Energy Performance of Buildings in Danube Region

Overview of new and refurbished residential buildings stock

Project is co-funded by the European Union (ERDF)

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DISCLAMER

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LIST OF ABBREVIATIONS

BAU	Business-as-usual
EE	Energy efficiency
EEAG	Guidelines on State aid for environmental protection and energy
EED	Energy Efficiency Directive (Directive 2012/27/EU)
EEOS	Energy Efficiency Obligation Scheme
EPBD	Energy Performance of Buildings Directive (Directive 2010/31/EU)
ERDF	European Regional Development Fund
ESCO	Energy Service Company
ETS	EU Emission Trading Scheme
EU	European Union
EUA	European Union Allowance
GHG	Greenhouse gas
HVAC	Heating, Ventilation and Air Conditioning
IEA	International Energy Agency
NECP	National Energy and Climate Plan
NEEAP	National energy efficiency action plans
nZEB	Nearly zero-energy buildings
PV	Photovoltaic
RED II	2018 Renewable energy Directive
RES	Renewable energy source

EXECUTIVE SUMMARY

The study covers mapping of the current measures in the field of energy performance of residential building stock (new and refurbished) implemented in the Danube Region countries and regions.

Residential building stock

In all countries, the building stock is steadily increasing. Somewhere, the number of construction permits stagnates, some countries saw spikes in issuing the permits. The common trend in construction activity is, nonetheless, clear. In the last decade, urban areas attracted more projects and strengthened their position in the gravity centre of construction activity in most of the countries.

Another universal trend is shrinking of newly built apartments. Regardless of actual figures, an apartment built in 2020 is smaller than one inhabited ten years ago. In Slovakia, the difference is a mere 3%, in Romania one fifth of an average flat disappeared in the last decade.

Renovation rate and depth

When comparing the current renovation strategies with provisions of EPBD and EED Directives the results differ significantly. The compliance is obviously higher by the EU Member States. Nevertheless, a number of shortcomings was still identified. Those are rather country specific without any common feature. Regarding the compliance with the Renovation Wave provisions, most of the countries reached only a partial success as their Renovation roadmaps have been issued before the Renovation Wave document.

Identified barriers

There was a number of barriers identified through the Long-term renovation strategies; specifically, financial, legal, social and also informational. Among the barriers there were specific barriers presented by the non-EU Member States, e.g. delay in implementation strategic documents, gap in various financial mechanisms and gap in long-term development of strategic documents in the energy efficiency field.

1. INTRODUCTION

The study on Energy Performance of building in Danube Region is part of the Interreg Danube transnational programme. The work is divided into two phases; the first one covers mapping of the current measures in the fields of energy performance of residential building stock (new and refurbished) implemented in the Danube Region countries and regions. The study focuses on the analysis of following topics:

- Climate conditions;
- Residential building stock;
- Trends in the construction of residential buildings;
- Energy consumption trends;
- Heating and cooling trends;
- Regulatory framework in the field of the energy performance of buildings;
- Renovation support schemes;
- Renovation rate and depth;
- Comparison with the Renovation wave for Europe requirements;
- Identified barriers to complying with the requirements of EU legislation;
- Proposal for energy saving measures in Danube region.

The topics are addressed to the countries belonging to the Danube region. These were 9 EU Member States – Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Slovakia, Slovenia – and 5 non-EU countries – Bosnia and Herzegovina, Moldova, Montenegro, Serbia and Ukraine. Further the study includes comparison with the Renovation Wave initiative, Long-term renovation strategies, EPBD, and EED Directives. The study includes metrics of measures across the states of the Danube regions and barriers of the compliance with the current EU legislation.

The second phase of the study covers identification of the best practice cases and their potential spread out in other countries. The study further introduces additional measures to the renovation rate increasing.

1.1 GOALS OF THE STUDY

The study focuses on the analysis of following topics according to the contract:

- Climate conditions;
- Residential building stock;
- Trends in the construction of residential buildings;
- Energy consumption trends;
- Heating and cooling trends;
- Regulatory framework in the field of the energy performance of buildings;
- Renovation support schemes;
- Renovation rate and depth;
- Comparison with the Renovation wave for Europe requirements;

- Identified barriers to complying with the requirements of EU legislation;
- Proposal for energy saving measures in Danube region.

The topics are addressed for countries belonging to the Danube region. These are 9 EU Member States – Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Romania, Slovakia, Slovenia – and for 5 non-EU countries – Bosnia and Herzegovina, Moldova, Montenegro, Serbia and Ukraine[1].

Figure 1: Map definition of the Danube region

Source: (Interreg: Danube Transnational Programme, 2021)

1.2 METHODS AND DATA ACQUISITIONS

First, a search of available data relevant to the study assignment is performed. The goal is to get acquainted with the current situation in the investigated countries, especially in terms of traceability of sources and the language of their processing. Based on the search, the obtained resources are sorted.

The data obtained and processed differ between EU and non-EU Member States. EU Member States are bound by the obligation to prepare specific documents (strategies, action plans) according to EU requirements, while non-Member States are not necessarily subject to this obligation.

Few international agreements with non-EU member states were found, on the basis of these states also develop strategic documents relevant to energy efficiency. However, it was found that these documents are usually not as detailed as in the Member States, are not up-to-date or are missing. Therefore, in the case of non-EU member countries, unofficial and secondary data sources will also be used.

[1] Bosnia and Herzegovina, Montenegro and Serbia have EU candidate status. Moldova and Ukraine signed an Association agreement, which is s the main tool for bringing them and the EU closer together.

Subsequently, a qualitative analysis of the processed data is administered with an emphasis on answering the questions addressed in this study.

The findings for each country, in particular with a focus on EU countries, which are subject to EU legislation, are compared with the requirements of the European Commission's new Renovation Wave for Europe initiative, published by the European Commission on 14 October 2020 ("A Renovation Wave for Europe - Greening our buildings, creating jobs, improving lives ") and requirements for the development of a Long-term renovation strategy according to Article 2a of the EP and Council Directive (EU) 2018/844 of 30 May 2018 amending Directive 2010/31 / EU on energy performance of buildings and Directive 2012/27 / EU on energy efficiency. Barriers to complying with the requirements of applicable EU legislation will be identified.

Subsequently, measures are proposed to reduce energy intensity across the states of the Danube region. The draft measure is primarily processed in the form of a matrix. Secondary (Phase II of the project) a proposal for additional measures that could lead to improved rate of renovation, along with the identification of examples of good practice in the Danube region and the possibility of their implementation in other countries is developed.

In the end, the most important findings from the previous chapters are summarized.

1.2.1 Essential definitions

Dwelling definition

> *A dwelling is a room or suite of rooms - including its accessories, lobbies and corridors - in a permanent building or a structurally separated part of a building which, by the way it has been built, rebuilt or converted, is designed for habitation by one private household all year round.*
>
> *A dwelling can be either a one-family dwelling in a stand-alone building or detached edifice, or an apartment in a block of flats. Dwellings include garages for residential use, even when apart from the habitation or belonging to different owners.*

Source: Eurostat

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Dwelling

Household

A household, in the context of surveys on social conditions or income such as EU-SILC or the Household budget survey (HBS), is defined as a housekeeping unit or, operationally, as a social unit:

- *having common arrangements;*
- *sharing household expenses or daily needs;*
- *in a shared common residence.*

A household includes either one person living alone or a group of people, not necessarily related, living at the same address with common housekeeping, i.e. sharing at least one meal per day or sharing a living or sitting room.

Source: Eurostat

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Household_-_social_statistics

Residential building

Buildings that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences. Houseboats, barges, mobile homes and caravans used as principal residences of households are also included, as are historic monuments identified primarily as dwellings.

Source: Eurostat

https://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=DSP_GLOSSARY_NOM_DTL_VIEW&StrNom=CODED2&StrLanguageCode=EN&IntKey=16680085&RdoSearch=&TxtSearch=&CboTheme=&IsTer=&ter_valid=0&IntCurrentPage=1

1.2.2 Data acquisitions for EU Member States

Primary the data from official documents and statistics of the Member States will be used as a basis for the study. The following resources will be used:

- World Hydrometeorological Organization website (http://climexp.knmi.nl/start.cgi);
- National Meteorological Services websites (based on the information in https://www.chmi.cz/odkazy/narodni-meteorologicke-sluzby/evropa);
- Statistical office of the European Union – Eurostat;
- National statistical offices;
- National Energy Efficiency Action Plan from 2017;
- Annual reports on the National Energy Efficiency Action Plans from 2018–2020;
- National Energy and Climate Plan from 2020;
- Building renovation strategy from 2017;
- Long-term renovation strategy from 2020.

Secondarily, data were obtained from partners involved in the Interreg Danube Transnational Programme. These are mainly specific data for the Danube sub-regions, e.g. Baden-Württemberg and Bayer in Germany.

1.2.3 Data acquisitions for non-EU Countries

Data will be used from both the official and unofficial sources.

- World Hydrometeorological Organization website (http://climexp.knmi.nl/start.cgi);
- National Meteorological Services websites (based on the information in https://www.chmi.cz/odkazy/narodni-meteorologicke-sluzby/evropa) ;
- Statistical office of the European Union – Eurostat;

- National statistical offices ;
- Documents relevant to energy efficiency and building renovation;
    - Strategic plans (however, some countries do not have them or they are not updated);
    - Studies dealing with the topic in the given countries (for example Independent comprehensive studies by the International Energy Agency – https://www.iea.org/countries);
    - Articles on the topic of energy efficiency and building renovations;
    - News information, press releases .

2. CLIMATE CONDITIONS

Country climate conditions affect the consumption patterns significantly. Weather conditions, especially the temperature throughout the year, is therefore an important parameter that must be considered when analysing and evaluating energy consumption patterns. This chapter describes the climatic conditions of the countries. The description of climatic conditions consists of:

- a general description of the country's climate;
- average temperature;
- average precipitation;
- average intensity of solar activity;
- temperature change in past decades.

2.1 CLIMATE CONDITIONS IN DANUBE REGION COUNTRIES

Austria

The Austria's national weather service *Zentralanstalt für Meteorologie und Geodynamik* (ZAMG) provides high quality climate data for the country. ZAMG runs one of the densest weather measuring networks in the world. The meteorological stations measure temperature, precipitation, wind, sunshine and many other meteorological parameters. ZAMG provides current and historical weather data, the longest continuous observations reach back to 1768. Checked data build the fundament for climate-relevant products and services, which are available to private persons, authorities and clients. ZAMG-internal climate research department evaluates these data scientifically (Zentralanstalt für Meteorologie und Geodynamik, 2021).

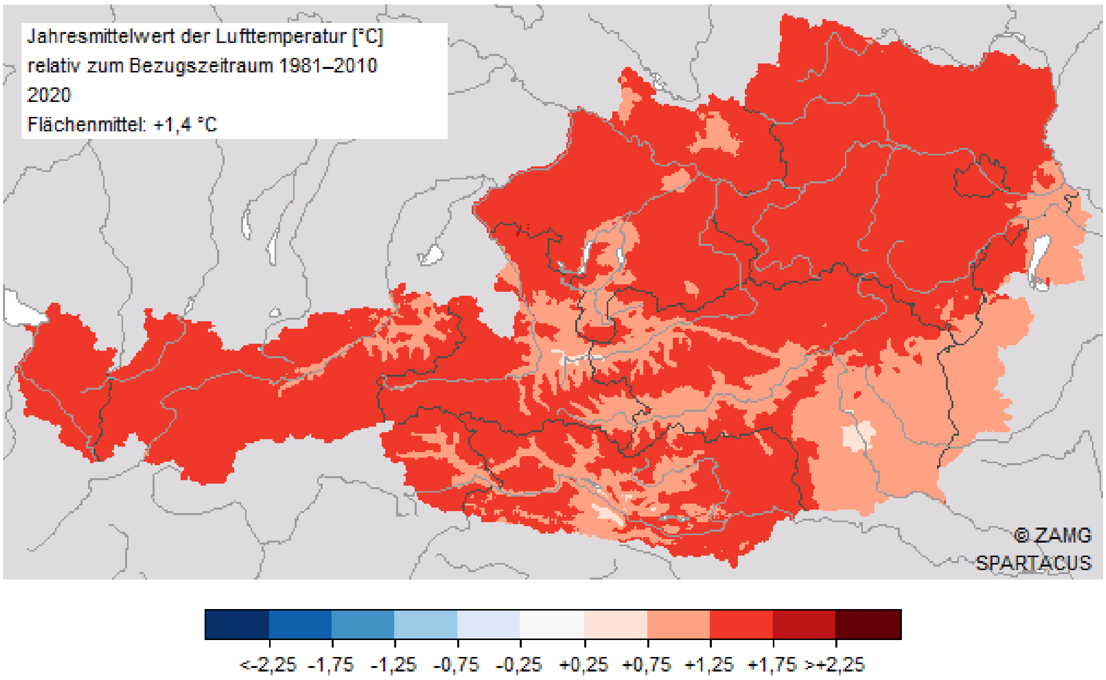
Temperature

Austria's climate has become significantly warmer in the last decades. A comparison of 2020 with the different 30-year climate periods shows significant effects of the global warming: Compared to a typical year in the period 1961 to 1990, 2020 was 2.0 °C warmer, and between 1981 and 1990 the difference was 1.2 °C. In comparison with the most recent climatic period, 1991 to 2020, the year 2020 is only 0.7 degrees above the average, because the temperature level has already risen significantly.

The last year of the second decade in the 21st century was also significantly warmer in Austria than many years in the 18th, 19th and 20th centuries. All in all, the year 2020 was 1.2 °C (HISTALP lowland data set) warmer than the climatological mean 1981-2010 and 2.0 °C warmer than the climatological mean for the 1961–1990 period, which was not yet influenced significantly by global warming. In the overall billing, 2020 was the fifth warmest in the Austrian lowlands on record (first full year 1768). A total of 15 of the warmest years on record are in the 21st century. The years 1994 (dev. +1.2 °C), 2000 (dev. +1.0 °C) 1822 (dev. +0.5 °C) belong to the top 20 years that are not in the 21st century.

In Upper Austria, Lower Austria, Vienna and Burgenland, the year 2020 was 1.2 to 1.6 °C warmer than the 1981–2010 mean. In the valleys of Tyrol, Salzburg, Styria and Carinthia, the temperature deviations were between +0.7 and 1.3 °C. Above 1,000 m above sea level, the year was between 0.7 and 1.9 °C warmer than the 1981–2010 mean (Zentralanstalt für Meteorologie und Geodynamik, 2021).

Figure 2: Austria - Temperature deviation for 2020

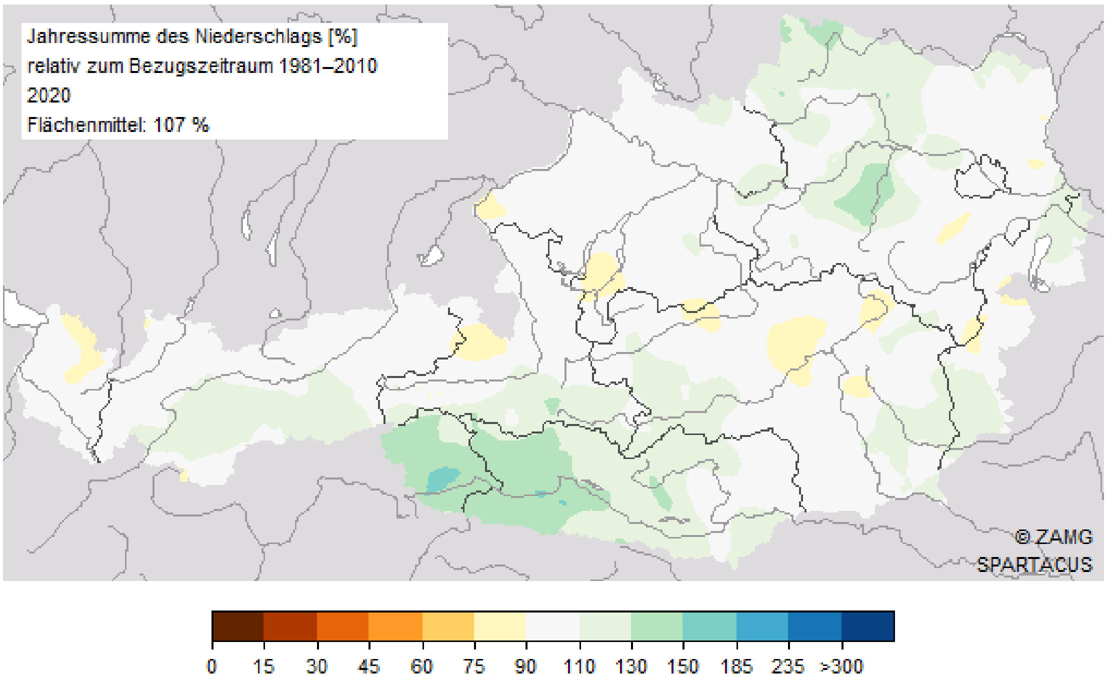


Source: (Zentralanstalt für Meteorologie und Geodynamik, 2021)

Precipitation

With ten percent more precipitation, nine percent more hours of sunshine, 2020 brought an above-average amount of precipitation and was one of the 25 wettest years since the beginning of the precipitation measurement series in 1858. In the country evaluation, there was ten percent more precipitation in 2020 than the average (climate mean 1981–2010). The year 2020 was also one of the ten sunniest years since the Austria-wide sunshine measurement series began in 1925. In 2020, the sun shone nine percent longer than in an average year (the climate period 1981–2010).

