	No	No
Georgia	Yes	Yes
<i>Central Asia</i>		
Kazakhstan	No	No
Kyrgyzstan	<i>No data</i>	<i>No data</i>
Tajikistan	<i>No data</i>	<i>No data</i>
Turkmenistan	Yes	No
Uzbekistan	No	Yes

Source: Mapping of Existing Energy Efficiency Standards and Technologies in Buildings in the UNECE Region, UNECE, 2018

In many countries enforcement of energy efficiency standards depends on the level of resources available for such enforcement, such as number of local code enforcement officials and/or information and tools available to them. Various stakeholders within the government, utilities, private sector and other institutions play key roles in ensuring effective implementation of building energy codes (Cox, 2016).

INSTITUTIONAL CAPACITY

South-Eastern Europe

The institutional framework in the South Eastern European countries is presented in Table 13. In Albania, Bosnia and Herzegovina, and Serbia the energy efficiency policy and its implementation is concentrated in a department within the Ministry of Energy. The Ministry of Economy is also involved in energy efficiency policies in Albania, Montenegro and North Macedonia. “The cross sector nature of energy efficiency is not best served when a ministry of energy is in charge with both policymaking and policy implementation. Measures in transport, public services are difficult to implement through an energy ministry department and this is one of the causes for which there is rarely a coherent and consistent strategic approach to energy efficiency” (Kogalniceanu, 2011).

In Albania, North Macedonia, and Serbia there are dedicated energy agencies. The National Agency of Natural Resources in Albania has responsibilities for energy efficiency policies. The Energy Agency of the Republic of North Macedonia is mandated to monitor and analyze the effects of the energy policy in North Macedonia and of the implemented energy efficiency, as well as the measures and degree of use of renewable energy sources in light of the obligations taken from the Energy Community. Serbia also established an Energy Efficiency Agency that is responsible for the implementation of NEEAPs.

Table 13. Institutions Responsible for Energy Efficiency Policies in South Eastern Europe

Country	Institutions
Albania	<ul style="list-style-type: none"> • The Ministry of Economy, Trade and Energy • The Ministry of Energy and Infrastructure • The National Agency of Natural Resources • The Agency of Energy Efficiency
Bosnia and Herzegovina	<p>The state level:</p> <ul style="list-style-type: none"> • The Ministry of Foreign Trade and Economic Relations • The State Electricity Regulatory Commission • Elektroprenos BiH • Brčko District Government <p>Federation of Bosnia and Herzegovina:</p> <ul style="list-style-type: none"> • The Federal Ministry of Energy, Mining and Industry • The Federal Ministry of Physical Planning • The Environmental Fund of the Federation BiH • Elektroprivreda BiH • Elektroprivreda HZHB <p>Republika Srpska:</p> <ul style="list-style-type: none"> • The Ministry of Industry, Energy and Mining • The Ministry of Spatial Planning, Civil Engineering and Ecology • Elektroprivreda RS
Montenegro	<ul style="list-style-type: none"> • The Ministry of economy/ Directorate for Energy Efficiency • The Ministry of Sustainable Development and Tourism
North Macedonia	<ul style="list-style-type: none"> • The Ministry of Economy (designated ministry for energy related legislation) • The Ministry of Environment and Physical Planning

	<ul style="list-style-type: none"> • The Regulatory Commission (regulator for energy, support scheme) • The Energy Agency of Republic of Macedonia
Serbia	<ul style="list-style-type: none"> • The Ministry of Mining and Energy • The Ministry of Construction, Transport and Infrastructure • The Serbian Energy Efficiency Agency

Eastern Europe and the Russian Federation

The institutional framework in the Eastern European countries and in the Russian Federation is presented in Table 14.

The Ministries of Energy in Belarus, Russian Federation, and Ukraine are responsible for energy sector planning. The Ministry of Energy of the Russian Federation shapes policy in the sphere of energy efficiency. The Ministry of Economy (or Economic Development) are also implementing energy policy in the Republic of Moldova, Russian Federation and Ukraine.

The Ministry of Regional Development is also involved in the Republic of Moldova and the Ministry for Communities and Territories Development in Ukraine. In the Republic of Moldova, it is in charge of establishing, monitoring and evaluating the national priorities for regional development, including promotion of energy efficiency, as well as developing environmental and natural resource management policies and strategies. In Ukraine, the Ministry ensures energy efficiency strategies and policies in the district heating system and buildings.

In Belarus, the responsibilities for energy efficiency in buildings are shared between two ministries: the Ministry for Housing and Communal Services which is responsible for issues related to the maintenance and management of the existing housing stock as well as utilities; and the Ministry of Architecture and Construction which is responsible for policies in the field of architecture, urban planning and construction (GIZ, 2016).

The Ministry of Construction, Housing and Utilities in the Russian Federation was set up in November 2013 and has taken over key responsibilities in the field of energy efficiency in terms of new constructions and major renovations from the Ministry of Regional Development.

The dedicated energy agencies are established in the countries as follows:

- In the Republic of Moldova, the Energy Efficiency Agency was established in 2010 and is responsible to implement state policy for energy efficiency; coordinate programs and action plans developed by local authorities ; participate in drafting national programmes and action plans on EE; develop minimum EE requirements for devices and equipment produced or imported to the country and submit them for approval to the central branch authority in charge of the energy sector.
- The Russian Energy Agency (REA) under the Ministry of Energy was established to ensure progress in accelerating the implementation of energy efficiency at the federal and regional level.
- The State Agency of Energy Efficiency and Energy Saving (SAEE) of Ukraine is the key institution responsible for the implementation of state policy on energy efficiency and energy savings.

In Belarus, the Department for Energy Efficiency of the State Committee for Standardization is responsible for the development and implementation of State policy in the area of energy saving and efficient use of energy resources. It develops and monitors state energy saving programmes (primarily directed at the industrial sector) and issues technical norms and standards for the energy sector.

Table 14. Institutions Responsible for Energy Efficiency Policies in Eastern Europe and in the Russian Federation

Country	Institutions
Belarus	<ul style="list-style-type: none"> • The Ministry of Architecture and Construction • The Ministry of Housing and Communal Services • The Ministry of Energy • The Ministry of Anti-Monopoly Regulation and Trade • The Department for Energy Efficiency of the State Committee for Standardisation
Republic of Moldova	<ul style="list-style-type: none"> • The Ministry of Economy and Infrastructure • The Ministry of Agriculture, Regional Development and Environment • Energy Efficiency Agency
Russian Federation	<ul style="list-style-type: none"> • The Ministry of Energy • The Ministry of Economic Development • The Ministry of Regional Development • The Ministry of Industry and Trade • The Ministry of Construction, Housing and Utilities • The Russian Energy Agency, under the Ministry of Energy
Ukraine	<ul style="list-style-type: none"> • The Ministry of Energy • The Ministry of Regional Development, Construction and Public Services • The Ministry of Economic Development and Trade, • The State Agency on Energy Efficiency and Energy Saving • The State Environmental Investment Agency of Ukraine • The National Energy and Utilities Regulatory Commission of Ukraine

The Caucasus

The institutional framework for energy efficiency policies in the Caucasus countries is presented in the Table 15.

In Armenia, the Ministry of Energy addresses a wide range of strategic goals, including energy efficiency, through the implementation of national projects, programmes and draft legislation. Additionally, the Ministry of Construction in Armenia regulates construction activities, including insulation and building energy efficiency standards. The Ministry of Territorial Administration and Infrastructure has overall responsibility for energy policy, including Armenia's transposition of the 2010 EU Energy Performance of Buildings Directive as part of the EU-Armenia Comprehensive Enhanced Partnership Agreement (CEPA) implementation. The Urban Development Committee elaborates and implements the policy of the Government of the Republic of Armenia in the field of urban development.

In Azerbaijan, the Ministry of Energy ensures the implementation of measures related to the efficient use of energy resources and protection of public interests in this area; takes measures for the efficient use of state property in the energy sector; and ensures its regulatory role in the energy sector. The Ministry of Economy has functions regarding the development of policies related to the improvement of energy efficiency in industry.

In Georgia, the Ministry of Economy and Sustainable Development is responsible for state policy in the energy sector and policies related to the sustainable development of the country's economy. It can adopt secondary legislation related to the energy sector (through ministerial orders). The Ministry of Economy and Sustainable Development is responsible for the development and implementation of the energy efficiency policy, while the Ministry of

Infrastructure and Regional Development is responsible for the implementation of the energy efficiency policy. The Ministry of Finance and the Ministry of Environmental Protection and Agriculture are responsible for the support of the energy efficiency policy.

The Ministry of Infrastructure and Regional Development is overseeing several building renovation projects that have an energy efficiency component and are funded by various donors through the Municipal Development Fund.

Table 15. Institutions Responsible for Energy Efficiency Policies in the Caucasus

Country	Institutions
Armenia	<ul style="list-style-type: none"> • The Ministry of Energy and Natural Resources • The Ministry of Construction • The Urban Development Committee
Azerbaijan	<ul style="list-style-type: none"> • The Ministry of Economy • The Ministry of Energy
Georgia	<ul style="list-style-type: none"> • The Ministry of Economy and Sustainable Development • The Ministry of Finance • The Ministry of Infrastructure and Regional Development • The Ministry of Environmental Protection and Agriculture

Central Asia

The institutional framework for energy efficiency policies in the Central Asian countries is presented in Table 16.

The Ministries of Energy are leading energy policies in Kazakhstan, Tajikistan, Turkmenistan, and Uzbekistan:

- In Kazakhstan this Ministry was created following a merger of functions of the former Ministry of Oil and Gas, the Ministry of Industry and New Technologies and the Ministry of Environmental Protection and Water Resources.
- In Tajikistan, the Ministry of Energy and Industry also addresses energy efficiency policy mandate in the buildings sector.
- The Ministry of Energy and Industry in Turkmenistan is responsible for management of the country’s electricity sector and includes “Turkmenenergo”, the state electric energy corporation managing all state assets in the sector.
- In Uzbekistan, the Ministry of Energy, established in 2019, is responsible for regulation of the energy sector, implementation of production sharing agreements and supervision of their execution; development of public-private partnership arrangements, and improving the tariff policy to facilitate the formation of a competitive business environment, increasing and diversifying energy production.

Prior to 2016, the Ministry of Energy and Industry was the key government agency in Kyrgyzstan responsible for energy efficiency policies, tariff and price setting, development of the National Energy Programme, and coordination of international assistance in the project implementation. Currently, the State Committee on Industry, Energy and Subsoil Use is responsible for development and implementation of state policies in the energy sector and energy efficiency, measures and the achievement of targets.

Additionally, the Committee for Regulation of Natural Monopolies and Protection of Competition, at the Ministry of National Economy in Kazakhstan, is responsible for tariff setting and competition matters. Some sections of the energy efficiency programme are the responsibility of the Ministry of National Economy.

The Ministry of Finance in Turkmenistan is engaged in handling tariff methodology matters and setting basic tariffs for transmission, shaping a tariff policy in the national economy.

In Uzbekistan, the Ministry of Finance co-ordinates the procedure for tariff-setting for certain types of goods and services and strengthens payment discipline. The Ministry of Construction, established in 2018, implements the state policy in the area of engineering and technical research for urban planning and construction to increase productivity, reduce construction and installation costs, and introduce innovative energy-efficient and energy-saving projects and solutions into construction.

Table 16. Institutions Responsible for Energy Efficiency Policies in Central Asia

Country	Institutions
Kazakhstan	<ul style="list-style-type: none"> • The Ministry of Energy • The Committee for Regulation of Natural Monopolies and Protection of Competition • The Ministry of National Economy • State Committee on Construction, Housing and Communal Sector and Land Resources Management
Kyrgyzstan	<ul style="list-style-type: none"> • The State Committee on Industry, Energy and Subsoil Use • The State Agency for Regulation of the Fuel and Energy Complex • The State Agency for Architecture, Construction, Housing and Communal Services • The Research Institute on Energy and Economics.
Tajikistan	<ul style="list-style-type: none"> • The Ministry of Energy and Industry • The Ministry of Economic Development and Trade • The Ministry of Land Reclamation and Water Resources • The State Power Supervision Agency
Turkmenistan	<ul style="list-style-type: none"> • The Ministry of Energy and Industry, including “Turkmenenergo” State Electric Energy Corporation • The Ministry of Finance
Uzbekistan	<ul style="list-style-type: none"> • The Ministry of Energy • The Ministry of Economic Development and Poverty Reduction • The Ministry of Finance • The Ministry of Construction

EFFECTIVENESS OF ENERGY EFFICIENCY POLICIES

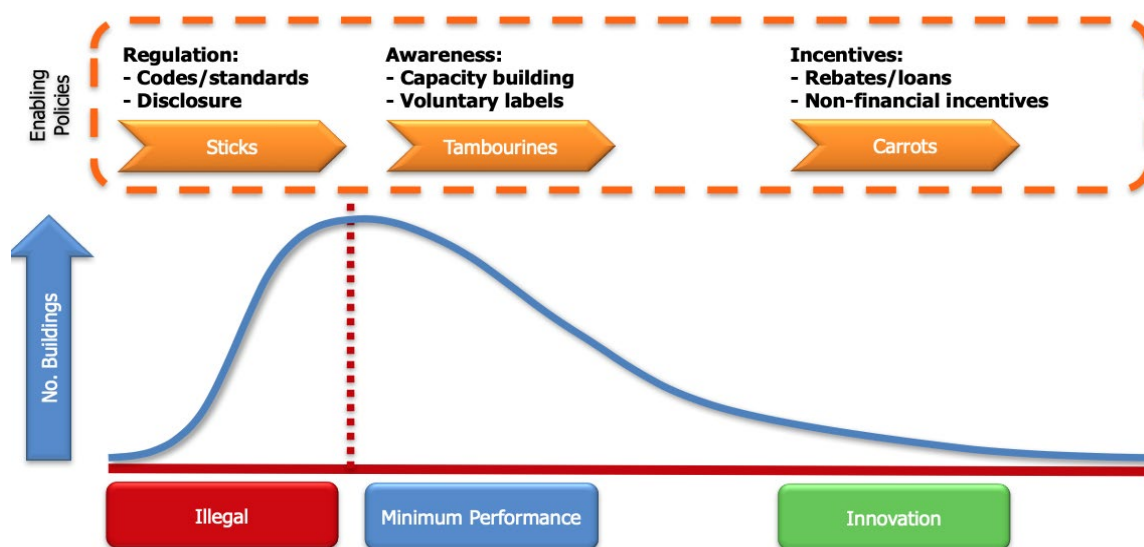
The energy efficiency standards in buildings are the policy instruments that contribute to reaching more energy savings and avoiding greenhouse gas emissions by setting up the framework for targeted situation (Blok *et al.*, 2004). Their effectiveness can be assessed by looking cumulatively at the following elements:

- (i) Policy definition: objectives, targets, legal and regulatory frameworks;
- (ii) Policy development: incentives, penalties, technical assistance, financing support;
- (iii) Policy implementation: institutional framework, stakeholders, capacity development, supporting infrastructure;
- (iv) Policy evaluation: monitoring of achieved results through energy statistics and energy efficiency indicators, qualitative and quantitative evaluation of policy instruments' impacts (Morvaj & Bukarica, 2010).

The effective policy making process requires a strategy “act, then learn, then act again.” (Blok *et al.*, 2004).

Fig. 22 below also reflects the importance of effective energy efficiency policies and demonstrates that energy efficiency standards play the vital role in this process. In addition, it shows that only a combination of “sticks”, “tambourines” and “carrots” can provide effective enabling policy environment to enhance energy efficiency.

Figure 22. Scheme for Effective Energy Efficiency Policies



Source: OECD/IEA 2018 adapted from GBPN

The World Bank makes assessment of energy efficiency improvements in the countries since 2014. The RISE (Regulatory Indicators for Sustainable Energy) reports present developments based on the following indicators: (i) national energy efficiency planning; (ii) energy efficiency entities; (iii) information provided to consumers about electricity usage; (iv) energy efficiency incentives from electricity rate structures; (v) incentives and mandates for industrial and commercial end users; (vi) incentives and mandates for public sector; (vii) incentives and mandates for utilities; (viii) financing mechanisms for energy efficiency; (ix) minimum energy efficiency performance standards; (x) energy labeling systems; (xi) building energy codes; (xii) and carbon pricing and monitoring. The latest RISE report in 2020 also adds indicators on transport sector energy efficiency.

This set of indicators provides a reference point for benchmarking policy and regulatory framework in the countries and can be used as a powerful tool to help develop policies and regulations that advance sustainable energy. Together, these indicators provide a “comprehensive picture of the strength and breadth of government support for sustainable energy and the actions they have taken to turn that support into reality” (World Bank RISE).

For the purposes of this analysis, the RISE assessment will be used to review effectiveness of energy efficiency policies, with emphasis on energy efficiency in buildings, and conclude on the progress made by countries in the South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia and in the Russian Federation since 2014.

RISE uses a traffic light system to assess the countries progress. The green zone includes scores between 67–100 and indicates that most elements of a strong policy framework to support sustainable energy are in place. The yellow zone includes scores between 34–66 and indicates that significant opportunities exist to strengthen the policy framework. The red zone includes scores between 0–33 and indicates that few or no elements of a supportive policy framework have been enacted.

The assessment in 2014 concluded that most of the indicators in Armenia (one of the 17 RISE pilot countries) were in the yellow zone with the three ones being in red zone. This meant

absence of incentives or mandates for energy supply utilities, minimum incentives for public entities, and absence of incentives for large scale users in the country.

The assessment in **2016** concluded that Armenia (score of 42), Belarus (score of 62), Kazakhstan (score of 58), Kyrgyzstan (score of 38), Tajikistan (score of 45), Ukraine (score of 37), and Uzbekistan (score of 51) were in the yellow zone. The Russian Federation was in the green zone with a score of 70 out of 100. It concluded that the progress made by countries is encouraging, however remain significant gaps in policy and regulatory frameworks still existed.

Figure 23. Assessment of EE Progress in Countries, 2016

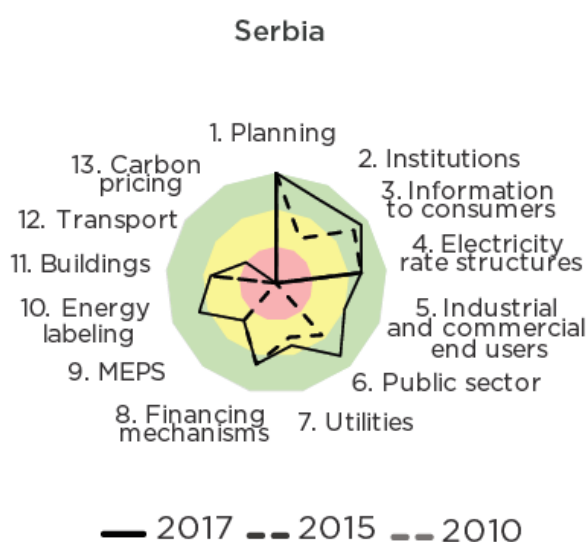
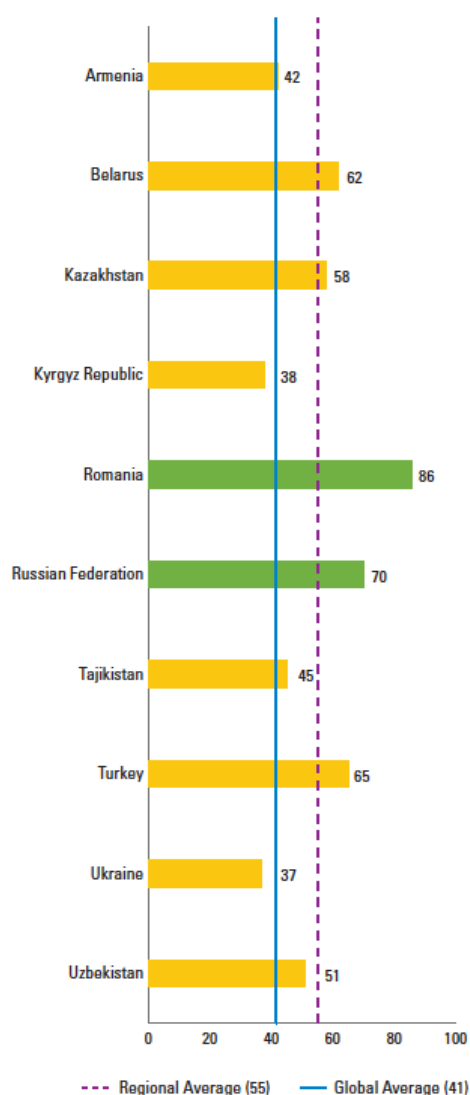


Figure 24. Progress in EE in Serbia over 2010-2017

Source: World Bank, RISE 2016

According to the assessment in **2018**, Belarus has achieved energy efficiency score in the green zone in 2017. Armenia, Kazakhstan, Russian Federation, Serbia, Tajikistan, Ukraine, and Uzbekistan were in the yellow zone. Azerbaijan, Kyrgyzstan, and Turkmenistan were in the red zone. Serbia was among the fastest movers in the energy efficiency pillar. Establishing dedicated energy efficiency entities was the most evident area of progress for Serbia. The country has also improved scores on energy labeling schemes.

Source: World Bank, RISE 2016

Overview of energy efficiency policy framework concluded that countries in the Europe and Central Asia region have adopted the regulations for utilities. Most countries in ranked in the top tier for building energy codes.

However, measures to improve energy performance of buildings needed more improvements. Minimum standards for HVAC equipment, compliance programmes and building energy efficiency incentives were lagging.

There was a clear gap between residential building codes and compliance systems. Heating and cooling was a crucial issue in the residential building sector. Effective residential building energy codes are an important policy lever to ensure that demands for heating and cooling are minimized as much as possible. However, having a building code in place is not sufficient; the code needs to be supplemented with an effective compliance system that includes commission testing and incentives for energy efficiency investments by building developers. The compliance systems for residential building energy codes need improvements.

According to the RISE assessment in 2020, the policy frameworks for energy efficiency policies improved more slowly between 2017-2019 than between 2015-2017. “The annual improvement rate in the global average score for energy efficiency improved by only 1.6 points per year between 2017 and 2019, compared with an annual rise of 3.6 points between 2015 and 2017...Standards for heating and cooling were among the fastest growing policies...Meanwhile, building codes that embraced policies on ... energy efficiency slowed in 2017-2019” (World Bank, 2020).¹⁴ “This could be explained by the possibility that most of the easier actions were taken between 2010 and 2017 where more complex policies require more time to implement as well as additional investment and infrastructure.”

Globally, the standards for energy efficiency are developing. In the countries of South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia and in the Russian Federation the average RISE score is significantly higher than the global average. However, the indicators such as minimum energy efficiency standards, energy labeling systems, and carbon pricing and monitoring seem to lag behind the rest. The overview of countries’ score is presented in Fig. 25 and 26.

Figure 25. Countries Score in Energy Efficiency in 2019 (out of 100)



Source: World Bank, RISE 2020

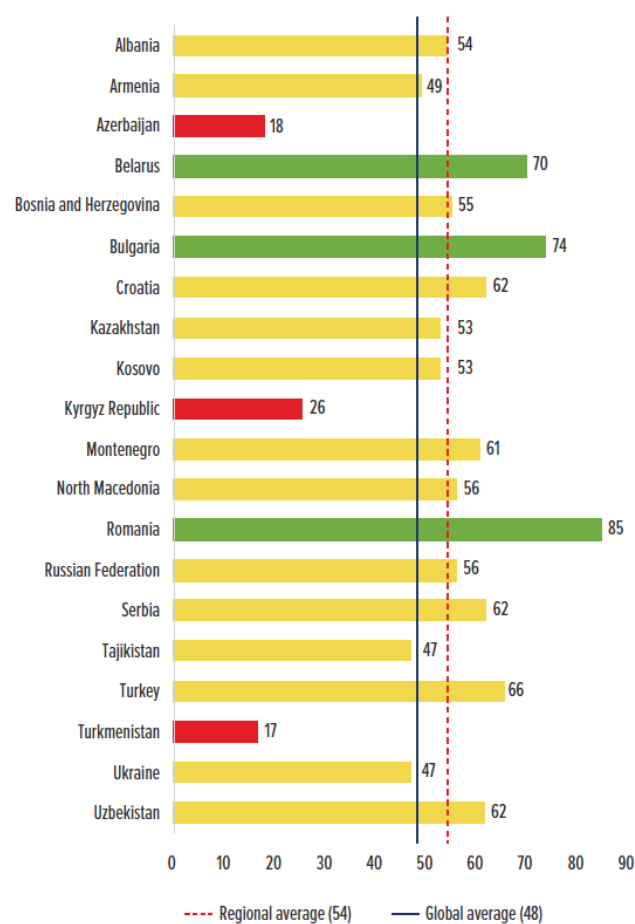
Belarus is presented in the green zone with the highest score of 70. Most of the other countries in the South-Eastern Europe, Eastern Europe, the Caucasus and Central Asia are in the yellow zone (including Albania, Armenia, Bosnia and Herzegovina, Kazakhstan, Montenegro, North Macedonia, Russian Federation, Serbia, Tajikistan, Ukraine, and Uzbekistan). However, Azerbaijan (score of 18), Kyrgyzstan (score of 26) and Turkmenistan (score of 17) are in the red zone.

The report indicates that the fastest improvers in the region are Montenegro (with overall score of 61 in 2020 and rate of improvement in score by 6.0), and Bosnia and Herzegovina (with its

¹⁴ <https://rise.esmap.org/data/files/reports/2020-full-report/RiseReport-010421.pdf>

overall score of 55 and rate of improvement in score by 3.7).¹⁵ The improvement happened mainly because of their adoption of policies pertaining to financial and regulatory incentives.

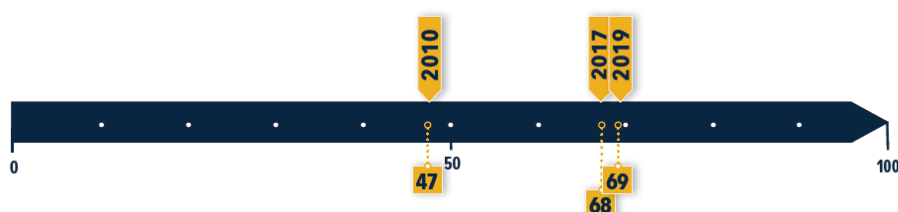
Figure 26. Overview of Progress in Energy Efficiency in Countries in the Period of 2010-2019



Source: World Bank, RISE 2020

Several assessments conducted for the RISE include an overall period from 2010 to 2019 (Fig. 27 & 28). This provides an opportunity to observe a progress made by the countries on energy efficiency. The regional overview includes all reviewed countries and indicates that the countries averagely moved from score of 47 in 2010 to score of 69 in 2019, though with little progress made in the last couple of years (Fig. 27)

Figure 27. Regional Overview of Progress in Energy Efficiency in 2010, 2017 and 2019



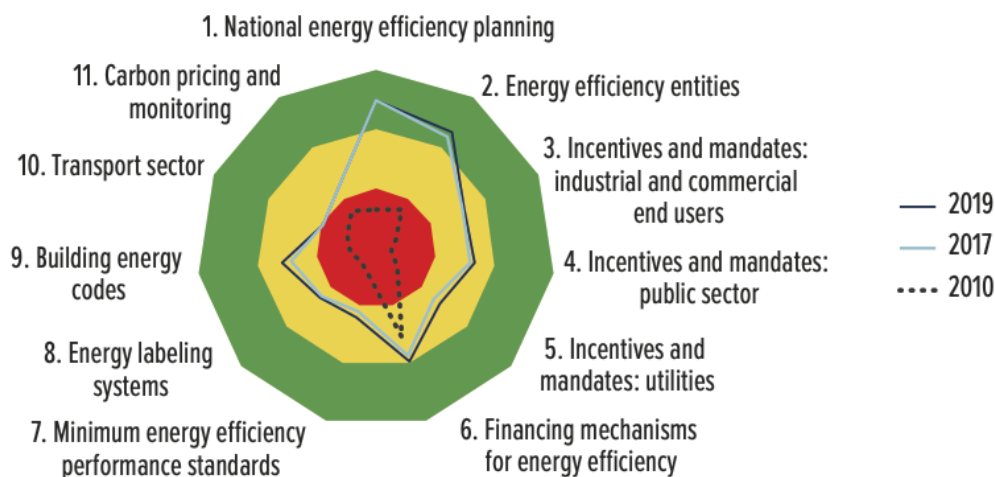
Source: World Bank, RISE 2020

The countries made progress on building energy codes, including on such sub-indicators as new residential and commercial buildings, compliance system, renovated buildings, building energy information, and building energy efficiency incentives (Fig. 29)

¹⁵ The RISE score on energy efficiency is calculated in 2020 and compared to the RISE score 2017-2019.

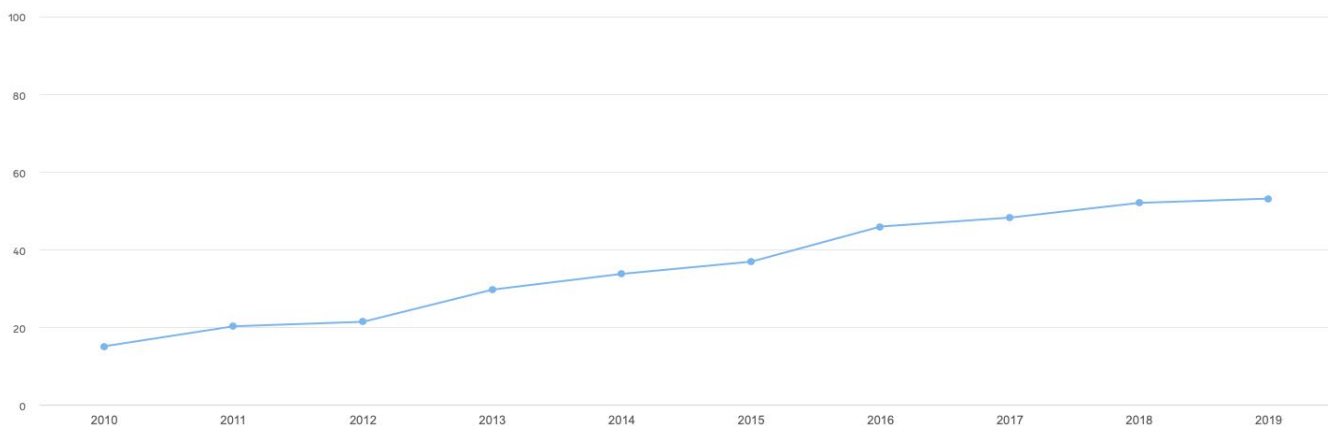
However, the situation differs from country to country with the highest score on building energy codes in Kazakhstan (score of 73), a bit lower in the Russian Federation (score of 67), followed by Montenegro (score of 63), Belarus and Serbia (both score of 60), as well as Bosnia and Herzegovina, Kyrgyzstan and North Macedonia (score of 53). Armenia has score of 40, Tajikistan -33, Azerbaijan and Ukraine both have score of 27. The lowest score is attributed to Uzbekistan (7) and Turkmenistan (5).

Figure 28. Overview of Progress in Energy Efficiency in the Period of 2010-2019, by each indicator



Source: World Bank, RISE 2020

Figure 29. Overview of Progress on Building Energy Codes in the Period of 2010-2019



Source: World Bank, RISE 2020

The minimum energy efficiency performance standards are most developed in Belarus (score of 77). Uzbekistan has average score of 52, Bosnia and Herzegovina has score of 50, Kazakhstan, North Macedonia, Serbia, and Ukraine have score of 45, Tajikistan has score of 42 followed by Kyrgyzstan (35), Montenegro (33) and the Russian Federation (25). Score of zero is in Armenia, Azerbaijan and Turkmenistan.

The energy labelling systems are most developed in Montenegro (score of 96) and followed by Uzbekistan (score of 75) and Belarus (score of 71). Ukraine has score of 58; Serbia and North Macedonia both have score of 50; Armenia, and Bosnia and Herzegovina have score of 42. Score of 25 is attributed to Kazakhstan, Kyrgyzstan, and the Russian Federation. Score of zero have Azerbaijan, Tajikistan and Turkmenistan.

GAP ANALYSIS OF ENERGY EFFICIENCY STANDARDS AND THEIR IMPLEMENTATION IN THE COUNTRIES

SWOT ANALYSIS

Strength-Weakness-Opportunity-Threat (SWOT) analysis can be regarded as a strategic planning method used to evaluate the strengths, weaknesses or limitations, opportunities, and threats or risks in implementation of existing energy efficiency standards in buildings. Such analysis will allow identifying internal and external factors that are favourable and unfavourable to achieve the initial objective. The SWOT analysis will also allow identifying the existing barriers and help in developing recommendations to overcome these barriers.

Every policy instrument is aimed to address barriers and improve situation, however none of them can address all barriers at the same time. The stronger instruments operate in combination with other tools, and often their impacts are synergistic. Combining regulations, incentives and measures to attract attention has the highest potential to increase energy efficiency (Urge-Vorsatz *et al.*, 2012).

The strengths of energy efficiency standards is that they can accelerate transformation of markets toward higher efficiency. Among strong policy options are the MEPS (Minimal Energy Performance Standards), voluntary or mandatory labelling programs, rebate programs and others. Building energy codes can be combined successfully with voluntary or mandatory certification of buildings. This combination eliminates the least efficient products, while compensating manufacturers for some of the increased production costs both through tax credits and premiums.

Financial incentives, such as loans, subsidies, and tax credits can be very effective. The labelling of energy efficient products is necessary, which ensures that only the most efficient categories of equipment can be financially supported.

The weaknesses of energy efficiency standards can be in the absence or lack of their enforcement. Regulatory policy instruments can be effective, however lack of their enforcement can become a barrier. Voluntary labelling programmes may not be very effective, as the premium labelled products are more expensive, and that discourages customers, especially from lower-income households from purchasing them.

The opportunities for standards implementation can be seen in various combinations of policy options. Introduction of “building energy codes and implementation processes, coupled with other key policies and incentives, can address key barriers to deployment of energy-efficient technologies in the building sector.” Potential impacts of building energy codes can then be assessed by cost-benefit analysis, which will look at the building energy and cost savings, greenhouse gas emission and other air pollution impacts, as well as construction and other administrative costs to implement the codes. In addition to this, market analysis is also critical to ensure availability of products and suppliers to implement building code requirements. Specific action plans can be developed to support building code implementation. Defining short-, medium-, and long-term objectives and targets can provide framework for an energy saving strategy. Adopting building codes for new buildings is beneficial because implementing energy efficiency technologies during construction of a building is often considerably less costly than retrofitting an existing inefficient building (Cox, 2016).

Factors for success of building codes are mostly in their enforcement. Factors for success of appliance standards may include periodic update, independent control, information, communication and education. Procurement regulations require enabling legislation, EE

labelling and specifications. EE obligations and quotas need continuous improvements, new EE measures, target change, and short-term incentives to transform markets.

Mandatory labelling and certification programmes can be effective in combination with other instruments and regulation. Utility demand-side management programmes can be combined with regulatory incentives, adaptation to local needs and market research.

Fiscal instruments, such as tax exemptions stimulate more efficient equipment and new buildings. Capital subsidies, grants and subsidized loans can be a successful option for low-income households.

Awareness raising, education and information campaigns are more applicable in the residential sector and require understandable message and adaptation to local audience. Detailed billing and disclosure programmes can work in combination with other measures and periodic evaluation

Potential risks and threats can include insufficient budget, staff, and analytical resources to support code implementation. At the local level, there is often a need to devote resources to training government authorities and institutions to support compliance and enforcement.

Compliance and enforcement of building energy codes is the biggest risk. A compliance cycle includes key inspections and activities at the design and construction stages, prior to occupancy of the building and when the building is occupied. It helps to support various stages of building code implementation. “In many cases, builders may be required to cover compliance inspection costs through fees, while local and national governments may fund other enforcement activities, such as additional random periodic inspections... Building on compliance data, policymakers at the local and national level can assess the effectiveness of building energy codes to support future improvements.”

“While countries may begin with a more limited scope of building code implementation, it is important to have a longer-term roadmap for implementation across the full building sector. Effective strategies encompass robust plans to implement, enforce, monitor, evaluate, and improve building codes over time” (Cox, 2016).

Based on assessment of the existing energy efficiency policies and implementation of energy efficiency standards in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia, and in the Russian Federation, the following SWOT tables were prepared. They intend to provide an overview of the situation in each sub-region and indicate potential risks or threats as well as opportunities for further EE standards development and implementation.

South Eastern Europe

Table 17. SWOT Analysis for Countries of South-Eastern Europe

Strength:	Weakness:
<ul style="list-style-type: none"> • Well-developed framework legislation, including EE laws, energy development strategies, NEEAPs • Mandatory building energy codes for new and existing buildings 	<ul style="list-style-type: none"> • Residential sector is the largest (in Bosnia and Herzegovina, Montenegro, Serbia) and the 2nd largest energy consumer (Albania and North Macedonia) • High energy consumption for heating and cooling

<ul style="list-style-type: none"> • Mandatory EPC of residential and non-residential buildings, in Albania only for non-residential buildings • Relevant legislation on ESCOs • Existence of energy efficiency funds • Requirements for modern insulation and glazing for new constructions 	<ul style="list-style-type: none"> • High energy consumption in existing building stock • Absence of central registry for energy passports, or even where exists - still not mandatory • Lack of ESCO activities, except in Serbia
Opportunity:	Threat:
<ul style="list-style-type: none"> • Active operations by the dedicated energy agencies in Albania, North Macedonia, Montenegro and Serbia • Further development of measurement and verification systems, use of IPMVP • Introduction of mandatory regular inspections in Albania and in Bosnia and Herzegovina • Introduction of additional financial methods for guaranteeing EE project development • Further development of minimum standards for HVAC • Introduction of compliance programmes. 	<ul style="list-style-type: none"> • Absence of mandatory energy performance monitoring requirements • Low and cross-subsidized energy prices • Absence of enforcement on mandatory labelling of appliances • Lack of specific incentives for building energy codes enforcement, except for Bosnia and Herzegovina and Montenegro • Lack of commercial financing for energy efficiency projects in buildings

Eastern Europe and the Russian Federation

Table 18. SWOT Analysis for Countries of Eastern Europe and the Russian Federation

Strength:	Weakness:
<ul style="list-style-type: none"> • Developed framework legislation, including laws on energy saving and EE, NEEAPs (for Moldova and Ukraine), state program on EE (for Russian Federation) • Adoption of building energy codes • Laws on energy performance in buildings • Energy labelling requirements • Incentives programmes, including subsidies/grants/soft lending (in Belarus), EE fund (in Moldova); “Warm Loans” programme and EE Fund (in Ukraine), fund for housing and public utilities (in the Russian Federation) 	<ul style="list-style-type: none"> • Absence of EPC in Belarus • Absence of ESCOs in Belarus and Moldova • Residential sector is the largest energy consumer in Belarus, Moldova, and the Russian Federation; and the 2nd largest sector in Ukraine (according to 2019 energy balance data) • Heat supply system technology is in a transition phase • Increased energy consumption for cooling and ventilation • High energy consumption of existing building stock (esp. constructed during the Soviet time)
Opportunity:	Threat:
<ul style="list-style-type: none"> • Increased energy prices in Ukraine providing incentives for higher energy savings 	<ul style="list-style-type: none"> • Absence of mandatory energy performance monitoring requirements in Belarus, Moldova, and Ukraine

<ul style="list-style-type: none"> • Reductions in energy intensity since 2000 • Major access to district heating system where consumption can be easier reduced (up to 45 per cent of energy savings) • Adopted standards and labels for appliances leading to increased EE equipment in households • Requirements for regular inspection of heating systems • Dedicated energy agencies in Moldova, the Russian Federation and Ukraine. 	<ul style="list-style-type: none"> • Absence of penalties for non-compliance with building energy codes
--	--

The Caucasus

Table 19. SWOT Analysis for the Caucasus Countries

Strength:	Weakness:
<ul style="list-style-type: none"> • Transposition of EE standards in accordance with the EU requirements (in Armenia and Georgia) • Developed legislation, including EE laws, NEAAPs in Armenia and Georgia; Energy Strategy (in Georgia); National Energy Security Concept (in Armenia) • Law on Energy Labelling (in Georgia) • Mandatory building energy codes and requirement for building energy passport (in Armenia) • Mandatory EPC (in Georgia) • Tax exemption on EE equipment (in Azerbaijan and Georgia) • Numerous awareness programmes on energy efficiency 	<ul style="list-style-type: none"> • Primary and secondary EE legislation is not developed (in Azerbaijan) • Absence of mandatory EE standards in building codes (in Georgia) • Absence of financial incentives (in Armenia) • Absence of specific incentives for improving compliance (in Azerbaijan) • Absence of functional ESCO market • Buildings is the largest energy consuming sector in Armenia and Azerbaijan and the 2nd largest in Georgia • Lack of energy performance regulations for new constructions (in Georgia)
Opportunity:	Threat:
<ul style="list-style-type: none"> • Draft law on energy efficiency in Azerbaijan • New law on energy efficiency in buildings in Georgia • Mandatory state certification of energy-intensive equipment (in Azerbaijan) • Increased energy tariffs in Armenia • Variable tariffs to promote rational use of electricity in Georgia 	<ul style="list-style-type: none"> • Absence of energy agency in Armenia, Azerbaijan and Georgia • Absence of minimum energy performance requirements for buildings (in Azerbaijan) • Absence of energy performance monitoring requirements (in Armenia) • Absence of requirement for regular inspection (in Azerbaijan) • Absence of penalties for non-compliance with building energy codes (in Armenia and Azerbaijan)

<ul style="list-style-type: none"> • Efficient lighting for increasing potential for significant energy tariffs reduction in Georgia 	<ul style="list-style-type: none"> • Unchanged electricity tariffs (in Azerbaijan) • Abandoning of district heating system (in Georgia and Armenia)
---	---

Central Asia

Table 20. SWOT Analysis for the Central Asian Countries

<p>Strength:</p> <ul style="list-style-type: none"> • Laws on energy saving and energy efficiency, except in Turkmenistan • Law on EE in Buildings in Kyrgyzstan • State programme on Energy Saving in Kazakhstan; National Sustainable Development Strategy in Kyrgyzstan; Strategy for Transition to a Green Economy in Uzbekistan • Adoption of building energy codes • Minimum energy performance requirements for buildings in Kyrgyzstan and Uzbekistan • Mandatory norms for thermal efficiency of buildings in Kazakhstan • Financial incentives for EE improvements in buildings: subsidies for building retrofits, building-level meter installation, taxation, policies, soft loans, pricing policies • Mandatory demand for energy marking and EE class of appliances in Uzbekistan 	<p>Weakness:</p> <ul style="list-style-type: none"> • Absence of EE law in Turkmenistan • No ESCO market in Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan • Absence of energy performance contracts in Kazakhstan • Residential sector is the largest energy consumer in Kyrgyzstan, Tajikistan and Uzbekistan; the 2nd largest – in Kazakhstan • Absence of requirement for regular inspection for heating and AC system in Kazakhstan • Absence of incentives for improving compliance with building energy codes in Kazakhstan and Turkmenistan • Absence of penalties for non-compliance with EE standards in buildings in Kazakhstan and Uzbekistan
<p>Opportunity:</p> <ul style="list-style-type: none"> • Draft Energy Strategy for 2030 in Turkmenistan • Introduction of energy service contract envisaged by Kazakhstan 2050 Strategy • Requirement for regular inspection for heating and AC systems in Turkmenistan and Uzbekistan; periodic monitoring of heating and hot water supply systems in Kyrgyzstan 	<p>Threat:</p> <ul style="list-style-type: none"> • Low electricity prices • Consumption of district heating is the highest among buildings energy services in Kazakhstan • Unstable electricity supply in winters in Tajikistan • Absence of data on energy performance monitoring, requirement for regular inspection for heating and AC systems Turkmenistan • Absence of dedicated energy agencies in Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan

Based on this sub-regional SWOT analysis, it is possible to identify common elements in each category.

Common strengths:

- The project countries have quite well-developed framework legislation, including energy efficiency laws, energy development strategies and energy efficiency programs, NEEAPs (except in the Central Asian countries).
- Building energy codes were adopted, where in many countries they are mandatory.
- Some countries have adopted laws on energy performance in buildings and energy efficiency in buildings.
- Energy labelling requirements are present in most of the countries.
- Financial incentives, such as subsidies, soft loans, tax exemption or reductions are present in most of the countries.

Common weaknesses:

- Out of 17 project countries, the residential sector is the largest energy consumer in eleven countries and the second largest in six countries.
- High energy consumption in the existing building stock is a problem in all project countries.
- Energy consumption has recently increased for heating and cooling in many countries.
- Lack of ESCO activities in some countries, or absence of ESCO market in the other project countries; absence of EPC in many project countries too.
- Azerbaijan and Turkmenistan have not adopted energy efficiency legislation.
- Specific incentives for improving compliance with building energy codes are absent in some countries.

Common opportunities:

- Operations by the energy agencies to monitor and implement energy efficiency measures and activities are existing in seven countries (out of 17). The agencies are established in South-Eastern Europe, Eastern Europe and in the Russian Federation. In the Caucasus and Central Asian regions, the energy agencies are not established.
- Mandatory regular inspections for heating and AC systems have been introduced in most of the project countries.
- The energy tariffs have been increased in Armenia, Ukraine and Uzbekistan.
- Development on energy efficiency related legislation is on the way in Azerbaijan (draft law on energy efficiency in Azerbaijan), Georgia (new laws on energy efficiency in buildings, on energy efficiency and on energy labeling) and Turkmenistan (draft Energy Strategy for 2030).

Common risks and threats:

- Low energy prices in many countries lead to absence of driving force for energy efficiency improvement in buildings.
- Mandatory energy performance monitoring requirements are absent in many project countries.
- Penalties for non-compliance with building energy codes are also absent in many project countries.
- Energy agencies are not established in Bosnia and Herzegovina, Montenegro, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

CONFORMITY OF ENERGY EFFICIENCY STANDARDS WITH THE FRAMEWORK GUIDELINES

The Framework Guidelines for Energy Efficiency Standards in Buildings (further Framework Guidelines) provide guiding principles for sustainable buildings. In particular, these principles provide the following guidance (i) strategic nature; (ii) design and construction of buildings; (iii) management of buildings.

Strategic guidance

In line with these guidelines, the buildings must be science-based, service-oriented, integrated with the built environment lifecycle, cost effective, using low-carbon technologies, having low energy consumption, performance-monitored and performance-based, safe and healthy.

These high standards of buildings should be addressed in the national legislation, which in its turn should be recent and take into account the current trends and modern technologies to enhance energy efficiency in buildings. However, not all countries have adopted and/or recently updated their energy efficiency standards to address such high-level requirements.

For example, in the **South-Eastern European** countries the energy efficiency standards are introduced as follows:

- Albania's energy building code was adopted in 2003 with the law on thermal heat requirements for building as of 2002. However, Albania adopted new law on energy performance of buildings in November 2016. The recent developments include introduction of minimum energy performance requirements of buildings and building elements in 2020.
- Bosnia and Herzegovina has the law on energy efficiency adopted in 2017 (for the Federation of Bosnia and Herzegovina) and the law on construction (for Republika Srpska). Although it has more recent regulations on minimum energy efficiency of buildings (for both entities), the regulations on minimum energy performance of buildings in Republika Srpska as of 2015, and in the process of adoption for the Federation of Bosnia and Herzegovina.
- Montenegro adopted the law on efficient use of energy in 2014 as well as the guidelines for energy efficiency certification of buildings and the guidelines for energy audits of buildings in 2015.
- North Macedonia's law on energy was adopted in 2011. The laws on construction as well as spatial and urban planning are existing too. The rulebooks on energy audits and energy characteristics of buildings, system for monitoring and management of energy consumption at legal entities in public sector were adopted in 2013.
- Serbia adopted law on planning and construction in 2009 and amended in 2014 together with the rulebook on energy performance of buildings as of 2011. The rulebook on certificates on energy performance of buildings is existing since 2012.

For **Eastern Europe and the Russian Federation**, the situation is the following:

- Belarus adopted the law on energy saving in 2015 and a set of legislative acts, including a decree on improving energy efficiency of multi-apartment residential buildings in 2019, the construction norms for heating and ventilation and hot water supply are established in 2020. However, the building code was adopted in 2002, the technical code on thermal engineering building design standards in 2006, and the technical code on thermal protection of buildings in 2010.
- The Republic of Moldova has the law on Energy Performance of Buildings adopted in 2014, and the law on energy efficiency from 2012; the building code is more recent (2016). The country also uses methodology for calculating cost-optimal levels, minimum energy performance requirements for buildings and their components.

- The Russian Federation has a federal law on energy saving and energy efficiency improvement as of 2009 as well as the more recent standards related to energy savings as of 2017.
- Ukraine adopted law on energy efficiency of buildings in 2017; law on metering in domestic heating and water supply in 2017; law on ESCO in 2015. However, the state building codes were adopted in 2006 and the standards concerning the engineering systems in 2010.

For the **Caucasus** countries the standards are the following:

- Armenia adopted the law on standardization and the law on technical regulation in 2012. The energy law, adopted in 2001, had amendments in 2017 and 2018. The mandatory building energy code was introduced in 2016. The technical codes on thermal protection of buildings (as of 2016) and the construction climatology (as of 2011) are currently in force.
- Azerbaijan is in the process of adoption of the draft law on “Efficient Use of Energy Resources and Energy Efficiency” and planned to draft a law on “Energy Efficiency in Buildings” afterwards. The Urban Planning and Building codes are the regulatory documents.
- Georgia adopted very recently the law on energy efficiency prepared according to the Energy Efficiency Directive 2012/27/EU (May 2020) and the law on energy efficiency of buildings (May 2020). This law is in accordance with the Energy Performance of Buildings Directive 2010/31/EU. The law on energy labeling is also adopted (December 2019). Secondary legislation still remains to be adopted. The Georgian Space Planning, Architectural and Construction Activity Code was enacted in June 2019 and includes a general article on building’s energy efficiency.

For the **Central Asian** region, the energy efficiency standards are the following:

- Kazakhstan adopted its law on energy saving and energy efficiency in 2012. There is no law on energy efficiency in buildings. The standards on thermal protection and energy consumption of buildings were adopted 2004 and amended in 2011.
- Kyrgyzstan’s law on energy efficiency of buildings was adopted in 2011 with latest amendment in 2019. The norms on thermal protection of buildings, method for calculating energy efficiency of buildings and energy certification of buildings as well as instruction for conducting monitoring of boilers, heating systems and hot water supply of buildings are dated to 2013.
- Turkmenistan adopted the standards on design of energy efficient residential buildings in 2015 and on thermal building engineering in 2017. The standards for roofs and roofing are as of 2001.
- Uzbekistan adopted its building regulations in 2013. The rules on the improvement of settlements taking into account architectural and town-planning requirements were adopted in 2009. Norms regulating energy consumption for heating ventilation and air conditioning of buildings and structure are as of 2000.

This overview shows that the framework legislation for energy efficiency in buildings was recently updated in many countries. However, the building energy codes are not recently adopted and thus cannot reflect the recent requirements and technological advances. Some countries, such as Armenia and Georgia, have recently adopted their regulatory documents that would allow including the most recent low consumption and performance-based standards in buildings. For the other countries, shifting to higher performance standards for new and existing buildings is required to ensure the contribution to the transition to sustainability in these countries.

Performance-based approach

The Framework Guidelines indicate that “buildings and the materials and technologies...[should be] assessed over their life cycle in terms of their energy performance.” The energy efficiency standards in buildings are to be “outcome-based anchored in energy actually consumed.”

However, it is not the case for all countries. The assessment presented in Chapter 2 shows that countries have different levels of standards addressing the performance of buildings.

In all countries of **South-Eastern Europe**, the building energy codes have specific requirements for (i) thermal characteristics and geometry of the building (envelope and internal partitions); (ii) air-tightness; (iii) space heating system and hot water supply units; (iv) air-conditioning system(s); (v) mechanical and natural ventilation; (vi) design position and orientation of buildings; and (vii) thermal bridge. The requirements for built-in lighting system exist only in Albania and in Bosnia and Herzegovina. Passive solar systems and solar protection requirement are present in Albania, Montenegro, and North Macedonia. The specific requirement depending on indoor and outdoor climatic conditions are indicated in all countries of the sub-region, except Serbia.

No mandatory requirement to assess post-construction requirement of the thermal bridge and no mandatory requirement for air tightness testing exist in Albania.

Only Bosnia and Herzegovina uses ISO standards and other technical requirements following the adoption of the EU standards such as EPB from 2017 (EN ISO 52000). Software for compliance verification is used only in Montenegro. The International Performance Measurement and Verification Protocol (IPMVP) is used only in Bosnia and Herzegovina.

All countries in the **Eastern Europe and the Russian Federation** have requirements for thermal characteristics and geometry of the building, air-tightness, space heating system and hot water supply units, air-conditioning system(s), mechanical and natural ventilation, design position and orientation of buildings, built-in lighting system, indoor and outdoor climatic conditions, and thermal bridge. Passive solar systems and solar protection exist, except in the Russian Federation.

Software for compliance verification is used only the Russian Federation. Energy Performance in Buildings standards are used in Belarus, Republic of Moldova, and Ukraine. The IPMVP is used only in the Russian Federation. Only Ukraine and the Russian Federation have mandatory requirement to assess post-construction requirement of the thermal bridge.

In the **Caucasus** sub-region, the requirements for thermal characteristics and geometry of the building, air-tightness, air-conditioning system(s), space heating system and hot water supply units, mechanical and natural ventilation, built-in lighting system, design position and orientation of buildings, passive solar systems and solar protection, indoor and outdoor climatic conditions, and thermal bridge exist in Armenia and Azerbaijan. No elements, which must be taken into account for the calculation of the energy performance of a building, exist in Georgia by now, however, developing the secondary legislative act on the national methodology of the calculation of the energy efficiency of buildings started in 2020.

Software for compliance verification is not used in any of the three countries of this sub-region. Mandatory requirements to assess post-construction requirement of the thermal bridge as well as requirement for air tightness testing are not existing in all countries. In Georgia, there are also no existing standards for determining the energy characteristics of buildings in operation

by now, nevertheless, the elaboration of the secondary legislative act on the minimum energy efficiency requirements for buildings, buildings units and buildings elements started in 2020.

The ISO standards are used in Azerbaijan and Georgia. The IPMVP is used only in Azerbaijan.

In **Central Asia**, the requirements for thermal characteristics and geometry of the building, space heating system and hot water supply units are present in the building energy codes of all five countries. The requirements for thermal bridge are existing in all countries, except Kyrgyzstan. Air-tightness requirements exist only in Kazakhstan and Uzbekistan. The air-conditioning system(s) requirements are present in Kyrgyzstan, Turkmenistan and Uzbekistan. Design position and orientation of buildings is regulated in Kazakhstan and Turkmenistan. Requirements for indoor and outdoor climatic conditions are present in Kazakhstan, Turkmenistan and Uzbekistan. Specific requirement for mechanical and natural ventilation and built-in lighting system exist only in Kyrgyzstan and Uzbekistan. The same is for the passive solar systems and solar protection. Passive cooling requirement is present only in Kyrgyzstan.

Software for compliance verification and the EPB standards are reported to be used only in Uzbekistan. There are no mandatory requirements for post-construction assessments of the thermal bridge in the countries.

Table 21 provides an overview of existing performance-based requirements in building energy codes in the countries of the South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia and in the Russian Federation. It is visible that technical requirements are mostly observed in the countries of South-Eastern Europe and Eastern Europe and in the Russian Federation. They are less present in the Central Asian countries. Such requirements are not present in Georgia.

Table 21. Overview of Performance-Based Requirements in Building Energy Codes in the Countries

Country	Thermal characteristics and geometry of the building (envelope and internal	Air-tightness	Space heating system and hot water supply units	Air-conditioning system(s)	Mechanical and natural ventilation	Built-in lighting system (mainly in the non-residential sector)	Design position and orientation of buildings	Passive solar systems and solar protection	Indoor and outdoor climatic conditions	Thermal bridge
<i>South-Eastern Europe</i>										
Albania	X	X	X	X	X	X	X	X	X	X
Bosnia and Herzegovina	X	X	X	X	X	X	X	-	X	X
Montenegro	X	X	X	X	X	-	X	X	X	X
North Macedonia	X	X	X	X	X	-	X	X	X	X
Serbia	X	X	X	X	X	-	X	-	-	X
<i>Eastern Europe and the Russian Federation</i>										
Belarus	X	X	X	X	X	X	X	X	X	X
Republic of Moldova	X	X	X	X	X	X	X	X	X	X
Ukraine	X	X	X	X	X	X	X	X	X	X
Russian Federation	X	X	X	X	X	X	X	-	X	X
<i>The Caucasus</i>										
Armenia	X	X	X	X	X	X	X	X	X	X
Azerbaijan	X	X	X	X	X	X	X	X	X	X
Georgia	-	-	-	-	-	-	-	-	-	-

<i>Central Asia</i>										
Kazakhstan	x	x	x	-	-	-	x	-	x	x
Kyrgyzstan	x	-	x	x	x	-	-	x	-	-
Tajikistan	<i>No data</i>									
Turkmenistan	x	-	x	x	-	-	x	-	x	x
Uzbekistan	x	x	x	x	x	-	-	x	x	x

Table 22 reflects on existence of requirements for assessment of post-construction requirement of the thermal bridge and air-tightness testing. Based on this overview, it is understandable that such requirements are almost not present in the countries.

This table also provides an overview of practices for the use of the IPMVP, EPB standards and software for compliance verification in the countries. It shows that IPMVP is used only in Bosnia and Herzegovina, Russian Federation, and Azerbaijan. EPB standards are used in Bosnia and Herzegovina, Azerbaijan, Georgia, and Uzbekistan. The software for compliance verification is applied in Montenegro, Russian Federation, and Uzbekistan.

Table 22. Overview of Requirements to Identify the Energy Performance Gap in the Countries

Country	Use of IPMVP	Use of Energy Performance in Buildings standards	Use of software used for compliance verification	Assessment of post-construction requirement of the thermal bridge	Air-tightness testing	Use of individual energy metering and control units
<i>South Eastern Europe</i>						
Albania	-	-	-	-	-	-
Bosnia and Herzegovina	x	x	-	-	-	-
Montenegro	-	-	x	-	-	-
North Macedonia	-	-	-	-	-	-
Serbia	-	-	-	-	-	-
<i>Eastern Europe and the Russian Federation</i>						
Belarus	-	-	-	-	-	-
Republic of Moldova	-	-	-	-	-	-
Ukraine	-	-	-	x	-	-
Russian Federation	x	-	x	x	-	-
<i>The Caucasus</i>						
Armenia	-	-	-	-	-	-
Azerbaijan	x	x	-	-	-	-
Georgia	-	x	-	-	-	-
<i>Central Asia</i>						
Kazakhstan	-	-	-	-	-	-
Kyrgyzstan	-	-	-	-	-	-
Tajikistan	<i>No data</i>					
Turkmenistan	-	-	-	-	-	-
Uzbekistan	-	x	x	-	-	-

The Framework Guidelines for Energy Efficiency Standards in Buildings particularly indicate that there should be the “building heating and cooling requirements to 15 kWh/m²a in new builds and to 25 kWh/m²a for retrofit projects (final energy in conditioned space)... Total primary energy use in buildings’ conditioned spaces, including heating, ventilation, cooling and hot water, can be limited to 45 kWh/m²a or, including plug-in loads (appliances), to 90 kWh/m²a.” with potentially lower targets in future.

However, not all countries reflect the performance-based limits directly in their building energy codes. Table 23 below provides an overview of building energy codes requirements in the countries, where they are applicable.