Figure 3: Austria - Percent of average precipitation amount for 2020



Source: (Zentralanstalt für Meteorologie und Geodynamik, 2021)

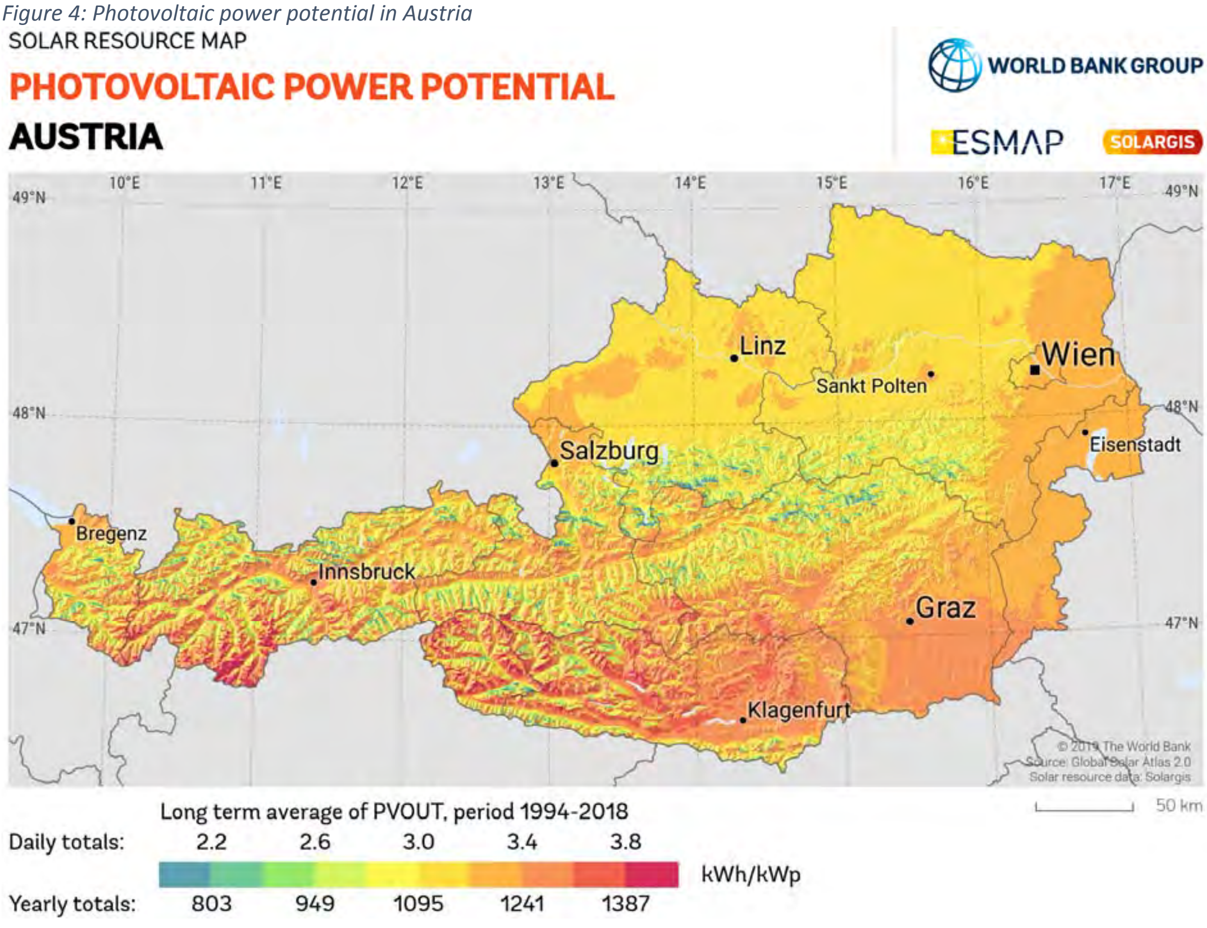
At first glance, the precipitation conditions in Austria were balanced. However, there were considerable differences within the federal territory in the distribution of the usual amounts of precipitation. From Vorarlberg to Upper Styria as well as in East Tyrol and Carinthia, precipitation totalled 5 to 25 percent more than in an average year. In some places the sums here corresponded to the average. In Upper Carinthia and in places in East and North Tyrol, up to 50 percent more precipitation fell (Zentralanstalt für Meteorologie und Geodynamik, 2021).

Solar intensity

Last years in Austria were also extremely sunny. On average, the sun shone 6 percent longer than in an average year. As with precipitation, there are greater regional differences. In Upper Austria, Lower Austria, Vienna and Northern Burgenland there was 5 to 15 percent more sunshine compared to the 1981–2010 mean. Similar anomalies also occurred in parts of Styria and in the Rhine Valley. In the Mühlviertel, in the eastern Weinviertel and in the south of Vienna, the sun shone 15 to 25 percent longer. In Tyrol, Salzburg, Carinthia and parts of Styria as well as in southern Burgenland, the sunshine conditions were balanced (Zentralanstalt für Meteorologie und Geodynamik, 2021).

Austria's solar intensity is assessed in terms of its photovoltaics power potential. The average solar intensity is above 1150 kWh / kWp with higher outputs exceeding 1300 kWh / kWp in the southern and south-eastern areas.

Figure 4: Photovoltaic power potential in Austria



Source: (World Bank Group, 2021)

Bulgaria

Bulgaria has a temperate-continental climate with moderate features which is characteristic for Central Europe, with hot summers, long, cold winters and very distinct seasons. Abundant snowfalls may occur throughout the country from December to mid-March, especially in the mountainous areas (Climate of the World: Bulgaria | weatheronline.co.uk, 2021).

Temperature

The annual average temperature depends on latitude and ranges from 8°C in the North and 11°C in the South, with temperatures of 2.6°C in the mountains and 12°C in the plains. In general, the warmest areas are in the southern districts of bulgaria, influenced by the nearby mediterranean sea. Daytime temperatures vary from 0–5°C in the winter and 25–30°C in summer months. In the southern areas it can be warmer, in the northern and eastern mountainous districts of Balkan mountains it can be cooler with moderate daytime temperatures and cool nights in the summer and temperatures far below zero in the winter (Climate of the World: Bulgaria | weatheronline.co.uk, 2021).

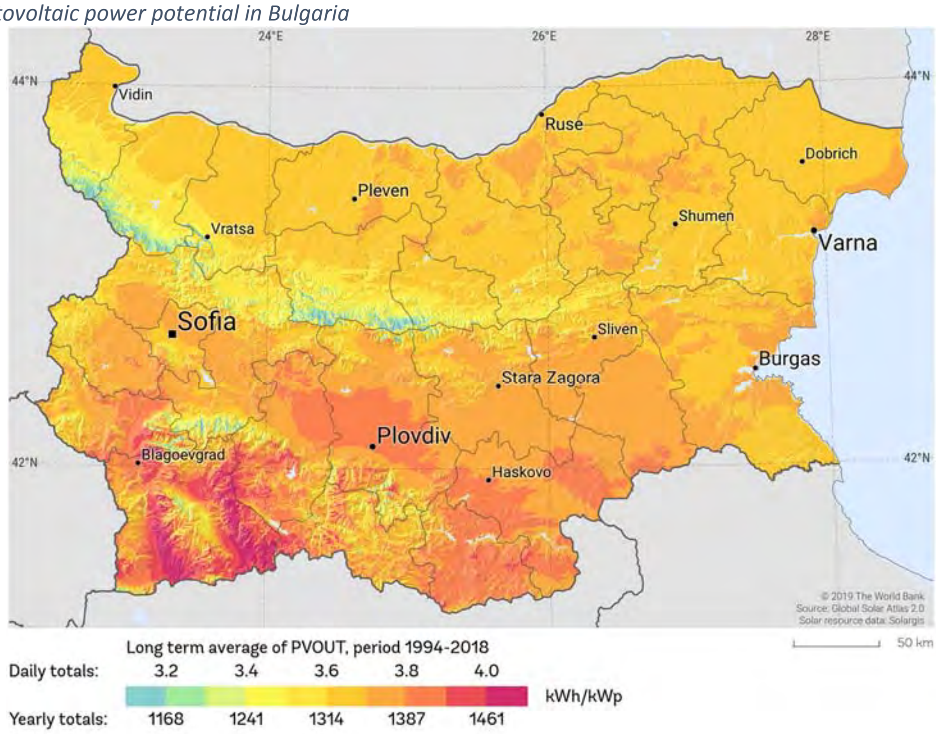
Precipitation

Annual average rainfall is about 700 mm, more in the mountains (up to 1000 mm and more) and less on the coast (around 400–600 mm). It can rain throughout the year; in general, winter is the driest season. In summer, showers and thunderstorms are common, especially in the mountains (Climate of the World: Bulgaria | weatheronline.co.uk, 2021).

Solar intensity

In general, the weather in Bulgaria is very sunny. Solar intensity is interesting not only in terms of the possibility of summer holidays, but also in terms of usability for photovoltaics. Areas of central Bulgaria (around city of Plovdiv), southwest (mountain) and southeast areas have higher solar intensity potential, see following figure.

Figure 5: Photovoltaic power potential in Bulgaria



Source: (World Bank Group, 2021)

Croatia

Croatia's climate is determined by its position in the northern mid-latitudes and the corresponding weather processes on a large and medium scale. The most important climate modifiers over Croatia are the Adriatic and the Mediterranean, the Dinarides' orography with their form, altitude and position relative to the prevailing air flow, the openness of the north-eastern parts to the Pannonian plain, and the diversity of vegetation. Therefore, the following three main types of regions – with continental, mountain and maritime climate, prevail in Croatia (Croatian Meteorological and Hydrological Service, 2021).

Continental climate

Continental Croatia has a temperate continental climate and throughout the year it is in a circulation zone of mid-latitudes, where the atmospheric conditions are very variable. They are characterised by a diversity of weather situations with frequent and intense exchanges during the year. The climate of continental Croatia is modified by the maritime influence of the Mediterranean, which is stronger in the area south of the Sava River than in the north, and which weakens towards the east. The next local climate modifier is orography which, for example, facilitates the intensification of short-term heavy precipitation on the windward side of the orographic obstacle or the appearance of precipitation shadow on the leeward side. Weather characteristics differ between seasons.

In **spring**, fast-moving cyclonic weather types (cyclone and trough) are characteristic, resulting in frequent and sudden weather changes, from rainy to dry periods, from calm to windy, from colder to warmer. In April, there are usually about ten successive days with a moderate, even strong cold northern wind at the front side of the meridional anticyclone stretching from Scandinavia to Central and even Southern Europe.

In **summer**, the zero pressure gradient fields and a cooling night breeze blowing down mountain slopes are interrupted by cold fronts passing through. They bring in fresh air from the Atlantic, with very strong air mixing, increased wind, thunder and showers from dense clouds with vertical development. This unstable atmosphere stratification and convective clouds usually stay for a day or two after the cold air outbreak, until the new air mass is warmed by the land surface.

In **autumn**, periods of calm anticyclonic weather are very common, but there are also rainy days as cyclones pass over Croatian territory. Calm weather in early autumn is characterised by warm and sunny days and fresh nights with heavy dew and low fog patches over streams and rivers, which dissipate quickly by the morning. In late autumn, calm weather is cold, foggy and gloomy; in open plains there is a short period of sunshine through fog around noon. On mountain peaks, however, the weather is sunny throughout the whole day (Croatian Meteorological and Hydrological Service, 2021).

Mountain climate

At higher altitudes, in the mountainous districts of Gorski kotar, Lika and the Dinaric Alps, there is a mountain climate that differs from the wider area primarily by its air temperature and snow regime, characterized with lower temperatures and more abundant snow and longer-lasting snow cover (Croatian Meteorological and Hydrological Service, 2021).

Maritime climate

The Croatian Littoral is also in a circulation area of mid-latitudes with frequent and intense weather changes most of the year. In summer, however, this area comes under the influence of the subtropical zone, as a result of the influence of the Azorean anticyclone, which prevents cold air outbreaks to the Adriatic. One of the most important climate modifiers in this area is the sea, so the climate can be referred to as maritime.

In summer, on the Adriatic, stationary clear weather prevails in the zero-pressure gradient field of about 1015 hPa. Due to the general pressure gradient in the Mediterranean and the position of the Adriatic, there are north-western winds (etesians) in the open sea, a gentle wind in the Northern Adriatic, moderate wind in the Middle Adriatic, and, occasionally, strong wind closer to the Strait of Otranto. At the same time, local daily periodic circulation is developed on the larger islands and the coast, due to the unequal warming (and cooling) tendencies of the sea and the land, as well as of the hills and the surrounding valleys. Its most important characteristics are a regular daily wind from sea to land and, at night, wind blowing from land and downhill slopes towards the sea. All this enables a strong turbulent exchange of air characteristics, the establishment of a homogeneous spatial distribution of meteorological parameters and the mitigation of extremes.

During the cold part of the year (and at night), in calm weather, turbulence is gentle, so local conditions are dominant, and, therefore, there are great differences in the values, courses and spatial distribution of meteorological parameters at adjacent stations. On the other hand, the strong winds, bura and jugo, are more frequent and stronger in the cold part of the year, although the intensity of the summer bura can also create problems in road and maritime traffic (Croatian Meteorological and Hydrological Service, 2021).

Temperature

The Adriatic coast enjoys a Mediterranean climate of cool, rainy winters and hot, dry summers. Winter temperatures range from -1 to 30°C in the continental region, -5 to 0°C in the mountain region and 5 to 10°C in the coastal region. Summer temperatures range from 22 to 26°C in the continental region, 15 to 20°C in the mountain region and 26 to 30°C in the coastal region (Weatheronline.co.uk. 2021).

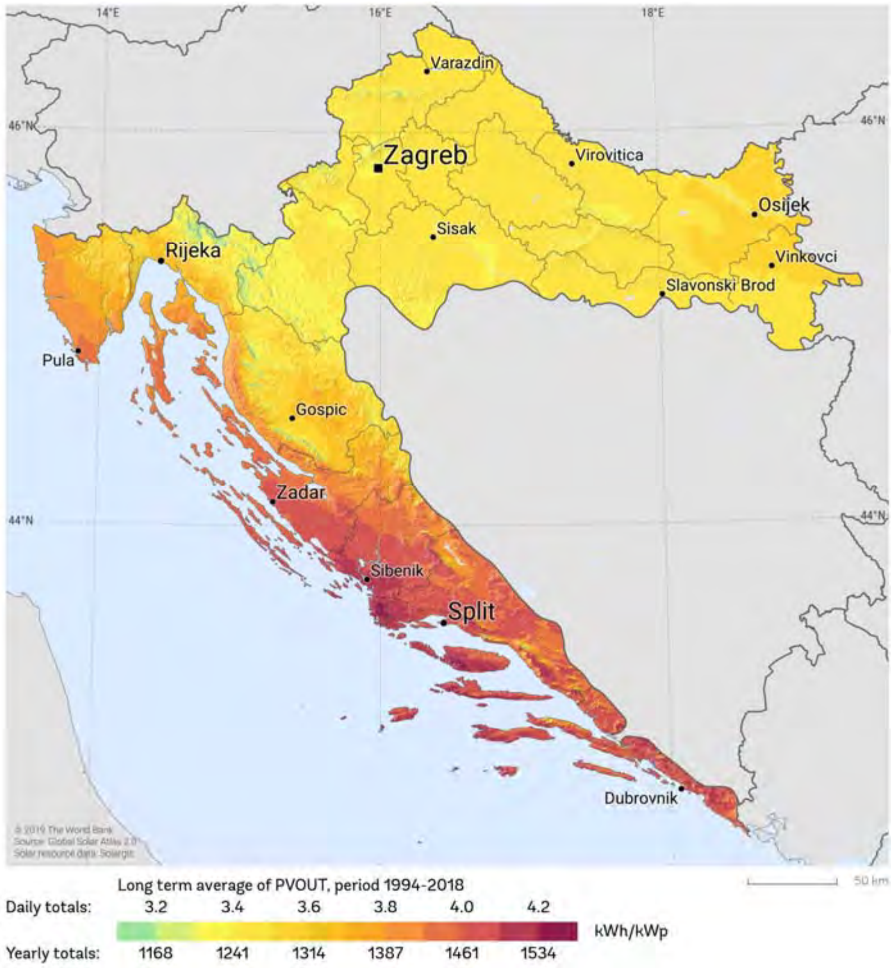
Precipitation

The amount of precipitation varies depending on the region of Croatia. According to statistics for the years 2018 to 2020, the average amount of precipitation exceeded 1000 mm / year, with a min-max range of about 600 to 2600 mm / year (Croatian Meteorological and Hydrological Service, 2021).

Solar intensity

Croatia's solar intensity is assessed in terms of its photovoltaics power potential. The average solar intensity is above 1200 kWh / kWp with higher outputs exceeding 1400 kWh / kWp in the southern and coastal areas.