Table 23. Overview of Requirements for Energy Use in Buildings in the Countries

Country	Building energy codes requirements
<i>South-Eastern Europe</i>	
Albania	Performance based requirements: <ul style="list-style-type: none"> • for new buildings up to 55 kWh/m²a; • for existing buildings up to 80 kWh/m²a
Bosnia and Herzegovina	<i>No data</i>
Montenegro	<ul style="list-style-type: none"> • Performance-based requirements for buildings do not exist. • Total primary energy use
North Macedonia	<ul style="list-style-type: none"> • The national classification of buildings for the needs of energy audits includes: residential sector min "C class" 100 kWh/m² annual consumption, public sector min "C class" 150 kWh/m² annual consumption. Mandatory for public sector min "D class" after substantial refurbishment
Serbia	<ul style="list-style-type: none"> • The energy class of the new building shall not be lower than class "C" or higher. The class of energy consumption of existing buildings should be upgraded to at least one class after reconstruction.
<i>Eastern Europe and the Russian Federation</i>	
Belarus	Technical Code on Thermal protection of buildings defines norms for annual consumption of heat for different types of buildings: (i) residential buildings and hotels: 48-96 kWh/m ² a; (ii) individual residential houses: 108 kWh/m ² a; (iii) kindergardens: 38 kWh/m ² a; (iv) schools: 37 kWh/m ² a; (v) clinics and hospitals: 35 kWh/m ² a; (vi) public buildings: 36 kWh/m ² a.
Republic of Moldova	Energy efficient development systems Details/values of the performance-based requirements: After year 2021, all new buildings must be Nearly Zero Energy Buildings Class A = 50 kWh/m ² a; B=99 kWh/m ² a
Russian Federation	<i>No data</i>
Ukraine	<i>No data</i>
<i>The Caucasus</i>	
Armenia	Performance-based requirements for buildings do not exist.
Azerbaijan	Performance-based requirements for buildings do not exist.
Georgia	Performance-based requirements for buildings do not exist.
<i>Central Asia</i>	
Kazakhstan	Performance-based requirements for buildings do not exist.
Kyrgyzstan	<i>No data</i>
Tajikistan	<i>No data</i>
Turkmenistan	<ul style="list-style-type: none"> • The primary indicator for estimating the energy consumption of buildings is the primary energy consumption for heating, cooling and ventilation. • Total primary energy use.
Uzbekistan	<ul style="list-style-type: none"> • Total primary energy use.

From this table, one can see that Albania, North Macedonia, Belarus, and Republic of Moldova provide requirements for total primary energy use for certain categories of buildings.

The performance based requirements for buildings in Albania (for new buildings up to 55 kWh/m²a; for existing buildings up to 80 kWh/m²a) are in line with the Framework Guidelines, taking into consideration that they provide limit up to 90 kWh/m²a for building including heating, ventilation, cooling and hot water.

In North Macedonia, the limits of annual consumption for residential and non-residential buildings are higher than those indicated in the Framework Guidelines.

In Belarus, the annual consumption requirements for heating and cooling are higher than those indicated in the Framework Guidelines (limiting requirements to 15 kWh/m²a for new buildings and up to 25 kWh/m²a for retrofitted projects). As in Belarus they are in the range of 48-96 kWh/m²a for residential buildings, and 35-38 kWh/m²a for non-residential buildings, including schools, kindergartens, hospitals and other buildings.

In the Republic of Moldova, the annual consumption of certain categories of buildings should be up to 50 kWh/m²a (classified as class A) and up to 99 kWh/m²a /classified as class B), while the Framework Guidelines have lower indications energy use in buildings.

In Montenegro and Serbia (from the South-Eastern European region), as well as in all countries in the Caucasus and Central Asian regions the requirements based on annual energy consumption are not specified. The indicator for estimating energy consumption of buildings in these countries is the primary energy use for heating, cooling and ventilation.

ENERGY EFFICIENCY GAP

Despite numerous policy developments on improving building energy performance over the last decade, the overall building energy consumption continues to grow. The factors explaining such growth can include the “rapid increase in the number of buildings across the world: building sector energy intensity measured as energy use per square meter continues to improve at an average annual rate of 1.5 per cent, yet global built floor area is increasing at a rate of 2.3 per cent per year, offsetting those energy efficiency and intensity improvements” (OECD/IPEEC, 2019).

Enhancing energy efficiency in buildings can be “a cost-effective opportunity to reduce energy consumption and resulting greenhouse gas emissions” (OECD/IPEEC, 2019). Different policy instruments have been implemented to promote energy efficiency in the buildings sector. However, there is no single instrument that can capture the entire energy saving potential (Urge-Vorsatz *et al*, 2012).

In many countries of South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation both primary and final energy consumption are high.

In South-Eastern Europe, the final energy consumption in buildings (Table 24) is significantly higher than previewed by the national energy efficiency targets. The reports prepared by countries under the Energy Efficiency Directive (submitted to the Energy Charter Secretariat) indicate that the national target for final energy consumption in buildings for 2018 in Montenegro was 48.18 ktoe, while the real consumption in 2018 was 274.1 ktoe. In North Macedonia, the situation is similar: the national target previewed 83,27 ktoe, however the final energy consumption was 484 ktoe. In Serbia, the national target for 2018 was 277.69 ktoe and the actual consumption the same year was 2872 ktoe.

According to the IEA data, the final energy consumption in the residential sector in Eastern Europe, the Caucasus and Central Asia is very high (Table 25). In the period from 2010 to 2018, in Azerbaijan the final energy consumption increased from 3081 to 3296 ktoe. In the Republic of Moldova, the energy consumption also increased over from 1122 to 1361 ktoe. In Belarus, Georgia, Ukraine, and Uzbekistan the energy consumption slightly reduced. However, the overall level of consumption remains high, and the residential sector is mostly the largest energy consumer.

Table 24. Energy Consumption in South-Eastern Europe, 2018: National Targets vs Actual Energy Consumption (ktoe)

Country	National EE target (2018)			Total PEC	Total FEC	FEC in Buildings
	PEC	FEC	FEC in Buildings			
Albania	2131.9	2077.1	10.7	2131.86	2077.13	500.22
Bosnia and Herzegovina	6646 (in 2020)	4249 (in 2020)	-	7470.6	4211.9	1719.4
Montenegro	-	-	48.18	996.24	741.9	264.1
North Macedonia	185.74	180.28	83.27	2599	1853	484
Serbia	-	9376.7	277.69	15370	8470	2872

PEC-primary energy consumption; FEC-final energy consumption

Source: Annual Reports under the Energy Efficiency Directive, Energy Charter Secretariat

Table 25. Final Energy Consumption in the Countries in 2010 and 2018 (ktoe)

Country	FEC in residential sector in 2010	FEC in residential sector in 2018
Azerbaijan	3081	3296
Belarus	5262	5196
Georgia	1289.7	1218.1
Republic of Moldova	1122.5	1361.4
Ukraine	17588 (in 2016)	16668
Uzbekistan	5159 (in 2014)	5063.5 (in 2017)

FEC-final energy consumption

Source: IEA, Energy Efficiency Indicators Highlights, 2020.

According to the Framework Guidelines, the “total primary energy use in buildings’ conditioned spaces, including heating, ventilation, cooling and hot water, can be limited to 45 kWh/m²a or, including plug-in loads (appliances), to 90 kWh/m²a.” “Limiting building heating and cooling requirements to 15 kWh/m²a in new builds and to 25 kWh/m²a for retrofit projects (final energy in conditioned space) each reduces energy needs sufficiently...”

The situation with new buildings in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia, and in the Russian Federation differs.

For example, in Kyrgyzstan the thermal requirements for multi-apartment buildings, depending on the number of storeys, ranged from 64 to 78 kWh/m²a. However, the average space heat demand for multi-family apartment buildings constructed after 2004 was 100-110 kWh/m²a.

In Belarus, in some recent residential buildings constructed in Minsk a heat demand was indicated as 39,5 kWh/m²a for the entire building, however the recalculated energy demand for the entire building was calculated with 56 kWh/m²a. The residential buildings in Gomel were with a calculated energy demand of 95 kWh/m²a-102 kWh/m²a. The recently constructed multiapartment buildings in the city of Solnechny ranged between 54 and 90 kWh/m²a depending on the orientation of a particular apartment.

In the Russian Federation, the heating energy intensity for new multi-family high buildings was 77 kWh/m²a.

Overall, one can conclude that construction of the new buildings can lead to energy efficient improvements and staying within the limits indicated in the Framework Guidelines is possible. That will, however, require the observation of the performance-based requirements in the buildings and ensuring the compliance with the building energy codes.

In the existing buildings the situation is completely different:

- In **Bosnia and Herzegovina**, on average, residential buildings consumed more than 200 kWh/m²a, while private households consume as much as 350 kWh/m²a.
- In **Montenegro**, the average energy consumption of residential buildings in 2016 was 161 kWh/m²a.
- In **Belarus**, the buildings constructed during the Soviet times are characterized by high energy consumption and on average consume between 150–200kWh/m²a. According to World Bank assessment, majority of existing buildings consume 121-160 kWh/m²a; and only 9 per cent of buildings consume less than 90 kWh/m²a.
- In **Armenia**, the buildings constructed in 1960s-1980s consume from 140 to 210 kWh/m²a. However, the thermal retrofit of such a multi-apartment panel building can reduce consumption to 74 kWh/m² after thermal rehabilitation of the building façade.
- In **Azerbaijan**, the average energy consumption of residential buildings in 2017 was 276 kWh/m²a.
- In **Georgia**, the energy demand for heating individual houses is between 200-410 kWh/m²a.
- In **Kazakhstan**, as per Energy Charter assessment, the consumption of heat by residential buildings is on average 273 kWh/m²a. In Almaty, the residential and public buildings consumed up to 250 kWh/m²a.
- In **Tajikistan**, the requirement for heat energy of the buildings was estimated minimum as 148 kWh/m²a. For single-family houses with less efficient space-heating systems the consumption is between 220-244 kWh/m²a.
- In **Uzbekistan**, energy consumption by living space was 423 kWh/m²a. Nearly 50 per cent of heat loss is due to inefficient windows, doors, ceilings and walls, which led to energy consumption of 320 to 690 kWh/m²a.

The existing buildings in all countries consume high amount of energy. The examples of residential building retrofits, however, show that the potential to reduce energy consumption is also very high. It will require more resources and efforts at all levels starting from planning, implementation and compliance with the outcome-based approach and requirements.

According to the UNECE survey in 2018, the gap between predicted and actual performance levels is Albania was 30-40 per cent. In Serbia, the energy performance gap between predicted and actual performance levels is 10 per cent. Kazakhstan's average energy performance gap between the projected and actual levels of energy efficiency and energy consumption is 20-30 per cent in new buildings (UNECE, 2018).

EXISTING BARRIERS

A gap between energy efficiency policies potential and effective achievement is existing mainly due to barriers affecting those energy efficiency policies and measures. The identification of barriers is a required process to support policy development and ensure the success of their implementation.

The barriers can be grouped into several main categories: (i) regulatory and institutional, (ii) economic (financial and market barriers), (iii) behavioural (awareness, advice and skills).

Regulatory and institutional barriers are related to legislative, regulatory and planning issues; conflicting guidelines in the governance structure; multistakeholder issues; and lack of policy coordination.

Economic barriers refer to difficulties in accessing to finance; insufficient and unstable funding; payback expectations; high risk for investors and financial institutions.

Behavioural barriers refer to low awareness about energy efficiency and non-energy benefits; lack of information in processing information; lack of skills and knowledge of building professionals; lack of trust; customer attitude and lifestyle.

The overall picture of existing barriers in the countries is presented below:

- **In South-Eastern Europe**, “lack of understanding of energy efficiency financing by banks and other financial institutions is viewed as the main barrier...followed by administrative barriers and bureaucracy. The next four barriers [also equally present]: lack of specific policies, programmes, legislation, by-laws, norms and standards; inadequate implementation and enforcement of policies and legislation; lack of technical expertise and capacity to identify/evaluate/implement projects; and problems with using savings on energy efficiency measures.”
- **In Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation**, “the following are considered as main barriers: low awareness about the multiple benefits of energy efficiency projects and high interest rates for energy efficiency projects...followed closely by lack of technical expertise and capacity to identify/evaluate/implement projects; difficulties with obtaining commercial loans and other types of financing; and low energy prices.” (UNECE, 2017b)

Regulatory and institutional barriers

The regulatory barriers for energy efficiency in buildings can include (i) lack of an extensive regulatory system covering new and existing residential and non-residential building sector; (ii) discrepancy between national, regional and local norms which implies redundancy of legislation; (iii) delays in adopting policy schemes; (iv) lack of effective implementation; (v) absence of enforcement mechanism; (vi) absence or malfunctioning incentives; (vii) unclear regulation about labelling; and (viii) frequent changes in regulation.

The institutional barriers for energy efficiency in buildings are mainly related to the roles of stakeholders and include (i) absence of the dedicated institution; (ii) coordination failures; (iii) lack of transparency; (iv) lack of control over implementation; (v) lack of government guidance on energy conservation policy. These barriers also constitute significant limitations to the promotion and diffusion of energy efficiency technologies, undermining the success of government regulation.

The energy efficiency supporting laws are indirect and require adoption of a significant number of by-laws (Arkhangelskaya, 2014). Insufficient volumes of implementation of progressive energy efficiency standards and regulatory legal acts can lead to failure in significant energy efficiency improvements.

In 2017, the UNECE conducted a survey and measured a level of positive responses (in per cent) on existence of energy efficiency legislation, policies and programmes in the countries (Fig. 30). The assessment concluded that respondents rated the development of framework legislation, programmes and policies to support energy efficiency quite high, however the development of by-laws, specific norms and standards was rated significantly lower.

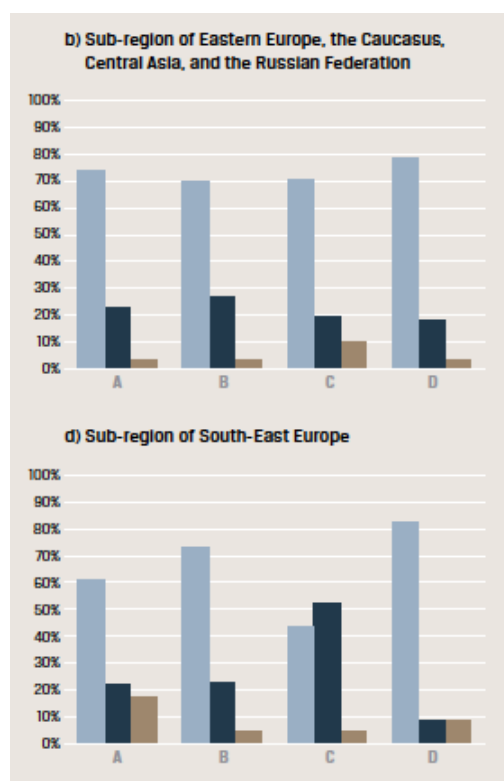
The analysis presented in this study also showed in most of countries the framework legislation and policies are developed. However, among these countries there are two exceptions. In Azerbaijan and Tajikistan, there is a lack of specific policies, programmes, legislation. Secondary legislation and specific standards are not always introduced in the reviewed countries.

The existence of appropriate energy efficiency supporting and promoting legislation is a necessary, however is not sufficient *per se*. The assessment of perception on the strength of existing legislative and regulatory framework indicated that regulatory framework was

considered weak in Azerbaijan and North Macedonia. Belarus, Kazakhstan and Ukraine have their frameworks in place “but the support it provides for energy efficiency investments is not considered strong, particularly in Ukraine” (UNECE, 2017b).

The energy legislation focuses more on supply needs and neglecting the fact that energy saved is also an energy resource. “Therefore, important energy efficiency opportunities are usually omitted from national and local policies, especially with regard to the residential sector. Also, housing policies, condominium laws, energy laws are often not coordinated, leading to confusion and mismanagement of properties and the basic services offered to residents.” (REEEP).

Figure 30. Overview of Existence of Particular Types of Legislation, Programmes and Policies to Support Investments in Energy Efficiency in the Countries



- A. Government programmes and policies to support investment in EE
- B. Norms and standards on EE
- C. By-laws (secondary legislation) on EE
- D. Framework legislation (law on EE or equivalent)

Blue color-yes,
Dark blue-no,
Brown-no answer.

The countries established institutional framework at the national level responsible for developing and implementing energy efficiency policies. However, not always the acting institutions are considered efficient in implementing the assigned functions. The assessment of perception in the level of support provided by authorities at various levels (in per cent of positive responses) indicated that institutions at the national level are providing more support than institutions at the regional or local levels (UNECE, 2017b).

Source: *Overcoming Barriers to Investing in Energy Efficiency*, UNECE, 2017

Additionally, “the lack of proper organizational structures and decision-making structures in multi-family buildings results in few organized initiatives to renovate common spaces” in the countries (HHI, 2017).

Despite numerous developments and improvements, the regulatory and institutional barriers are still present in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation.

Economic barriers

The economic barriers to energy efficiency in the building sector undermine the effectiveness of EE regulations and norms, energy saving obligation schemes and economic instruments, such as EPCs. “In particular, the small incidence of energy costs on companies/families involves a general lack of incentives to invest in energy efficiency. Split incentives and principal-agent problems affect energy efficiency investments as tenants have limited incentive to invest in energy efficiency. Difficulties in accessing credit caused by economic stagnation

also limit energy efficiency investments, affecting both building administrators and ESCO companies” (Bagaini *et al.*, 2020).

The particular barriers to enhancement of energy efficiency in buildings include the prolonging the payback time and downsizing the internal rate of return on investments, transaction costs, limited access to capital, energy subsidies, fragmented market structures, lack of enforcement and perception on the high risk for investors.

These barriers are caused by (i) price and tariff policy for energy carriers; (ii) lack of investment from both the state and consumers; (iii) lack of a mechanism for partnership between the state and the private sector in the field of energy saving; (iv) high bank interest rates on loans; (v) low paying capacity of consumers; (vi) lack of available best practice for financing energy saving investments (Arkhangelskaya, 2014).

Many building energy codes require the use of efficient products including insulation, efficient glass, efficient HVAC systems and lighting. However, higher investment costs of efficiency technologies require significant investments, which some households are not able to afford. In the countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia, and in the Russian Federation, some “households are unable to meet their utility bills” (REEEP). Lack of financing for the major repairs and renovations of residential buildings is a problem nowadays when most countries in the region lack financing for this purpose (HHI, 2017).

Low energy prices also make the payback periods too long to be considered attractive by population widely (REEEP). For bigger renovations, the payback time may be equal to or exceed 20 years (HHI, 2017).

Public financing options exist in limited quantity in the countries. However commercial lending is still considered as “high risk”, and the mortgage markets for energy efficiency are immature. “Financial institutions still view financing of energy efficiency projects significantly riskier compared to other types of business projects.” (UNECE, 2017b).

“Another barrier emerges from the underdeveloped concept of home equity loan facility. The unavailability of home equity loans for apartment owners makes it impossible to finance higher cost energy efficiency improvements. In addition, obtaining resources for projects through other methods of commercial financing, such as traditional loan mechanisms, is precluded by ...high interest rates, a lack of borrowers’ credit history and inability to secure reliable loan guarantees” (REEEP).

In the countries of South-Eastern Europe, Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation, the problem to finance renovation of multi-resident apartment buildings also exists due to the requirements of banks to provide personal guarantees (HHI, 2017).

For example, difficulties with obtaining commercial loans and other types of financing are viewed as the main barrier in Belarus. The high interest rates for energy efficiency projects is also a barrier in this country. In Ukraine, among main barriers is also high interest rates for energy efficiency projects and difficulties with obtaining commercial loans and other types of financing (UNECE, 2017b).

The market failures refer to flaws in the ways that markets operate. They can be caused by (i) misplaced incentives; (ii) administrative and regulatory barriers; (iii) imperfect information; (iv) fragmented market structure; and (v) limitations of the typical building design and construction process.

The impacts of market failures are rarely measured. However, it is estimated that “up to 100 per cent of energy services and up to 80 per cent of primary energy use of buildings are affected by misplaced incentives. If the barrier is removed, the energy savings, for instance for space and water heating, may reach 50–75 per cent” (Urge-Vorsatz *et al.*, 2012).

The following regulatory instruments can help in improving the situation and overcoming the barriers: appliance standards, building codes, EE obligations requiring the use of technology or a building with specific standards; procurement regulations ensuring the purchase of efficient equipment. The economic instruments for this include ESCO financing of energy efficiency improvements, cooperative procurement used by bigger buyers to specify the energy efficiency standards for the equipment in use, and energy efficiency certificates.

“Energy price plays very different role in different countries.” It can provide “a sufficient incentive for the implementation of energy efficiency measures...but often insufficient incentive for improving energy efficiency” (UNECE, 2017b).

The subsidized energy prices are considered a strong barrier in many countries. However, one can look at these subsidies as enablers of access to minimal energy service levels for certain population groups. Removing subsidies in some countries is considered socially difficult and undesirable. “In these cases energy efficiency programs may be especially important because improved efficiency can either reduce the need for public subsidies or enable elevated service levels and the more effective use of subsidies” (Urge-Vorsatz *et al.*, 2012).

Introduction of voluntary labelling, mandatory performance regulations, and financial incentives help in increasing the production of energy efficient products. The energy efficiency standards can also provide examples where the production has shifted toward higher efficiency. For building retrofits, accessible mechanisms for providing information and capital are needed.

Behavioural barriers

Behavioural barriers are related to people consumption practices, different purchasing choice, as well as limited trust in local and national public administration. These barriers can be “linked to knowledge gaps which both affect energy efficiency improvement and energy-efficient technologies implementation” (Bagaini *et al.*, 2020).

The specific barrier to energy efficiency improvements in the building sector includes lack of awareness of the importance of energy efficiency improvements as well as lack of qualified personnel and insufficient energy service levels (Urge-Vorsatz *et al.*, 2012).

Low awareness on energy efficiency benefits at the individual level can also limit the enhancement of energy efficiency both at individual and community level. There is a lack of large-scale information campaign in the mass media to raise the level of consciousness of all segments of population about the benefits of the economical use of energy and the consequences of their wasteful consumption (Arkhangelskaya, 2014).

Lack or low trust in energy efficiency measures is “one of the common barriers to investing into energy efficiency, particularly for homeowners.” The acceptance and willingness to adapt to the new consumption patterns is required for users. However, in many countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia, and in the Russian Federation it is usually seen as “high transaction costs, such as time and effort spent investing in energy efficiency” (HHI, 2017).

The energy consumption in building sector depends on its residents’ consumption patterns and behavior. The energy efficiency refurbishment process depends greatly on awareness of the

residents and their homeowners' associations. In many countries in the South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia, and in the Russian Federation, the owners in the multiapartment buildings are “often reluctant to take responsibility over the maintenance of common spaces in the multi-family buildings where they live” (HHI, 2017).

Lack of knowledge among architects and system providers to incorporate energy efficiency is another major barrier. Energy efficiency in buildings is not usually taught as a part of the curriculum in most schools of architecture (Urge-Vorsatz et al, 2012).

The provisions of the building energy code are often viewed as not critical. The adequate allocation of resources and time for building code enforcement will address this issue with building energy code compliance. Through targeted educational and outreach programmes the policymakers can communicate the benefits of building energy efficiency (Cox, 2016).

In Central Asia, for example, construction of the low-rise buildings by the households is often done without any significant knowledge and reference to the existing building codes and other practices and guidelines.

In Armenia, there is low awareness about the multiple benefits of energy efficiency projects and lack of technical expertise and capacity to identify, evaluate and implement projects (UNECE, 2017b). A Roadmap to Energy Efficient Buildings in Armenia also stated that “good communications and awareness-raising are also important for effective engagement with key market and supply chain actors (construction firms, auditors, installers, etc.)” (IEA Armenia, 2020).

Information programs and behavioural interventions, such as feedback, commitments, goal setting, social comparisons and normative messages can become a way to close the energy efficiency gap (Ramos *et al*, 2015).

CONCLUSIONS

Framework legislation is quite developed in the majority of countries in the South-Eastern and Eastern Europe, the Caucasus, and Central Asia, and in the Russian Federation. The framework legislation includes energy efficiency and energy saving laws. Relevant secondary legislation, energy development strategies and specific energy efficiency programmes were also considered. While the energy efficiency framework legislation in the South-Eastern Europe is well developed, the by-laws are less developed. The energy efficiency legislation, related by-laws, norms and standards are quite well developed in Eastern Europe, the Caucasus, Central Asia, and the Russian Federation, however there are two exceptions. In Azerbaijan and Tajikistan, there is no specific legislation and standards.

Building energy codes have been adopted in most reviewed countries. The countries of South-Eastern Europe transposed the European Union directive on Energy Performance of Buildings, adopted energy performance laws and introduced regulations on minimum performance requirements of buildings. The countries in Eastern Europe and the Russian Federation have adopted the building codes for different types of buildings, such as family houses, apartment blocks, commercial and public buildings. The situation in the Caucasus region differs from country to country. There is a mandatory energy building code in Armenia. Only general design and reporting requirements for building envelopes are specified in Azerbaijan. In Georgia, there are no effective mandatory energy efficiency standards in the building codes. In all Central Asian countries the building energy codes are adopted.

Energy performance certification is introduced in some but not all reviewed countries. The requirements for energy performance certification for buildings are specified in the laws on

energy performance in buildings in some countries. Energy labelling requirements are introduced in most reviewed countries. Mandatory energy performance monitoring requirements are absent in many project countries.

Energy pricing measures are not introduced in some countries. Low energy prices in the countries lead to absence of a driving force for energy efficiency improvement in buildings. Energy tariffs were recently increased in Armenia, Ukraine, and Uzbekistan. Low energy prices also make the payback periods for energy efficiency improvements too long to be considered attractive by banks, other financial institutions and population.

Promotion of ESCO: in some countries there is no ESCO market, the other countries have a lack of ESCO activities. The energy performance contracts are not implemented in many countries. Activities related to ESCO in the South-Eastern European countries are in their early stages and limited despite the existence of relevant legislation in Albania, Montenegro, and Serbia. In the past few years, ESCO market is being developed in Ukraine. Kazakhstan started introduction of energy performance contracts, however, implementation of this measure remains limited.

Awareness programmes and initiatives to promote energy efficiency among final consumers, as well as specific training courses for energy auditors, inspectors and evaluators exist in many reviewed countries. Despite this, low awareness on the benefits of energy efficiency at the individual level can preclude or limit the introduction of energy efficiency measures both at individual and community level. In many countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia, and in the Russian Federation energy efficiency measures are still seen as high transaction costs, such as time and effort spent investing in them.

Energy consumption: out of 17 reviewed countries, the residential sector is the largest energy consumer in eleven countries and the second largest in six countries. High energy consumption in the existing building stock is a problem in all reviewed countries. Energy consumption has recently increased for heating and cooling in many countries.

Compliance mechanisms: The countries introduced prescriptive technical requirements in their building energy codes. The performance-based requirements for new buildings also exist in most countries, however such requirements for the existing buildings are not present in many countries. The energy performance monitoring requirements are absent in Bosnia and Herzegovina, Belarus, Ukraine, Armenia, and Kazakhstan.

Enforcement and encouragement mechanisms: Financial incentives, such as subsidies, soft loans, tax exemptions or reductions are present in most of the countries. Specific incentives for improving compliance with building energy codes are absent in some countries. Mandatory regular inspections were introduced in most project countries. Penalties for non-compliance with building energy codes are also absent in many countries.

Institutional capacity: The energy agencies aimed to monitor and implement energy efficiency measures and activities exist in seven out of 17 countries. Such agencies are not established in Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, Montenegro, Tajikistan, Turkmenistan, and Uzbekistan.

Effectiveness of energy efficiency policies: In the recent years, the frameworks for energy efficiency policies improved slowly. The building codes that embraced policies on energy efficiency slowed in 2017-2019. This is explained by the possibility that most of the actions were taken between 2010 and 2017. Overall, in the countries of South-Eastern Europe, Eastern Europe, the Caucasus, and Central Asia and in the Russian Federation the standards for energy

efficiency have been introduced in the relevant legislation, policies, and strategies. However, minimum energy performance requirements, energy labelling systems, and carbon pricing seem to lag behind.

Conformity of energy efficiency standards with the UNECE Framework Guidelines for Energy Efficiency Standards in Buildings: According to the Framework Guidelines, the buildings must be science-based, service-oriented, integrated with the built environment lifecycle, cost effective, using low-carbon technologies, having low energy consumption, performance-monitored and performance-based, safe and healthy. These high standards of buildings should be addressed in the national legislation, which in its turn should be recent and take into account the current trends and modern technologies to enhance energy efficiency in buildings. However, in many reviewed countries the existing energy efficiency standards are not recently adopted or updated and thus cannot reflect the recent requirements and technological advances.

The Framework Guidelines also indicate that buildings, materials and technologies should be assessed over their life cycle in terms of their energy performance. And the energy efficiency standards in buildings are to be outcome-based anchored in energy actually consumed. However, it is not the case for all countries. The countries have different levels of standards addressing the performance of buildings. The existing performance-based requirements in building energy codes are mostly observed in the countries of South-Eastern Europe and Eastern Europe, and in the Russian Federation, while significantly less present in the countries of Central Asia. Such requirements are not present in Georgia.

The Framework Guidelines particularly indicate the building heating and cooling requirements for new buildings and retrofit projects as well as guidance for total primary energy use in buildings' conditioned spaces, including heating, ventilation, cooling and hot water. However, not all countries introduced performance-based limits directly in their building energy codes. The performance-based requirements for buildings in Albania are in line with the Framework Guidelines. In North Macedonia, the limits of annual consumption for residential and non-residential buildings are higher than those indicated in the Framework Guidelines. In Belarus, the annual consumption requirements for heating and cooling are higher than those indicated in the Framework Guidelines. In the Republic of Moldova, the annual consumption of certain categories of buildings is higher than the indications on energy use in buildings in the Framework Guidelines. In Montenegro and Serbia (sub-region of South-Eastern Europe), as well as in all countries in the Caucasus and Central Asia the requirements based on annual energy consumption are not specified. The indicator for estimating energy consumption of buildings in these countries is the primary energy use for heating, cooling and ventilation.

Energy efficiency gap: In South-Eastern Europe, the final energy consumption in buildings is significantly higher than previewed in their national energy efficiency targets. The consumption in the residential sector in the Eastern Europe, Caucasus and Central Asia is very high. In the period from 2010 to 2018, in Azerbaijan and the Republic of Moldova the final energy consumption increased. In Belarus, Georgia, Ukraine, and Uzbekistan the energy consumption slightly reduced. The residential sector is mostly the largest energy consumer.

Existing barriers: A gap between energy efficiency policies potential and effective achievement exists mainly due to barriers affecting those energy efficiency policies and measures. The three main categories of barriers were identified: (i) regulatory and institutional; (ii) economic (financial and market barriers); and (iii) behavioural (awareness, advice and skills).

OPPORTUNITIES TO BRIDGE THE GAP

Based on the analysis of this study, several recommendations can be made in order to help bridging the gap between the performance objectives set forth in the Framework Guidelines for Energy Efficiency Standards in Buildings and current energy efficiency standards and their implementation in the countries of South-Eastern and Eastern Europe, the Caucasus, Central Asia, and in the Russian Federation.

In line with principles of the Framework Guidelines for Energy Efficiency Standards in Buildings, the following actions should be undertaken in the countries:

Strategic guidance:

- The Governments should develop a comprehensive and long-term building code strategy, gradually increasing its strictness.
- The Governments should ensure the introduction of performance-based approach in the building energy codes and other energy efficiency standards.
- The building energy codes should be frequently evaluated, revised and improved in order to understand the existing strengths and eliminate weaknesses of energy efficiency policy design and implementation.
- Energy efficiency policies should be developed and adjusted to different regional contexts and institutional realities within each country.
- The Governments should set up targets for increasing the share of new high-performant buildings.
- The Governments should set up the ambitious timeline and targets for renovation of the existing buildings.
- The improved energy performance of building components and systems should be a target to improve the energy performance of all buildings.
- Sustainable high-performance construction know-how should be introduced into the curriculum of educational institutions in the countries.
- Awareness of population on energy efficiency benefits need to be raised through the implemented demonstration projects and media campaigns in the countries.

Design and construction:

- The Governments should aim for net-zero energy consumption in new buildings.
- Comprehensive retrofits of existing residential and non-residential buildings should be planned and undertaken to reduce energy requirements and increase energy savings in buildings.
- The minimum energy performance standards should be mandatory for both new and existing buildings in all countries.
- The high costs of energy efficiency technologies may discourage consumers to install them. The Governments should introduce tax exemption or reduction to provide the initial incentive for purchase of energy saving technologies.
- Financial incentives should be introduced to encourage investment in the long-lasting high efficiency improvements.
- The stakeholders in the building sector should be educated on the importance of building energy codes in order to increase support for compliance and effective implementation of the energy efficiency policy.

Management:

- Energy agencies should be established in those countries where they do not exist. An energy agency is an institution playing a crucial role in recognition of energy efficiency as a priority action for the country.
- The baseline data on energy demand should be available to measure the success in implementation of energy efficiency policies.
- The energy performance certification of buildings should be applied as an obligatory measure in all countries. The energy rating for buildings should also be introduced.
- The building energy labels or certificates should be required at the sale or rental of properties.
- The efforts to develop or improve the energy service companies (ESCO) market should be undertaken in all countries.
- Energy pricing should be used as an effective tool for influencing the energy use behaviour. The removal of subsidies to energy use and diversification of pricing measures should be used to enhance the attractiveness of investments in energy efficiency.
- Strong compliance mechanisms and proper monitoring mechanisms should be established to ensure the effective building codes enforcement in the countries.
- Low interest loans for energy efficiency technologies and building constructions and retrofits should be introduced as important instrument in promoting energy efficiency.
- Carefully designed and targeted awareness-raising programmes should be developed to encourage energy efficiency improvements.

BIBLIOGRAPHY

- Acuner & Onaygil, 2015: E. Acuner and S. Onaygil. Comparative Analysis on Building Energy Efficiency for the Balkan World: Is It Really Developing?, Istanbul Technical University, Energy Institute, 2015
- ADB, 2013: Asian Development Bank. Energy Sector Assessment in Tajikistan, Access to Green Finance Project Supplementary Document 15, 2013
- ADB, 2016: Asian Development Bank. Tajikistan Promoting Export Diversification and Growth: Country Diagnostic Study, 2016, Manila, Philippines
- Akbarova, 2018: S. Akbarova. Trends of Energy Performance Certification of Buildings in Azerbaijan, 2018
- Alekseev *et al.*, 2019: A. Alekseev, S. Lobova, A. Bogoviz, Y. Ragulina. A Critical Review of Russia's Energy Efficiency Policies in the Construction and Housing Sector, International Journal of Energy Economics and Policy, 2019
- Almaty ESMAP, 2017: Y. Zhang, R. Behnke, A-M.Mot, A. Kushanova, A. Iskhakova, F. Liu. Municipal Energy Efficiency Plan for the City of Almaty, 2017, World Bank, Washington, DC.
- ARCEE, 2013: ARCEE. Energy Efficiency in Residential Housing: Country Dossier Belarus, 2013
- Arkhangelskaya, 2014: A. Arkhangelskaya. Energy Efficiency in the Kyrgyz Republic: State, Objectives, Problems and Investments, 2014, Bangkok
- Astana ESMAP, 2017: Y. Zhang, R. Behnke, A-M.Mot, A. Kushanova, A. Iskhakova, F. Liu. Municipal Energy Efficiency Plan for the City of Astana, 2017, World Bank, Washington, DC.
- Bagaini *et al.*, 2020: A. Bagaini *et al.* Assessing the Relevance of Barriers to Energy Efficiency Implementation in the Building and Transport Sectors in the European countries, The Electricity Journal, 2020
- Blok *et al.*, 2004: K. Blok, H. Groot, E. Luiten, M. Reitbergen. The Effectiveness of Policy Instruments for Energy-Efficiency Improvement in Firms, Kluwer Academic Publishers, 2004, Dordrecht, The Netherlands
- BPIE, 2018: F. Bean, J. Volt, M. De Groote, S. Paardekooper. Aligning District Energy and Building Energy Efficiency Belgrade, Buildings Performance Institute Europe, 2018
- C2E2, 2015: Copenhagen Centre on Energy Efficiency. Accelerating energy efficiency initiatives and opportunities in Eastern Europe, Caucasus and Central Asia, 2015, Copenhagen, Denmark
- Cox 2016: S. Cox. Building Energy Cods: Policy Overview and Good Practices, National Renewable Energy Laboratory, 2016
- Donev *et al.*, 2018: Donev *et al.* Energy Education - Building Envelope, 2018
- Dozic, 2017: A. Dozic. Improving Energy Efficiency in Public Buildings of Bosnia and Herzegovina, University of Ljubljana & University of Sarajevo, 2017
- Draft NEEAP: Draft National Energy Efficiency Action Plan through 2020, State Agency on Energy Conservation and Energy Saving of Ukraine
- EaPGreen, 2016: OECD, UNECE, UNEP, UNIDO. Assessing the Impact of Green Economy Investments in Belarus: A sectoral Study into Energy Efficiency and Renewable Energy, 2016
- Economidou *et al.*, 2011: M. Economidou *et al.* Transforming Europe's Buildings: A Country-by-Country Review on the Energy Performance of Buildings, Summer Study of the European Council for an Energy Efficient Economy, 2011

ECS, 2012: Energy Charter Secretariat. In-depth Review of Energy Efficiency Policies and Programmes of Bosnia and Herzegovina, 2012, Brussels, Belgium

ECS, 2013a: Energy Charter Secretariat. In-Depth Review of the Energy Efficiency Policy of the Republic of Belarus, 2013, Brussels, Belgium

ECS, 2013b: Energy Charter Secretariat. In-Depth Review of the Energy Efficiency Policy of Tajikistan, 2013, Brussels, Belgium

ECS, 2014: Energy Charter Secretariat. Review of the National Policy of the Republic of Kazakhstan in the Area of Energy Saving and Energy Efficiency, 2014, Brussels, Belgium

ECS, 2018: Energy Charter Secretariat. In-Depth Review of the Energy Efficiency Policy of Montenegro, 2018, Brussels, Belgium

EDEN Center 2018: Environmental Center for Development, Education and Networking. Evaluation of Energy Performance of Buildings from the Perspective of Energy Poverty, 2018, Tirana, Albania

EESK, 2019: Koroli Mehriya, Gafurova Mehrnos, Wschodnioeuropejskie Czasopismo Naukowe (East European Scientific Journal), No. 10 (50), 2019

EU, 2018: European Union. Guide on Good Practice in Energy Efficiency for Central and South Eastern Europe, 2018

EU, 2019: European Union. Clean Energy for the Western Balkans, 2019

EU, 2020: European Union. Making Heating and Cooling Sustainable-Barriers, Solutions and Best Practice, 2020

EU4ENERGY Georgia, 2020, International Energy Agency. Georgia Energy Factsheet, 2020

EU4ENERGY Kazakhstan, 2020, International Energy Agency. Kazakhstan Energy Factsheet, 2020

Evans *et al.*, 2014, M. Evans *et al.* Building Energy Code Compliance in Developing Countries: The Potential Role of Outcomes-Based Codes in India, ACEEE Summer Study on Energy Efficiency in Buildings 8-63, 2014

Evans *et al.*, 2017, M. Evans *et al.* An international survey of building energy codes and their implementation, Journal of Cleaner Production, Vol. 158; Issue: C; 2017

FINPro, 2014: The Federation of Finnish Technology Industries, Energy Efficiency in Russia, 2014

GIZ 2016, GIZ. Energy Efficient Residential Buildings in Belarus, 2016

GIZ, 2019: GIZ. Energy Demand, Supply and Efficiency in Rural Armenia: Baseline Data Collection and Analysis, 2019

Hagentoft, 2001: Hagentoft. An Introduction to Building Physics, 1st ed., Studentlitteratur AB

Hao Yu *et al.*, 2019: Hao Yu *et al.* The Final Energy Consumption Characteristics of the G7 and BRICS Nations, IOP Conference Series: Materials Science and Engineering, Vol. 677, Issue 3, 2019

HHI, 2017: Habitat for Humanity International. How to Improve Residential Energy Efficiency in South Eastern Europe and CIS, 2017

Howard, 1991: Alliance to Save Energy. Better Building Codes for Energy Efficiency, 1991, Washington DC

Howie & Atakhanova, 2017: P. Howie and Z. Atakhanova. Household Coal Demand in Rural Kazakhstan: Subsidies, Efficiency, and Alternatives, Energy and Policy Research, 4:1, 2017

Huseynova, 2015: H. Huseynova. Alternative and Renewable Energy Outlook for Azerbaijan 2014, Konrad Adenauer Stiftung, 2015, Berlin

IEA & UNEP, 2019: Global Alliance for Buildings and Construction, IEA, UNEP. Global Status Report for Buildings and Construction: Towards a Zero-Emission, Efficient and Resilient Buildings and Construction Sector, 2019

IEA Appliances, 2020: International Energy Agency. Appliances and Equipment Report, 2020, Paris, France

IEA Armenia, 2020: International Energy Agency. Energy Efficient Buildings in Armenia: A Roadmap Insights and Pathways for Better Buildings 2020-2040, 2020, Paris, France

IEA Azerbaijan, 2020: International Energy Agency. Azerbaijan Energy Profile, 2020, Paris, France

IEA Georgia 2020: International Energy Agency. Georgia 2020 Report, 2020, Paris, France

IEA Kazakhstan, 2020: International Energy Agency. Kazakhstan Energy Profile, 2020, Paris, France

IEA Kyrgyzstan 2020: International Energy Agency. Kyrgyzstan Energy Profile, 2020, Paris, France

IEA Lighting 2020: International Energy Agency. Lighting Report, 2020, Paris, France

IEA Uzbekistan 2020 : International Energy Agency. Uzbekistan Energy Profile, 2020, Paris, France

IEA, 2013: International Energy Agency. Modernizing Building Energy Codes, 2013, Paris, France

IEA, 2014: International Energy Agency. Energy Policy Review Russia, 2014, Paris, France

IEA, 2015: International Energy Agency. Eastern Europe, Caucasus and Central Asia Report, 2015, Paris, France

IEA, 2020: International Energy Agency. Energy Efficiency 2020 Report, 2020, Paris, France

KazEnergy 2019: KazEnergy, The National Energy Report, 2019

Kerimray *et al.*, 2016: A. Kerimray *et al.* Energy Efficiency Option for Buildings: Insights from Buildings Energy Audit Reports in Kazakhstan, 4th IET Clean Energy and Technology Conference, 2016, Kuala Lumpur

Kerimray *et al.*, 2017: A. Kerimray *et al.* Household Energy Consumption and Energy Poverty in Kazakhstan, IAEE Energy Forum, 2017

Kogalniceanu, 2011: V. Kogalniceanu. Energy Efficiency in the Western Balkans – Success or Failure?, Energy Community Secretariat in Summer Study of the European Council for an Energy Efficient Economy, 2011

Kolar & Rzayeva, 2013, S. Kolar & G. Rzayeva. Energy Efficiency in Azerbaijan: Policy Guidelines for Energy Efficiency in Public Buildings, Center for Strategic Studies, Vol. 13, 2013

KT-Energy, 2020: European Union, Improving the Performance of District Heating Systems in Central and Eastern Europe, District Heating in Ukraine, KeepWarm Project, 2020

Manić *et al.*, 2019: D. Manić *et al.* Energy Performance of Single Family Houses in Serbia: Analysis of Calculation Procedures, Thermal Science Journal, 2019

MCU: Improvement of Old Residential Buildings' Envelope, Nationally Appropriate Mitigation Action of the Republic of Serbia (NAMA), Ministry of Construction and Urbanism, Serbia

Mehinović & Strik, 2014: H. Mehinović and F. Strik. Survey on Homeowner Associations, Center for Education and Raising Awareness of Energy Efficiency-Energis, 2014, Bosnia and Herzegovina

Meshcheryakova, 2018: T. Meshcheryakova. Increase in Energy Efficiency of the Residential Building in Russia, International Scientific Conference Environmental Science for Construction Industry, Vol. 193, 2018

Millhone, 2010: J. Millhone. Russia's Neglected Energy Reserves, Carnegie Endowment for International Peace, 2010

Morvaj & Bukarica, 2010: Z. Morvaj and V. Bukarica. Energy Efficiency Policy, InTech, 2010

Nikolic *et al.*, 2020: D. Nikolic *et al.* Energy Analyses of Serbian Buildings with Horizontal Overhangs: A Case Study, *Energies* 2020, 13(17), 4577, 2020

NSEAP, 2019: Draft National Sustainable Energy Action Plan of Azerbaijan, prepared in the framework of the United Nations Economic Commission for Europe project, 2019.

OECD, 2020: Organisation for Economic Co-operation and Development. The Territorial Impact of COVID-19: Managing the Crisis Across Levels of Government, 2020

OECD/IEA, 2010: Organisation for Economic Co-operation and Development and International Energy Agency. Monitoring, Verification & Enforcement: Improving Compliance within Equipment Energy Efficiency Programmes, 2010

OECD/IPEEC, 2019: Organisation for Economic Co-operation and Development and International Partnership for Energy Efficiency Cooperation. Building Energy Performance Gap Issues: An International Review, 2019

OeEB, 2013a: Development Bank of Austria, Energy Efficiency Finance, Country report Armenia, 2013

OeEB, 2013b: Development Bank of Austria, Energy Efficiency Finance, Country report Azerbaijan, 2013

OeEB, 2015a: Development Bank of Austria, Energy Efficiency Finance Country Report: Bosnia and Herzegovina, 2015

OeEB, 2015b, Development Bank of Austria Energy efficiency potential Georgia, 2015

PNNL, 2012: Analysis of the Russian Market for Building Energy Efficiency, Pacific Northwest National Laboratory, 2012

PNNL, 2018: Improving Ukraine's Energy Security: the Role of Energy Efficiency, Pacific Northwest National Lab, 2018

Ramos *et al.*, 2015: A. Ramos *et al.* The Role of Information for Energy Efficiency in the Residential Sector, Robert Schuman Centre for Advanced Studies Florence School of Regulation Climate, 2015

REC, 2015: Regional Environmental Center for Central and Eastern Europe. The Typology of the Residential Building Stock of Montenegro and Modelling its Low-carbon Transformation, Support for Low-Emission Development in South Eastern Europe, 2015

REEEP: Alliance to Save Energy, Removing Barriers to Residential Energy Efficiency in Southeast Europe and the Commonwealth of Independent States

Rodina *et al.*, 2015: E. Rodina *et al.* Improving Energy Efficiency of Buildings, Вестник КРСУ, Vol.15. No.9, 2015

SAEE, 2017: State Agency on Energy Efficiency and Energy Saving of Ukraine. Setting a Target, Development and Implementation of National Energy Efficiency Action Plan, 2017

Simaku, 2017: G. Simaku. Albanian Building Stock Typology and Energy Building Code in Progress Towards National Calculation Methodology of Performance on Heating and Cooling, *European Journal of Multidisciplinary Studies*, Vol. 2, Issue 5, 2017

Šumarac, *et al.*, 2010: D. Šumarac *et al.* Energy Efficiency of Residential Buildings in Serbia, *Thermal Science Journal*, 2010

SWP, 2013: German Institute for International and Security Affairs (SWP). Comparison of Energy Efficiency Measures in Russia to those Implemented by Developed Countries (including IEA Measures), 2013

UEAA, 2019: United Nations Environment. United for Efficiency Azerbaijan Assessment, 2019

UN 2017: United Nations. Progress Report 2016-2017, Government of Turkmenistan and United Nations Partnership Framework for Development 2016-2020, 2017, Ashgabat

UNECE, 2011: United Nations Economic Commission for Europe. Country Profiles on the Housing Sector: Tajikistan, 2011

UNECE, 2013: United Nations Economic Commission for Europe. Enhancing Synergies in CIS National Programmes on Energy Efficiency and Energy Saving for Greater Energy Security, 2013

UNECE, 2015: United Nations Economic Commission for Europe. Uzbekistan Country Profile on Housing and Land Management, 2015, New York and Geneva

UNECE, 2017a: United Nations Economic Commission for Europe. Tajikistan Environmental Performance Reviews, Third Review, 2017, New York and Geneva

UNECE, 2017b: United Nations Economic Commission for Europe. Overcoming Barriers to Investing in Energy Efficiency, 2017, New York and Geneva

UNECE, 2018: United Nations Economic Commission for Europe. Mapping of Existing Energy Efficiency Standards and Technologies in Buildings in the UNECE Region, 2018, Geneva

UNECE, 2019a: Mapping of Existing Technologies to Enhance Energy Efficiency in Buildings in the UNECE Region, 2019, Geneva

UNECE, 2019b: United Nations Economic Commission for Europe, Progress in the Areas of Energy Efficiency and Renewable Energy in Selected Countries of the UNECE Region, 2019, Geneva

UNECE, 2020: United Nations Economic Commission for Europe. Updated Framework Guidelines for Energy Efficiency Standards in Buildings, ECE/ENERGY/GE.6/2020/4

UNFCCC, 2014: UN Framework Convention on Climate Change. The First Biennial Updated Report of the Republic of Azerbaijan, 2014, Baku

Urge-Vorsatz *et al.*, 2012: D. Urge-Vorsatz *et al.* Energy End-Use: Buildings in Global Energy Assessment in Global Energy Assessment - Toward a Sustainable Future, Cambridge University Press, 2012, Cambridge, UK and New York

USAID 2012: United States Agency for International Development. Analysis of Energy Consumption in the Multi-Apartment Residential Stock of Dushanbe and Assessment of Potential for Energy Efficiency, 2012

USAID, 2007: United States Agency for International Development. National Program on Energy Saving and Renewable Energy of Republic of Armenia, 2007

USAID, 2008: United States Agency for International Development. Energy Efficient Potential in Georgia and Policy Options for Its Utilization, 2008

World Bank, 2012: World Bank. Modernization of the District Heating Systems in Ukraine: Heat Metering and Consumption-Based Billing, 2012, Washington DC

World Bank, 2014: World Bank, Assessment of Household Energy Deprivation in Tajikistan, 2014

World Bank, 2015a: Balabanyan, K. Hofer, J.Finn, D. Henkinson, City Heating Options in Tajikistan, 2015

World Bank, 2015b: World Bank, Urban Heating Options in the Kyrgyz Republic, 2015

World Bank, 2015c: World Bank. Belarus: Scaling Up Energy Efficiency Retrofit of Residential and Public Buildings, 2015, Washington DC

World Bank, 2018: World Bank. Unlocking Energy Efficiency Potentials in Cities in Kazakhstan (Synthesis Report), 2018, Washington DC

World Bank, 2019a: World Bank, North Macedonia Public Sector Energy Efficiency Project, 2019

World Bank, 2019b: World Bank, Roadmap for the Implementation of Energy Efficiency in Public Buildings of the Kyrgyz Republic, 2019, Washington DC

World Bank, 2020a: K.Melikidze et al. Energy Efficiency Retrofitting of Residential Buildings: Solutions and Recommendations: Tbilisi Urban Regeneration Energy Efficiency Project - Second Phase, World Bank, 2020, Washington, DC.

World Bank, 2020b: World Bank, RISE 2020 -Regulatory Indicators for Sustainable Energy: Sustaining the Momentum, 2020, Washington DC

Yang *et al.*, 2019: M. Yang *et al.* Innovative Energy Policy to Transform Energy Systems in Ukraine, Mitigation and Adaptation Strategies for Global Change, Springer, Vol. 25(5), 2019

Zagora *et al.*, 2017: N. Zagora *et al.* Assessment of the Energy Savings Potential in the Residential Building Stock in Bosnia and Herzegovina, South East European Journal of Architecture and Design, 2017

Consulted websites:

Asian Development Bank : www.adb.org

Balkan Green Energy News platform: www.balkangreenenergynews.com

Energy Efficiency Agency of the Republic of Moldova: www.aee.gov.md

European Bank for Reconstruction and development: www.ebrd.com

Global Petrol Prices (GPP) portal: www.globalpetrolprices.com

International Energy Agency : www.iea.org

International Energy Agency EU4ENERGY: www.eu4energy.iea.org

Regional Energy Efficiency Programme for the Western Balkans: www.wb-reep.org

Regulatory Indicators for Sustainable Development: www.rise.esmap.org

Serbian Center for Energy Efficiency: www.scee.rs

State Agency on Energy Efficiency and Energy saving of Ukraine: <https://sae.gov.ua/en>

The Ministry of Energy (MoE) of the Republic of Azerbaijan: www.minenergy.gov.az

The Ministry of Energy (MoE) of the Republic of Uzbekistan: www.minenergy.uz

ANNEX: COUNTRY PROFILES

ALBANIA	
<p>Framework Legislation and Policy Documents</p> <p>The Second and Third National Action Plan for the Energy Efficiency for Albania for the period 2017-2020. (adopted in December 2017).</p> <p>The Law on Energy Performance of Buildings No. 116/2016 provides for the energy performance certification of buildings and includes the minimum requirements for the energy performance of buildings.</p> <p>The Energy Efficiency Law (November 2015) complaint with the Directive 2006/32/EC.</p> <p>The Law on Indication by labelling and standard product information of the consumption of energy and other resources by household appliances” (2009) is fully in line with EU Directive 92/75/EEC.</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> • Energy Building Code dated January 16, 2003; • The Law No. 8937, dated 12.09.2002 “On Conservation of Thermal Heat in Buildings”; • Energy performance on building law dated November 2016. <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • Energy use for heating, cooling, hot water, lighting, ventilation. <p>Performance-based requirements</p> <ul style="list-style-type: none"> • Thermal characteristics and geometry of the building (envelope and internal partitions, etc.) • Air-tightness • Space heating system and hot water supply units • Air-conditioning system(s) • Mechanical and natural ventilation • Built-in lighting system (mainly in the non-residential sector) • Design position and orientation of buildings • Passive solar systems and solar protection • Indoor and outdoor climatic conditions • Thermal bridge • No use of IPMVP • No mandatory requirement to assess post-construction requirement of the thermal bridge • No mandatory requirement for air tightness testing: • Performance-based requirements: energy efficient development systems • Values of the performance-based requirements: new buildings: 55 kwh/m2a, existing buildings: 80 kwh/m2a
<p>Institutions</p> <p>The Ministry of Energy and Industry The Ministry of Tourism and Environment The Natural Resource Agency (AKBN) The Agency of Energy Efficiency</p>	<p>Energy Performance Certification</p> <p>Coverage:</p> <ul style="list-style-type: none"> • Public buildings • new non-residential <p>Strictness: Mandatory Type of energy that the EPC refer to: Total primary energy, No existence of national registry database for EPC</p>
<p>Financial Incentives</p> <p>The regulation on the national Energy Efficiency fund to support the implementation of the NEEAP. Establishment of additional financing mechanisms to support energy efficiency investments (incl. energy efficiency criteria in public procurement and private sector investments/ESCOs) and better utilize available financing provided by regional assistance programmes. Tax exemption model development for existing building refurbishment based on defined cost optimal requirements for new and existing buildings. Financial support for building envelope and heating system energy efficiency improvements. Package of promotional instruments for the installation of solar water heating in households.</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: No Penalties, incentives and other mechanisms for improving compliance: Fines for non-compliance. Energy performance monitoring requirements: Yes</p>
<p>Promotion of ESCO</p> <p>The 2015 Energy Efficiency Law introduced the ESCO concept and energy performance contracting. However, the adoption of the by-law to introduce ESCO market procedures and model contracts, and establishment of the EE fund to support ESCO projects in the public sector are still pending.</p>	<p>Awareness Programmes</p> <p>Three conferences for promotion energy efficiency and renewable energy as well as raising awareness on the recently adopted related legislation in Albania at National level. Six workshops were organised for promotion energy efficiency and renewable energy at local level.</p>

Assistance for development and implementation of Energy Efficiency Projects

GIZ plans to support energy efficiency through its Open Regional Fund (ORF) for Western Balkan region between 2018-2021. GIZ has prepared a new webtool for monitoring, verification and evaluation of the implementation of the National Energy Efficiency Action Plan (NEEAP) 2017-2020. The EE monitoring procedures follows the requirements of the EU Directive on EE that was incorporated into the Albanian legislation.

The Western Balkans Sustainable Energy Direct Financing Facility (WeBSEDF)

WeBSEDF is an investment facility supported by the EBRD endowed with up to EUR 100 million of loan funds. WeBSEDF operates in Albania, Bosnia and Herzegovina, Croatia, FYR Macedonia, Montenegro and Serbia (including Kosovo). The facility is open to local small and medium enterprises (SME) or project developers.

In 2008, the Norwegian Government supported the project, Energy Auditing of Albanian Buildings - Capacity Building, Methods and Tools. The project was implemented by the Norwegian company, Energy Saving International (ENSI), the National Agency of Natural Resources, the Albanian-EU EEC and the Polytechnic University of Tirana. The objective of the project was to improve and increase the local capacities and skills on energy auditing of buildings, and thus contribute to improved energy efficiency in Albania. As a result of the implementation of the project, energy auditors for buildings have been trained and Albanian versions of the ENSI software and tools for energy audits have been developed.

With the collaboration of ProCredit Bank Albania and the European Fund for Southeast Europe (EFSE), a Framework Agreement was announced on July 2009. The aim was to grant individual loans totalling €5 million, with €2 million for Energy Efficiency Housing Loans and €3 million for rural loans

KfW bank promotion of energy efficiency. This energy sector programme of about €9m supports energy efficiency measures in public buildings (e.g. kindergarten). KfW is supporting the energy efficient rehabilitation of 5 public buildings (student dorms) in the city of Tirana between 2018-2021.

ENERGY PERFORMANCE OF CONSTRUCTIONS

New Buildings	Existing Buildings
<p>Design Envelope</p> <p>Almost 80% of the new buildings (<5 years) have no drafty doors or windows. The new buildings (<5 years old and 6-25 years old) represent the highest percentage of dwellings with full insulation (~39% and 43%). New buildings (<5 years old) represent the highest percentage of dwellings with double-glazed windows (~75%)*</p> <p>Dwellings in new buildings, built mainly over the 5 last years or those built after 1990, represent the dwelling in the best conditions in terms of insulation, presence of double glazing windows, lack of mold, and draft-proof windows and doors.*</p>	<p>Design Envelope, Heating and Cooling</p> <p>Dwellings built from 1983 until 1992 (26-35 years old) are problematic with only approximately 17% of them having full insulation. Dwellings older than 60 years have poor insulation, with ~40% lacking insulation completely*</p> <p>Older buildings (36-60 years old and >60 years old) represent the highest percentage (~65%) of dwellings with single-glazed windows*</p> <p>Corresponding to the main energy sources, stove is the most typical heating system (63.3%), followed by electric heaters (8.5%) and air heat pumps (air conditioners) (6%). Only 3.2% of the private households have central heating (building or dwelling heating), while 4.4% has a fireplace. According to the experts, even where central heating systems exist, there is a lack of metering and controls to adjust temperature levels.</p> <p>For heating their dwellings, people use also biomass (12% of the dwellings), which is what people actually used to heat most of the dwellings before 1990*</p> <p>According to the census, 6% of the households are equipped with air conditioner: in climate zone A 4%, while in Climate zone B 9% of the households have air conditioner.</p> <p>*based on a sample of 1954 units in the study including non-residential buildings</p>

ARMENIA

<p>Framework Legislation and Policy Documents</p> <p>The Energy Law AI-148 (07.03.2001) (Amendments 2014, 2017, 2018)</p> <p>The Law on Energy Saving and Renewable Energy AL-122 (2004) (Amendments 2016, 2017)</p> <p>The National Program on Energy Saving and Renewable Energy (Adopted January 2007)</p> <p>The National Energy Efficiency Action Plans (NEEAPs) (2010-2014; 2015-2017)</p> <p>Government of the Republic of Armenia decision of April 12, 2018 N 426-N: The resolution on “Establishing technical regulations on energy saving and energy efficiency in new residential apartment buildings, as well as in facilities under construction (reconstructed) at the expense of state funds”, came into force in October 2019.</p> <p>Mandatory consideration of energy efficiency in construction/reconstruction under the state funded activities is stipulated by the Government Decision #1504-N (December 25, 2014)</p>	<p>Building Energy Codes</p> <p>The following building codes are currently into force:</p> <ul style="list-style-type: none"> • EE building Code - “Thermal Protection of Buildings” 24-01-2016 RACN • RACN II-7.02-95 “Construction thermophysics of building envelope” • RACN II-7.01-2011 “Construction Climatology” <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Commercial • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • The building stock is divided into five categories depending on their volume, significance, importance and complexity, as well as the safety of citizens and the environment. 1) low-risk objects: category I; 2) objects of medium risk: category II; 3) objects of medium risk: category III; 4) high-risk objects: category IV; 5) objects with the highest degree of risk: category V • Mandatory measures to ensure EE of buildings (at the expense of public funds) • Indicators for assessing EE and energy consumption in building codes have not yet established. • Energy use for: heating, cooling, hot water, lighting, ventilation.
<p>Institutions</p> <p>The Ministry of Territorial Administration and Infrastructure (MoTAI)</p>	<p>Energy Performance Certification</p> <p>Coverage:</p> <ul style="list-style-type: none"> • Single family houses • Apartment blocks • Commercial • Public buildings • new non-residential • new residential • existing residential • existing non-residential <p>Type of energy that the EPC refer to: Total primary energy, Stringency: Mixed (both voluntary and mandatory)</p> <p>No existence of national registry database for EPC</p>
<p>Promotion of ESCO</p> <p>The energy efficiency legislation in force does not introduce the ESCO mechanism. According to the UNECE, there are no operating energy service companies in Armenia, although the Armenian ESCO Association was mentioned in the past. To date, no information on its performance has been found.</p> <p>An action under the Neighbourhood Investment Platform (NIP) will aim to engage existing ESCOs in Armenia in carrying out the activities, which will gain necessary experience though learning by doing and receiving training on site in energy audit, engineering design, new technologies for improvement of EE in buildings, as well as for measurement and verification of savings.</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: Yes, for heating systems only</p> <p>Penalties, incentives and other mechanisms for improving compliance: AL-204-N (24.10.2005) Law on State regulation of technical security protection. For equipment >0.07MPa, <115°C, < 60 kW and >115°C</p> <p>No energy performance monitoring requirements</p>
<p>Awareness Programmes</p> <p>The energy efficiency legislation in force does not introduce the ESCO mechanism. According to the UNECE, there are no operating energy service companies in Armenia, although the Armenian ESCO Association was mentioned in the past. To date, no information on its performance has been found.</p> <p>An action under the Neighbourhood Investment Platform (NIP) will aim to engage existing ESCOs in Armenia in carrying out the activities, which will gain necessary experience though learning by doing and receiving training on site in energy audit, engineering design, new technologies for improvement of EE in buildings, as well as for measurement and verification of savings.</p>	<p>In Armenia, there is no mandatory requirement to promote energy efficient products. In general, green procurement is promoted through public awareness raising campaigns under the different projects or institutions. In that framework despite the existence of an institutional mechanism to assure the control for implementation of such requirements, obligatory requirements are not established.</p> <p>As regards the vocational training and education sector, currently neither the technical schools nor the universities address sufficiently the topic of energy efficiency in buildings.</p> <p>Donor efforts have addressed these:</p> <ul style="list-style-type: none"> • Regulation on energy labelling of household appliances was approved by Government of Armenia in December 2015. • Regulatory Framework to Promote Energy Efficiency in the Countries of Eurasian Economic Union (EEU) Project supported by Trust Fund for Development of Russian Federation and UNDP seeks to harmonize standards and labelling regulations in countries of the EEU.