Figure 6: Photovoltaic power potential in Croatia



Source: (World Bank Group, 2021)

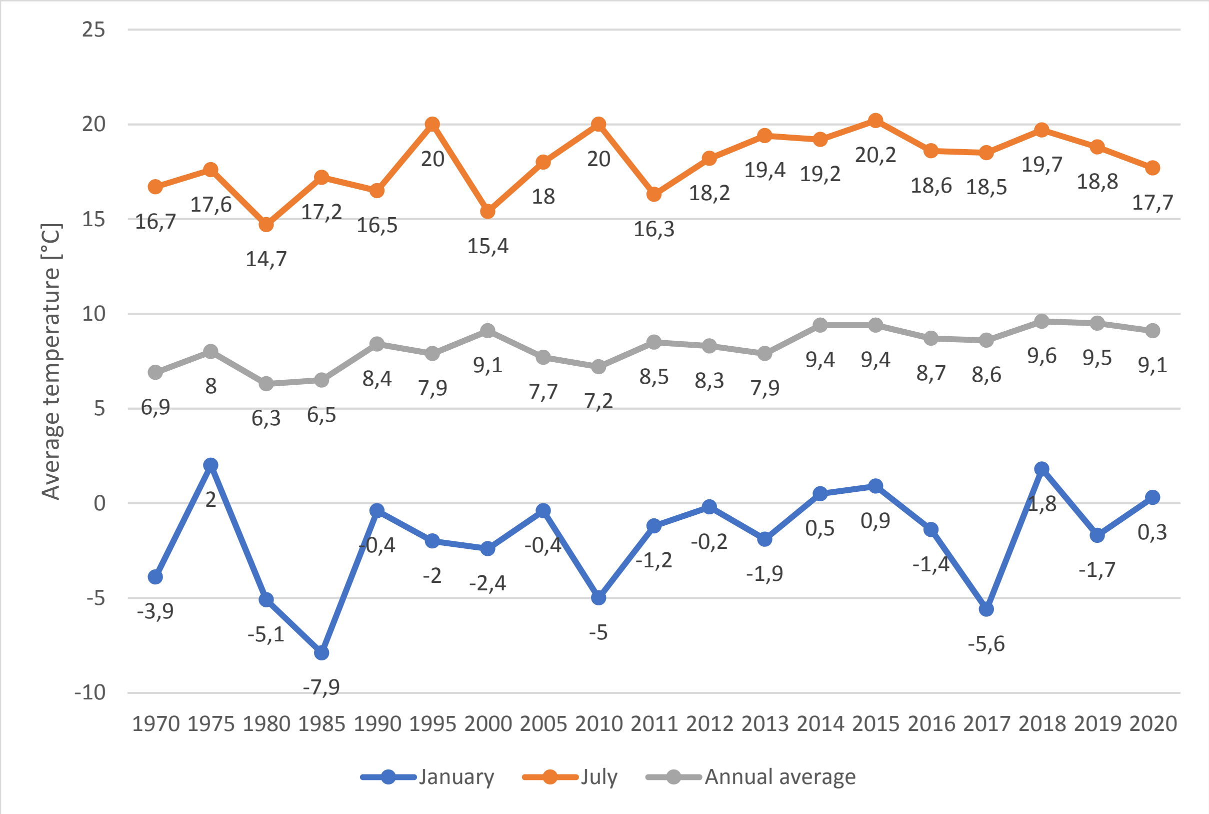
Czech Republic

Czech Republic has a temperate climate. It is situated in the transition zone between the oceanic and continental climate types, with warm summers and cold, cloudy and snowy winters. landlocked geographical position causes significant temperature difference between summer and winter (R. Tolasz et all, 2007). Czech Republic is characterized by alternation of 4 seasons. The climate is characterized by a predominant westerly flow and intense cyclonic activity. The oceanic influence prevails mainly in Bohemia, while the continental climate is more intense in Moravia and in Silesia. The climate is significantly influenced by the landscape and altitude.

Temperature

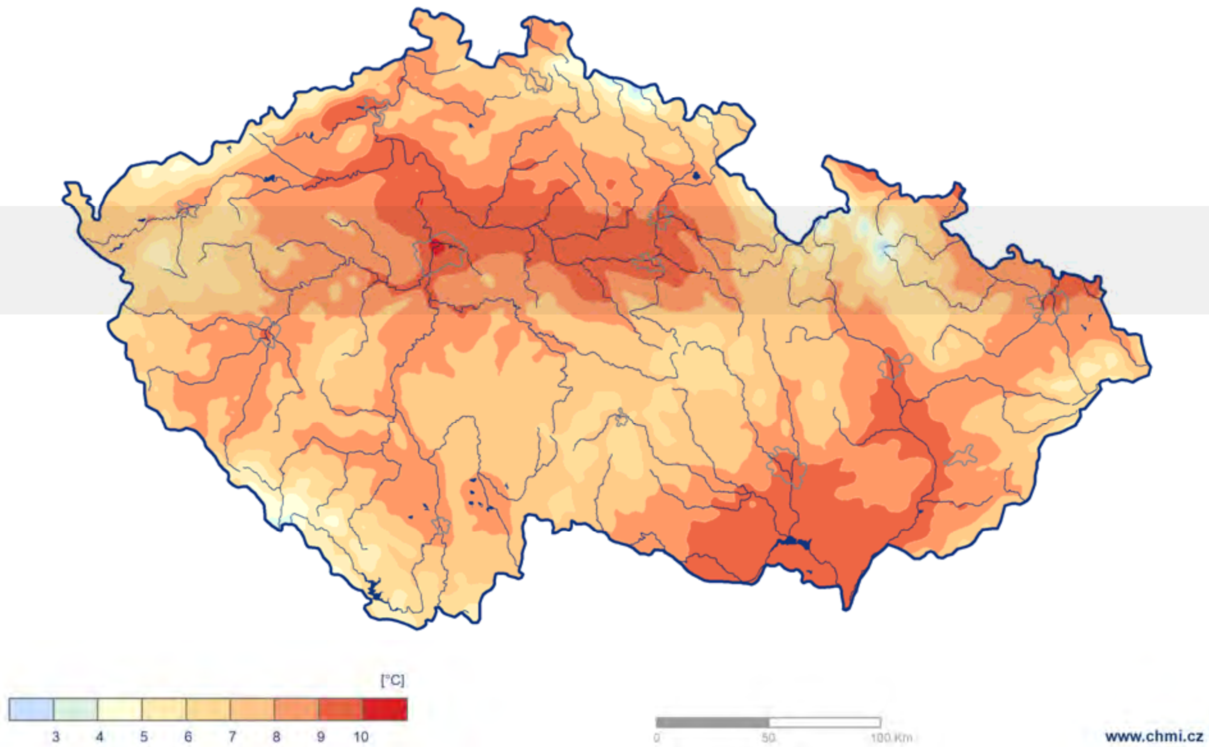
The average annual temperature in the Czech Republic is between 5.5°C and 9°C with median of 8.4°C. The coldest month of the year is January with average temperature falling below freezing point, while the warmest one is July with average temperature of nearly 20°C.

Figure 7: Average annual air temperature in the Czech Republic



Data source: (CHMI, 2021)

Figure 8: Average annual air temperature for the period 1981–2020 in the Czech Republic

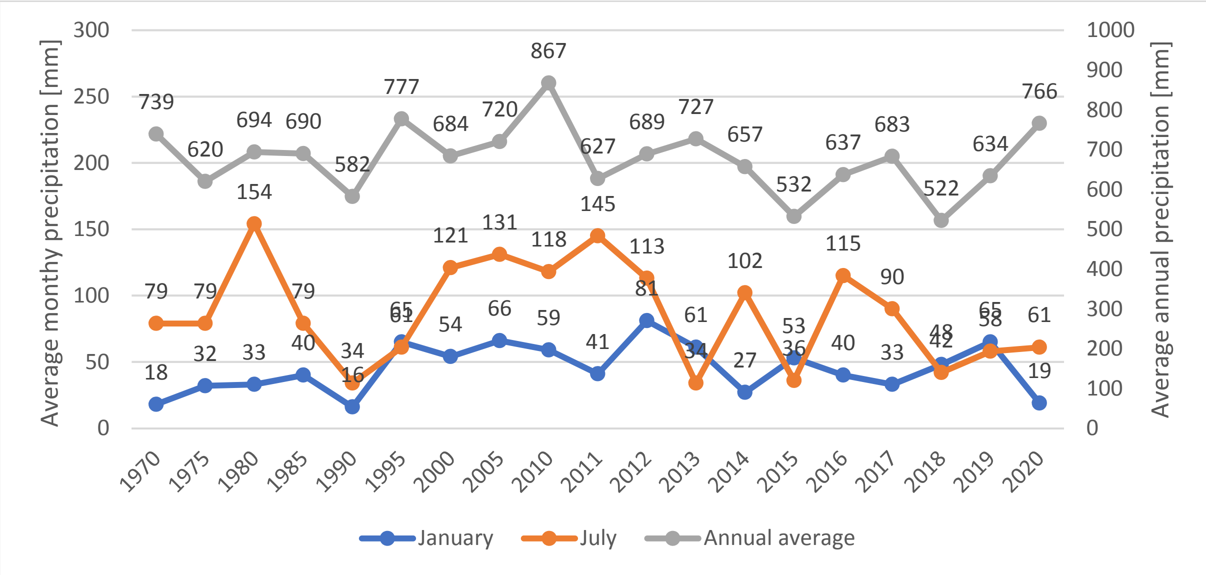


Source: (CHMI, 2021)

Precipitation

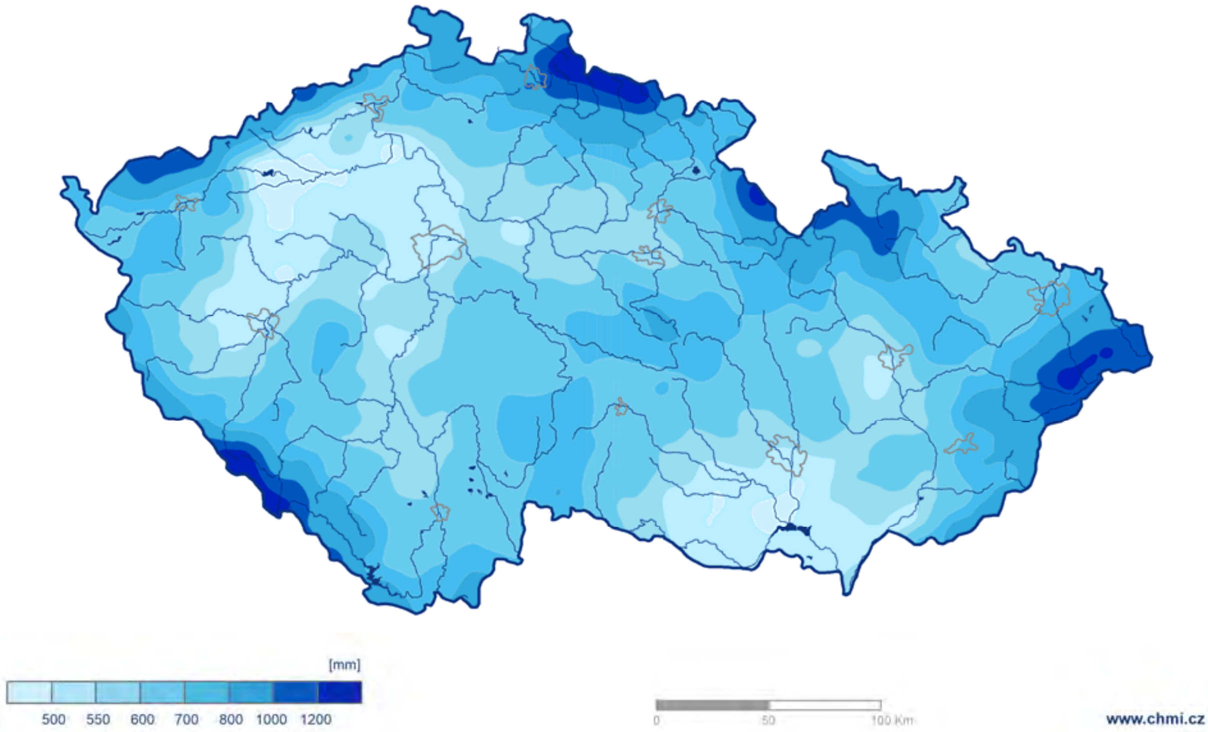
The average annual precipitation in the Czech Republic is between 600 mm and 800 mm with median of 684 mm. Most precipitation in the Czech Republic falls in the summer months (June, July), and the least in the winter months (January, February). In the Czech Republic, there are significant differences in annual precipitation totals due to the highly fragmented relief. The lowest precipitation is in the rain shadow of the Ore Mountains in the lowlands and reaches 450 mm/year, while the highest precipitation is in mountains with values over 1500 mm/year.

Figure 9: Average precipitation in the Czech Republic



Data source: (CHMI, 2021)

Figure 10: Average annual precipitation for the period 1981–2020 in the Czech Republic

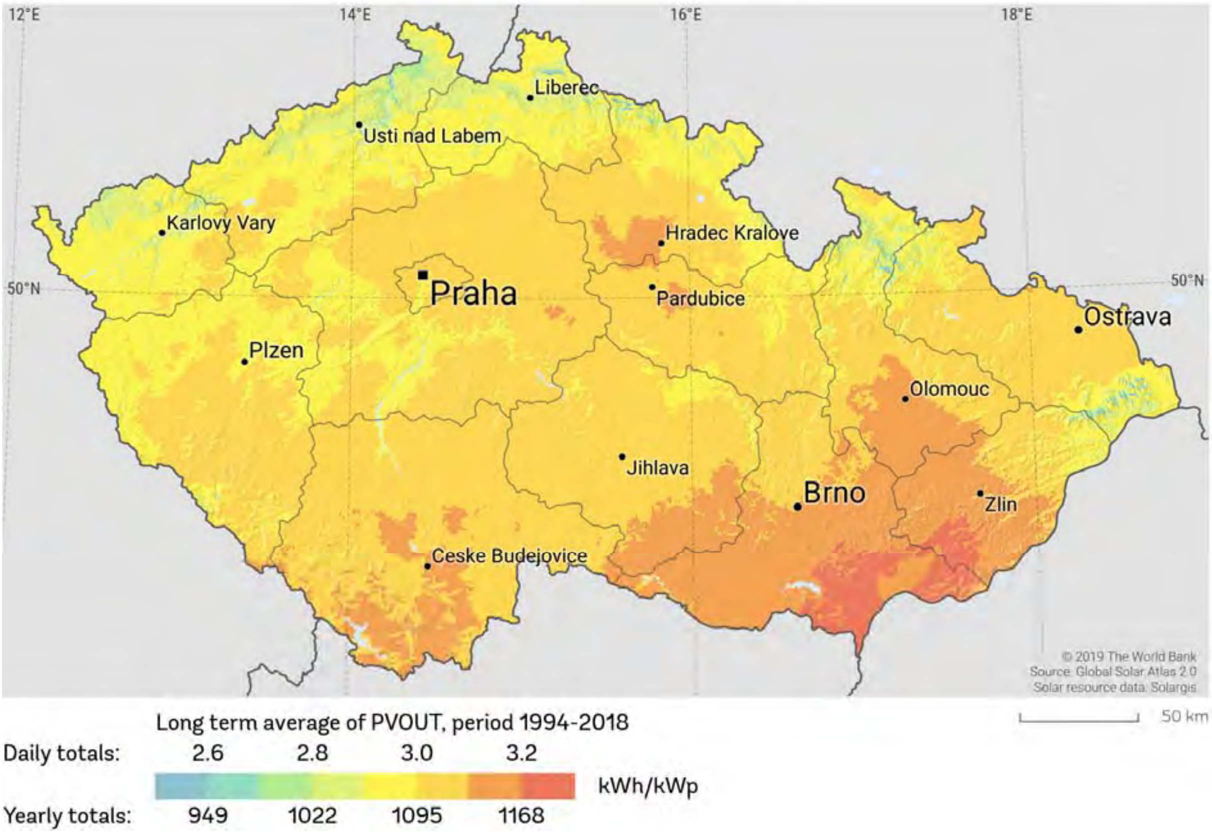


Source: (CHMI, 2021)

Solar intensity

The duration of sunshine in the Czech Republic ranges from 1,500 hours per year to approximately 1,800 hours per year in South Moravia (R. Tolasz et all, 2007). In terms of photovoltaics power potential, the average solar intensity is around 1,050 kWh/kWp with higher outputs exceeding 1,100 kWh/kWp in the southern and especially the south-eastern part of the country.

Figure 11: Photovoltaic power potential in the Czech Republic



Source: (World Bank Group, 2021)

Germany

Germany is mainly located in Central European climate zone. It is characterized by the transition from the Western European maritime climate to the Eastern European continental climate. In the north German plains and by the North and Baltic Sea coast, the summers are pleasantly warm and the winters are not too cold. Further to the south and east, the temperature differences between the seasons are sometimes significantly greater. From June to September, it is the warmest period in Germany with monthly average temperatures of 21 to 25°C. The lowest temperatures are measured in January. Most rainy days can be found in winter, but showers can also occur frequently in summer, especially in the mountains.

Temperature

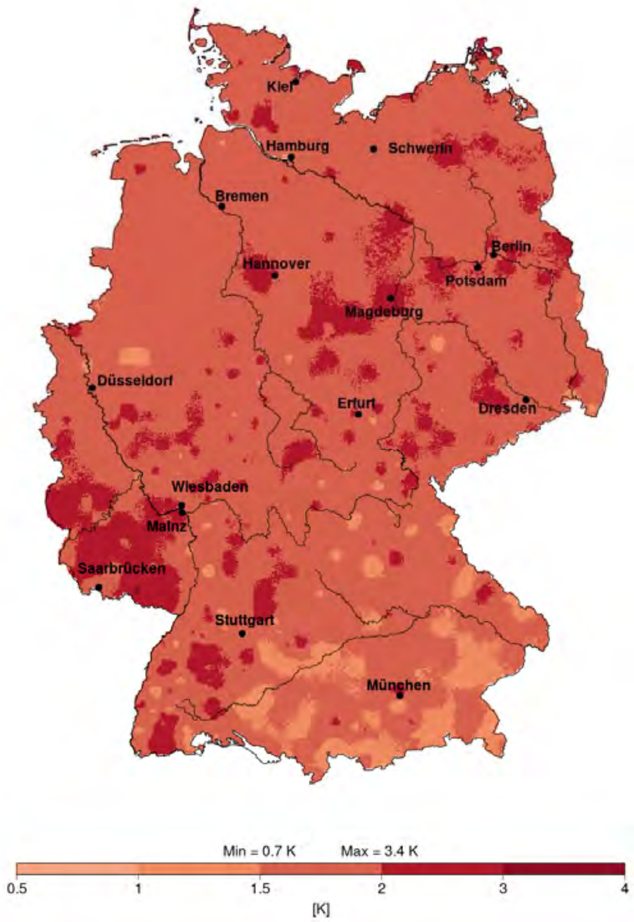
For almost 100 years until the middle of the 19th century there was a period of slight cooling, then from 1900 to the beginning of the 21st century a strong warming took place. Between 1881 and 2018, there was a 1.5°C temperature increase in Germany, which significantly exceeds the global warming of around 1°C. There is almost no difference between warming in the seasons. The warmest years in

Germany were so far 2018 and 2020 with the average temperature of 10.5 and 10.4°C respectively. Years 2014 and 2019 follow with 10.3°C each.

The average temperature in the 2010s reached a value of 2°C compared to the average values 1881–1910. This means that the 2-degree limit, which according to the Paris Climate Conference should not be exceeded by 2100, has already been reached in Germany today.

The graph below shows the deviation of average annual temperature in 2020 compared to the standard values 1971–2000.

Figure 12: Germany - Temperature deviation from standard value for 2020



Source: (Deutscher Wetterdienst, 2021)

Precipitation

As for precipitation, the fluctuations from year to year are even greater in Germany than in the case of temperature. Nevertheless, a significant increase in total precipitation has occurred between 1901 and 2007 from 735 mm to 800 mm or around 10%. Depending on the season, however, the amount of precipitation changed quite differently. It has decreased slightly in summer by 1.2% and increased significantly in winter by 28%. Such a strong increase in winter has taken place due to the generally warmer winters, as well as because of predominant westerly currents with moist air from the Atlantic. Warm summers, on the other hand, are associated with a high-pressured state when there is usually little of rain. The month with the most significant decrease in precipitation in summer is August (Deutscher Wetterdienst, 2021).

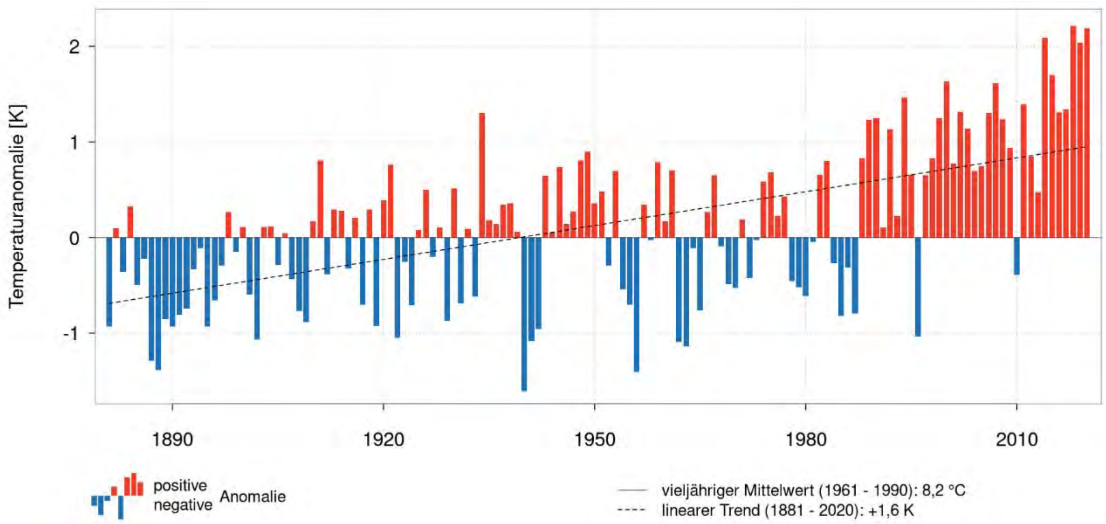
Figure 13: Germany - Deviation of precipitation level 2020 from standard values 1971 - 2000

Source: (Deutscher Wetterdienst,2021)

Changes in annual temperature

To record an abnormal change in temperature so-called characteristic days are used, such as hot days with a maximum temperature of at least 30°C or ice days with a maximum temperature below 0°C. In the 1950s there was an average of 3.5 hot days per year across all weather stations. During the 30-year period 1991–2020 there was more than double with 9 days per year. The number of ice days per year has also decreased significantly. In eight years from 2011–2020 there were at least 10 fewer ice days than the 1961–1990 average, and in 2020 even 20 fewer ice days.

Figure 14: Germany – Annual temperature abnormality 1881–2020 (reference period 1961–1990)

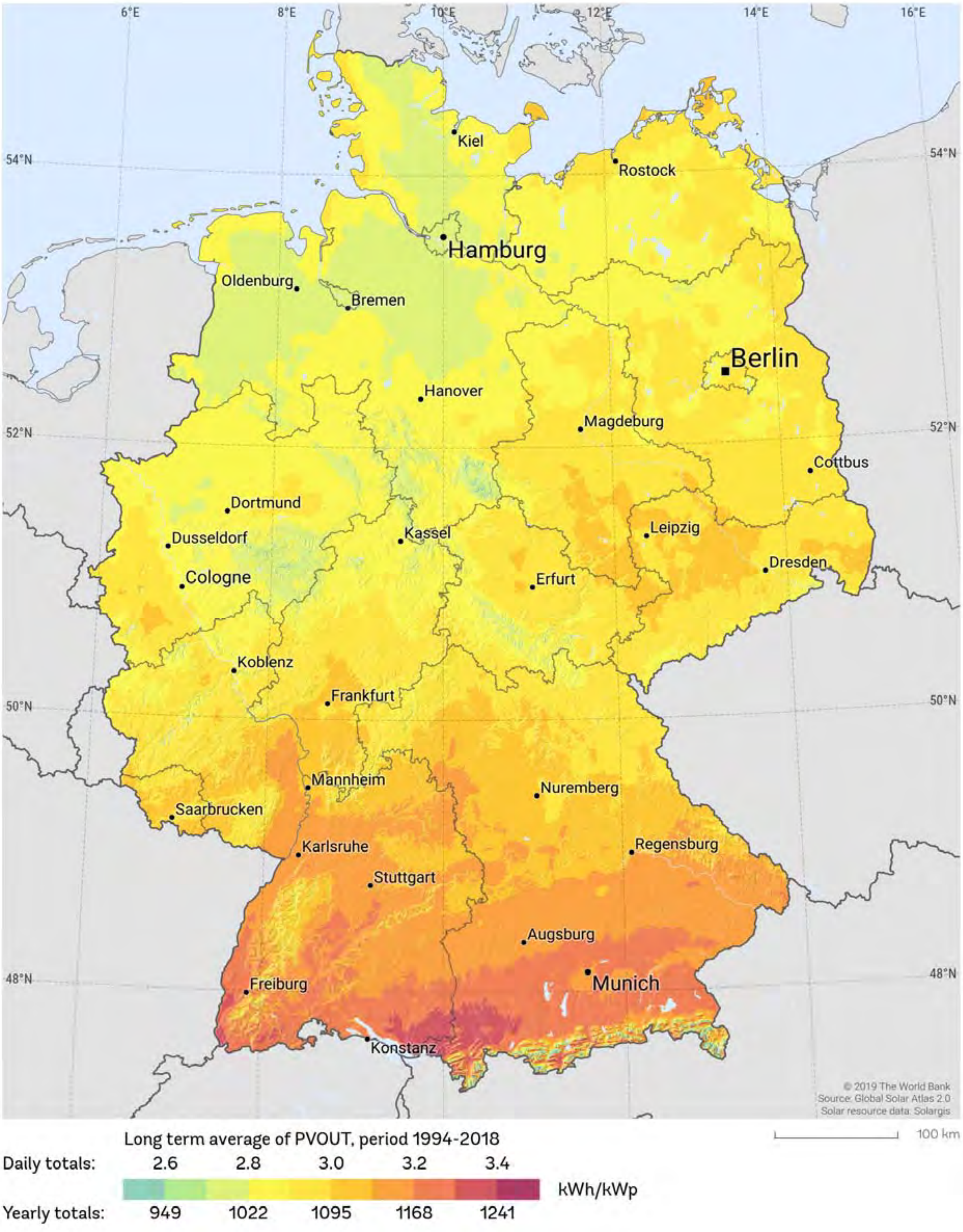


Source: (Deutscher Wetterdienst,2021)

Solar intensity

Solar intensity for Germany is assessed in terms of its photovoltaics power potential. The solar intensity averages at 1,700 kWh/kWp in northern half of the country and rises to an average of 1,200 kWh/kWp in the southern parts half of the country with higher outputs exceeding 1,240 kWh/kWp in the mountainous Alp regions.

Figure 15: Photovoltaic power potential in Germany



Source: (World Bank Group, 2021)

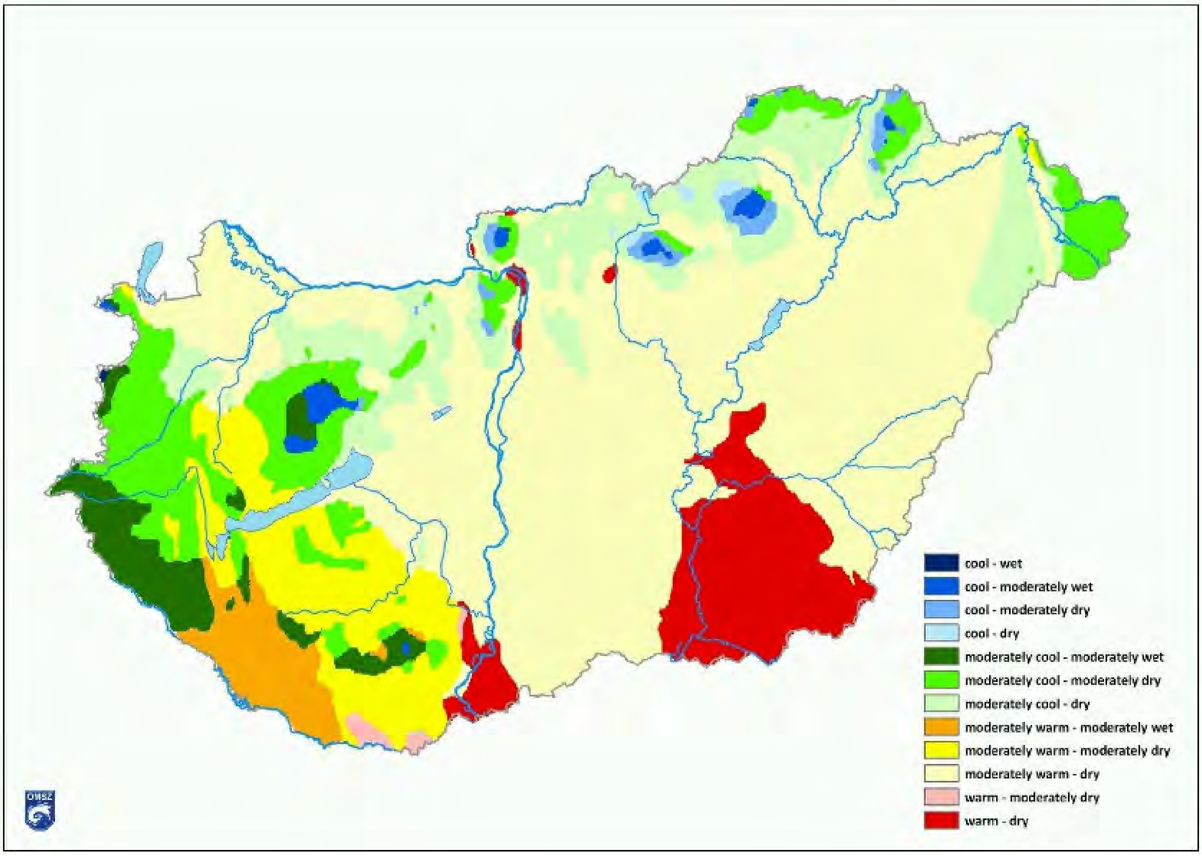
Hungary

Hungary is situated between the 45°45'N and 48°35'N latitudes, about halfway between the Equator and the North Pole, in the temperate climatic zone according to the solar climatic classification. Its climate is very erratic. One of the main reasons for this is the fact that Hungary is situated in between 3 climatic zones: the oceanic climate with less varying temperature and more evenly dispersed precipitation; the continental climate with more extreme temperature and relatively moderate precipitation; also, a Mediterranean effect with dry weather in summer, and wet one in winter. For a shorter or longer period of time, any of these types can become prevailing. Due to these reasons great differences can occur in the weather of the country, despite of its lower altitudes and relatively small extent (National Meteorological Service, 2021).

Temperature

The annual mean temperature in most parts of Hungary is between 10 and 11°C. The spatial distribution of two-metre temperature is primarily influenced by the distance from the Equator, the altitude and the distance from the seas.

Figure 16: Climate regions of Hungary (based on the work of György Péczely)



Source: (National Meteorological Service, 2021)

The lowest values appear in the higher altitudes (the Bakony Mountains, around the western border, and in the Northern Mountains), where the mean temperature usually does not exceed 8°C. Values above 11°C only occur scarcely, mostly on southern exposed slopes.

The spatial distribution shows a decrease from SW to NE, which is due to the warming effect of the Mediterranean Sea and the cooling effect of the Siberian anticyclone. Note that in the last decade the size of areas, where the average temperature exceeded 11°C, has increased, particularly in the south of Hungary.

Although the impact of orography on the temperature is obvious, an inversion is common in winter, when the temperature increases with the altitude instead of decreasing. Stronger inversion can cause a cold-air pool within the Carpathian Basin, which means higher altitude areas can be warmer as they rise from the cold air mass that fills the bottom of the basin.

The maximum and minimum values are important practical features of air temperature. In Hungary the diurnal temperature range is the lowest in December (4–6°C) when the days are the shortest and the cloud cover is the thickest, while in the sunny and longer summer days more than twice (11–13°C) of that is common (National Meteorological Service, 2021).

Precipitation
The annual precipitation amount in Hungary is 500–750 mm, but there are remarkable differences between different regions.

The spatial distribution of the annual precipitation amount shows effects. The effects of the altitude and the distance from the Mediterranean Sea are important, but the Atlantic Ocean also influences the climate. A hundred-meter increase in altitude equals to about 35 mm extra precipitation in the annual amount, while the growing distance from the seas causes a decrease. The wettest are the south-western areas of the country and the mountains, where the yearly amount could exceed 800 mm. On average, the low altitude valley of the river Tisza receives the least precipitation, the value does not reach 500 mm. The annual sum decreases, roughly, from SW to NE.

Spatial and year-to-year variability is notable in Hungary. The most precipitation falls between May and July, least between January and March. Due to a stronger cyclone activity, there is a secondary maximum in most parts of the country during the autumn – this is particularly true for Southern Transdanubia. Its temporal uncertainty is shown in the fact that three times as much can fall than in the driest years that in the wettest years and zero precipitation can occur in any month. The country-wide annual precipitation amount showed a decreasing tendency during the last century, the decrease in 109 years was nearly 10 percent (National Meteorological Service, 2021).

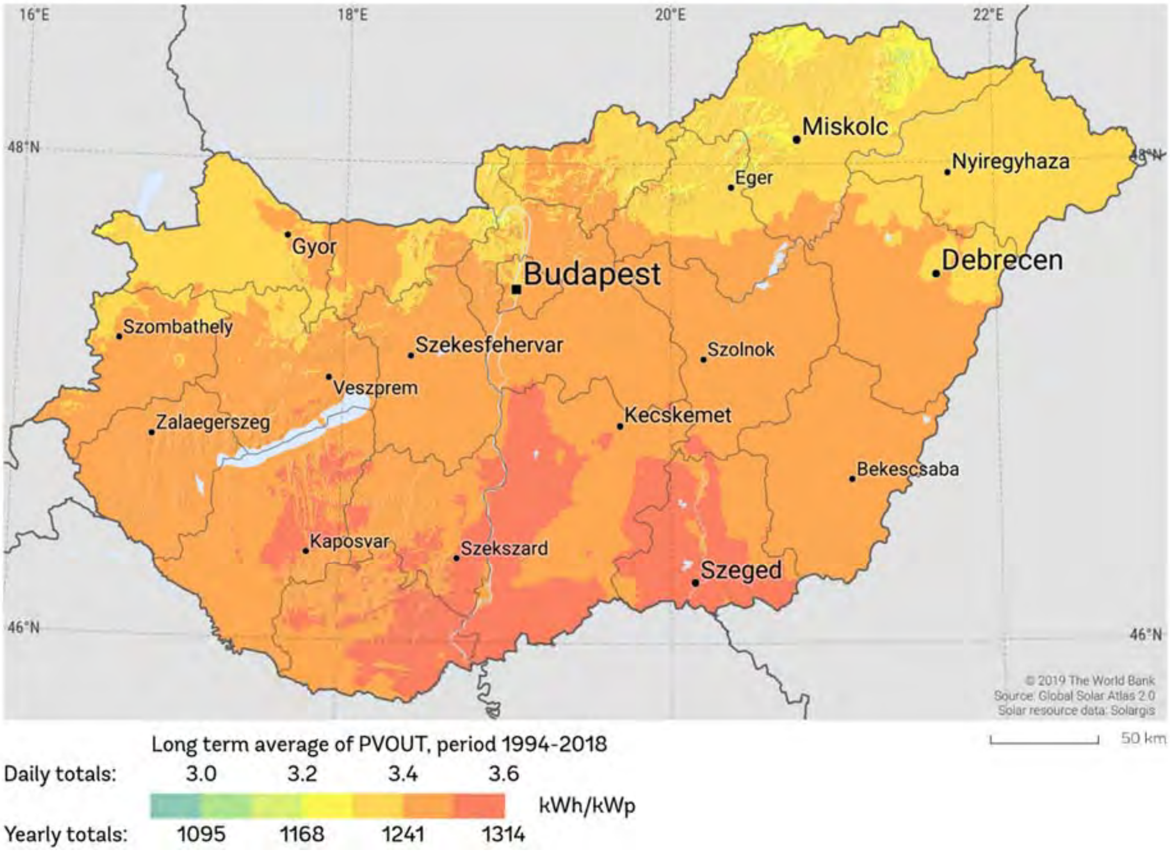
Solar intensity
The spatial distribution of the irradiation is defined by the latitude and the cloud cover. In Hungary, there is only small latitude distance, therefore, cloud cover plays a key role. The south eastern parts of the country have the highest irradiation values, the region of Szeged reaches 1,333–1,361 kWh/m^2, and also, the global radiation exceeds 1,250 kWh/m^2 in large areas. The lowest irradiation values are around the northern mountains, here less than 1,194 kWh/m^2 values could occur.