	Training programme to raise awareness among households as part of its Residential Energy Efficiency for Low Income households (REELIH) project.
<p>Energy Pricing Measures</p> <p>Tariffs for delivery of electricity, thermal energy and natural gas are regulated by Public Services Regulatory Commission (PSRC), the activities of which are based on the law “On Energy”, “On regulatory body” and other relevant legal acts. PSRC has increased tariffs for energy several times over the last decade.</p> <p>In 2017, households spent an average 20% of their total expenditures on electricity, heating, and hot water. In the last decade (2007-2017), the electricity price rose by 94-112%, while the natural gas price rose by 250%.</p> <p>The relatively high level of household energy consumption – primarily in the form of natural gas – translates into significant end-user costs.</p>	<p>Financial Incentives</p> <p>With regards to the residential sector, loans by credit lines established by EBRD, IFC, GGF, AFD and KfW are offered to finance energy efficiency investments and integrated renewable energy solutions (mostly solar water heaters and PV panels) in private households. This market is growing, especially considering the integration with mortgage lending. When the consumer seeks to borrow for purchasing real estate or renovation, an EE mortgage or EE renovation loan product is usually available at the same bank at more affordable terms or with cash-back option. The IFIs design their product in a way to allocate the funds as quick as possible. Most of them specify “white product lists” to help the loan officers to assess the eligibility of the applications and reduce processing time. Some of these loans are packaged with some degree of incentives, such as lower interest rates or grant money back (returning cash back to the borrower after the energy efficiency is verified).</p>
<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>Renewable Resources and Energy Efficiency Fund (R2E2) was established with support from the Global Environment Facility (GEF) in 2006. The fund is responsible for the facilitation of investments in energy efficiency and renewable energy sectors, promote the development of energy efficiency and renewable energy markets in Armenia and increase the use of clean, efficient, safe and affordable heating technologies in multi-apartment buildings and schools in Armenia.</p> <p>The UNDP-GEF project on Improvement of Energy Efficiency in Buildings supports development of building codes with energy efficiency requirements; control, testing and certification of energy efficiency of materials; awareness raising and piloting of integrated building design. Incremental energy efficiency measures were funded for a social residential building construction in Goris and Akhuryan towns.</p> <p>The European Commission INOGATE Energy Saving in Building Initiative (ESIB) focused on capacity building energy efficiency in housing sector.</p> <p>The IFC Sustainable Energy Finance Project supports establishment of a sustainable market for energy efficiency and renewable energy investments. For energy efficiency, IFC project primarily supports financial institutions to develop energy efficiency lending and awareness raising on sustainable energy finance.</p> <p>The Armenia Sustainable Energy Financing Facility (ArmSEFF) of EBRD supported private enterprises access to energy efficiency investment funds through line of credit to local commercial banks.</p> <p>A recent grant of USD 20 million from the Green Climate Fund (GCF) will allow municipalities to upgrade and insulate external walls, entrances, roofs, ceilings, floors and windows of around 6,000 single-family houses, 290 apartment buildings and over 150 public buildings, including schools and kindergartens.</p> <p>Yerevan Energy Efficiency Project (EIB loan, with Yerevan Municipality co-financing, GCF and E5P grant), EUR 15 mln, 2016-2019, SUB-SOVEREIGN: The Yerevan Energy Efficiency project targeting improvements of 150 kindergartens started in 2016 with an EU Municipal Project Support Facility (MPSF) grant to prepare the project and financings from the EIB and from the E5P.</p> <p>Armenia benefits from the Covenant of Mayors regional funding covering all COMO-East countries; in Armenia the technical assistance is extended to 23 Municipalities, national administrations, regional authorities, NGOs. The EU support through many grant projects is used for leveraging and blending. These include:</p> <ul style="list-style-type: none"> • Municipal Project Support Facility (2015 – 2022, Eur12.3mln EU contribution), • Feasibility Study EE in buildings (EIB/E5P), Eur250k <p>French Development Agency (AFD) credit line through the National Mortgage Company was set up in 2014 to work through 13 participating financial institutions (PFIs) on household energy efficiency loans and micro loans with an overall USD 13 767 000,00 credit line and a target of 3,000 households to be reached. Social and Energy Efficiency Housing Finance Programme (SEEHFP) is supported by a Neighbourhood Investment Fund grant of Euro 1.5 million for (i) technical assistance (ii) investment grants for energy efficiency loans and (iii) a strategic study on sustainable housing in Armenia. The criteria of eligibility to the loans and grants under SEEHFP are currently being reviewed in order to simplify the access to those products while enhancing the energy efficiency aspect of the program.</p> <p>The European Bank for Reconstruction and Development (EBRD) has been actively promoting energy efficiency, renewable energy and green investments in various sectors of the Armenian economy and invested in this area over EUR 178 m out of its total investments of EUR 937 m since 2006.</p> <p>The Caucasus Energy Efficiency Programme (2008 – 2020) in Armenia being the credit line for EE and RE investments implemented by private businesses and residential sector sub-borrowers (Energocredit) was supported by:</p> <ul style="list-style-type: none"> • the EU contribution of EUR 1.7M provided as investment incentives to final beneficiaries and EUR 160,000 for the comprehensive Technical Assistance package and visibility. 	

- the EBRD Special Shareholder Fund (SSF): EUR 1.1M for investments incentives and EUR 160,000 for Technical Assistance;
- Austrian Ministry of Finance (BMF): EUR 2.625 M for Technical Assistance.

In October 2018 the EBRD have launched a Green Economy Financing Facility (GEFF) implemented for the commercial sector: USD 20 M credit line, supported by EUR 1M for comprehensive TC package and USD 3M investment incentives from CIF/SREP (for four types of RE sub-projects: solar PV, solar thermal, biogas and geothermal heat pumps).

The Facility in Armenia is a product of the European Bank for Reconstruction and Development (EBRD), supported by the Green Climate Fund (GCF) and the Scaling-up Renewable Energy Program (SREP) of the Climate Investment Funds (CIF).

The program “EU for Yerevan: Solar Community” (2018 – 2020) involves 90 multi-apartment buildings, on the roofs of which it is planned to install photovoltaic systems which will provide generation of energy required for energy supply of common use premises (lighting of staircases and backyard areas, as well as elevators).

UNDP Armenia, through its Project “De-risking and Scaling-up Investment in Energy Efficient Building Retrofits”, is cooperating with the Ministry of Territorial Administration and Infrastructure of the RA on implementation of Energy Efficient (EE) Building Retrofits within the State Subvention Program (since 2019). Based on amendment of the regulation of the State Subvention Program the EE retrofits of multi-apartment buildings (MAB) became eligible.

Within this cooperation, the Project provides technical assistance to communities in understanding the benefits for EE retrofitting in MABs, selecting relevant buildings, preparing applications, estimating costs and later in design development with objective to co-finance the EE retrofits (up to 25% for full and up to 20% for partial retrofit works).

ENERGY PERFORMANCE OF EXISTING RESIDENTIAL BUILDINGS

Design envelope

Most of Armenia's 19,195 buildings were built during the Soviet era, 35 to 60 years ago, where 73% of all apartment buildings are stone buildings built between 1940s-60s. Stone block apartment buildings have at least two or up to five upper floors and a basement. That type of apartment buildings is made from masonry of classical metric perforated stones (usually local stones like tuff or basalt). The standard thickness of the outdoor wall is 40/50 cm. The walls have exterior lime-cement render with paint finish or generally exposed masonry. Additional, thermal insulation is almost not practiced at all. The heat energy consumption of that type of residential buildings varies from 150 to 180 kWh/m² per year.

Around 23% of the overall number of apartment buildings in Armenia is built with concrete prefabricated panels. All of these buildings were constructed in urban areas during the 60's, 70's and 80's. The heat energy consumption of residential concrete panel buildings varies from 140 to 210 kWh/m² per year. Exterior walls have a thickness of approximately 35 cm. No insulation layer is present in these buildings.

6% of the overall number of apartment buildings in Armenia is built with monolithic concrete or concrete frame constructed from 1970s until now. Additional thermal insulation is almost not practiced at all.

Heating and Cooling

About 70% of the Armenian population uses natural gas for space heating, whereas 23% use electricity for heating purposes. Other sources like firewood only have a minor share.

The residential buildings have a higher heat energy demand due to poor insulation and building aging. The results of documented and monitored pilot projects implemented by UNDP-GEF Building Energy Efficiency Improvement project estimated that the average heating energy demand in typical multi-apartment residential buildings is 185 kWh/m² year and with cost-effective energy efficiency improvements the energy use can be cut by 38-40% and the demand can go down to 111 kWh/m² year.

Only 5% of Armenian households have an AC unit, although the figure is higher in Yerevan at just over 10%.

While currently accounting for a relatively small share of overall demand, cooling-related energy use in Armenia is projected to quadruple from 0.36 PJ in 2020 to 1.61 PJ in 2036, overtaking energy demand for lighting.

Hot Water

In rural areas, during the heating season, 62% of households heated water with natural gas, 22% heated with wood, 10% got hot water using electricity.

Ventilation

Mechanical ventilation is almost non-available in multi-apartment buildings in Armenia.

In a few newly built office and public buildings, centralized ventilation systems (with or without heat recovery units) have been executed.

Appliances and equipment

Armenia has introduced energy labels (labels scale: A to G) in line with – sometimes quite old - EU regulations, however, only for refrigerators/freezers, washing machines and air conditioners. Armenia has committed to a schedule of further EU-based energy labels in coming years, however, has also agreed to introduce energy labels as defined by the EurAsian Economic Union (EEU).

Lighting

Armenia has made considerable progress in converting to LED lighting, according to local experts. However, precise data for level of LED penetration – or, conversely, the number of remaining inefficient incandescent lamps still in use – is currently not available. A survey of 2500 households conducted by UNDP in 2015 found that incandescent lamps were still highly prevalent (up to 70%) in Armenian households.

AZERBAIJAN

<p>Framework Legislation and Policy Documents</p> <p>The Law on energy saving and energy efficiency (under consideration by the relevant government institutions)</p>	<p>Building Energy Codes</p> <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Apartment blocks • Commercial • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Voluntary
<p>Institutions</p> <p>The Ministry of Energy The Energy Regulatory Agency The Ministry of Economy</p>	<p>Energy Performance Certification</p> <p>Coverage:</p> <ul style="list-style-type: none"> • Apartment blocks • Commercial • Public buildings <ul style="list-style-type: none"> • new non-residential • new residential • existing residential • existing non-residential <p>Strictness: Mandatory No existence of national registry database for EPC</p>
<p>Energy Pricing Measures</p> <p>Electricity tariffs in Azerbaijan were relatively stable during 2008–2017, seeing only three major changes in tariff rates and structure. The latest changes were related to the introduction of inclining block tariffs for residential consumers and purchase prices from generators using alternative and renewable energy sources.</p>	<p>Compliance Mechanism</p> <p>Specific policy packages and incentives that complement or motivate compliance with building codes: There are not specific policy packages and incentives. Requirements for regular inspection of heating and AC systems: No Penalties, incentives and other mechanisms for improving compliance: Fines and fees for non-compliance, Refusal for occupancy or construction permit There is no any penalty for non-compliance, but it will be considered in the further planned project named as “Energy efficiency in buildings” Energy performance monitoring requirements: Yes, there is. The government according to the law of the utilizing of energy resources controls it.</p>
<p>Awareness Programmes</p> <p>Under the framework of the INOGATE Programme, several activities to raise energy savings awareness have been implemented in Azerbaijan with the collaboration of the Ministry of Industry and Energy. A number of training activities have been carried out by SAARES since 2011 at the Gobustan Experimental Polygon training centre it created. In addition, relevant training has been carried out at the University of Construction and Architecture, the president’s training centre, the Center for Strategic Studies (SAM Centre) and the Ministry of Foreign Affairs.</p> <p>Energy auditing seminars for the buildings and industry sectors organized by Norway’s Foreign Ministry, the INOGATE Technical Secretariat and Germany’s Renac Academy.</p> <p>INOGATE and the Azerbaijan University of Architecture and Construction (AzUAC) are developing educational materials.</p>	<p>Financial Incentives</p> <p>Exemption on the import of equipment and technology used in energy efficiency and alternative and renewable energy from customs duties and VAT (the government of Azerbaijan passed Resolutions No. 112 and 113 of April 2014)</p>
<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>The International Finance Corporation has signed a 15 million US dollar worth of loan contract with the Bank Respublika on financing of energy efficiency projects in the country.</p> <p>The EBRD’s Caucasus Energy Efficiency Programme (CEEP) is active in Azerbaijan and since 2014 has supported 4 local banks (Demirbank, Muganbank, FINCA and Unibank) with credit lines totalling USD 16.5 million since 2014. In addition, the Green for Growth Fund (GGF) has concluded credit lines with two further banks (Accessbank and Muganbank). These credit lines help local companies and households to buy and install more energy-efficient equipment, appliances and materials, together with small scale renewable technologies. Credit lines come with technical assistance support where necessary to help design and appraise projects.</p>	<p style="text-align: center;">ENERGY PERFORMANCE OF NEW CONSTRUCTION</p> <p>Appliances and equipment</p> <p>There is no primary and secondary legislation framework on energy-related products in Azerbaijan. However, once adopted, the Law on the Use of Energy Resources will require the implementation of the following policy instruments:</p> <ul style="list-style-type: none"> • Energy labelling; • Ecodesign requirements. <p>Potential energy savings from the introduction of MEPS for residential refrigerators in Azerbaijan :-</p>
	<p>Lighting</p> <p>Azerbaijan has begun to promote energy efficient lighting. A proposal for The Parliament is considering MEPS for lamps and the National Standard Agency is preparing mandatory labels for lamps. Energy efficiency awareness raising campaigns through media and school educational programmes have been conducted in some cities. Baku is planning to establish CFL collection points and to build a recycling facility for electronic waste.</p>

<p>Annual electricity savings in 2030: 0.44 TWh Cumulative electricity saving in 2030:2.4 TWh.</p> <p>Potential energy savings from the introduction of MEPS for room air conditioners in Azerbaijan :- Annual electricity savings in 2030: 0.18 TWh Cumulative electricity saving in 2030: 1.0 TWh.</p>	<p>Replacement of 5-10 Vt light bulbs used for lighting purposes with LED technology would help reduce energy consumption by 15-30 million kVt/hour</p> <p>Potential energy savings from the introduction of MEPS for lighting in Azerbaijan :- Annual electricity savings in 2030: 0.16 TWh Cumulative electricity saving in 2030:2.1 TWh.</p>
--	---

ENERGY PERFORMANC OF EXISTING RESIDENTIAL BUILDINGS

<p>Design Envelope</p> <p>The average energy consumption of residential buildings in Azerbaijan varied from 204 kWh/m²/year in 2013 to 276 kWh/m²/year in 2017. In total, average energy consumption decreased by almost 20%.</p> <p>An energy audit of two types of residential buildings was under conducted the EU project in Baku in 2013-2014, showing that high-quality thermal insulation could save between 50 and 70% of the energy consumed by the building.</p>	<p>Heating</p> <p>Natural gas is the main source for heating and cooking in the residential sector and only 2.6% of residential buildings in Azerbaijan had access to district heating services in 2017.</p> <p>Most of the apartments and houses (almost 90% of households in rural areas are separate houses) have decentralized heating systems, which mainly use gas due to its cheap price. EBRD (2008) describes that gas fired mini-boilers called "combi-systems" are popular in Baku and typically mounted at the balconies. They heat water both for apartment heating and for hot water supply. Due to the lack of gas supply and central heating in rural areas: wood, kerosene and electricity are increasingly used for heating.</p>
---	---

BELARUS

<p>Framework Legislation and Policy Documents</p> <ul style="list-style-type: none"> - Law of the Republic of Belarus on “Energy Saving” (No. 239-3; January 8, 2015) - Directive of the President of the Republic of Belarus No.3 “On Priority Directions of Strengthening the Economic Security of the State” (June 14, 2007) - Resolution of the Council of Ministers of the Republic of Belarus No. 706 “On approving the Comprehensive Programme for the Design, Construction and Reconstruction of Energy- Efficient Houses in the Republic of Belarus for 2009-2010 and until 2020” (June 1, 2009) - Decree of the President of the Republic of Belarus dated No. 327 "On Improving Energy Efficiency of Multi-Apartment Residential Buildings" (September 4, 2019) 	<p>Building Energy Codes</p> <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mandatory • There is a power classification of buildings by consumption of thermal energy on heating and ventilation, classes G - A+. • An indicator for reference to a certain class - specific annual consumption of thermal energy on heating and ventilation • It is not allowed to design new buildings if the requirements for buildings do not correspond to classes A +, A or B. • Types of energy considered in building codes and regulations: use of energy for heating <p>• Technical Code on Thermal protection of buildings defines norms for annual consumption of heat for different types of buildings: (i) residential buildings and hotels: 48-96 kWh/m2a; (ii) individual residential houses: 108 kWh/m2a; (iii) kindergartens: 38 kWh/m2a; (iv) schools: 37 kWh/m2a; (v) clinics and hospitals: 35 kWh/m2a; (vi) public buildings: 36 kWh/m2a.</p>
<p>Institutions</p> <p>The Ministry of Architecture and Construction Th Ministry of Housing and Communal Services The Ministry of Energy The Ministry of Anti-Monopoly Regulation and Trade The Department for Energy Efficiency of the State Committee for Standardisation</p>	<p>Energy Performance Certification</p> <p>In the country, there is no system of power certification of buildings. There is a system of classification of buildings by an indicator of specific consumption of thermal energy on heating and ventilation. No existence of national registry database for EPC</p>
<p>Energy Pricing Measures</p> <p>The energy tariffs for residential users are set by the Council of Ministers, those for industrial users by the Ministry of Antimonopoly Regulation and Trade. The Ministry of Antimonopoly Regulation and Trade is responsible for the state policy in the sphere of antimonopoly activities and competition fostering, tariff policy, regulates the prices (tariffs) for goods (works, services) within its competence. The tariffs are set region-wise. The energy tariff rates depend on the type of consumer and the time and period of use (day/night and heating/non-heating season).</p>	<p>Compliance Mechanism</p> <p>Existence of mandatory requirements for regular inspection of heating systems No penalties, incentives and other mechanisms for improving compliance with building energy codes in your country</p> <p>The national standard STB 2409-2015 "Method for determining the specific consumption of heat energy for heating and ventilation of operated residential buildings" has been developed, which provides for the determination of the specific heat indicators of buildings for the design operating conditions according to the readings of the whole-building heat meter</p>
<p>Promotion of ESCO</p> <ul style="list-style-type: none"> - The Law on Public Private Partnership (December 2015) and supporting mechanisms on foreign investments aim to attract investors and potentially improve ESCO market development in the medium term. - The EU4Energy Governance Programme, jointly with the Department for Energy Efficiency of the State Standardization Committee and other stakeholders in 2018-2019 carried out the study “Support to development of legislative and regulatory basis for providing energy efficiency services. Revision of the existing legal framework and the situation with the provision of energy 	<p>Financial Incentives</p> <p>In the structure of financing of the State Program "Energy Saving" for 2016-2020, about 75% are non-budgetary sources (own funds of organizations, loans, credits, other sources). Similar approaches are laid down in the State Program "Energy Saving" for 2021-2025. It is estimated that implementation of the set of measures to achieve the target indicators of the state program for the next 5 years will require about 320-360 million US dollars annually.</p> <p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>Social Infrastructure Retrofitting Project</p> <p>The goal of the project is to reduce energy consumption at the social facilities (schools, kindergartens, hospitals, etc.), improving thermal comfort and lighting quality. Financing: the IBRD original loan - US \$ 22.6 million, co-financing from the Belarusian side - US \$ 17.8 million; the IBRD additional loan - USD 15 million. Implementation period:</p>

<p>services and the activities of energy service companies (ESCOs)".</p> <p>- In December 2020, the Department for Energy Efficiency of the State Standardization Committee of the Republic of Belarus submitted to the Government of the Republic of Belarus a draft resolution of the Council of Ministers of the Republic of Belarus "On Approval of the Concept of Development of Energy Service Activities in the Republic of Belarus". The purpose of the Concept is to create conditions for the development of energy service activities in Belarus.</p>	<p>the original loan - 2002-2008, the additional loan - 2008-2010.</p> <p>Belarus Energy Efficiency Project</p> <p>The goal of the project is to increase the efficiency of the use of fuel and energy resources in the production of heat and electricity in certain cities of the Republic of Belarus. Financing: the IBRD original loan - USD 125 million, co-financing from the Belarusian side -US \$ 31.7 million; the IBRD additional loan - US \$ 90 million. Implementation period: the original loan - 2009-2017, the additional loan - 2014-2017.</p>
<p>Awareness Programmes</p> <p>- A multi-level system of education in energy efficiency and energy saving from kindergartens to Universities.</p> <p>- International and national exhibitions, forums and conferences, awareness raising and educational workshops and training courses at the regional and sectoral levels.</p> <p>- Awareness raising and educational initiatives are being implemented through mass media and social advertising.</p>	<p>Belarus Post Chernobyl Recovery Project</p> <p>The goal of the project is to reduce energy consumption at the social facilities in the areas affected by the Chernobyl disaster, improving thermal comfort and quality of artificial lighting. Financing: the IBRD original loan - US \$ 50 million, co-financing from the Belarusian side - US \$ 11 million; the IBRD additional loan - US \$ 30 million. Implementation period: the original loan - 2006-2011, the additional loan - 2011-2013.</p> <p>Biomass District Heating Project</p> <p>The goal of the project is to replace the imported natural gas at boiler houses of housing and utilities sector with local wood fuel, as well as to increase the reliability of heat and power supply to the consumers. Financing – the IBRD loan of US \$ 90 million. Implementation period: 2014-2021.</p> <p>Sustainable Energy Scale-Up Project</p> <p>The goal of the project is to scale up efficient energy use for heating of multi-apartment buildings and use of renewable wooden biomass for heating purposes in the settlements of Belarus included in the Project. Financing - the IBRD loan - 90 million euros, the European Investment Bank loan - 90 million euros. In support of the project, an agreement was signed with the IBRD to raise funds from the Global Environment Facility grant at the amount of US \$ 3.653 million. The implementation period is 2020-2025.</p> <p>UNDP/GEF activities on financing of pilot projects “Improving Energy Efficiency in Residential Buildings in the Republic of Belarus”:</p> <p>The objective of the project was to reduce the energy consumption (imported fuel) and related GHG emissions with the focus on new residential buildings by introducing new performance-based building design and construction standards with related energy certification scheme(s) and by ensuring their effective implementation and enforcement. Financing: The UNDP/GEF financing amounted to US \$ 4.9 million. Implementation period: 2012-2018.</p>
<p>ENERGY PERFORMANCE OF NEW RESIDENTIAL CONSTRUCTION</p>	
<p>Design Envelope</p> <p>Measurement of heat and power indicators of new buildings, carried out in Minsk, Mogilev, Vitebsk and Gomel showed that when the readings of the heat metering devices in the buildings are converted into the values of specific heat energy consumption for heating and ventilation and compared with the design operating conditions, the obtained values comply with the regulatory requirements at the moment of construction.</p> <p>Residential buildings at 3, 5, 7 Ptashuk str., Minsk. Analysis of the specific consumption of heat energy for heating for the design operating conditions of new 19-storey buildings of series 111-90 MAPID at 3, 5, 7 Ptashuk str., Minsk built in 2017 showed that the specific heat</p>	<p>Appliances and equipment</p> <p>Starting from the 1st of July, 2018 Energy Efficiency requirements for some electrical products came in force in Belarus.</p> <p>The following product categories became subject to National Energy Efficiency approval in Belarus:</p> <ul style="list-style-type: none"> • Power supplies • Electric motors • Household electrical appliances • Office equipment • Light equipment • Air conditioners <p>The national system of Belarus will require to confirm the compliance of the products with the established requirements for energy efficiency.</p>

<p>consumption for design conditions in buildings is less than 45 kWh/m²a (correspond to class B), which meets the requirements of the modern standards. Consequently, operational heat and power indicators of the new buildings comply with the regulatory requirements, which confirms the high quality of the construction</p>	<p>Depending on the specific product category, a Declaration of Conformity or a Certificate of Conformity will need to be obtained. National requirements for energy efficiency of the Republic of Belarus are fully harmonized with the European requirements. 01.01.2019: TV sets and TV monitors; Microwave oven</p>
<p>Ventilation The country's first energy-efficient building at 107 Pritytskiy str., Minsk. The apartments are equipped with a mechanical supply and exhaust ventilation system with heat recovery from exhaust air. The supply air is supplied through the air ducts to the living rooms, and the exhaust vents are located in the kitchens and bathrooms. The ventilation units are located in the loggias. The building has been in operation since 2007. More than 70 % of the apartments use for ventilation the systems installed during the construction.</p> <p>Energy efficient buildings in Minsk, Grodno and Mogilev, built under the UNDP/GEF project. The apartments are equipped with a mechanical supply and exhaust ventilation system with heat recovery from the exhaust air. The supply air is supplied through the air ducts to the living rooms, and the exhaust vents are located in the kitchens and bathrooms. The ventilation units are located in the loggias. The building has been in operation since 2017. More than 50% of the apartments use for ventilation the systems installed during construction.</p>	<p>Heating For new buildings (built after 2009) specific energy consumption for space heating it is 90 kWh/m². For energy efficient buildings it is set at 40 kWh/m²</p>

ENERGY PERFORMANCE OF EXISTING RESIDENTIAL BUILDINGS

<p>Design envelope Residential Standard building types is the so-called 'khrushchovka, which denominates the buildings of the first generation of mass housing constructed from the late 1950s until the late 1960s. These buildings are usually five-storey buildings with originally small flats and rooms and without lifts. In 2007 in total 1,700 houses in Belarus belonged to this type of buildings. During Soviet time, little or rather no attention was paid to energy performance characteristics of the building and energy efficiency was not considered at all. Therefore, the buildings that were constructed according to the Soviet practices and norms are characterized by high energy consumption. The annual heat energy consumption in these buildings is usually between 150–200kWh/m².</p> <p>Estimated Specific Heat Consumption of Residential Buildings in Belarus by Percentage of Floor Area, 2014 Primarily built before 1996: 121 – 160 kWh/m²a Primarily standalone wooden buildings: >200 kWh/m²a Primarily built after 1996 : < 90 kWh/m²a or 91 – 120 kWh/m²a</p> <p>Non- Residential Difference in energy consumption between older building and newer ones is quite visible, with pre-1994 buildings consuming between 150-200 KWh/m²a, while newer buildings consume on average 60 kWh/m²a</p>	<p>Heating There are three types of heat supply and provision in Belarus: district heating, individual natural gas boilers, and individual wood, coal boilers and stoves. Urban households are mostly served by district heating systems (around 80 percent of urban households), while rural households more typically use individual boilers and stoves (around 85 percent of rural households). District heating (DH) supplies heat and domestic hot water (DHW) to a total of 61 percent of the households in Belarus. For old buildings (built before 1993) specific energy consumption for space heating it is 130 kWh/m².</p>
--	--

BOSNIA AND HERZEGOVINA

<p>Framework Legislation and Policy Documents</p> <p>The Federation of Bosnia and Herzegovina: Law on Efficient Use of Energy in Federation of Bosnia and Herzegovina (2017) Energy Efficiency Action Plan of Federation of Bosnia and Herzegovina for the Period 2016-2018 (2017)</p> <p>The Republika Srpska: Law on Efficient Use of Energy in Republic of Srpska (No. 01-1518/13, 27.06.2013)</p>	<p>Building Energy Codes</p> <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mandatory • The values are the same as for new buildings and major renovations. • The maximum transmittance for buildings on the climate zone, use of the building and the shape factor of the building (geometry of buildings)
<p>Institutions</p> <p>The Federation of Bosnia and Herzegovina: Federal Ministry of Energy, Mining and Industry (FMoEMI) Federal Ministry of Physical Planning (FMPP) Environmental Fund of the Federation BiH (FBiH Fund) Elektroprivreda BiH Elektroprivreda HZHB</p> <p>The Republika Srpska: Ministry of Industry, Energy and Mining (MoIEM) Ministry of Spatial Planning, Civil Engineering and Ecology (MSPCEE) Environmental Protection and Energy Efficiency Fund (RS Fund) Elektroprivreda RS</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: No Penalties, incentives and other mechanisms for improving compliance: Refusal for occupancy or construction permit Energy performance monitoring requirements: No</p>
<p>Energy Performance Certification</p> <p>Coverage:</p> <ul style="list-style-type: none"> • Single family houses • Apartment blocks • Commercial • Public buildings • new non-residential • new residential • existing residential (e.g. after substantial refurbishment) • existing non-residential (e.g. after substantial refurbishment) <p>Stringency: Mandatory Type of energy that the EPC refer to: Energy for heating space and water Entitled to issue EPC: accredited domestic energy assessors Existence of national registry database for EPC</p>	<p>Awareness Programmes</p> <p>Campaigns for energy efficiency in buildings implemented and supported by the UNDP.</p> <p>Information on energy efficiency to general public by NGOs, such as REIC which holds annual summer school dedicated to EE and RE promotion.</p> <p>Promotion of energy efficiency as part of project implementation in partnership with the chambers of commerce (especially active is Sarajevo Chamber of Commerce) and regional development agencies.</p> <p>Seminar programmes on the efficient use of energy sources and their environmental impact initiated by consulting companies and supported by the UNDP, GIZ, and USAID</p>
<p>Financial Incentives</p> <p>The Federation of Bosnia and Herzegovina:</p> <ul style="list-style-type: none"> - Provision of subsidies and incentives in the form of non-refundable financing from the budget spending programme with allocation criteria “Current transfers to other levels of government and Funds for the projects of thermal insulation of buildings aimed at energy savings” -The Environmental Protection Fund of the Federation BiH which allocated a total of 9.1 million Bosnian Marks for energy efficiency projects. - The Green Economic Development 2014-2018 programme which provides grant co-financing for energy efficiency projects. The end user must contribute at least 50 per cent of the project value. Funds are allocated to buildings owned by the public sector. <p>The Republika Srpska:</p> <ul style="list-style-type: none"> - The Environmental Protection and Energy Efficiency Fund founded by the Republic of Srpska and responsible for fundraising activities and financing preparations, implementation and development of programmes, projects 	

and similar activities in the area of conservation, sustainable use, protection and improvement of the environment EE and use of RE sources.