Sunshine duration means the amount of time when the surface receives direct radiation. The factors influencing sunshine duration are the astronomically possible sunshine duration, orography and cloud cover - the latter one has a stronger effect than the irradiation itself.

In Hungary, the most sunshine with more than 2,000 hours a year is common in the southern and south-eastern parts, while the least sunny regions are in the northern and north-eastern parts, and around the western borders, with less than 1,800 hours.

In winter, the highest mountains receive one and a half times as much sunshine as the plains, since in winter the inversion is a common phenomenon (when the mountains rise above the fog covering the lower regions). However, in summer they have 10 percent less sunshine as the lower regions, because of the more cloudy and wet weather. December is with the least sunshine, while the maximum duration is in July (National Meteorological Service, 2021).

Figure 17 Photovoltaic Power Potential - Hungary



Source: (SolarGIS.com, 2021)

Romania

Romania's climate is affected by temperate-continental transition, marked by oceanic, continental, Scandinavian-Baltic, sub-Mediterranean and Pontic climatic influences. Thus, in Banat and Oltenia the Mediterranean nuance is felt, characterized by mild winters and a richer rainfall regime, especially in autumn. In Dobrogea the Pontic shade is manifested, with rare but torrential rains.

In the eastern regions of the country, the continental character is more pronounced. In the northern part of the country (Maramureş and Bucovina), the effects of the Scandinavian-Baltic influence are manifested, causing a wetter and colder climate with frosty winters. In the west of the country, influences of low-pressure systems generated over the Atlantic are more pronounced causing more moderate temperatures and richer rainfall.

Climatic nuances are also manifested on the altitudinal steps. Mountain massifs of the Carpathian arc have the cool mountain climate, with high humidity throughout the year (Administrația Națională de Meteorologie, 2021).

Temperature

The temperature characteristics are expressed by the following figures. The central region of Romania is generally colder, while the eastern and southern and western parts are warmer.

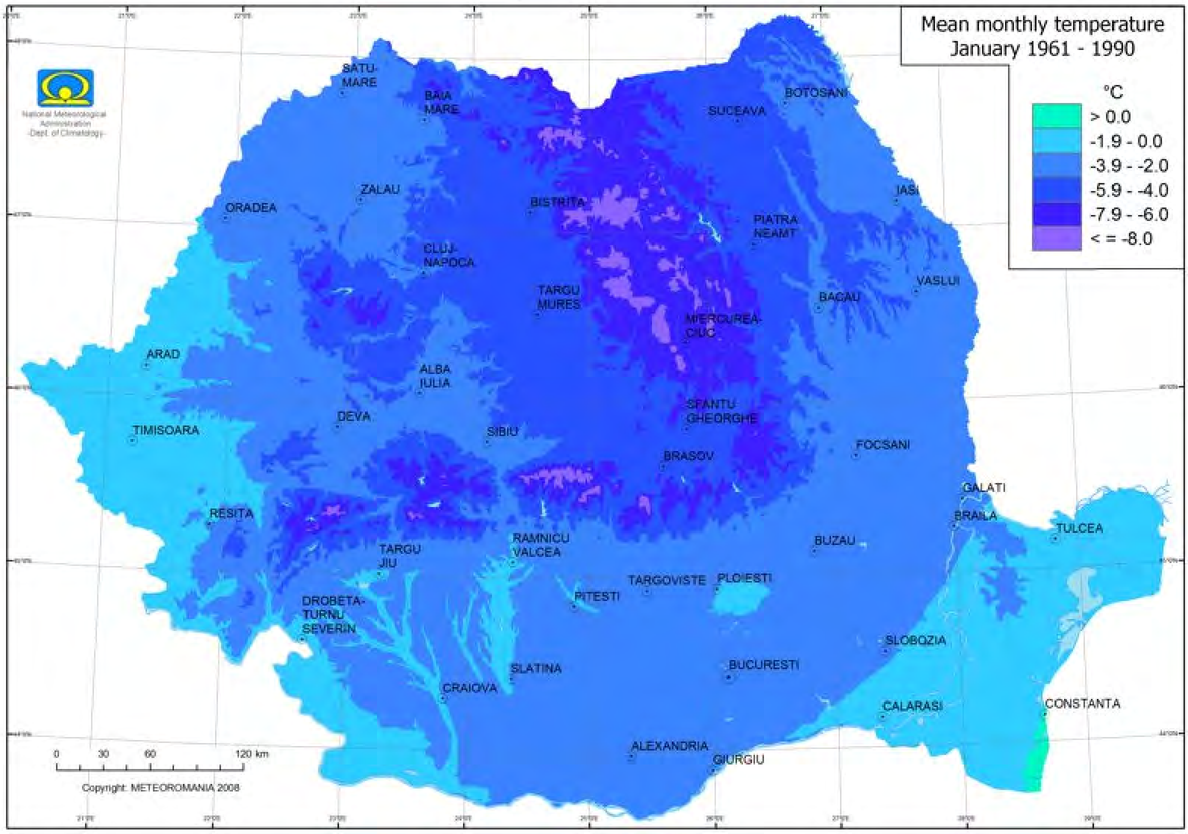
In summer daytime temperatures reach 2025°C, but sometimes quite higher, 30°C or more. In most of the time is dry weather with sunny spells, although sometimes heavy Thunderstorms can occur at the end of the day. July is the warmest month with an average Temperature of 22°C (Weatheronline.co.uk., 2021).

Precipitation

In winter, precipitation is higher in the south and northwest of the country, while precipitation in the east and southeast (coastal area) is rather lower. In summer, precipitation is highest in the central part of Romania, while precipitation in the south-eastern area is lowest, despite being coastal area.

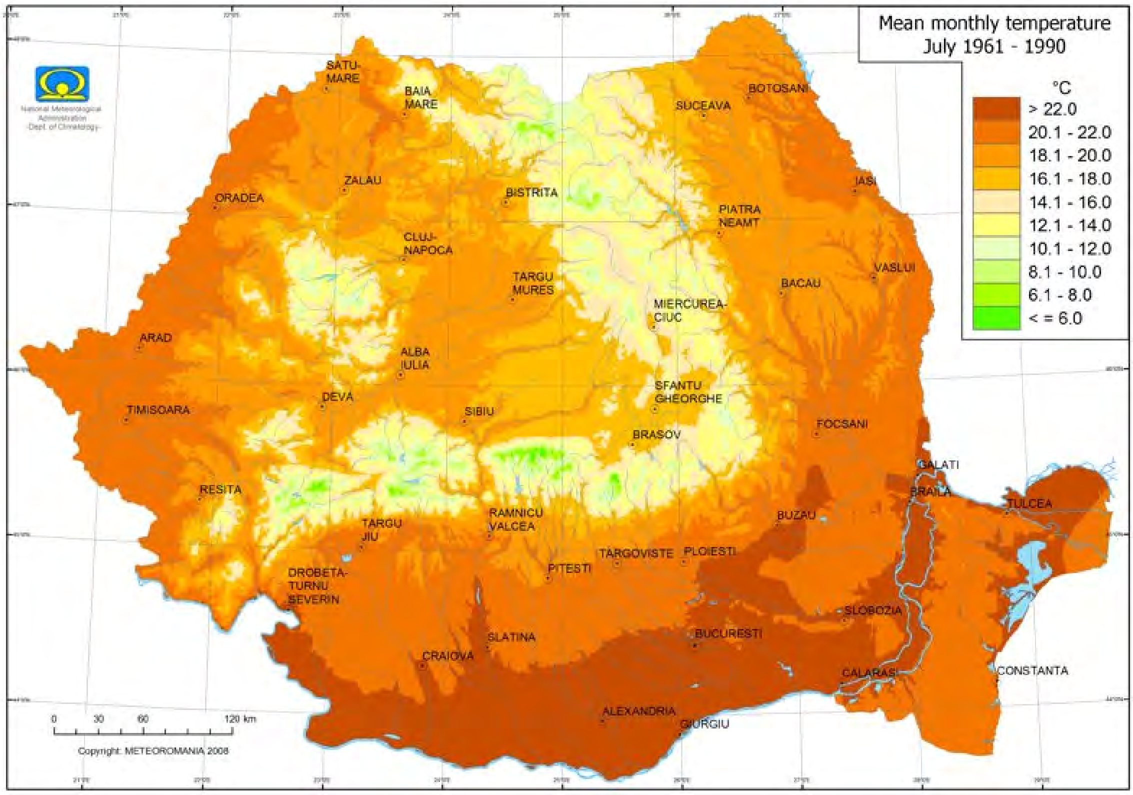
Annual average rainfall is about 700 mm, more in the mountains (up to 1,000 mm) and less on the coast (around 400 mm). It can rain throughout the year; spring is the driest season. In summer, showers and thunderstorms are common, especially in the mountains (Weatheronline.co.uk., 2021).

Figure 18: Mean monthly winter temperature (January) in Romania



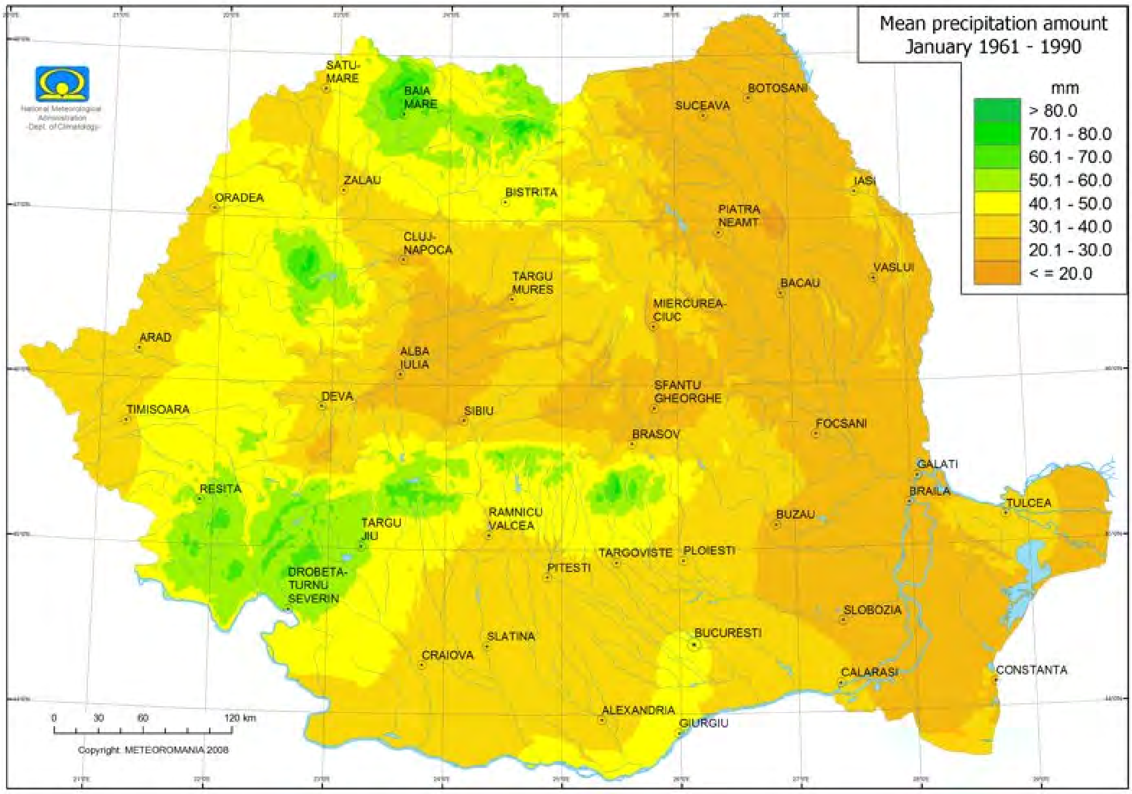
Source: (Administrația Națională de Meteorologie, 2021)

Figure 19: Mean monthly summer temperature (July) in Romania



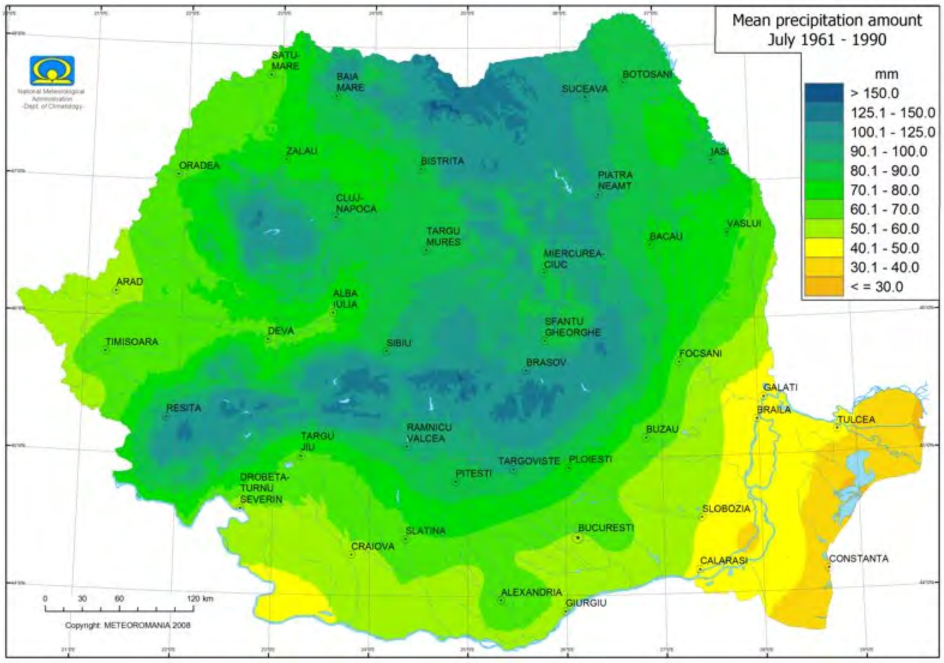
Source: (Administrația Națională de Meteorologie, 2021)

Figure 20: Mean monthly winter precipitation (January) in Romania



Source: (Administrația Națională de Meteorologie, 2021)

Figure 21: Mean monthly summer precipitation (July) in Romania

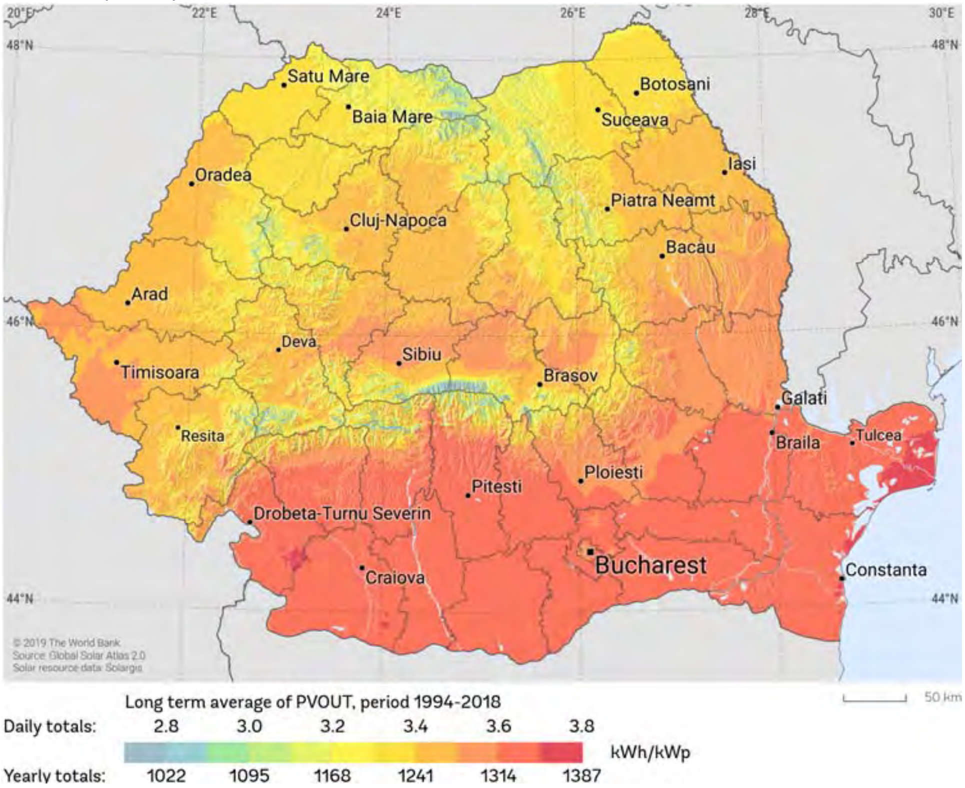


Source: (Administrația Națională de Meteorologie, 2021)

Solar intensity

Romania's solar intensity is assessed in terms of its photovoltaics power potential. The average solar intensity is above 1,150 kWh/kWp with higher outputs exceeding 1,300 kWh/kWp in the southern and coastal areas.

Figure 22: Photovoltaic power potential in Romania



Source: (World Bank Group, 2021)

Slovakia

In terms of global climate classification, the territory of Slovakia belongs to the northern temperate climate zone with regular alternation of four seasons and variable weather with a relatively even distribution of precipitation during the year. Slovakia's climate is influenced by several air masses:

- Western current in moderate latitudes – brings moist ocean air from the Atlantic Ocean. It alleviates temperature amplitudes throughout the day and year and brings atmospheric precipitation.
- Continental air masses of mostly mild latitudes – they are manifested by higher daily and annual amplitudes of air temperatures and less total atmospheric precipitation. The temperate continental air produces warm, sunny and less humid summers and cold winters with low precipitation.
- Tropical air masses – comes mainly from the southwest, south and southeast and pass through the Mediterranean on their way. The air coming from the south to the southeast is mostly drier and warmer (in the summer dry and warm to hot weather, in winter reduction in the colder nature of the weather with the possibility of more frequent and sometimes heavier precipitation). In winter, relatively cold and humid air can sometimes come from the Balkan.
- Arctic air masses – affect the climate of Central Europe mainly in winter. The continental Arctic air from the northeast is very cold, stably stratified and dry, the marine Arctic air from the northwest to the north is wetter, usually unstable stratified and less cold at low altitudes.