Assistance for development and implementation of Energy Efficiency Projects

The Bosnia Energy Efficiency Project (BEEP) is being implemented with the support from the World Bank. BEEP is the largest EE project with total planned investments over the next three years of 19 million USD in the Federation of BiH and 13 million USD in the Republika Srpska.

GIZ supports the Open Regional Fund for South-East Europe - Energy Efficiency, which promotes regional cooperation between owners of reform processes in the energy sector, with the goal to achieve national objectives defined in the action plan.

USAID supports the Energy Investment Activity programme which aims to improve EE of distribution system operators and suppliers with the goal to reduce CO2 emissions and energy costs. This project provides active technical assistance to address the legal obligation to establish the EE obligation scheme.

The EBRD provided a €10 million loan to finance energy efficiency and renewable energy projects by private companies in BiH.

The UNDP Efficient Housing Programme (2004/2005) aims to introduce low-cost methods of saving energy when building or reconstructing buildings, thus mitigating the emissions of greenhouse gases while at the same time reducing the operational costs and increasing the comfort level of the buildings.

ENERGY PERFORMANCE OF EXISTING BUILDINGS

Design Envelope

On average, the buildings in Bosnia and Herzegovina consume more than 200 kWh / m2, while private households consume as much as 350 kWh / m2.

Over 85% of dwelling units in BiH are characterized by an extremely poor energy performance with a high coefficient of heat transfer of external heat layer (U), resulting in the inefficient end-use of an estimated 30% of energy loss.

Heating

The average annual energy consumption for heating in residential buildings is 200 kWh/ m2.

All district heating systems in the territory of BiH are used only for space heating, in rare cases as industrial processing heat, and not for warm water heating.

Energy consumption for heating is around 220 kWh/m2 in public administration and 572 kWh/m2 in health sector.

GEORGIA

<p>Framework Legislation and Policy Documents</p> <p>The Law on Energy Efficiency (prepared according to the Energy Efficiency Directive 2012/27/EU) (Adopted 21 May 2020)</p> <p>The Law on Energy Efficiency of Buildings ((prepared according to the energy performance of buildings Directive 2010/31/EU) (Adopted 21 May 2020)</p> <p>The Energy Strategy 2020-2030 (finalized in October 2019)</p> <p>The Georgian Law on Energy Labelling (prepared according to the 2010/30/EU Directive and the Regulation (EU) 2017/1369) (2019)</p> <p>Georgian Space Planning, Architectural and Construction Activity Code (enacted June 3, 2019)</p> <p>The Energy and Climate Integrated Plan (NECP) (draft)</p>	<p>Building Energy Codes</p> <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential <p>Except for the following buildings:</p> <ul style="list-style-type: none"> • Buildings with status of cultural heritage monuments, • Buildings used as places of worship/religious activities, • Temporary buildings with use of 2 years or less, • Industrial sites, • Workshops and non-residential agricultural buildings with low energy demand, • Stand-alone buildings with a total useful floor area of less than 50 m². <p>Strictness</p> <ul style="list-style-type: none"> • Mandatory • Performance-based requirements in building energy codes: New buildings • Energy levels are considered in building codes • Energy use for: heating, cooling, hot water, lighting, ventilation. • Non-renewable primary energy use <p>Prescriptive requirements</p> <p>When the law enters into force, the relevant regulations will be adopted and detailed information will be available on:</p> <ul style="list-style-type: none"> • Requirements for mandatory regular inspection of heating and AC systems • Mandatory requirement for individual energy metering and control units
<p>Institutions</p> <p>The Ministry of Economy and Sustainable Development (MoESD)</p> <p>The Ministry of Finance (MoF)</p> <p>The Ministry of Infrastructure and Regional Development</p> <p>The Energy Efficiency Centre</p>	

<p>Energy Performance Certification</p> <p>The Law on Energy Efficiency of Buildings creates a legal basis for the introduction of a mandatory system to issue EPCs for buildings.</p> <p>According to the Law EPC shall be mandatory for new buildings or new building units.</p> <ol style="list-style-type: none"> a) existing buildings that are sold or rented/leased; b) existing building units that are sold or rented/leased; c) buildings with total useful area more than 500m² that are occupied by public authority and frequently visited by the public. From June 30, 2026, the threshold of 500 m² shall be lowered to 250 m². <p>Stringency: Mandatory</p> <p>Who is entitled to issue EPC: Accredited body</p> <p>Existence of national registry database for EPC: No</p> <p>Type of the EPC energy: Total primary energy, Non-renewable primary energy</p> <p>The Law on Energy Efficiency of Buildings requires the adoption of the National Methodology for Calculating the Energy Performance of Buildings and the establishment of Minimum Energy Performance Requirements for Buildings or Building units and Building elements before June 30, 2021. Currently, both normative acts are being developed.</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: According to the Law on Energy Efficiency of Buildings the rules and procedures for regular inspection of heating and air-conditioning systems of buildings are established by a normative act of the Government of Georgia.</p> <p>Penalties, incentives and other mechanisms for improving compliance: Yes, Articles 12-18 of the Chapter III of the Energy Efficiency of Buildings Law</p> <p>Energy performance monitoring requirements: Yes</p> <p>MoESD will in 2021 establish a Registry of the buildings owned and occupied by public administrative bodies, with information on the energy performance and other relevant information related to energy consumption of buildings.</p>
--	---

<p>Financial Incentives</p> <p>According to the Law of Georgia on Energy Efficiency of Buildings, with the aim to promote activities for improving the energy performance of buildings, the Government of Georgia ensures:</p> <ol style="list-style-type: none"> a) development and distribution of information, methodological materials and guidelines on the energy performance of buildings, on energy performance certificates and inspection reports, on cost-effective ways to improve the energy performance of buildings, and on available financial instruments to the owners and tenants of buildings; b) public information and relevant guidance on training, certification and accreditation for experts involved in activities related to the energy performance of buildings;

- c) reflecting measures within their national plans to support public authorities to implement the recommendations included in the energy performance certificate issued for buildings under their ownership;
- d) drawing up and updating every three years a list of existing measures and instruments, including those of a financial nature, which promote the improvement of the energy performance of buildings and support implementation of this Law.
2. The cost-optimal levels of energy performance when providing incentives for the construction or major renovation of buildings.

Awareness Programmes

Energy Efficiency Training Week was held in Tbilisi during 16-20 October of 2017. The event was conducted by the International Energy Agency (IEA), the Ministry of Energy of Georgia and in the framework of an assistance program of the European Union – EU4ENERGY.

USAID has had an active rural energy programme and has conducted feasibility studies into increasing the efficiency and improving the standard of performance of stoves in Georgia. It held a seminar on energy efficient stove design techniques in 2008, inviting stove makers from all over the country.

The Home Energy Improvement Program (HEIP). HEIP educates customers on various improvements as well as provides rebates of 50% of the cost up to \$600 per year. Energy and monetary savings from improvements continue for years. The program's Individual Improvement approach allows Georgia Power customers to receive incentives for installing one or more qualifying individual energy efficiency measures, including air sealing, duct sealing, attic insulation and more.

Georgia Power has also continued offering separate energy efficiency options throughout the pandemic, including rebates for LED lighting and programmable Smart Thermostats.

Save energy and money by changing a standard light bulb in your home to an ENERGY STAR®-qualified LED bulb. LEDs use up to 90 per cent less energy than standard bulbs and can last up to 15 times longer.

When used properly, a programmable Smart Thermostat can help you save energy when you're asleep or away from home. Use the thermostat's pre-programmed energy-saving setpoints as a guide for summer, winter and vacation modes. According to ENERGY STAR®, with proper use, programmable thermostats can save about \$180 per year in energy costs.

Assistance for development and implementation of Energy Efficiency Projects

Reducing Greenhouse Gas Emissions through improved Energy Efficiency in the Industrial Sector of Georgia
 Donor: Austria
 Executor: UNIDO
 Partners: Austrian Energy Agency
 Budget: €800,000
 Duration: 2017-2019

In 2020, the E5P Contributors Assembly approved 2.6 million grant in order to support project implementation by NEFCO, which refers to energy efficiency improvement in public schools in mountainous regions of Georgia.

CEB/E5P: Project on the Rehabilitation of Public Schools in Tbilisi and the Introduction of Energy Efficiency in Schools:

CEB/E5P: The Council of Europe Development Bank (CEB) received 5 million EURO grant from E5P to rehabilitate and increase energy efficiency of more than 20 schools in Tbilisi. In total, for the project 20 million EURO resource is assigned, from which 14 million EURO is allocated with the low-interest loan by CEB and 6 million EURO grant by E5P fund. With the mentioned resources and plus Georgia's co-participation with 2 million EURO (in non-financial form) we are given a chance to renovate approximately 25 public schools and increase the energy efficiency. Currently project design documentation is being prepared.

NEFCO/E5P: Improving the energy efficiency of public buildings in Georgia and the use of renewable and alternative energy:

Within the project 2.83 million Euro loan was allocated from the Nordic Environment Finance Corporation (NEFCO), and 1.9 million Euro grant from the E5P fund.

The aim of the project is to implement energy efficiency measures in public buildings in Georgia (approximately 25 buildings), which will be achieved by introducing renewable and alternative energy sources in the administrative and educational buildings envisaged by the project.

- Construction works are currently underway.

ENERGY PERFORMANC OF NEW CONSTRUCTIONS

Residential

Large variations in energy performance of newly constructed buildings derives due to the absence of the mandatory EE standards as well as approved use of the Technical Regulations of Member-states of the European Union and the Organization for Economic Cooperation and Development for construction activities in Georgia.

However, also many developments with better energy performance, significantly exceeding legal minimum requirements.

Thermal transmittance (U value, W/m²K) value of building envelope:

Floor : 0.2 W/m²K
 External Walls : 0.74 W/m²K
 Roof : 0.7 W/m²K
 Windows : 2.85 W/m²K

Non- Residential

High energy efficiency standards were implemented in the several public buildings/ kindergartens that have undergone the energy efficiency rehabilitation. The thermal transmittance U values of the building envelope components of the above buildings constituted as follows:

U value for Floor: 0.25 W/m²K
 U value for External Walls: 0.33W/m²K
 U value for Roof: 0.207 W/m²K
 U value for Windows: 1.6 W/m²K

Within the framework of the WB/ESMAP project the technical design solutions and recommendations for the EE retrofitting of the residential buildings were developed. Thermal transmittance the U values for the building envelope components were defined in line with the developed regulation on the minimum energy performance requirements (not adopted yet) and constituted for the Climate zone-2 as it follows:
 Floor: U value 0.38 W/m²K;
 External walls: 0.38 W/m²K;
 Roof: 0.3 W/m² K;
 Windows & External Doors: 0.3 W/m² K.

ENERGY PERFORMANCE OF EXISTING BUILDINGS

Residential

Design envelope

A large share of the housing stock was constructed between 1960 and 1990 in accordance with old, Soviet standards, and made out of concrete blocks or panels. This results in an increased share of the housing stock have very low thermal efficiency and are deteriorating.

Buildings in the cities and in Tbilisi especially have more than five floors and basements and exterior walls with sand-cement rendering and paint finish. The standard thickness of the walls is 40-50 cm, usually without any thermal insulation.

Buildings are of poor quality due to improper design and assembly. Rarely ceramic bricks are found, but they are mostly in rural areas. About 60% of windows and doors in the block buildings in Tbilisi are of old, wooden construction and have to be replaced.

The majority of buildings built in Georgia have a thermal resistance that fluctuates between $R = 0.62-0.78 \text{ (m}^2 \cdot \text{OC} \cdot \text{W}^{-1}\text{)}$

The mandatory level R-value required by the old Soviet codes as an example for Tbilisi and Rustavi for walls constitutes: $R=0.55 \text{ m}^2 \cdot \text{oC/W}$ (which is four times lower than the level with consideration of energy efficiency).

Heating and Cooling

The district-heating network in Tbilisi and the main cities of Georgia collapsed in the 1990s and is not currently operating. Individual heating (gas heaters and/or electricity and firewood stoves) and air conditioning systems were introduced for each apartment and house in Georgia.

Fuel wood is mostly being used in rural areas and the places where there is no gas distribution network.

The current level of specific energy consumption for space heating during the heat supply season estimated for seven Tbilisi buildings (erected back in the Soviet era) was estimated at 125 kWh/m² according to the USAID project. According to other expert estimates, space heating requires on average 160 kWh/m²: some 140 kWh/m² in apartment buildings and 180 kWh/m² in private housing. Space heating is responsible for about 70-80% of residential energy consumption.

KAZAKHSTAN

<p>Framework Legislation and Policy Documents</p> <p>Integrated Energy-Savings and Energy Efficiency Plan for Astana 2016-2020</p> <p>2020 State Program on Energy Saving (Approved by the Decree of the Government of the Republic of Kazakhstan No 904, 2013)</p> <p>Law of the Republic of Kazakhstan on Energy Saving and Improving Energy Efficiency (2012)</p> <p>Comprehensive Plan to Improve the Energy Efficiency of the Republic of Kazakhstan for 2012-2015</p> <p>Institutions</p> <p>The Ministry of Energy The Committee for Regulation of Natural Monopolies and Protection of Competition The Committee on Statistics at the Ministry of National Economy</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> • SN 2.04-21-2004 " Thermal protection and energy consumption of civil buildings"; • SN RK-2.04-04-2011 " Thermal protection of buildings". <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Apartment blocks • Commercial • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mandatory • National classification of buildings in the building code of 2012: A++; A+; A; B+; B; C+; C; C-; D; E. • Requirements for the assessment of energy efficiency and energy consumption exist but not really implemented. • Energy use for heating, ventilation.
--	--

<p>Energy Performance Certification</p> <p>Main regulatory documents for the EPC: No EPC Coverage: currently EPC is not used Policy requirement level for EPC: mandatory Existence of national registry database: No</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: No Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No Energy performance monitoring requirements: No</p>
---	---

<p>Promotion of ESCO</p> <p>Introduction of energy service contract is a priority for Kazakhstan, which has been pointed out in the Address of the First President (Kazakhstan 2050 strategy, Step 59). Despite legislative amendments designed to improve energy service contracts, their implementation remains very limited: for example, during the period 2015-18 only eight energy service contracts were concluded.</p>	<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>Removing Barriers to Energy Efficiency in Municipal Heat and Hot Water Supply, a GEF-UNDP project, was designed to address these issues by increasing energy efficiency in the district heating supply systems of Almaty, Astana, and Karaganda.</p>
---	---

ENERGY PERFORMANCE OF EXISTING BUILDINGS

Residential	Non-Residential
<p>Design Envelope and Heating</p> <p>An energy audit of the buildings carried out under the project of the UNDP showed that consumption of heat by residential buildings in Kazakhstan generally equals 273 kWh per m² every year.</p> <p>The total area of housing stock of the Republic of Kazakhstan is above 270.9 million m², out of which 50.1 million m² or 32% of the housing stock are pertaining to apartment blocks in need of various kinds of repair works (repair of facades, roofs, tightening joints of wall panels, etc.), and 3.8 million m² or 2% of the housing stock are in an emergency state and require demolition as unsuitable for further use.</p> <p>Approximately 20-30% of the residential building stock in Astana is made of old houses, while 80% has been built in the recent decade. Old apartment buildings have usually nine floors with a total of 54 apartments per building, while new residential constructions have usually 12-16 floors.</p> <p>Residential and public buildings use the largest amount of energy among the entire building stock in the city of Almaty --250 kWh/m²</p>	<p>Design Envelope and Heating</p> <p>Municipal buildings in Astana account for 7% of the building stock in the city. Municipal buildings use the largest amount of energy per square meter among the entire building stock in the city - 290 kWh/m² - which is 20% higher than in industrial facilities.</p> <p>Analysis indicates that public buildings in Astana have some good 50% energy savings potential.</p> <p>In Almaty, 65% of the energy consumed in public buildings is district heat.</p> <p>Most schools in Astana were built in former Soviet times. They are old and have issues with the building structures. Except for 17 units that are equipped with autonomous heating systems, all other schools in Astana are connected to the centralized heating system.</p> <p>84% of the energy consumed in public buildings in Astana is heat. All public buildings in Astana are connected to the centralized heating network.</p> <p>Municipal buildings in the Kazakh cities have the highest heat consumption - between 200 kWh/m² and 250 kWh/m².</p>

By experts' estimates, thermal and technical characteristics of 70% of buildings (especially ones built in 1950-1980) do not meet modern requirements, which is why 30% and more of the heat they consume goes out of these buildings through the fencing structures.

In Kazakhstan, despite its more severe climatic conditions walls have poorer insulation properties, with U value of 0.85-1.2 W/m²K.

Most of the existing housing stock consists of apartment blocks with central heating based on boiler houses or CHPPs.

The residential sector is the main consumer of district heat (57% of total heat) in Astana. All city residents in Astana are connected to electricity network and most of the multi-storey residential buildings are linked to the centralized heating system.

Residential sector is the largest energy user in Astana, especially when it comes to heat. Due to cold weather, but also poor insulation and waste of energy because rooms are overheated and people open the windows, Astana has the highest heat consumption per square meter.

The residential sector is the main consumer of the district heat (63% of total heat) in Almaty.

Not all buildings in Almaty are connected to the centralized heating system. Single housing units have individual heating systems based on natural gas.

In Kazakhstan, detached or semi-detached houses are usually heated by coal and/or wood. In urban and suburban areas, some coal-consuming households have access to central heating or network natural gas.

Rural households in Kazakhstan have lower access to district heating and to the gas network, hence these areas mainly rely on coal, wood and LPG for heating and cooking.

Consumption of district heating is the highest among buildings energy services with an average of 185 kWh/m².

Consumption of hot water in buildings is at an average of 67 kWh/m².

Lighting

Under an energy efficiency program between 2014 and 2015 around 15-20 schools changed their lighting system to LEDs in Astana.

Framework Legislation and Policy

Documents

Master Plan for energy sector of the Kyrgyz Republic up to year 2040 (The Master Plan will analyze the electric sector as well as other energy carriers and important related topics such as, among others, energy efficiency and tariff policy)

Concept for the development of the fuel and energy complex of the Kyrgyz Republic until 2030(draft).

National Sustainable Development Strategy for 2018-2040 (The strategy foresees the scaling-up of energy-savings and energy-efficiency programs for the existing building stock and net-zero-energy buildings (NZEBs) for new construction.)

Decree of the Government of the Kyrgyz Republic on approval of the Medium-term tariff policy of the Kyrgyz Republic for electric and thermal energy for 2020-2022.

Decree On approval of the Action Plan of the Government of the Kyrgyz Republic for 2019 for the implementation of the Plan of the Government of the Kyrgyz Republic for 2019-2023 for the implementation of the program of activities of the Government of the Kyrgyz Republic, approved by the Resolution of the Jogorku Kenesh of the Kyrgyz Republic dated 20 April, 2018 No. 2377-VI (Decree no. 141, dated 29 March 2019).

Energy Efficiency in Buildings Law 137 (Dated 26 July 2011 ; As amended by the Laws of the Kyrgyz Republic of 18 October, 2013 No. 194, 20 June, 2019 No 74).

Decree on the Rational Use of Energy (Decree no.255, dated 2 June 2005).

Institutions

The State Committee on Industry, Energy and Subsoil of the Kyrgyz Republic (SCIES) (prior to 2016 named the Ministry of Energy and Industry).

The Research Institute on Energy and Economics under the SCIES (prior to December 2015 under the Ministry of Economy).

Building Energy Codes

Building norms of the Kyrgyz Republic / System of regulatory documents in construction / Single apartment residential buildings (27 December, 2018, Contains paragraph on energy performance.)

SNiP 23-01:2013, “Building Heat Engineering (Thermal Protection of Buildings)”

SP 23-101-2013, “Design of Thermal Protection of Buildings”

Method for Calculating the Energy Efficiency of Buildings and Determining Energy Efficiency Class for Energy Certification of Buildings
Gosstroy order, 26.05.2013

Methodical instructions for conducting periodic monitoring of the energy efficiency of boilers, heating systems of buildings, and hot water supply of buildings
Gosstroy order 26.05.2013

Guide to the settlement application for energy certification of buildings
Gosstroy order 26.05.2013

Coverage

- New residential
- New non-residential
- Existing residential
- Existing non-residential
- Public, administrative and multifunctional buildings

Strictness

- Mandatory
- The minimum energy efficiency requirements for buildings do not apply to: (i) individual residential buildings, the total area of which does not exceed 150 square meters; (ii) buildings designed for religious rites, rituals and ceremonies; (iii) buildings that, in accordance with legislation, are assigned to cultural heritage sites ; (iv) temporary objects of non-capital construction; (v) holiday homes; (vi) buildings and structures of auxiliary use.

Energy Performance Certification

The Law on the Energy Performance of Buildings obliges residential, public, administrative and multifunctional non-industrial buildings building owners to prepare energy passports and energy certificates for the buildings. Due to the absence of certified energy efficiency specialists, very few new or retrofitted buildings have been certified up to now. Despite the existence of a legislative basis for energy performance certification, a responsible state institution for implementation and enforcement as well as a pool of qualified experts is not yet available.

Compliance Mechanism

Requirements for regular inspection of heating and AC systems: periodic monitoring of energy efficiency of boilers, heating systems and hot water supply. According to the Methodical instructions for conducting periodic monitoring of the energy efficiency of boilers, heating systems of buildings, and hot water supply of buildings the boilers should be monitored every 2-7 years depending on fuel and capacity.

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country:
- Penalties: According to the Law on Energy Efficiency in Buildings there is an administrative liability for violation of the law, but there is no article in the Administrative code.
- Incentives: Incentives are not available. One of the key issues is that the state entities (such as schools, hospitals, etc.) are not interested in any economy of funds as they cannot get or redistribute the savings.

Energy performance monitoring requirements: carried out at least once a year.

	<p>According to the Guide to the settlement application for energy certification of buildings energy certificate is valid for 10 years. All the inspections are to be done by certified specialists.</p>
<p>Energy Pricing Measures Residential district heat (DH) and hot water tariffs for the period 2020-2022 Residential consumers DH: 1134.76 Som/Gcal Hot Water: 981.76 Som/Gcal / 64.38 Som/m³ / 309.03 Som/(person*month)</p> <p>All other consumers, including public institutions DH: 1695.1 Som/Gcal Hot Water: 1965.1 Som/Gcal / 97.19 Som/m³</p> <p>Electricity tariffs for main categories of consumers Residential consumers: Consuming less than 700 kWh/month - 0.77 Som/kWh, Consuming more than 700 kWh/moth – 2.16 Som/kWh Other consumers: 2.24 Som/kWh</p> <p>The natural gas cost is pegged to the US dollar rate and makes 0.23\$/m³ and 0.28\$/m³ for residential and other consumers respectively. In national currency tariff for residential consumers changed from 13.8 Som/m³ in the beginning of 2015 to 18.06 Som/m³ in the end of 2020. For other consumer the tariff changed from 16.57 Som to 21.79 Som for the same period.</p> <p>The price for coal is permanently increasing. According to the data of National Committee for Statistics for the last 10 years it changed from 3575 Som/t in 2010 to 4304 Som/t in 2020.</p>	<p>Financial Incentives There is no determined strategy or practice on support of energy efficiency measures introduction. Some incentives can be provided by international organisations as consultancies, grants, preferential loans for introduction of energy efficient measures. While in governmental plans, decrees, etc. some incentives may be declared (eg. Decree On approval of the Action Plan of the Government of the Kyrgyz Republic for 2019 for the implementation of the Plan of the Government of the Kyrgyz Republic for 2019-2023 for the implementation of the program of activities of the Government of the Kyrgyz Republic, approved by the Resolution of the Jogorku Kenesh of the Kyrgyz Republic dated April 20, 2018 No. 2377-VI para.52).</p>
<p>Promotion of ESCO There were some projects, starting 2004-2006 promoting ESCO. Development of ESCO was mentioned in The Program on Energy Conservation and Energy Efficiency Policy for 2015– 2017, but no practical result was achieved. At least one ESCO was created in 2004, but don't exist from 2006.</p>	<p>Awareness Programmes There was a project financed by EBRD and supported by the government in 2009-2015 The initiative of transparency of the fuel and energy complex of the Kyrgyz Republic. Energy public awareness program financed by ADB. Both projects are mainly focused on energy sector in general, the second one is very weak. From the side of the government no work in progress.</p>
<p>Assistance for development and implementation of Energy Efficiency Projects Heat Supply Improvement Project by IDA(WB) (2019 – present \$43 million). Component 1: Improving supply efficiency and quality of the DH system in Bishkek. Installation of new substations and smart meters. Component 3: Demonstrating the benefits of energy efficiency improvements in public buildings.</p> <p>Housing Microfinance Project (2012 – present) The project helps improve housing conditions for low-income Kyrgyz households by introducing an innovative housing microfinance lending product to local financial institutions, enabling them to provide funding for home improvements to low-income residents. Donor partner is the government of Switzerland. The project promotes energy efficiency in residential buildings by means of insulation, use of RE.</p> <p>Kyrgyzstan Sustainable Energy Financing Facility (KyrSEFF) (2013 – present) EBRD and EU supported project with a loan amount of EUR 55 million by EBRD as credit lines for two phases and a grant of 9.24 million by EU.</p> <p>A World Bank “Urban Development” project for the rehabilitation of four schools and two kindergartens to improve their energy efficiency and seismic resilience, strengthen the building structure, and renew the heating system and building insulation;</p> <p>A UNDP project, “Improving the Energy Efficiency of Buildings” (2010-2014), to build an energy-efficient school in Osh and design an energy-efficient school in Bishkek; and</p> <p>A World Bank “Enhancing Resilience in Kyrgyzstan” (ERIK) project, which aims to improve the safety and functional conditions of schools (including energy efficiency improvements) in the areas of highest seismic hazard.</p>	

ENERGY PERFORMANCE OF NEW CONSTRUCTIONS	
<p>Design Envelope In 2013, the standards were revised towards increasing the energy efficiency classes of buildings from 5 to 7, which is in line with the European Union Directives on Energy Efficiency in Buildings: 2002/91/EC and 2010/31/EC. In accordance with the new building codes, the actual thermal requirements for multi-apartment buildings, depending on the number of storeys, range from 64 to 78 kWh / m2. Monitoring showed that in 2014, 92% of new building projects in Kyrgyzstan comply with new building codes.</p> <p>Requirements for U-value of building structures for New Buildings External Walls: 0.32 (W/m²K) Windows in external walls and doors in spaces which people reside <=1.5 Flat roof: 0.20 Ceiling with vertical thermal flow (depending on the thermal flow direction and temperature difference): 0.2.-1.70</p>	<p>Heating Average space heat demand for newly- constructed multi buildings apartment buildings (built after 2004) : 100-110 kWh/m2.</p>
ENERGY PERFORMANCE OF EXISTING BUILDINGS	
Residential buildings	Non-Residential buildings
<p>Design Envelope, Heating and hot water Average Space heat demand per year for residential buildings</p> <p>Constructed in 1940-60s : 100-143 kWh/m2 Constructed in 1960-80s: 130-143 kWh/m2</p> <p>Specific demand for hot water in residential buildings</p> <p>In Bishkek (Average year) 50 kWh/m2</p> <p>In Tokmok (Average year) 27 kWh/m2</p>	<p>Design Envelope, Heating and hot water The specific energy consumption currently averages 162 kWh per square meter of floor area, while demand averages 250 kWh per square meter. Approximately 70 to 88% of energy use in public buildings can be attributed to space heating, and electricity is used for space heating in 60% of all public buildings.</p> <p>Specific heat demand in kWh/m3/year Educational buildings: 30-66 Health facilities: 36-40 Administrative buildings: 45-50</p> <p>Specific demand for hot water(norm) in public buildings</p> <p>In Bishkek (Average year) Healthcare: 22 kWh/m3</p> <p>In Tokmok (Average year) Healthcare: 22 kWh/m3</p>

MONTENEGRO

<p>Framework Legislation and Policy Documents</p> <p>The Law on Efficient Use of Energy (2014) Energy Policy of Montenegro until 2030 Energy Development Strategy of Montenegro until 2030 Energy Efficiency Action Plans (2010-12; 2013-15; 2016-18)</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> Guidelines for energy efficiency certification of buildings (official Gazette of Montenegro 75/15) Guidelines for energy audits of buildings (official Gazette of Montenegro 75/15) 2014-2015 Secondary regulation for EPBD implementation: five rulebooks are adopted in 2013 and updated in 2015. <p>Coverage</p> <ul style="list-style-type: none"> New residential New non-residential Existing residential Single family houses Apartment blocks Commercial buildings Public buildings Other buildings that are heated on temperature above 12° C, has area more than 50 m2 and are not under cultural heritage. <p>This typology is represented in current Rulebook on minimal energy efficiency requirements in buildings. New building typology will be defined within the EEPPB II project.</p> <p>Strictness</p> <ul style="list-style-type: none"> Mandatory Energy classes are defined within the EEPPB II project
<p>Institutions</p> <p>The Ministry of Economy/ Directorate for Energy Efficiency The Ministry of Sustainable Development and Tourism</p>	<p>Energy Performance Certification</p> <p>Coverage:</p> <ul style="list-style-type: none"> Single family houses Apartment blocks Commercial Public buildings new non-residential new residential Existing residential (e.g. after substantial refurbishment) Existing non-residential (e.g. after substantial refurbishment) <p>Stringency: Mandatory EPC is not carried out in practice due to the lack of national software for calculating. This will be done in the project EEPPB II. Existence of national registry database for EPC: No</p>
<p>Financial Incentives</p> <p>Financial support for the improvement of the energy efficiency of final consumers is rather limited, as no fund exists which could provide sustainable financing of such projects. However, the establishment of the Eco Fund is currently underway. Montenegro has not yet established tax measures to promote energy efficient technologies or products.</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: Yes, for both heating and AC systems Penalties, incentives and other mechanisms for improving compliance: Fines for non-compliance, specific incentive, refusal for occupancy or construction permit Energy performance monitoring requirements: Yes, Mandatory</p>
<p>Promotion of ESC</p> <p>The REEP initiative has supported the development of an adequate legal framework for the implementation of the ESCO concept in Montenegro and developed models of energy performance contracts for buildings, water supply systems and public lighting. [“Regional energy efficiency program in Western Balkans” (REEP), implemented by the European Bank for Reconstruction and Development (EBRD) in partnership with the Energy Community Secretariat and co-financed by the EU].</p>	<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>Energy Efficiency project in Montenegro (MEEP) by IBRD Energy efficiency program in Public Buildings (EEPPB) by KfW bank</p>
<p>ENERGY PERFORMANCE OF EXISTING BUILDINGS</p>	
<p>Design Envelope</p> <p>The average energy consumption of residential buildings in Montenegro decreased from 178 kWh/m²/year in 2011 to</p>	<p>Heating and Cooling</p> <p>Buildings in the residential sector tend to be heated and cooled by individual systems such as air-conditioners,</p>

<p>161 kWh/m²/year in 2016. This was partially achieved with the introduction of the MEPR for new buildings in 2013.</p>	<p>including air source heat pumps, individual boilers for apartments or houses and biomass stoves.</p> <p>Buildings in the service sector are usually equipped with a central heating system based on light fuel oil, electricity, coal or biomass.</p> <p>In Montenegro, 54 percent of dwellings are equipped with mechanical cooling systems, and the share is increasing significantly. In 2005 it was just 21.4 percent. These are predominantly decentralized systems (split units). Most of the cooling units are reversible, thus they are used also for heating, although this cannot be supported by statistical data.</p> <p>In Montenegro, electricity and wood are the most typical energy sources used for heating and hot water production. Typically, in Montenegrin households hot water is produced using an electric boiler.</p>
<p>Appliances and equipment</p> <p>The Government of Montenegro adopted ecodesign requirements for 16 groups of products in 2017. The schedule for entry into force of the rulebooks regulating ecodesign requirements is as follows:</p> <ul style="list-style-type: none"> - from the 1st July 2018: non-directional household lamps, fluorescent lamps and electric motors; - from the 1st January 2019: directional lamps, LED lamps and related equipment; household washing machines; household tumble driers; household dishwashers; household refrigerating appliances; air conditioners and comfort fans; televisions; simple set-top boxes; external power supplies; electrical and electronic office and household equipment in standby and off mode and networked standby mode; water pumps; glandless standalone circulators; and fans. 	