The result of the alternation of the above-mentioned air masses during the year and the fact that the territory of Slovakia is highly fragmented vertically, is the presence of regionally very different climatic regions in territory. Mountain ranges, especially high ones, form significant climatic divisions and, together with rugged terrain, significantly affect individual climatic elements, especially air temperature, atmospheric precipitation, humidity, clouds, sunshine and wind conditions, and so on.

The influence of the Atlantic Ocean on Slovakia's climatic conditions gradually declines from west to east on average, which is reflected, for example, in the fact that winters in eastern Slovakia at the same altitude are up to 3°C colder than in the west. The impact of the Mediterranean is more complex. It depends on the time of year, the direction of flow and the exposure to orography (Slovak Hydrometeorological institute, 2021).

Temperature

On average, the warmest area is the Danubian Lowland, with an average air temperature of -1 to -2°C in January, 18 to 21°C in July and an annual average of 9 to 11°C (with the average air temperature in the center of Bratislava approaching 11°C and on some south-facing slopes). In the area of the East Slovakian lowlands, the air temperature is on average slightly lower. In the basins and valleys of rivers adjoining the lowlands (eg Považie, Ponitrie, Pohronie ...) the average annual air temperature reaches values in the range of 6 to 8°C, in the highest basins (Popradská, Oravská kotlina) it is less than 6°C. With higher altitude, the average annual air temperature decreases. At an altitude of 1,000 m it reaches an average value in the range of 4 to 5°C, at an altitude of 2,000 m above sea level around -1°C, on the ridges of the High Tatras less than -3°C. In mountain valleys and basins, temperatures in winter reach less than -30°C, maximums in summer in the lowlands reach up to 40°C.

The average monthly air temperature is the warmest month of July, in the highest places of the Tatras August. The average monthly air temperature in July reaches less than 15°C in the basins from 16 to 18°C, in the mountains, depending on the altitude (eg Tatranská Lomnica 14.8°C, Štrbské Pleso 12.3°C, Skalnaté lake 9.4°C, Chopok 6.8°C, in August on Lomnický štít 3.6°C). The coldest month is January, in the highest positions of the Tatras February. The mildest winters are in the southern and western parts of the Záhorská and Podunajská lowlands with the January average air temperature above -2°C. The impact of continentality to the east is manifested by a decrease in the average January air temperature in the lowlands to -2°C to -4°C. In the basins, the average monthly air temperature in January is -3 to -5°C (Slovak Hydrometeorological institute, 2021).

Precipitation

In Slovakia, the average annual rainfall varies from less than 500 mm in the Galanta, Senec and eastern part of Žitný ostrov to approximately 2,000 mm in the High Tatras (Zbojnícka chata 2,130 mm). The amount of precipitation in Slovakia generally increases with an altitude of approximately 50–60 mm per 100 m altitude. The rainiest month is June or July and the least precipitation is in January to March.

The high variability of precipitation causes frequent and sometimes prolonged droughts, especially in the lowlands. The Danube Plain is one of the driest areas in Slovakia, both because it has the smallest totals (even less than 500 mm per year), but also because there is little rainfall in summer and it is also the warmest and relatively windiest area, due to which is a high potential vapour (Slovak Hydrometeorological institute, 2021).

Solar intensity

On average, the sunniest area is the south-eastern half of the Danube Plain with 2,000–2,200 hours of sunshine per year (the maximum astronomically possible duration of sunshine for this area is 4,447 hours per year). The considerably long duration of sunshine is also typical for the peaks of high mountain massifs, for example, the peaks of the eastern part of the High Tatras have an average of up to 1,800 hours of sunshine per year. In the mountain valleys and basins of northern Slovakia and in the extreme northwest of Slovakia, the duration of sunshine generally decreases to 1,400–1,500 hours per year due to shading and higher clouds (eg Trstená-Ústie nad Priehradou 1,052 hours).

The average annual amounts of global radiation are highest in the lowlands, 1,200 to 1,300 kWh/m^2, in the highest parts of the eastern part of the Tatras it is 1,100 to 1,200 kWh/m^2, in the middle mountain areas and in the extreme northwest of Slovakia 1,050–1,100 kWh/m^2, which is mainly affected by increased clouds. In the basins, global radiation is affected by inversions and low clouds, the values range from 1,100 to 1,200 kWh/m^2 (Slovak Hydrometeorological institute, 2021).

Slovenia

Slovenian climate can be described as typically European continental with warm, dry summers and fairly cold winters. Coastal areas and the lowlands in the south have a Mediterranean. January is the coldest month with daytime temperatures usually around zero in the north, but in some cases winter months can be very cold with temperatures far below zero and strong, cold north-easterly winds, called Bora, especially in the mountainous regions, where the weather is strongly influenced by the nearby Alps. Heavy snowfall or even snowstorms are also possible on some days there; the yearly average number of days with snow is less than 40 in the low-land regions and up to 120 days in the mountainous regions of Slovenia. In the coastal areas long-lasting frost periods and snow are quite seldom because of the influence of the warm water temperatures of the Mediterranean Sea (Weatheronline.co.uk., 2021).

Temperature

The average annual temperature is around 9°C in the central part of the country, while the border zones are slightly warmer (11–13°C) throughout the east and in the west to southwest of the country (Agencija rs za okolje, 2021).

In summer daytime temperatures reach 20–25°C, but sometimes quite higher, 30°C or more. In most of the time is dry weather with sunny spells, although sometimes heavy Thunderstorms can occur at the end of the day, especially in the mountainous regions. July is the warmest month with an average Temperature of 22°C (Weatheronline.co.uk,2021).

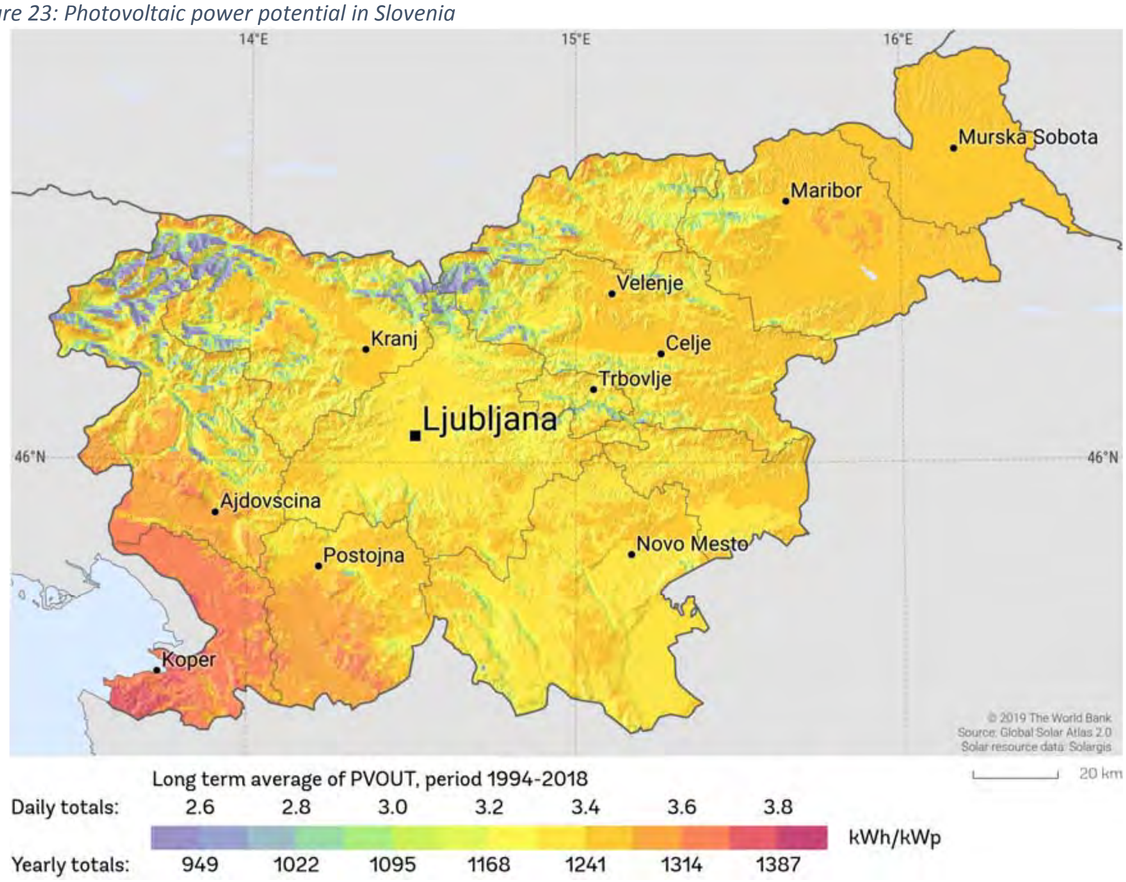
Precipitation

Average annual rainfall is increasing from east to west. In the east it is about 1,000–1,100 mm / year, in the vicinity of the capital Ljubljana about 1,300–1,400 mm / year and in the west in the mountains they exceed 3000 mm / year (Agencija rs za okolje, 2021).

Solar intensity

Croatia's solar intensity is assessed in terms of its photovoltaics power potential. The average solar intensity is above 1150 kWh / kWp with higher outputs exceeding 1300 kWh / kWp in the southwest and area and lower outputs in mountain northern and northwest areas.

Figure 23: Photovoltaic power potential in Slovenia



Source: (World Bank Group, 2021)

Bosnia and Herzegovina

General climate characteristics of Bosnia and Herzegovina are greatly influenced by characteristics of Adriatic Sea, local topography-especially the Dinarides Mountains, which are located along the coast and run from NW to SE parallel to the coast - and atmospheric circulation on a macro scale (Vukmir et al., 2009).

The warm zone corresponds to the Adriatic coast and lowland Herzegovina. In lowland Herzegovina, summers are hot, and winters are very mild. Mean winter temperatures are above 5°C, whereas summer temperatures reach 40°C. Mean annual temperatures have the value of above 12°C.

Moderate areas include plain and hilly regions in the central part of the country. Summers are warm and winters are moderately cold. Mean winter temperatures are around 0°C and summer temperatures reach 35°C. Mean annual temperature ranges between 10°C and 12°C, whereas in the area above 500 m, it is below 10°C.

Cold regions refer to mountainous areas where summers are fair (days moderately warm and nights chilly), while winters are very cold. During at least 3 months of the year, these regions have a mean temperature lower than 0°C (ClimateChangePost.com, 2021a).

Air temperature changes until now

The increase in the mean annual temperature in Bosnia and Herzegovina over the last 100 years was around 0.6°C. Trends were different for individual seasons. The biggest trend of increases was seen in the summer and winter (Majstorović, 2008).

For part of South-East Europe (including parts of Northern Serbia and Southern Hungary, as well as smaller areas in Bosnia-Herzegovina, Croatia and Romania), the change of the likelihood of an extreme summer such as the one of 2012 between the decades of 1960–1970 and 2000–2010 was assessed. From this study it was concluded that the magnitude and frequency of heat waves have increased considerably in South-Europe between the 1960s and the 2000s. In addition, indices combining temperature and precipitation to assess changes in dryness and heat stress risk have been analysed; these results also show an increase in return time, although the results are subject to uncertainties (Sippel, S., Otto, F., 2014).

Air temperature changes in the 21st century

Projections of air temperature change over the Mediterranean for the thirty-year period 2031–2060, compared with 1980–1990 (SRES B2 scenario), indicate (1):

- The largest temperature increases would occur in summer, and in inland areas: Tmin by 4°C and Tmax by 5 °C on average;
- The second largest increase would occur in the fall (2 to 3°C everywhere);
- Spring temperatures could rise by approximately 2°C;
- Winter and spring temperatures could rise less than 2°C;
- The rise in coastal region temperatures (although less pronounced due to the sea) are expected to be in the 1-2°C range on average, and a bit more than 2°C in summer for Tmax;
- Tmax is expected to rise more than Tmin;

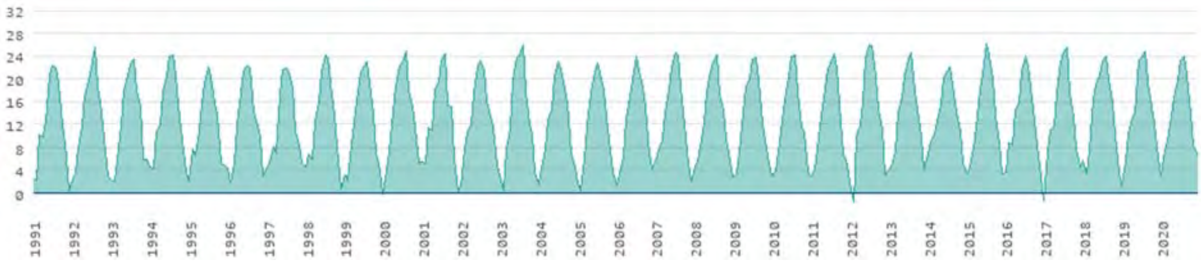
- The increase in the number of summer days, defined as the number of days when Tmax exceeds 25°C, is from 2 to 6 weeks. This translates into about one additional month of summer days on average;
- The increase in the number of hot days in the Balkans, defined as the number of days with Tmax> 30°C, ranges from 2 weeks along the coast to 5-6 weeks inland, indicating the role the Mediterranean Sea plays in moderating extremely hot weather (ClimateChangePost.com 2021a).

The climate in Bosnia and Herzegovina

In the years 1991 to 2020 there were only these 2 weather stations in the whole country, which reported continuous temperature values (Mostar, Sarajevo Bjelave). From these weather reports we have created a long-term development that shows the monthly average temperatures. The hottest month in this entire period was 2015 with 26.2 °C. 2012 was the coldest month with an average temperature of -1.7 °C.

The average annual temperature was about 12.6 °C in the years after 1991 and about 13.7 °C in the last years before 2020. So, in less than 30 years it has increased by about 1.2 °C. This trend only applies to the selected 2 weather stations in Bosnia and Herzegovina. A considerably more comprehensive evaluation of the global warming has been provided separately (WorldData.info, 2021a).

Figure 24: The average annual temperature in Bosnia and Herzegovina



Source: (WorldData.info, 2021a)

Precipitation changes until now

Annual precipitation amounts range from 800 mm in the north along the Sava River to 2000 mm in the central and south-eastern mountainous regions of the country. Maximum rainfall occurs mostly at the end of autumn or beginning of winter, i.e. in November or December (ClimateChangePost.com, 2021a).

The quantity of precipitation shows minimum changes in the previous 100 years of at most +/- 5%. The largest area of Bosnia and Herzegovina shows a negative trend during the spring and summer, while an increase in rainfall is found in the winter half of the year. A special related issue is the trend of decrease of snow during the winter periods, which decreases the accumulation of water in mountainous regions.

In the last decade, in the central mountainous zone, there is a trend of increase of rainfall sums at an annual level, whereas in the south-west areas (the area of Mostar) and north-west (area around Prijedor) part of the country there is a trend of decline (excluding final west – area around Bihać). In the north-east part of Bosnia and Herzegovina, particularly the area around Doboj and Sokolac, there is an increase in rainfall (up to 13%) (Vukmir et al., 2009).

Precipitation changes in the 21st century

Projections of precipitation change over the Mediterranean for the thirty-year period 2031–2060, compared with 1980–1990 (SRES B2 scenario), indicate that all parts of the Mediterranean (including the Balkans) are expected to see a decrease in summertime precipitation and a small decrease or no change in the other seasons (Vukmir et al., 2009).

Solar intensity in Bosnia and Herzegovina

Solar intensity in the Bosnia and Herzegovina is assessed in terms of its photovoltaics power potential. The average solar intensity is around 1200 kWh / kWp in most of the country with higher outputs exceeding 1400 kWh / kWp in the southern area of the country – in the lower altitude areas to the south below the Dinaric Mountains.

Figure 25: Photovoltaic power potential in Bosnia and Herzegovina (Solargis.com 2021)

Source: (World Bank Group, 2021)

Moldova

The climate of the Republic of Moldova is moderately continental, characterized by relatively mild winters with little snow, long warm summers and low humidity. The average annual air temperatures vary between 8–12°C, and precipitations between 450–900 mm per year (MENR, 2009).

Climate zone: Moderate zone of the northern hemisphere. The climate in Moldova is much more unsettled than in central Europe and offers varied seasons with deep winters and warm summers. Due to the warmer temperatures the best time for traveling is from May to September. Nearly unattractive for tourists are the cold months from November to March.

Air temperature changes in Moldova

Changes in air temperature have been calculated for two periods: 1887–1980 and 1981–2008. It can be said with high confidence that the mean seasonal (except autumn) and annual temperatures in the last three decades are different from the previous years. The variability of air temperature remains practically the same.

Annual air temperature in Moldova has increased during 1887–1980 by 0.035°C per decade, and by about 0.58°C per decade during 1981–2008. The temperature trends in last three decades are statistically significant for summer and annual temperatures (at a 95% confidence level) and for spring (at a 90% level). Further evidence of the acceleration of regional warming can be seen in the fact that seven years among the ten warmest in the history of instrumental observations in Moldova have been in the last two decades (UNDP, 2009).

Air temperature changes in the 21st century

The table below shows the results of projections of annual mean temperature change with respect to the period 1961–1990 that have been calculated for three-time horizons by six General Circulation Models and two emission scenarios (UNDP, 2009):

Table 1 Air temperature change in Moldova for next century

Time horizon	A2 scenario	B2 scenario
2010-2039	1.7°C	2.0°C
2040-2069	3.4°C	3.2°C
2070-2099	5.4°C	4.1°C

Source: (WorldData.info, 2021b)

Moldova expects maximal warming in winter and transition seasons. By the 2080s, the baseline negative winter mean temperatures (-2.1°C) could increase to up to +2 to +4°C; the spring and autumn mean temperatures could increase by about 40-50%. Minimal relative warming is expected in the summer months: by 9–12% in the beginning and by about a third by the end of the century. On the whole, Moldova will face warmer and wetter winters but hotter and drier summers and autumns. To use an analogy, Moldova can expect winters like in England and summers like in Greece or Spain (UNDP, 2009).