NORTH MACEDONIA

<p>Framework Legislation and Policy Documents</p> <p>The Law on Energy Efficiency (transposing the EU Energy Efficiency Directive, Energy Performance of Buildings Directive, Regulation on Labelling of energy related products, and Directive on Eco-design of energy related products.) (Adopted February 2020)</p> <p>The Strategy for Energy Development of the Republic of North Macedonia until 2040</p> <p>National Energy Efficiency Action Plans (2010; 2014; 2017)</p> <p>Energy Efficiency Strategy (2010)</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> • The Law on spatial and urban planning • Rulebook on energy audits 2013. • Rulebook for energy characteristics of buildings 2013, • Rulebook for Information • System for monitoring and management of energy consumption at legal entities in public sector 2015. <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • The national classification of buildings covered by the energy codes include residential and non-residential for the means of certification. • The national classification of buildings for the needs of energy audits includes: residential sector min "C class" 100 kWh/m² annual consumption, public sector min "C class" 150 kWh/m² annual consumption. Mandatory for public sector min "D class" after substantial refurbishment
<p>Institutions</p> <p>The Ministry of Economy</p> <p>The Energy Agency of the Republic of Macedonia</p> <p>The Energy Regulatory Commission</p>	<p>Energy Performance Certification</p> <p>Coverage:</p> <ul style="list-style-type: none"> • Single family houses • Apartment blocks • Commercial buildings • Public buildings • new non-residential • new residential • existing residential (e.g. after substantial refurbishment) • existing non-residential (e.g. after substantial refurbishment) <p>Stringency: Mixed (both voluntary and mandatory)</p> <p>No existence of national registry database for EPC</p>
<p>Financial Incentives</p> <p>The Ministry of Economy subsidies 50 per cent of replaced inefficient windows with energy efficient one or up to 500€ per installation.</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: Yes, for both heating and AC systems</p> <p>Penalties, incentives and other mechanisms for improving compliance: Yes, losing the license</p> <p>Energy performance monitoring requirements: Yes</p>
<p>Awareness Programmes</p> <p>“Energy mathematics” campaign provided households with practical examples on how to save energy.</p>	<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>Regional Energy Efficiency Programme (REEP) - The European Bank for Reconstruction and Development (EBRD) and the European Commission (EC)</p> <p>Western Balkans Sustainable Energy Finance Facility (WeBSEFF).</p> <p>EBRD €2.5 million loan to Ohridska Banka AD Skopje for residential energy efficiency in April 2020. The financing is the EBRD’s third loan agreement with Ohridska Banka AD Skopje and comes under the Green Economy Financing Facility programme (GEFF). The funds will be on-lent to support investment by private homeowners in green technologies and materials as well as investment in boilers, windows and lighting. The country’s building stock is in urgent need of refurbishment and the introduction of insulation, for example, is expected to lower costs and improve comfort.</p>
<p>ENERGY PERFORMANCE OF EXISTING BUILDINGS</p>	
<p>Heating</p> <p>Most of the heating systems in buildings are largely inefficient. Heating is typically provided by three sources: electricity (25%), biomass (firewood) (64%) and district heating (DH) (9%, Skopje only).</p>	

Framework Legislation and Policy

Documents

Law no.139 on Energy Efficiency

This Law implements Directive 2012/27/EU of the European Parliament and of the Council on energy efficiency and Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products. The purpose of this Law shall be to create the legal framework necessary to promote and improve energy efficiency through the implementation of energy efficiency action plans, the development of the energy services market.

Action Plan for 2014-2020 on harmonization of buildings sector

The Action Plan for 2014-2020 on harmonization of buildings sector' technical regulations and national standards with European regulations and standards was adopted on 12.11.2014 (GD no. 933).

Law no.75 on Dwellings

The Law no. 75 on Dwellings was adopted on April.2015 and entered into force on November 2015, except for the provisions relating to the energy performance of buildings with reference to ventilation, cooling and lighting (entered into force on 01.01.2017)

Regulation (GD no.1325 of 12.12.2016) on the “Periodic Inspection of the Heating Systems in Buildings”

Voluntary Energy Efficiency in Heating Utilities (2014).

Heating utilities have to choose either to implement Energy Audits every 4 years, or to implement the Energy Management Systems as per ISO50001

Energy Strategy of the Republic of Moldova until 2030

Law on eco-design requirements applicable for energy-related products (Law no. 151 as of 01.07.2016) – is being supported by the Regulation 750/2016 which establishes requirements for equipment such as household dishwashers, air conditioners etc.

Regulation (GD no.750 of 13.06.2016) on the “Requirements on eco-design applicable to products with an energy impact”

The Regulation transposes EC Regulation No 643/2009 of 22 July 2009 on implementing Directive 2005/32 / EC of the European Parliament and of the Council on eco- design requirements for household refrigerating appliances (Official Journal of the European Union L 191/53 of 23 July 2009), as well as amendments and additions made by European Commission (EC) Regulation 2016/2282 of 30 November 2016.

National Energy Efficiency Action Plan (NEEAP 2019-2021) (G.D. no. 698 of 27.19.2019)

To facilitate energy efficient retrofits of public buildings with cumulative savings of 58 ktoe by end of 2021 and energy efficient retrofits of multi-apartment residential buildings, in frame of a separate programme by the end of 2021 with average annual savings of 83,6 ktoe (cumulative savings of 193,6 ktoe by the end of 2021).

National Programme on Energy Efficiency 2011-2020

20% reduction in overall primary energy consumption by 2020 compared to 2009 levels.

Law on Energy Performance of buildings (Law no. 128 as of 11.07.2014)

Building Energy Codes

•Law on Energy Performance of Buildings (2014)

•Law on energy efficiency nr 140 from 2012; transpose Directive 32/2010 on energy performance of the buildings. -In year 2012

-Moldova is on the way to transpose EU standards. Some current standards are old GOST and SNIP norms and need revision.

•**Building Code (NCM M.01.04: 2016)**

"Methodology for calculating cost-optimal levels, minimum energy performance requirements for buildings and their components" (heating component and domestic hot water preparation).

•**NCM E.04.03-2008 Energy conservation in building**

This norm refers to residential buildings and public buildings (preschools, general culture institutions, medical institutions and clinics, administrative institutions) with prescribed temperature and relative humidity of the internal air. All requirements in the document are designed for the construction of buildings with efficient use of energy to ensure comfortable conditions.

NCM M.01.02:2016 „Energy Performance of Buildings. Methodology for calculation of the Energy Performance of Buildings”

The document presents the methodology and conversion factors for energy units for calculation of the Energy Performance of Buildings.

Coverage

- New non-residential
- Existing residential
- Existing non-residential
- Single family houses
- Apartment blocks
- Public buildings

Strictness

- Mixed: both voluntary and mandatory
- Types of energy considered in building codes and regulations: energy use for heating, cooling, hot water, lighting, ventilation.
- Law on energy performance of buildings (2014) transposes the Directive 2010/31/EC. Energy class – system of measurement from "A" to "G" for specifying of energy efficiency of the building. In case of classification of buildings with very outstanding energy performance, the class "A" can be subdivided into sub-classes.

Performance-based requirements in building energy codes:

Energy efficient development systems
 Details/values of the performance-based requirements:
 After year 2021, all new buildings must be NZEB
 Class A = 50 kWh/m2/year; B=99 kWh/m2/year
 Energy use for: heating, cooling, hot water, lighting, ventilation.

<p>Law on energy labelling of energy-related products (Law no. 44 as of 27.03.2014) is being supported by the Regulation 1003/2014 which establishes a set of labelling requirements for the following appliances – household tumble driers, air conditioners, domestic ovens and range hoods, electrical lamps and luminaries, household washing machines, household dishwashers, household refrigerating appliances and TV sets.</p> <p>Low Emissions Development Strategy 2030 (GD no. 1470, 30.12.2016)</p>	
<p>Institutions</p> <p>Agency for Energy Efficiency (EEA) National Agency for Energy Regulations (ANRE)</p>	
<p>Energy Performance Certification</p> <p>Regulation (GD no.896 of 21.07.2016) on the “Procedure of energy performance certification of buildings and of building units”</p> <p>The implementation of these European standards in the Republic of Moldova took place through the Government Decision no. 896/2016 "On the approval of the Regulation on the procedure for the certification of the energy performance of buildings and of building units"</p> <p>NCM M.01.02:2016 „Energy Performance of Buildings. Methodology for calculation of the Energy Performance of Buildings”</p> <p>The document presents the methodology and conversion factors for energy units for calculation of the Energy Performance of Buildings.</p> <p>Energy Audits, 2020</p> <p>The normative document CP G.04.02-2003 "Regulation on energy audits of existing buildings and the heating and domestic hot water, provide the basis for conducting energy audit of existing buildings: requirements, the content, the energy audit documentation and the way for approval.</p> <p>When central and local public authorities apply for funding by EEA, from state or local public authorities budgets, the project has to be accompanied by an energy audit that has to be deployed by experienced energy auditors. Regulation on energy audit, GD 884/27.11.2012 sets thorough requirements with regard to minimum criteria, providing list of energy efficiency indicators.</p>	<p>Compliance Mechanism</p> <p>Law on eco-design requirements applicable for energy-related products (Law no. 151 as of 01.07.2016) – is being supported by the Regulation 750/2016 which establishes requirements for equipments such as household dishwashers, air conditioners etc.</p> <p>Regulation (GD no.750 of 13.06.2016) on the “Requirements on eco-design applicable to products with an energy impact”</p> <p>The Regulation transposes EC Regulation No 643/2009 of 22 July 2009 on implementing Directive 2005/32 / EC of the European Parliament and of the Council on eco- design requirements for household refrigerating appliances (Official Journal of the European Union L 191/53 of 23 July 2009), as well as amendments and additions made by European Commission (EC) Regulation 2016/2282 of 30 November 2016.</p> <p>Requirements for enforcement and compliance Requirements for regular inspection of heating and AC systems: Yes, for both heating and AC systems Penalties, incentives and other mechanisms for improving compliance: No Energy performance monitoring requirements: Yes</p>
<p>Financial Incentives</p> <p>The Energy Efficiency Agency (EEA) finances projects in:</p> <ul style="list-style-type: none"> • energy-saving measures such as thermal insulation of walls and roofs, replacement of windows and exterior doors • rehabilitation of heating and domestic hot water source and distribution systems • renewable energy resources • public lighting <p>The EEA offers financing in the form of grants, credits, leasing and guarantees.</p>	<p>Promotion of ESCO</p> <p>The NEEAP 2019-2021 provides in art.27 basic conditions to promote ESCO and Energy Performance Contracts.</p>
<p>Awareness Programmes</p> <p>Energy services awareness programmes under NEEAP 2019-2021</p> <p>Publish articles and brochures on energy services; Training courses for Energy Managers/ industrial sector; Training courses for Energy Management Systems; Training for Energy Auditors, Inspector and Evaluators.</p> <p>Energy Performance of Buildings awareness programmes under the NEEAP 2019-2021</p> <p>Publishing articles on energy performance certifications;</p>	<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>EU Technical Assistance Project „STARS”; “Support to Modernization of the Energy Sector in the Republic of Moldova” (STARS), an EU-funded project, at local level, support is underway to assess city energy use in a number of municipalities (comprising over 100,000 citizens) that will facilitate future energy efficiency investments as well as provide capacity building-seminars</p>

Publishing articles about regular inspection of heating and air conditioning systems ;
Publishing brochures on energy performance for end-users;
Conducting training courses for undertaking employees on implementing the Energy Management System EN ISO 50001.

across the country to facilitate the development of local energy efficiency plans.

Technical Assistance of the United States Agency for International Development (USAID);

In support of Moldova's democratic and free-market reforms, USAID activity "Assessment of Local Power Generation Options in Moldova" is to support Moldova's economic growth through improving energy supply security and availability for all economic activities, and minimizing economic losses caused by an insufficient and unreliable energy supply. The activity assesses the technical, commercial and legal issues related to a potential increase in local conventional high efficiency generation capacity and its impact on increasing security of supply, reliability and the balancing of renewable resources.

Energy Community Secretariat and the EU4Energy Programme;

Under the EU4ENERGY Governance Project managed by the Energy Community Secretariat, the Energy Community Member countries including Moldova are receiving enhanced assistance to reform their legal and regulatory frameworks in line with the Energy Community Treaty and EU best practice.

GIZ Project „Modernization of Local Public Services in the Republic of Moldova

Under the Modernization of Local Public Services (MLPS) project, of the GIZ assisted the government of Moldova through the Ministry of Regional Development and construction (MRDC) to translate national targets into action on the regional level in Regional Sector Programmes (RSP) for Energy Efficiency in Public Buildings. The estimated total investment cost in Moldova for 100% refurbishment of education and healthcare institutions (excluding other public buildings) is about EUR 760 mill and EUR 135 mill, respectively, excluding Chisinau. For comparison, the third call for proposals of the Energy Efficiency Fund had a budget of EUR 5.7 mill, and a World-Bank financed school refurbishment programme

The NEFCO

The framework agreement between the Republic of Moldova and Nordic Financial Corporation for Climate is ratified as per Law 263 of 07.12.2017. NEFCO funding is provided in the form of investments, loans and guarantees provided by NEFCO, and priority investments are considered to be those that have a beneficial impact on the environment. First projects in Moldova were implemented for street lighting systems in Ungheni and Festelita.

The Green Climate Fund

Republic of Moldova is able to directly access the financial means of the Fund, through the accredited national entities or indirectly via the accredited international entities. The citizens of Moldova will benefit from new green technology thanks to a €5 million loan provided by the European Bank for Reconstruction and Development (EBRD) and the Green Climate Fund (GCF) to Moldova Agroindbank SA (MAIB) under the EBRD's Green Economy Financing Facility (GEFF). The loan combines €3.75 million of EBRD finance and €1.25 million of GCF concessional co-finance. The financing for MAIB is the first loan to be made available under the GEFF in Moldova and is expected to facilitate the country's transition to a more sustainable, low-carbon and climate-resilient economy.

The loan will be used for on-lending to individuals, small and medium-sized enterprises (SMEs) and corporates for investments in climate change mitigation and adaptation technologies and services, such as thermal insulation for buildings, energy-efficient glazing, LED lighting, heat pumps, photovoltaic generation and energy storage systems, electric vehicles as well as drip irrigation lines, conservation agriculture machinery and rainwater harvesting equipment.

ENERGY PERFORMANCE OF NEW CONSTRUCTIONS	
<p>Design envelope</p> <p>The National Technical Standard has set the thermal performance, (U value, W/m²K) for new buildings as follows: External wall: 0.4 Flat roof: 0.3 Windows: 2.56</p> <p>The new standards that will be implemented based on the regulation for Energy performance in buildings (as of 2011) External wall: 0.32 Flat roof: 0.2 Windows: 1.5</p>	<p>Ventilation and Cooling</p> <p>Annex nr. 11 to GD nr.750 of 13 June 2016 Annex nr. 10 to GD nr.750 of 13 June 2016</p>
<p>Appliances and equipment</p> <p>Energy labels are on a scale from A to G, depending on their energy consumption. Class A (green) being the most efficient and class G (red) the least efficient. Currently, given the fact that most electrical appliances of a certain type are class A, 3 other classes have been added: A +, A ++ and A +++.</p> <p>Since 2014, in the Republic of Moldova, energy labels are mandatory for 11 categories of household electrical products:</p> <ul style="list-style-type: none"> Refrigerators Dishwashers Air conditioners TV sets Ovens and kitchen hoods Water heating installations Enclosure heating installations Electric lamps and luminaires Washing machines Dryers Vacuums 	<p>Lighting</p> <p>69 lm/W - Annex nr. 1 to GD nr.750 of 13 June 2016 for residential buildings.</p> <p>Depending on the power of the lamp. Min 88 lm/W - Annex nr. 2 to GD nr.750 of 13 June 2016 for non-residential buildings.</p>
ENERGY PERFORMANCE OF EXISTING BUILDINGS	
RESIDENTIAL	NON-RESIDENTIAL
<p>Heating</p> <p>The multi-storey buildings energy consumption index in Chisinau area is 110-140 kWh/M²/year, opposite to 154 kWh/M²/year in the whole country¹.</p> <p>The heating load in 2019 was 1,951 mil. Gcal or 2,27 TWh² for the whole country, and 1,532 mil. Gcal or 1,78 TWh for Chisinau area over the same period. In 2019 the total energy consumption of the building sector (electricity and heating load) was an equivalent of 4,7 TWh for the whole Moldova and 2,38 TWh for Chisinau area.</p> <p>In the multi-level residential sector on a recent energy audit reports in Moldova the energy consumption for heating can easily be improved: the current energy index for multi-level typical residential buildings is 110-140 kWh/M²a (46% potential savings).</p>	<p>Heating and Ventilation</p> <p>The vast majority of public buildings and residential apartments in Moldova are not heated: only about 60% of buildings are heated, and ensure sufficient thermal comfort (approx. 20-22°C). Consequently, after a building retrofit is implemented, thermal comfort normally improves and heat load increases.</p> <p>In 2020, according to a study carried out in Chisinau city, a public or building heated from district heating network has the annual energy consumption of thermal energy of 112 kWh / m²/year. For buildings that use natural gas the consumption was 157 kWh / m²/year, at an average efficiency of boiler of 92%. For buildings heated from biomass - 235 kWh / m²/ year. The efficiency of the boilers was 75%.</p> <p>Ventilation system is not in operation in majority of public buildings.</p>
<p>Design Envelope</p> <p>The National Technical Standard has set the thermal performance, (U value, W/m²K) for old and existing (15-30 years old) buildings as follows: External wall: 1-1.2 Flat roof: 1.2 Windows: 2.8-3.5</p> <p>The new standards that will be implemented for old and existing (15-30 years old) based on the regulation for Energy performance in buildings (as of 2011) External wall: 0.32 Flat roof: 0.2 Windows: 1.5</p>	

RUSSIAN FEDERATION

<p>Framework Legislation and Policy Documents</p> <p>Russian State Programme on Energy Efficiency and Energy Sector Development: Subprogram on Energy Efficiency and Energy Saving. (2013)</p> <p>Resolution no. 577 - Amendment to Energy Audits and Energy Passports (2012)</p> <p>Federal Law No. 261-FZ "On Energy Conservation and Increase of Energy Efficiency"</p> <p>Resolution no. 1203 - Subsidies for Regional Improvement Programs on Energy Efficient Technologies (2011)</p> <p>Resolution no. 746 - Subsidies for Regional Programmes for Energy Saving and Energy Efficiency (2011)</p> <p>Resolution no. 88 - Requirements for Energy Efficiency of Goods (2011)</p> <p>Resolution no.18 - Establishing Energy Efficiency Requirements for Buildings and Structures (2011)</p> <p>Energy audits and energy passports (2010)</p> <p>Federal Program for Energy Savings and Energy Efficiency for the Period until 2020(2010)</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> • Federal law No. 261-FZ "On energy saving and energy efficiency improvement" – 23.11.2009 • GOST R 56828.18-2017 GOST R 51388-99 Energy Saving • Government resolution No. 18 of 25 January 2011 • Government resolution No. 452 of 16 May 2014 <ul style="list-style-type: none"> - Climatic zones - Sub-regions <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family • Apartment blocks • Commercial buildings • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • National classification of buildings covered in building energy code: A++, A+, A, B+, B, C+, C, C-, D, E. • Types of energy considered in building codes and regulations: energy use for heating, cooling, hot water, lighting, ventilation. Total primary energy use
<p>Institutions</p> <p>The Ministry of Energy The Ministry of Economic Development The Ministry of Industry and Trade The Ministry of Construction, Housing and Utilities The Russian Energy Agency (REA)</p>	
<p>Energy Performance Certification</p> <p>Main regulatory documents for the EPC: The EPC contract can be concluded between the customer and the contractor to perform a full cycle of work and responsibility for the risks.</p> <p>Coverage:</p> <ul style="list-style-type: none"> • Apartment blocks • Commercial buildings • Public buildings • new residential <p>Stringency: Mandatory Energy EPC refer to: total primary energy National registry database for the EPC</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: Yes, for heating only, Mandatory</p> <p>Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Yes,</p> <p>Refusal for occupancy or construction permit Energy performance monitoring requirements: Yes, Mandatory</p>
<p>Financial Incentives</p> <p>The Fund for Assistance to the Housing and Public Utilities Reform reimbursed the expenses of energy saving and energy efficiency services (in the amount of 33.98 million rubles). In particular, the Fund covered 10% of the costs of paying for new utilities resources aimed at increasing energy efficiency in apartment buildings.</p>	<p>Awareness Programmes</p> <p>Information on the current and proposed activities in energy efficiency improvement is constantly observed in magazines, newspapers and other periodicals across the country and special industrial publications.</p> <p>The updates on progress made in energy efficiency in Russia is regularly published on the website of the Ministry of Energy of Russia.</p>
<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>IFC (International Financing Cooperation), Russia Residential Energy Efficiency Project, since 2010. NIB, Nordic Investment Bank NIB has launched a 50 million EUR loan facility with Russia's Vnesheconombank (VEB) for on lending to energy efficiency investments located in northwest regions of Russia.</p> <ul style="list-style-type: none"> • The maturity of the new loan program is 10 years. 	

- VEB is joining NIB's Russia Energy Efficiency Program (REEP), intended to support the country's industries in improving the use of energy and heat and gradually crowd out energy generation from fossil fuels.
- As a REEP partner organization, VEB will benefit from the consultancy services financed by Sweden through its Ministry of Foreign Affairs.
- NIB launched a long-term funding program aimed at improving energy efficiency in the industrial and district heating sectors in the Russian Federation also in August 2011.
- NIB's Russia Energy Efficiency Program (REEP) is aimed to help potential borrowers in Russia to develop eligible projects and provide funds for them. The funds will be allocated by NIB with Russian Gazprombank and potentially some other intermediary banks. NIB has so far earmarked EUR 60 million for on-lending to REEP projects.

NEFCO initiatives in Russia

Energy Saving Credit Line - is dedicated to energy saving projects in municipal sector with a focus on social sector, e.g. kindergartens, schools, hospitals. NEFCO provides up to 90% for up to 5 years at a fixed interest rate of 3%. The minimum amount of financing is RUB 3.5 million and maximum is RUB 16 million.

Improving Efficiency in Public Buildings in the Russian Federation - under the Energy Efficiency Umbrella Program2 Start 2008

Funder GEF Trust Fund

Implementer EBRD

Approximate Total Project/Activity Funding in USD: \$78,007,675 (total project cost)

Specific Annual Funding Share (US\$ or percent US\$): \$9,209,075 (GEF grant)

Investments into Energy Efficient Renovations of Residential Multi-family Buildings in Russia.

Start 2010

Funder IFC/EBRD

Implementer Open Joint Stock Company Commercial Bank "Centerinvest"; Finnish Ministry of Employment and the Economy, the Finnish Ministry for Foreign Affairs, and the Global Environmental Facility (GEF)

Approximate Total Project/Activity Funding in USD: 50,000,000 (total IFC Investment)

GEF Project to Boost Urban Housing Energy Efficiency

Start 2010

Funder IFC/EBRD

Implementer GEF

Approximate Total Project/Activity Funding in USD: \$722,000,000 total Estimated Total

Funding Category: very large (multiproject umbrella activity or project that appears to be >\$5 million)

ENERGY PERFORMANCE OF NEW CONSTRUCTIONS

Heating

For new multi-family high buildings, the heating energy intensity is 77 kWh/m²/year.

Buildings built after 2000 can achieve hot water energy intensity below 0.04 Gcal/m²/year according to study by Pacific Northwest National Laboratory in 2012.

Lighting, Appliances and equipment

Energy Efficiency markings in Russia are based on the Order of the Ministry of Industry and Trade No 357 (amended on 12.12.2011), which contains Rules for determining energy efficiency class of goods by producers and importers.

•The order concerns:

Principal household energy-consuming appliances (TVs, refrigerators, washers, etc.) - since 1 January 2011.

Computers, computer electronic devices and office hardware (fax machines, copiers etc.) - since 1 January 2012.

Other goods (lifts used for the transportation of people, heating appliances) - from 1 January 2013.

“A” rating is most energy efficient, while “G” rating is the least efficient. Additionally, A+ and A++ classes can be assigned to extremely energy efficient items (A+++), assigned in some European countries, is currently not implemented in Russia).

•Energy efficiency class must be specified: in the technical documentation attached to the product, on markings and on labels. Final definition of the energy efficiency class is the responsibility of producers and/or importers.

Efforts have been undertaken to phase out inefficient lightbulbs. Since 1 January 2013, federal law No. 261-FZ dated 23 November 2009 prohibits the production, importation and sales of incandescent bulbs of 100 watts (W) or more, as well as the purchase of incandescent bulbs of any capacity used for lighting for government or municipal needs.

Russian energy efficiency law introduced a ban on the sale of incandescent bulbs of 100 watts and higher in 2011 and

	<p>broadened the gap to include all incandescent bulbs beginning in 2014.</p> <p>The Government of the Russian Federation approved the priority requirements for the energy efficiency of buildings and structures, providing for the mandatory use of energy efficient lighting and individual heating units with automatic weather control from January 1, 2018 during construction, reconstruction, and major repairs for a number of types of buildings, structures, structures.</p>
--	--

ENERGY PERFORMANCE OF EXISTING CONSTRUCTION

<p>Heating</p> <p>Russian average heating energy intensity for multi-family, high-rise buildings is 229 kWh/m²/year. Rehabilitating existing housing stock can reduce the energy intensity to 151 kWh/m²/year. A small percentage of the buildings erected after 2000 in compliance with new thermal insulation standards actually meet modern thermal performance and heat efficiency requirements. However, the majority of existing buildings have much lower parameters of space heating efficiency.</p> <p>Specific consumption of heat energy in residential apartment buildings in 2016 increased by 4% and amounted to 0.222 Gcal.</p> <p>Russia has the world’s largest, but also oldest district heating infrastructure, with most of it –70 percent of water boilers and 66 percent of district heating networks – having been constructed before 1990. The average heat boiler efficiency is about 73 percent , while production efficiency in district heating systems in Western Europe is 85 to 95 percent .</p>	<p>Water heating</p> <p>Buildings built before 1990 have hot water energy intensity between 0.08 and 0.18 Gcal/m²/year. Renovated buildings of this vintage can achieve 0.06 to 0.08 Gcal/m²/year. Buildings built between 1990 and 2000 achieve between 0.04 to 0.06 Gcal/m²/year.</p>
--	---

SERBIA

<p>Framework Legislation and Policy Documents</p> <p>Law on Efficient Use of Energy (Official Gazette of the RS, No 25/13)</p> <p>National Energy Efficiency Action Plan (2010-12; 2013-15; 2016-18)</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> • Rulebook on energy performance of buildings (No. 61/2011) • Rulebook on conditions, contents and manner of issuing certificates on energy performance of buildings (No. 69/2012). • Energy certification of buildings (2012), mandatory. • The energy class of the new building shall not be lower than class "C" or higher. The class of energy consumption of existing buildings should be upgraded to at least one class after reconstruction. <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • Energy use for: required thermal energy for heating • National classification of buildings covered by the energy codes: A+, A, B, C, D, E, F, G.
<p>Institutions</p> <p>The Ministry of Mining and Energy The Ministry of Construction, Transport and Infrastructure The Serbian Energy Efficiency Agency (SEEA)</p>	
<p>Energy Performance Certification</p> <p>Coverage:</p> <ul style="list-style-type: none"> • Single family houses • Apartment blocks • Commercial • Public buildings • New non-residential • New residential • Existing residential (e.g. after substantial refurbishment) • Existing non-residential (e.g. after substantial refurbishment) <p>Energy type to which EPC refers: total primary energy Stringency: Mixed (both mandatory and voluntary) Existence of national registry database for EPC: Central registry for energy passport, but it is not mandatory.</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: Yes, for both heating and AC systems, but it is defined in separate regulation, this is a mandatory requirement</p> <p>Penalties, incentives and other mechanisms for improving compliance: Refusal for occupancy or construction permit. Construction and use permits.</p> <p>Energy performance monitoring requirements: Yes, Mandatory</p>
<p>Financial Incentives</p> <p>In 2012, former Ministry of Environment, Mining and Spatial Planning granted funds of 1.3 billion RSD to tenants for rehabilitation of existing buildings.</p>	<p>Promotion of ESCO</p> <p>Model contract for ESCO companies is developed and adopted in a form of secondary legislation and is obligatory for the public users. There are more than 15 ESCO Street lighting projects ongoing in Serbia.</p>
<p>Awareness Programmes</p> <p>Ministry of Mining and Energy participates on many events explaining policy in the area of energy efficiency. The Ministry maintains website where relevant information may be found and provides additional information for citizens and investors.</p> <p>In accordance with the Law on Housing and Maintenance of Buildings, with regard to the improvement of the performance of buildings, the local self-government units are obliged, at least once a week, to provide advisory assistance to improve the energy efficiency of buildings to the citizens/ housing communities.</p>	<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>EBRD's Regional Energy Efficiency Programme The Regional Energy Efficiency Programme supports Western Balkan countries to improve their energy efficiency and move closer to EU standards. The EBRD programme, funded by the European Union and implemented in cooperation with the Energy Community Secretariat, provides policy dialogue and financing through either credit lines or the direct financing of municipalities.</p> <p>Energy Efficiency in Public Buildings, Serbia Donor/IFI: KfW Starting Year: 2014 Ending Year: Planned to be finished in 2018 Budget: 15 mil EUR Type of Donation: Investment grants Status: Ongoing</p>

	<p>Energy efficiency in public buildings, Phase II: Buildings from the health, education and administration sectors, Serbia Donor/IFI: KfW Starting Year: 2020 Ending Year: 2024 Budget: 20 mil EUR loan, 1.5 mil EUR grant Type of Donation: Policy based loan Status: Planned</p> <p>Green Economy Financing Facility (GEFF) for the Western Balkans[Energy Community] Donor/IFI: EBRD Starting Year: 2017 Ending Year: 2020 Budget: 85 mil EUR Type of Donation: Technical assistance and investment grants Status: Ongoing</p> <p>Energy efficiency in public buildings,GIZ Project description Title: Energy efficiency in public buildings Commissioned by: German Federal Ministry for Economic Cooperation and Development (BMZ) Country: Serbia Lead executing agency: Ministry of Mining and Energy of the Republic of Serbia Overall term: 2015 to 2018</p>
--	--

ENERGY PERFORMANCE OF EXISTING BUILDINGS

Design envelope

Buildings and apartments built before 1970 have almost no thermal insulation. Buildings built before 1980 have an unsatisfactory thermal insulation. Over 75 % of the building stock was constructed before 1980.

Residential buildings represent the biggest part of national building stock of Serbia, and more than 90% of them are single family houses. Most of these residential buildings (58.78%) are older buildings that were built in the 1960s, 1970s and 1980s, and are characterized by excessive energy consumption, due to the absence or poor thermal insulation, whether due to inefficient doors and windows, etc.

The average energy consumption in residential buildings in Serbia was over 150 kWh/m² per year in 2010.

Energy performance of single-family houses in Serbia

Type A is a free-standing single-family ground floor house, built between 1946 and 1970. This type was built in a massive construction system. The façade walls are of 38 cm solid brick, plastered on both sides. The foundation floor construction is a concrete slab on the filling, with no thermal insulation. The windows are wooden two single pane sashes in wide casements, additionally equipped with external blinds.

Type B is a free standing single-family house with two floors, built between 1971 and 1980. The construction system is massive, with 38 cm brick façade walls similar to type A and concrete floors. The windows are wooden double sashed with single panes and wooden roller blinds. The gabled roof is a traditional wooden construction.

Type C is a free standing single-family house with two floors, built between 1981 and 1990. The façade walls are of 38 cm solid brick, plastered on both sides. There is minimal thermal insulation installed in the key elements of the thermal envelope, including 5 cm insulation in the external walls and 10 cm thermal insulation in the floor construction to the unheated attic. The roof is gabled, with short eaves and thermal insulation.

Heating

Multi-family buildings in Šabac, which were built until 2005, are obligatory connected to district heating. These buildings are characterized by common vertical distribution pipelines and the measurement of the delivered thermal energy in the heat substation, as well as the fact that there is no centralized hot water heating in any building. All apartments have built-in electrical storage devices for sanitary water heating of 50 to 80 liters with electric water heaters with individual power of 2 kW. In buildings built after 2010, the concept has been changed by having distribution pipelines installed in corridors outside the living space and calorimeter housed in the floor cabinet for each apartment. These buildings also do not provide centralized heating of sanitary water.

After 2005, a number of newly constructed buildings, up to 2,000 m² in size, were connected to the gas distribution network, and gas boilers were installed in each of these buildings for heating and hot water heating (no electric water heaters in these apartments).

Buildings are the largest final consumers of energy, particularly for heating and cooling, and the majority of the Serbian district heating network is supplied by gas, of which 71% is imported.

Net heat demand for DHW is calculated based on the national Rulebook on Energy Efficiency (Republic of Serbia 2013). It is 10 kWh/m² per year for single-family houses and 20 kWh/m² per year for multi-family houses (on the basis of heated floor area). This means that hot water demand was not calculated on the basis of the number of persons and personal demand, but on statistical average consumption related to floor area.

U-values for building original thermal envelope elements [W/m ² K]		
Type A	Type B	Type C
External walls: 0.97 Windows:3.5 Ground Floor:1.7 Roof:2.65	External walls: 0.97 Windows:2.8 Ground Floor:1.48 Roof:2.65	External walls: 0.5 Windows:2.8 Ground Floor:1.48 Roof:0.32

Appliances and equipment

According to the Law of efficient use of energy, which was adopted in March 2013, in the Republic of Serbia, products that consume electricity must have the prescribed energy labels. This is primarily related to home appliances, such as washers and dryers, dishwashers, refrigerators, televisions, air-conditioning, air conditioners, electric lamps and light fixtures. Seven basic energy classes of products that affect energy consumption are defined by Law. These marks define that the device is labeled with G is the lowest efficient class, while the device is labeled with A is the most efficient. There are three subclasses, within the class A, that indicate greater energy efficiency of the device including: A +, A ++ and A +++.

According to some statistics, the largest consumers of electricity in the household are appliances (refrigerators, washing machines, electric stoves, water heaters, freezers), they spend one-fifth of the total amount of electricity that households need.

TAJIKISTAN

Framework Legislation and Policy Documents

Tajikistan Energy Saving and Energy Efficiency Law, 2013
The Decree of the President No. 653 “On additional measures on the economical use of energy and energy savings” (2009)

Resolution of the Government No. 626 banned the manufacture, import and sale of incandescent (2009)
National Development Strategy for the period until 2030

Institutions

The Ministry of Energy and Industry
The Ministry of Economic Development and Trade
The Ministry of Land Reclamation and Water Resources
The State Power Supervision Agency under the Ministry of Energy and Industry
The Agency for Construction and Architecture

Building Energy Codes

Coverage

- New residential
- New commercial
- Renovated buildings in residential sector
- Renovated buildings in commercial sector

Strictness

Generally, the building norms and regulations (SNiPs) are obligatory.

Assistance for development and implementation of Energy Efficiency Projects

The USAID “Improving energy efficiency in residential buildings in Dushanbe” project

Description: Energy audit and analysis for 11 multifamily buildings in Dushanbe. Identification of measures to reduce energy use. Implementing pilot project at 1 building and installation of autonomous heating system and solar collectors in the boarding school # 4.

Period: 2010-2012

Savings: 17% energy use reduction at pilot building. After the modernization of the heating system is more than 50% lower than the established limit.

ADB project “Access to green financing of renewable sources of energy” (Asian Development Bank, Government of Tajikistan, and the Japan Fund for Poverty Reduction)

Description: Promoting energy efficient and "green" housing via micro financing institutions to lend for acquisition of energy efficient windows, weatherization, insulation, solar heaters and PV panels, water pumps.

Period: 2013-2019

UNDP project. Promotion of Renewable and Sustainable Energy Use for Development of Rural Communities in Tajikistan

Description: Promotion income-generating end-use applications of renewable sources of energy in areas with either unreliable and limited power supply or no supply at all.

Period: 2009-2012

Programme of International Educational Project SPARE. Energy Efficiency and Quality of Indoor Microclimate in Tajikistan Schools

Period: 2012

ENERGY PERFORMANCE OF EXISTING BUILDINGS

Design envelope

Over 95% of buildings in Dushanbe do not conform to the modern insulation standards.

Most residential and public buildings in Tajikistan are characterized by low energy efficiency due to poor technical conditions and insufficient thermal insulation of outside walls, top and first floors, and high air permeability through windows and doors. In many cases, the internal heating systems of buildings connected to district heating systems or boiler houses are in poor condition, which leads to uneven heating within buildings and contributes to underheating.

Taking into account inefficient space heating systems (stoves and boilers), poor windows and the poor energy performance of building envelopes (lack of insulation), specific energy use for space heating should be at least 25 to 27 kgce/m² (203 to 220 kWh/m²). In multifamily buildings in Dushanbe, where electricity is used for space heating, specific energy use was assessed at close to 140 kWh/m²/year (17 kgce/m²), with underconsumption during winter peaks. For single-family houses with less efficient space-heating systems it should be much higher, close to

Heating

According to one survey, a large proportion of residential consumers use electric heating (33%) and fuel wood (44%) for space heating, while other households use mostly dry dung, coal and natural gas. [C2E2, 2015]

Theoretically about 67% of the city buildings are connected to the central heating grid, yet the real number is only 52%, of which according to the most optimistic estimation only 15-25% is heated from the grid.[USAID,2012]

According to a survey of household energy consumption that included 1.1 million households across the country, about 25% of residential electricity consumption is used 25% for water heating.

220-244 kWh/m²/year (27 to 30 kgce/m²). With 86.7 million m² of living space, this brings the estimate of residential energy use for space heating to 2.17-2.34 Mtce, and total residential energy use close to 3-3.3 Mtce.

Lighting

Electricity and candles are the main sources of lighting in urban and rural areas. During periods of unstable electricity supply in winter, many households use lanterns that work on batteries that can be recharged using electricity when it is available. In rural and semi-urban areas, more affluent households have generators to supplement system-supplied electricity for lighting and watching television.

In 2009, as per the presidential decree, the Government of Tajikistan banned production, importation and sale of incandescent lamps to promote energy-efficient devices such as compact luminescent and LED lamps. Since then, all public and industrial buildings, and more than 90% of the population, transitioned to energy saving lamps. The government also funded procurement of such lamps for 241,000 low-income families.

TURKMENISTAN

<p>Framework Legislation and Policy Documents</p> <p>Energy Strategy for the period of 2030 (under development)</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> • SNT 2.08.01-15 on "Residential buildings"; • SNT 2.01.03-17 on "Thermal building engineering"; • SNT 2.03.10-01 on "Roofs and roofing" • Guidance on the Design of Energy-Efficient Residential Buildings for SNT 2.08.01-15 "Residential Buildings"; • Guidance for the Design of Energy-Efficient Roofs and Roofing for the SNT 2.03.10-01* "Roofs and Roofing"; • Guidance for the SNT 2.01.03-17 "Thermal Building Engineering.
<p>Institutions</p> <p>The Ministry of Energy and Industry The Ministry of Finance</p>	<p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mandatory • Energy saving is a requirement of the new SNT 2.01.03 "Building heat engineering"
<p>Energy Performance Certification</p> <p>The main document related to certification (EPC) is the Regulation on the rules and procedure for conducting energy audits in residential buildings in Turkmenistan. The document is under review and not adopted yet.</p> <p>Coverage:</p> <ul style="list-style-type: none"> • Single family houses • Apartment blocks • new non-residential • new residential • existing residential (e.g. after substantial refurbishment) • existing non-residential (e.g. after substantial refurbishment) <p>Type of energy that the EPC refer to: total primary energy Stringency: Mandatory No existence of national registry database for EPC in your country:</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: Yes, for both heating and AC systems.</p> <p>Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Refusal for occupancy or construction permit.</p>
<p>Awareness Programmes</p> <p>The UN facilitated multiple dialogues to create a platform for exchange of experience, best practices and knowledge on energy efficiency in buildings and to promote further collaboration in this area.</p>	<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>In 2016-2017, the UN supported the creation and modernization of institutions that research, pilot and replicate energy efficiency initiatives, use of renewables and efficient waste management in rural and urban areas. For this purpose, the UN partnered with the Ministry of Municipal Services, Turkmen Gas State Concern and the Ministry of Energy to improve the energy efficiency in residential buildings and enhance energy performance.</p> <p>Using the funding from the Global Environmental Facility (GEF) and co-financing from the Government, the UN supported in development of the National Action Plan for Rational Use of Energy in the Residential Building Sector. The goal of the Plan is to reduce the annual consumption of energy resources by no less than 0.5% in the residential sector of Turkmenistan. The UN also assisted in construction of 3 new energy efficient buildings. The overall reduction of greenhouse gas emissions for the three pilot buildings equalled 1165-ton CO₂e per year.</p>

ENERGY PERFORMANCE OF EXISTING BUILDINGS

Design Envelope

Specific energy consumption per m² of residential floor space (energy intensity in residential buildings).

The residential sector is the major electricity consumer in Turkmenistan (29%, or 3.5 billion kWh in 2009, including 14.8% (1.78 billion kWh) consumed by the urban population and 14.2% (1.72 billion kWh) by the rural population. Average specific energy consumption per m² of the total living area is 36.21 kWh/m². Electricity consumption limits (free electricity supply) are as follows:

- 35 kWh/person per month (before 2013)
- 25 kWh/person per month (after 2013)

Turkmenistan has also set minimum consumption limits for natural gas (50 m³/person per month, or 600 m³/person per year).

Heating

Heat for space heating (district heat) – 0.044 Gcal/m², or 6.25 kgce/m²;

Heat for DHW (housing with access to central DHW supply) – 0.012 Gcal/m², or 204 kgce/m²)

UKRAINE

<p>Framework Legislation and Policy Documents</p> <p>Law on Energy Efficiency in Buildings № 2118-VIII, (Energy Performance of Buildings Directive 2010/31/EU implementation) (adopted June 22, 2017)</p> <p>Law on Metering in DH and WS № 2119-VIII, (Energy Efficiency Directive implementation) (adopted June 22, 2017)</p> <p>Law on Energy Efficiency Fund № 2095-VIII, (EED implementation) (adopted June 08, 2017)</p> <p>Law on ESCO № 327-VIII, (EED implementation) (adopted April 09, 2015) (amended by the Law № 1980-VIII 23.03.2017 on e-procurement of EPCs)</p> <p>National Energy Efficiency Action Plan (NEEAP) 2020</p> <p>Draft Order on Approval of requirements for Nearly-Zero Energy Buildings (under interservice consultation/submitted to the government)</p> <p>Draft Law on Energy Efficiency (under interservice consultation/ submitted to Government)</p> <p>Draft national energy efficiency targets and NEEAP till 2030 (submitted to Government as of January 2021)</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> •DBN.2.6-31 (state building codes) - the document concerns buildings •DSTU B A.2.2-8 (state standards of Ukraine) - the document concerns engineering systems <ul style="list-style-type: none"> - DBN B.2.6-31 - 2006 -DSTU B A.2.2-8 - 2010 -Climatic zones <p>Coverage:</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • existing non-residential • Single family houses • Apartment blocks • Public buildings: hotels, trade enterprises, buildings and facilities of educational institutions, pre-school institutions, health care institutions <p>Strictness</p> <ul style="list-style-type: none"> • Mixed: both voluntary and mandatory • National classification of buildings covered in building energy codes: A, B, C, D, E, F and G. • Types of energy considered in building codes and regulations: energy use for heating, cooling, hot water, ventilation. Total primary energy use.
<p>Institutions</p> <p>The State Agency of Energy Efficiency and Energy Saving of Ukraine</p> <p>The Ministry of Energy (MinEnergy)</p> <p>The Ministry of Regional Development, Construction and Public Services (MinRegion)</p> <p>The Ministry of Economic Development and Trade</p> <p>The National Energy and Utilities Regulatory Commission of Ukraine (NEURC)</p>	
<p>Energy Performance Certification</p> <p>EPC Coverage: currently under development</p> <p>Type of energy EPC refers to: currently under development</p> <p>Strictness: Mixed (both mandatory and voluntary)</p> <p>No existence of national registry database for the EPC</p>	<p>Compliance Mechanism</p> <p>NO requirements for regular inspection of heating and AC systems</p> <p>No penalties, incentives and other mechanisms for improving compliance with building energy codes in your country</p> <p>No energy performance monitoring requirements</p>
<p>Energy Pricing Measures</p> <p>One of the key steps in promoting energy efficiency was an increase in energy prices to cost-recovery levels. Increased energy prices have created strong incentives for all consumers to use energy resources more efficiently. The price increase was responsible for two thirds of the reduction in household's natural gas consumption in 2014-2015. To protect socially vulnerable households from increasing energy prices, the government expanded social safety net system for low-income households.</p> <p>The government adopted policies to increase energy prices, which were traditionally low to residential consumers. Before 2015, households paid only 12% of the cost recovery prices for natural gas. In the second quarter of 2015, natural gas prices for households and district heating tariffs increased on average 285% and 67%, respectively.</p>	<p>Financial Incentives</p> <p>Government-supported “warm loan program” that has been implemented in Ukraine since 2014. The program subsidizes 20-35% of investment costs for individual households and 40-70% for multi-apartment residents if they invest in energy efficiency for their properties. During the entire period of the program (from 2014 to 2020) about 854 thousand households have become its participants, which have attracted more than UAH 9,5 bln for energy efficiency measures, of which about UAH 3.3 bln have been reimbursed from the national budget.) The Cabinet of Ministers prolonged the Programme for the year 2021.</p>

Promotion of ESCO

Ukraine introduced energy efficiency retrofits for buildings by Energy Service Companies (ESCOs) under the Energy Performance Contracts (EPCs) in 2016. Currently, EPCs are applicable mostly for public buildings; additional incentives are needed for ESCOs to retrofit residential buildings.

In 2016, a large-scale promotion campaign for energy service contracting was started and the first 20 EPCs were concluded in five regions of Ukraine.

The European Union has provided funds to train experts on energy service contracting.

As of January 2021, more than 1251 tender procedures have been started; about 552 EPCs have been signed with a total price up to 1.25 bln UAH.

Awareness Programmes

The central government and several international organizations started information campaigns that focus on promoting energy efficiency and reducing energy consumption through energy conservation.

The government launched the website (<http://teplo.gov.ua/>) to inform households and public utilities about energy prices, energy subsidies, and best practices in energy efficiency.

Assistance for development and implementation of Energy Efficiency Projects

The EBRD IQ Energy programme: It was started in 2016 under the management of the EBRD. Under this programme households living in apartments or detached houses may obtain loans and grants for improving their energy efficiency.

The IFC Residential Energy Efficiency Project: The goal of the project is to establish a legal and institutional framework for creating opportunities and managing companies to obtain funding for energy efficiency projects.

The European Bank for Reconstruction and Development (EBRD) provides support for energy efficiency regulation in residential buildings, capacity building, and financing energy efficiency investments. The energy projects constitute about one third of €4.6 billion of the current EBRD portfolio in Ukraine.

The GIZ projects in Ukraine –“Energy Efficiency in Municipalities” and “Establishing Energy Agencies” : The main goal of the projects is to strengthen the role of municipalities as a driving force in improving energy efficiency.

The United States Agency for International Development (USAID) is working on the Municipal Energy Program Project, which aims to enhance energy security by reducing waste and inefficiency in central heating systems. USAID launched a new energy independence project in 2016 as part of a new \$220 million support program for Ukraine.

The Ukraine Public Buildings Energy Efficiency project is expected to be further financed by an EIB loan of €300 million and by grant contributions from the ESP and the EU on top of the advisory services. The project will increase energy efficiency in 1 000 buildings, mainly kindergartens, hospitals and schools. It will help save more than 1 million tonnes of CO₂ and benefit 2.5 million people across the country. By including COVID-19 safety measures, the project will also improve the medium and long-term pandemic resilience of public buildings, and in particular of hospitals.

ENERGY PERFORMANCE OF NEW CONSTRUCTIONS

Design Envelope

The minimum admissible resistance value of heat transfer of the building envelopes of residential and public buildings are as follows:

The type of building envelope	The values of $R_{q \text{ min}}$, m ² K/W, for Ukraine Temperature Zones	
	I	II
Outside walls	3.3	2.8
Combines coatings	6.00	5.5
The coatings of heated attics(technical storeys) and attic type coatings	4.95	4.5
Attic coatings of non-heated attics	4.95	4.5
Coatings over driveways and non-heated ones	3.75	3.3
Translucent building envelopes	0.75	0.6
External doors	0.6	0.5

Heating

During recent years, individual heating units have been massively installed at multi-apartment and public buildings in Ukraine to regulate the heat demand and perform localised hot water preparation for the clients, now actively using electrical boilers for this purpose.

Appliances and equipment

Ukraine has developed a number of national standards and requirements for appliances. The key driver behind this legislation is Ukraine’s aspiration for deeper integration with the EU. In accordance with European Directive 2010/30/EC (European Union, 2010), Ukraine has implemented a system of energy standards and labels for household electric equipment.

Approved Technical regulations for energy labeling of energy-consuming equipment:

- Refrigerators
- Electric lamps and fixtures
- TV sets
- Dishwashers
- Washing machines
- Drying machines
- Air conditioners
- Vacuum cleaners

ENERGY PERFORMANC OF EXISTING BUILDINGS

Design Envelope

Ukraine still has a large share of buildings with inefficient envelopes (about 85% of the buildings were built during the Soviet era).

Heating and Ventilation

Ukraine has about 17.5 million households, of which about 43% (7.5 million households) are connected to district heating networks. The remaining households have individual heat supply systems, such as individual gas and electric boilers. Additional heat is produced by autonomous and individual boilers for 25% of households and the rest by stoves.

Natural gas still remains the dominant fuel for the district heating sector, while the use of biomass for heating is growing. Ongoing district heating energy efficiency projects aim to balance current reduced heat loads with existing heat generation and transportation facilities, further centralise district heating and upgrade major technological equipment.

The most common ventilation system in residential buildings in Ukraine is natural ventilation.

UZBEKISTAN

<p>Framework Legislation and Policy Documents</p> <p>Strategy for the Transition to a Green Economy for the 2019-2030 Period - Resolution of the President of the Republic of Uzbekistan No. PP-4477(2019) This resolution outlines a strategy for the transition of the Republic of Uzbekistan to a "green" economy for the period 2019 – 2030, aiming to improve energy efficiency, rational consumption, and conservation of natural resources, reducing greenhouse gas emissions, ensuring access to green energy, creating green jobs and ensuring climate resilience.</p> <p>Resolution of the President of the Republic of Uzbekistan № PP 3012 (2017) The program of measures for the further development of renewable energy, energy efficiency in the sectors of the economy and the social sphere for 2017-2021.</p> <p>Resolution on Further Development of Renewable Energy and Energy Efficiency 2017-2025 (2016)</p>	<p>Building Energy Codes</p> <ul style="list-style-type: none"> • The Uniform Building Regulations of the Republic of Uzbekistan (Part 1) (Annex No. 3 to the Decision of the Cabinet of Ministers of the Republic of Uzbekistan on August 20, 2013, No. 229) • Rules of organization of works on the improvement of settlements taking into account modern architectural and town-planning requirements (Annex to the Decision of the Cabinet of Ministers of the Republic of Uzbekistan of 09.03.2009 N 59) • KMK 2.01.12-2000 Norms of energy consumption for heating ventilation and air conditioning of buildings and structures. <p>Coverage</p> <ul style="list-style-type: none"> • New residential • New non-residential • Existing residential • Existing non-residential • Single family houses • Apartment blocks • Commercial buildings • Public buildings <p>Strictness</p> <ul style="list-style-type: none"> • Mandatory • Energy use for heating, cooling, hot water, lighting, ventilation.
<p>Institutions</p> <p>The Ministry of Energy of the Republic of Uzbekistan The Ministry of Economic Development and Poverty Reduction The Ministry of Finance The Ministry of Construction</p>	<p>Energy Performance Certification</p> <p>The main legislative documents related to the EPC: Decision on measures to ensure the rational use of energy resources. November 8, 2017, No. PP-3379. Type of energy EPC refers to: total primary energy, electricity, heat and hot water Policy requirement for the EPC: Mandatory Existence of the national registry database for EPC</p>
<p>Financial Incentives</p> <p>Basic energy efficiency market mechanisms and economic incentive programmes. The “Law on Rational Energy Use” introduces the following market instruments: public co-financing for energy efficiency programmes, setting up an inter-sectorial energy efficiency fund, subsidies and taxes, and pricing policies.</p> <p>Basic energy efficiency market mechanisms and economic incentive programmes in the buildings sector: subsidies for buildings renovation and building-level meter installation, and taxation and pricing policies.</p>	<p>Compliance Mechanism</p> <p>Requirements for regular inspection of heating and AC systems: Yes, for both heating and AC systems Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Yes, differentiated tariffs for energy resources. Penalties and charges for non-compliance. Energy performance monitoring requirements: mandatory.</p>
<p>Assistance for development and implementation of Energy Efficiency Projects</p> <p>UNDP/GEF project “Promoting Energy Efficiency in Public Buildings in Uzbekistan”.</p> <p>Uzbekistan is deeply involved in international cooperation in energy efficiency. Several loans have been provided by the World Bank group to improve energy efficiency (power sector and industry), as well as by the Asian Development Bank (buildings), and there are also projects with individual countries.</p>	<p>Awareness Programmes</p> <p>The WB and UNDP-GEF projects have educational (seminars, workshops and conferences) and training components, which are the core of Uzbekistani activities in this area.</p>

ENERGY PERFORMANCE OF EXISTING BUILDINGS

Design Envelope

In 2011 energy consumption by living space was 423 kWh per m² per year, twice the average for Europe. Nearly 50 per cent of heat escapes through inefficient windows, doors, ceilings and walls, leading to energy consumption of 320 to 690 kWh/m² per year.

Because of outdated building standards, obsolete heat-insulation materials, inadequate engineering designs and inefficient heat supply systems, energy consumption in buildings is 2 to 2.5 times higher in Uzbekistan than in most developed countries.

Heating and hot water

Specific energy consumption for space heating per m² of residential floor space per degree-day of the heat supply season. Two thirds of residential energy consumption is related to space heating. Average total energy consumption for space heating of the whole buildings stock was 0.121 Wh/m²/degree days, 0.035-0.065 Wh/m²/degree days for multifamily buildings, and 0.136 Wh/m²/degree days for single-family houses.

Only about 43 per cent of the housing stock is provided with district heating, yet the operational lifespan of most district heating systems has been exceeded, challenging the ability to ensure stable central heating and hot water supply.

Specific hot water consumption per household with access to centralized DHW supply. In Uzbekistan, average energy consumption for DHW purposes per household is 807 kgce/year. The reasons behind the higher values include the larger size of a household in Uzbekistan (5.9 people versus 2.4 in the EU) and inefficient water heating equipment.

Appliances and equipment

Uzbekistan introduced mandatory demand for energy marking and information on energy efficiency class in technical documentation and labels of home appliances from 1 January 2016.

The decision was adopted in line with the resolution of the Cabinet of Ministers of Uzbekistan "On measures on introduction of the system on mandatory energy marking and certification of realized home appliances, newly constructed buildings and establishments" from 9 April 2015.

In line with the requirement, the home appliances should have labels of energy efficiency of such classes A, B, C, D, E, F and G. The class A means the most energy efficient device, while G – the lowest energy efficient device.

The document envisages additional classes of energy efficiency as A+ and A++, which can be used for the devices, energy efficiency of which is higher than A class.

The document said that Uzbekistan will ban import from 1 January 2016 and sales from 1 July 2016 of home appliances, which have no information on class of energy efficiency. The marks should be included in technical documentation of home appliances and their labels (except realization of second-hand home appliances).

The requirement will be applied to refrigerators and freezers, household and laundering washing machines, air conditioners and fans, household electric ranges, microwave ovens, dishwashers, TVs, electric water heaters, heating electrical appliances, monitors, and lamps.