According to the model results the number of days typical of the winter season will decrease in the central part of the country by 39–87 days (depending on the model used) by 2070 and by 85 days – under all the applied models – by 2100, as compared to the climate during the reference period (1961–1990). The days typical of the winter period will disappear in the central and southern part of the Republic of Moldova by 2100. In the north the number of the days typical for the winter period will decrease at least by half and reach 50–52 days as compared to the 105 days registered for the climate during the reference period (1961–1990). The resultant effect will be a higher number of the days typical of autumn, spring and summer. Thus, summer will be 25–40 days longer in the central and southern part of the Republic of Moldova and at least 35–53 days longer in the north (MENR, 2009).

The frequency of days with temperatures above 30°C in Moldova for the period 2071–2100 may reach 60 to 90 days a year, compared to 10 to 30 before the 1980s, depending on the climate model used. Night summer temperatures are also projected to increase considerably. By the 2080s the 99% quintile of mean summer T_{max} in Chişinău is likely to reach 35°C, which is 7°C more than the same quintile in 1961–1990 (UNDP, 2009).

Precipitation changes in the 21st century

The table below shows the results of projections of annual precipitation change with respect to the period 1961–1990 that have been calculated for three-time horizons by six General Circulation Models and two emission scenarios (UNDP, 2009):

Table 2 Precipitation changes in Moldova for next century

Time horizon	A2 scenario	B2 scenario
2010-2039	-9%	-17%
2040-2069	-38%	-11%
2070-2099	-64%	-23%

Source: (WorldData.info, 2021b)

According to these projections a continuous annual decrease of precipitation is expected. Some increase in precipitation is expected in winter and spring time, but the summer and autumn tendencies are mainly negative (20–30% decrease by the 2080s) (UNDP, 2009).

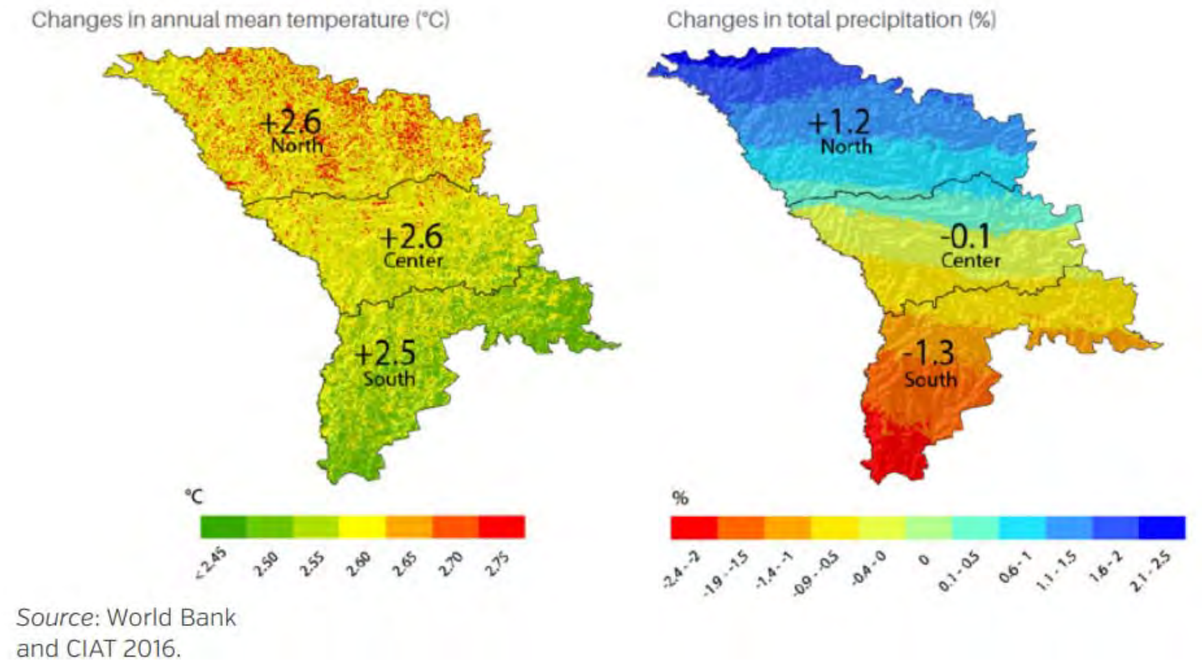
The projected precipitation levels fluctuate depending on the season as well as the particular climate model applied to make the forecast; model results have been reported that show an increase of annual precipitation in 2100 (by 48.61 and 107.71 mm, respectively). These model results show considerable differences throughout the year: a more pronounced increase during the winter months (December–February) and in spring (March–May) for the model results that indicated an annual precipitation increase. All the applied climate models have yielded the reduced monthly precipitation averages for summer (August) and autumn (September–November) already during 2010–2039 (MENR, 2009).

By 2100 the growing evaporation rates caused by higher temperatures will result in the increase by 12.7–33.3% in soil humidity deficit as compared to the reference period of 1961–1990 (MENR, 2009). Another study reports an evaporation increase of 15-20% in 2010–2039 and practically twice this value by the end of this century compared with 1961–1990. Moldova seems to be moving towards a dryer climate, from insufficiently wet and wet sub-humid zones to dry sub-humid and semiarid zones (UNDP, 2009) (ClimateChangePost.com, 2021b).

Projected Changes in Temperature and Precipitation in Moldova by 2050

By mid-century the air temperature in Moldova is expected to be 1.7–2.0°C higher than in 1961–1990, and by the end of the century to be 4–5°C higher, unless greenhouse gas emissions are significantly reduced. The projected rise in temperatures, rainfall volatility, and incidence and severity of drought could undermine the long-term positioning of the country as one of the region's major agricultural producers (ClimateChangePost.com, 2021b).

Figure 26: Changes of temperature and total precipitation in Moldova



Data source: (World Bank, 2016), (CIAT 2016), (reliefweb.int, 2021)

Precipitation changes in Moldova until now

Changes in precipitation have been calculated for two periods: 1887–1980 and 1981–2008. The changes in the precipitation regime are not significant in their quantity; however, there is evidence of an increase in their variability in transition seasons (ClimateChangePost.com, 2021b).

The precipitation picture is more complex. There is a change in the direction of some trends from 1887–1980 to 1981–2008: from a decrease to an increase in spring, and from an increase (about 6 mm per decade) to a decrease in the last thirty years (above 13 mm per decade) in summer. For autumn-winter and annual precipitation the previous slight increase is continuing (UNDP, 2009).

Solar intensity

Moldova's solar intensity is assessed in terms of its photovoltaics power potential. The country can be divided into three regions as the average solar intensity increases from north to south. Average solar intensity in the North Moldova is around 1,200 kWh/kWp. It increases to around 1,260 kWh/kWp in the Central part of Moldova and the highest is in the South Moldova with average values of more than 1,320 kWh/kWp.

Figure 27: Photovoltaic power potential in Moldova

Source: (World Bank Group, 2021)

Montenegro

Northern part of Montenegro is dominated by high mountains; the central part is made up of the karst area with major depression/lowland areas, while coastal plains varying in width from a few hundred meters to several kilometres extend in parallel with the coast. The coastal zone is separated from the mainland by mountains whose slopes sometimes steeply descend to the coast. The lowest part of the central mainland area consists of the Zeta River and lower flow of the Morača River valleys, making up the Zeta-Bjelopavlići plain with Skadar Lake - the largest lake in the Balkans.

The southern part of Montenegro and the Zeta-Bjelopavlići plain have a Mediterranean climate with long, hot and dry summers and relatively mild and rainy winters. The climate is significantly more severe in the karst fields whose lowest parts lie far below the surrounding mountain peaks and are located at a distance of 40–80 km from the Adriatic Sea, as well as in the fields that are quite close to the coast (about 20 km) but are separated from the sea by high mountains.

The central and northern parts of Montenegro have some characteristics of mountain climate, but the influence of the Mediterranean Sea is also evident, which is reflected through the precipitation regime and higher mean temperatures in the coldest months.

The far north of Montenegro has a continental climate and low annual precipitation evenly distributed over all months. In the mountainous areas in the north summers are relatively cool and humid, and winters are long and harsh, with frequent frosts and low temperatures, which rapidly decreases with height (MSPE, 2010).

Average annual air temperatures range from about 15.8°C in the south to 4.6°C in the north. Annual precipitation ranges from about 800 mm in the north to about 5,000 mm in the southwest. On the slopes Orjen, in the village of Crkvice (940 m above sea level), precipitation may even reach 7,000 mm in record years, which makes it the rainiest place in Europe (MSPE, 2010) (ClimateChangePost.com, 2021c).

Air temperature changes until now

Changes in temperature and precipitation have been quantified for Podgorica (Montenegro) for observations over the period 1951–2018. Maximum and summer temperatures have increased more than minimum and winter temperatures: the trend of increasing average spring and summer temperatures is 0.32°C and 0.37°C per decade, respectively, compared with 0.12°C and 0.15°C per decade for average autumn and winter temperature, respectively. The trend for average annual temperature is 0.27°C per decade. The number of summer and tropical days, and tropical nights is also increasing (Burić, D. and Doderović, M., 2021).

In coastal Montenegro, the frequency of warm nights and warm days increased while the frequency of cold nights and cold days decreased during 1951–2010 (Burić et al., 2014).

Historical air temperatures

Between 1955 and 2021, the hottest temperature on record was reported by the Podgorica weather station. In August 2007 the record temperature of 44.8 °C was reported here. The hottest summer from July to September, based on the data from the only two weather stations in Montenegro below 790 meters altitude, was recorded in 2012 with an average temperature of 28.2°C. This average temperature is measured every 4 to 6 hours, thus also including the nights. Long term average is 25.0°C. The average maximum daily temperature at that time reached 34.7°C.

The coldest day in these 66 years was reported by the weather station Podgorica. Here the temperature dropped to -8.6°C in January 2000. Podgorica lies at an altitude of 50 meters above sea level. The coldest winter (January to March) was in 1956 with an average temperature of 4.6 °C. In Montenegro, it is usual to have about 3.1 degrees more at 7.7°C for this three-month period.

The most precipitation fell in November 2019. With 22.1 mm per day, the Podgorica weather station recorded the highest monthly average of the last 66 years (Worlddata.info, 2021c).

Precipitation changes until now

Changes in temperature and precipitation have been quantified for Podgorica (Montenegro) for observations over the period 1951–2018. Seasonal and annual precipitation did not show significant changes in the period 1951–2018. The number of days with more than 1 mm precipitation has significantly decreased, and the number of days with more than 40 mm has increased, however, indicating that Podgorica's climate has become drier and with more frequent extremely high daily sums (Burić, D. and Doderović, M., 2021).

Precipitation changes in the 21st century

Projected seasonal precipitation change in 2001–2030 (SRES A1B Scenario), compared with 1961–1990, is negative or positive, depending on the part of Montenegro and the season (MSPE, 2010):

- summer: positive changes up to 5% for the central area of Montenegro;
- autumn: positive changes up to 5% near the border with Bosnia and Herzegovina;
- winter, spring: a decrease in precipitation from -10% to 0%.

For the SRES A1B scenario, projected seasonal precipitation change in 2071–2100, compared with 1961-1990, shows a decrease for all seasons and all parts of Montenegro:

- winter: -30% in the central parts of Montenegro, values of up to -30% in the northern and coastal parts;
- spring: about -10% in the whole territory;
- summer: a significant decrease in coastal areas, and a decrease in the central and northern parts of -20 to -15%;
- autumn: a significant decrease in precipitation from -30 to -50%.

For the SRES A2 scenario, during all seasons, except for winter, model results show a precipitation decrease over the entire territory of Montenegro (MSPE, 2010):

- winter: a precipitation increases of 5-10% is projected in the north-western parts, and a decrease of -5% to -10% in the other parts of the country;
- summer: the biggest decrease, especially along the coast, of -50%. A decrease of -10% in the northern parts;
- spring and autumn: a more uniform decrease with a mean value of -20% (ClimateChangePost.com, 2021c).

Solar intensity

Montenegro's solar intensity is assessed in terms of its photovoltaics power potential. The average solar intensity is above 1,250 kWh/kWp in northeast half of the country and above 1,400 kWh/kWp in southwest half of the country with higher outputs exceeding 1,500 kWh/kWp in areas with lower altitude (compared to the rest of the territory).

Figure 28: Photovoltaic power potential in Montenegro

Source: (World Bank Group, 2021)

Serbia

Serbia has a moderately continental climate with warm to hot summers and cold winters in the north and relatively mild winters in the south, close to the Adriatic. The temperate latitudes, presence of high mountain ranges, and the distance from major water bodies influence the climate of Serbia largely. The topographical features mainly include forests, farmlands, hills, mountains, rivers, and river valleys. The Dinaric Alps, Carpathian, Rhodopes, and Balkan Mountains are parts of mountain ranges that cover a large part of Serbia. The northern Vojvodina region consists of rich and fertile plains aided by the Danube River. The Morava River flows through the south, which consists of hills, mountains, limestone ranges, and river basins. The central and western parts have hilly terrain interspersed with rivers and creeks, while the eastern part consists chiefly of limestone ranges.

Temperature

Serbia has four distinct seasons with the average annual temperature in the 6.1°C to 11.1°C range depending on the altitude. Summers are warm to hot with the average high temperatures between 26.7°C and 32.2°C during the peak of August. Hot Saharan air can bring heat waves in the summer.

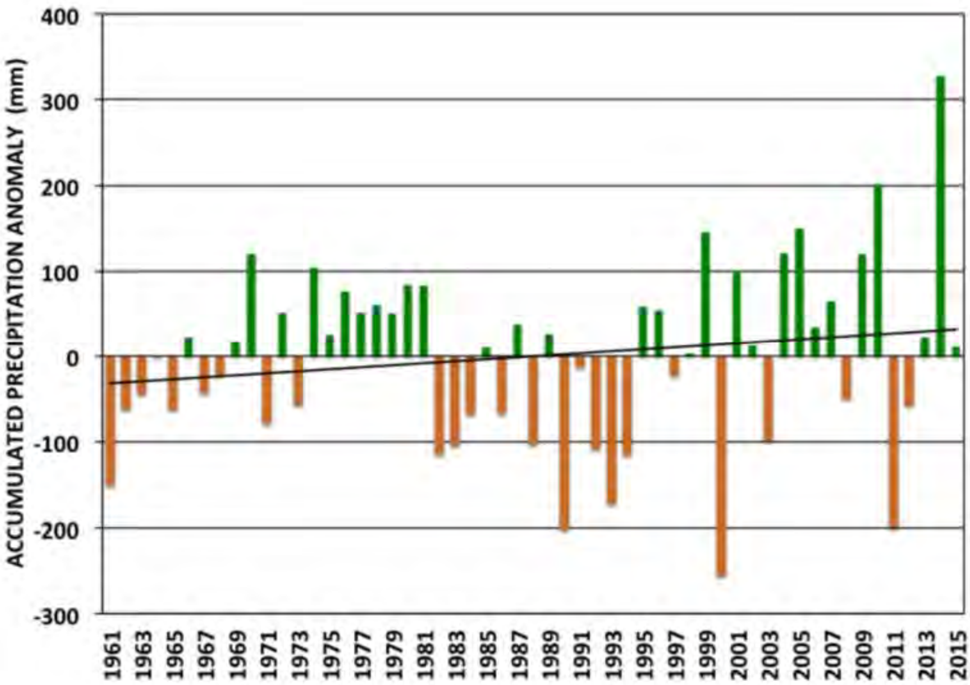
Winters are cold and snowy in the north, while the south has relatively mild temperatures due to the Mediterranean influence. Polar air masses can penetrate the country and further plummet the temperatures below freezing. Spring is damp and cold and receives snow in some parts of Serbia. Autumn is cloudy and wet, particularly during November in the western part of the country. The average annual temperature was about 11.9 °C in the years after 1991 and about 13.3 °C in the last years before 2020. So, in less than 30 years it has increased by about 1.4 °C (Worlddata.info, 2021d).

Precipitation

The annual precipitation varies by region with 584.2 mm in the north and east, and 609.6 mm in the south. Central Serbia with Belgrade accounts for 685.8 mm of rainfall, while the western part receives slightly more than 685.8 mm. The mountains receive more than 1,016 mm of rain at altitudes above 1,000 meters. May and June are generally the rainiest months in Serbia. The snow cover lasts from November to March, with the majority of the snowfall in January. Snowfall is moderate in the southern region while it increases with altitude and lasts for approximately 120 days on the higher mountain slopes.

Annual precipitation averaged over Serbia shows more complex variability during the period 1961–2015. During the 1980ties and first half of 1990ties precipitation over Serbia was decreasing, and started increasing from mid 1990ies, but with higher variability in values and intercepted with significantly dry years. Highest annual precipitation averaged over Serbia is recorded for 2014 and lowest for 2000. Mean annual accumulated precipitation over Serbia in the period 1996–2015 increased by 4.4% compared to the period 1961-1980, with highest increase during autumn (21.7%), but with decrease during summer (-9.2%) (Ana Vukovic et al., 2018). The most precipitation fell in May 2014, with 9.0 mm per day, the Beograd weather station recorded the highest monthly average of the last 70 years.

Figure 29: Serbia - Anomaly of annual accumulated precipitation with respect to the mean values for the period 1961-2015

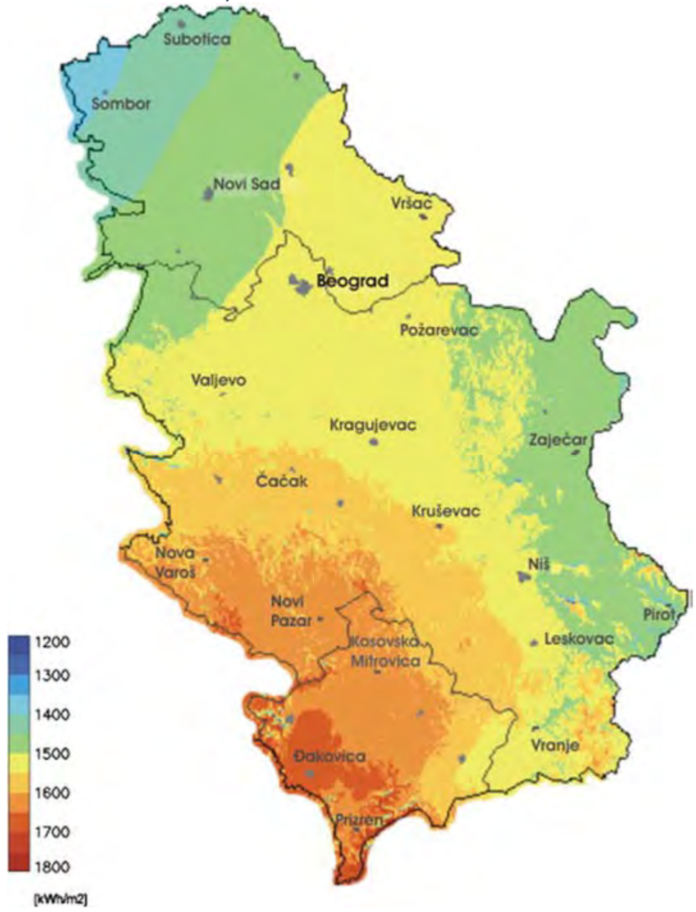


Source: (Ana Vukovic et al., 2018).

Solar intensity

Serbia has significantly higher number of solar radiation hours than most of the European countries. The number of hours of solar radiation on the territory of Serbia is between 1,500 and 2,200 hours per year. The average intensity of solar radiation is 1,200 kWh/m^2/year in northwest Serbia, 1,550 kWh/m^2/year in southeast Serbia, while in the central part is around 1,400 kWh/m^2/year. The occurrence of anomalies in the level of solar intensity in the country is not available.

Figure 30: Serbia – Annual solar radiation intensity



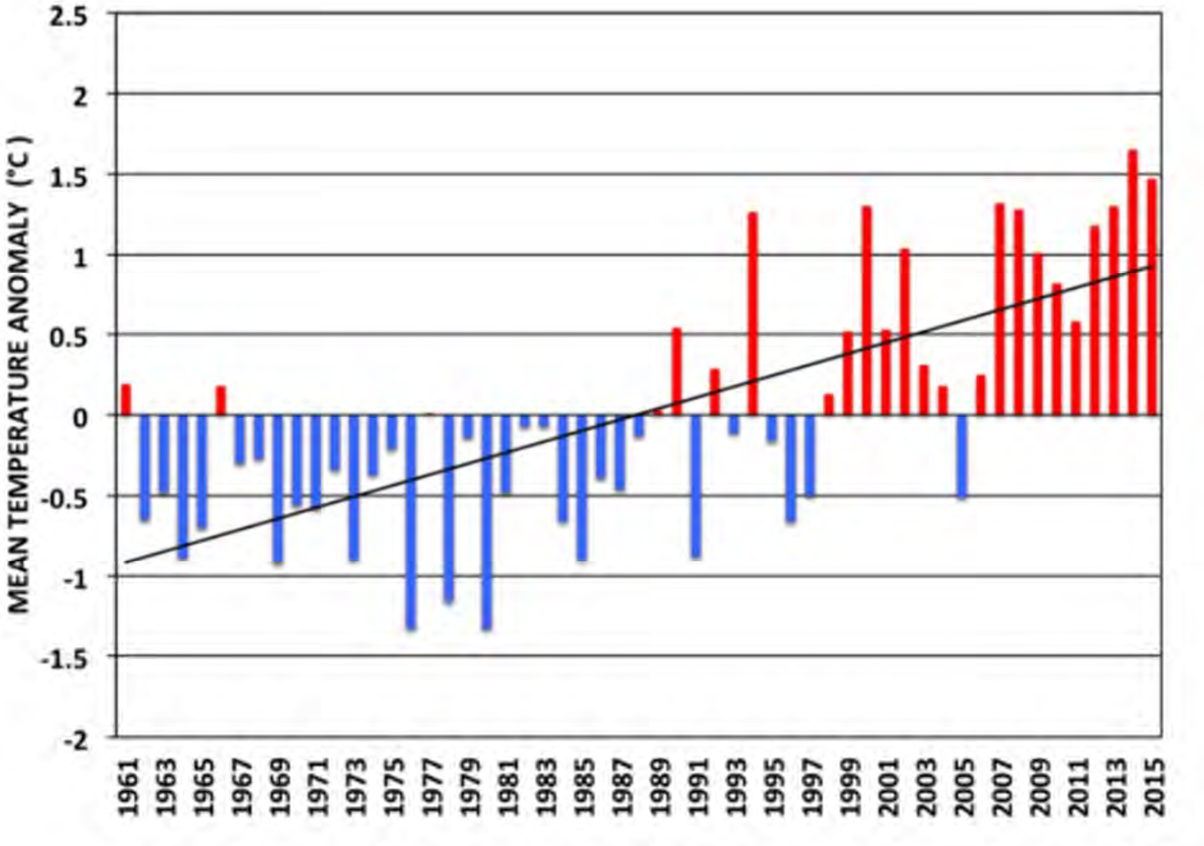
Source: (Renewable and Sustainable Energy Reviews, 2016).

Changes in annual temperature

During July and August 2007, record high temperatures were observed over almost the whole territory of Serbia, and the temperature of 44.9°C in July was registered in Smederevska Palanka, which was the absolute maximum value ever recorded. The highest increase over the previous absolute maximum temperature, dating back to 1888, of 3.1 °C, was registered in Belgrade. In Serbia, the mean summer temperature of 2007 exceeded the 1961–1990 mean by 3°C. An analysis of the daily maximum temperatures and heat waves during the summer of 2007 revealed significant changes in the trends of anomalies and extreme (90%) quantiles. 1987, 2007 and 1998 were the three years with the longest heat waves from the beginning of measurements, having a duration of 13, 11 and 10 days, respectively (Ana Vukovic et al., 2018).

Temperature increase averaged over the territory of Serbia is 1.2°C for the period 1996–2015 with respect to the period 1961–1980, with highest increase of maximum daily temperature during the summer season, 2.2°C.

Figure 31: Serbia - Anomaly of mean annual values of temperature with respect to the mean values for the period 1961–2015



Source: (Ana Vukovic et al., 2018).

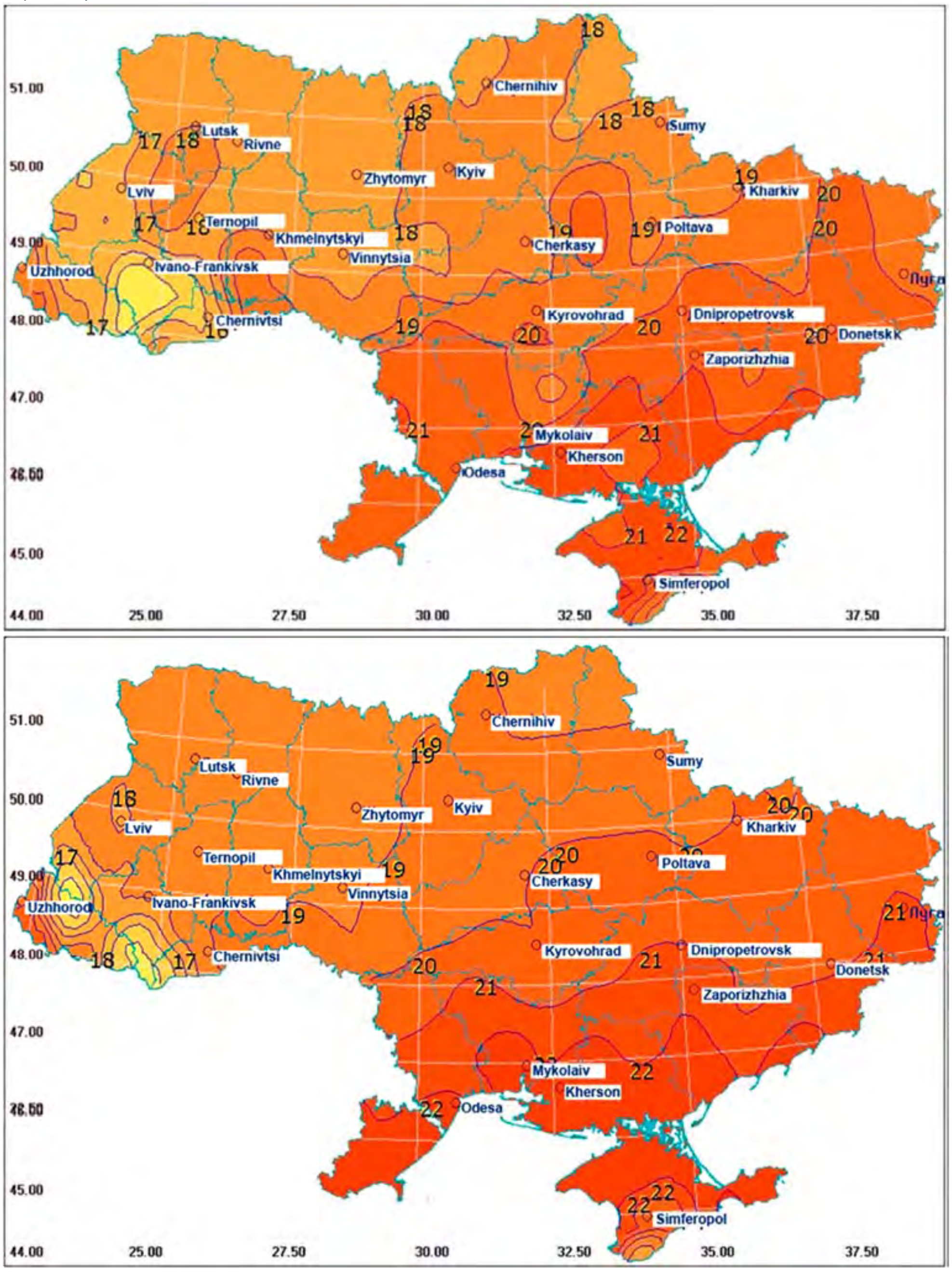
Ukraine

Ukraine primarily has a temperate continental climate, with a subtropical Mediterranean climate on the southern coast of Crimea. The west and northwest are mild and moist, and the south and southeast are characterized by a lack of precipitation and slightly warmer temperatures. Average annual temperatures range from 5–6°C in the northeast to 9–11°C in the southwest. On average, up to 1,200 mm of rain fall annually in the mountains, but 300–700 mm of rain falls in the plains, with decreasing amounts from the north/northwest to south/southeast. Ukraine has three large agro-ecological zones – the Polissya mixed forest zone in the north, a Forest-Steppe zone to the south and a Steppe zone in the south and southeast –as well as the Carpathian Mountain region in the west and the Crimean Mountains in the far south (climatelinks, 2016).

Temperature

Studies of the Ukrainian climate indicate that the temperature and some other meteorological parameters differ from the long-term average in recent decades (average values for the period 1961−1990).

Figure 32: Ukraine - The average summer air temperature near the ground over the period from 1961 to 1990 (above) and 1991 to 2010 (below)

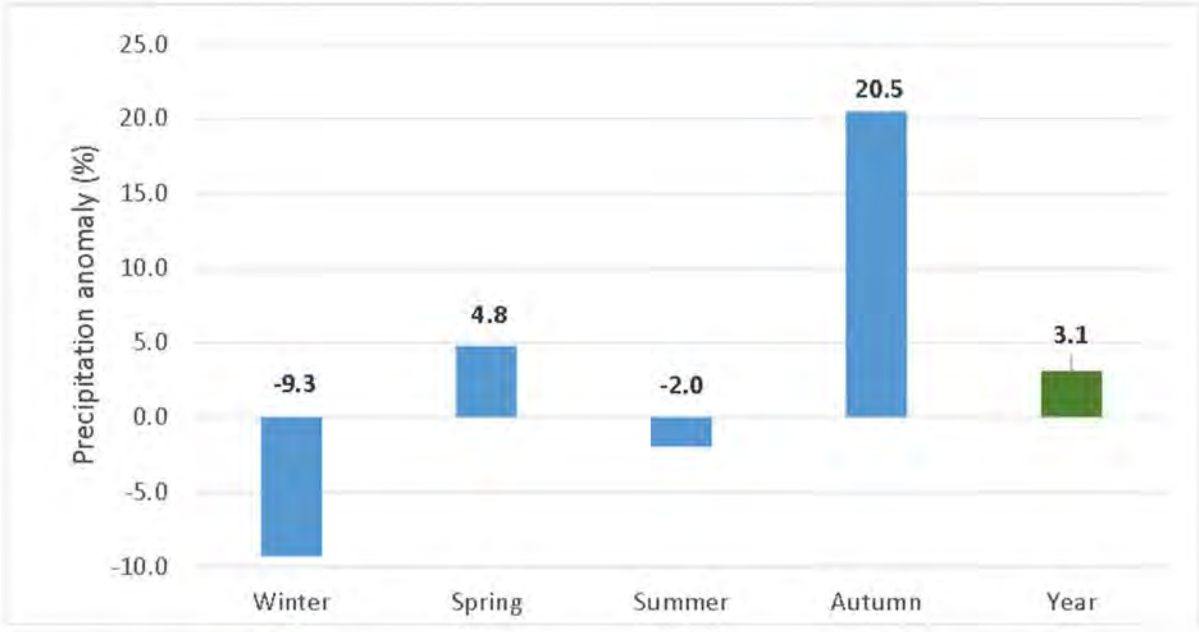


Data source: (Climate Forum East (CFE) and NGO Working Group on Climate Change, 2014)

Precipitation

Redistribution of precipitation was recorded both in terms of regions and seasons. Winter precipitation decreased in the whole country, in autumn, on the contrary, a slight increase was recorded. In spring and summer, the rainfall amount changed just slightly. Total annual rainfall remained unchanged. Recent decades witnessed the increase of heavy rains when a monthly amount of precipitation falls in one day. Increased air temperature and uneven distribution of storm precipitation, and localized heavy rainfall in the warm season, which does not provide an effective accumulation of moisture in the soil, can cause the increased incidence and intensity of droughts (Climate Forum East (CFE) and NGO Working Group on Climate Change, 2014).

Figure 33: Ukraine - Redistribution of seasonal precipitation over the period from 1991 to 2010 compared to the 1961–1990 average

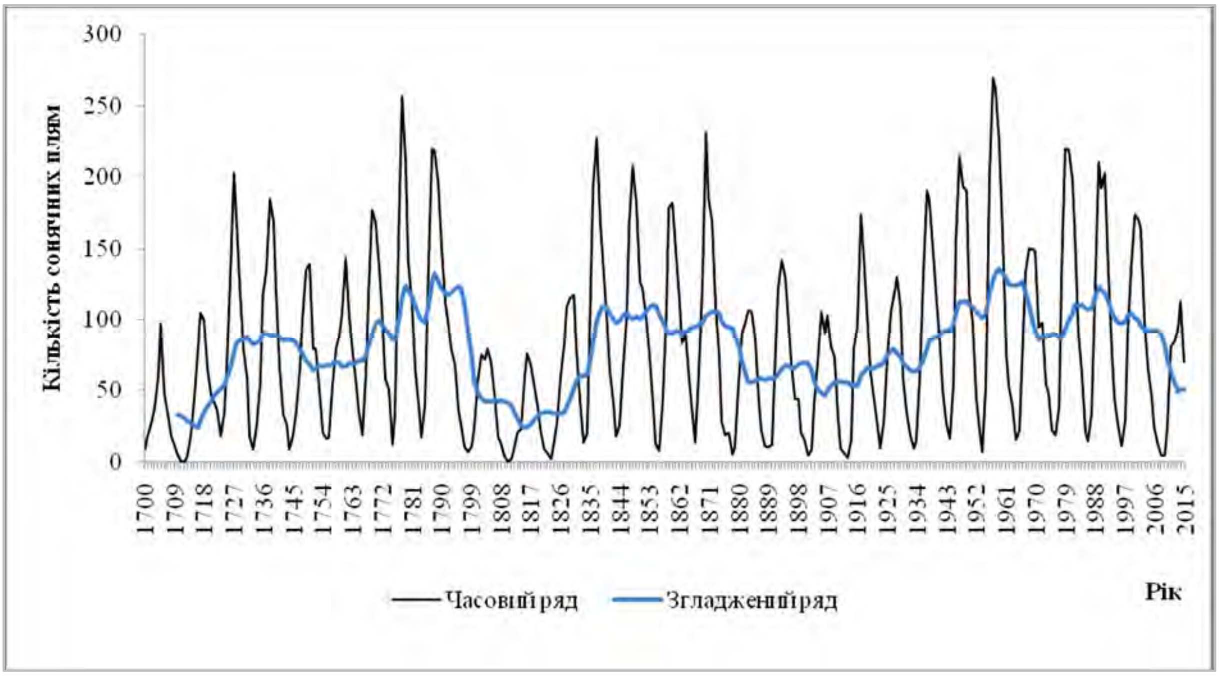


Data source: (Climate Forum East (CFE) and NGO Working Group on Climate Change, 2014)

Solar intensity

The level of solar intensity has increased quite substantially since the middle of 20th century, despite a drop in 2015, as you can see on the figure below.

Figure 34: Ukraine - Changes in the average annual number of sunspots in the period 1700–2015.



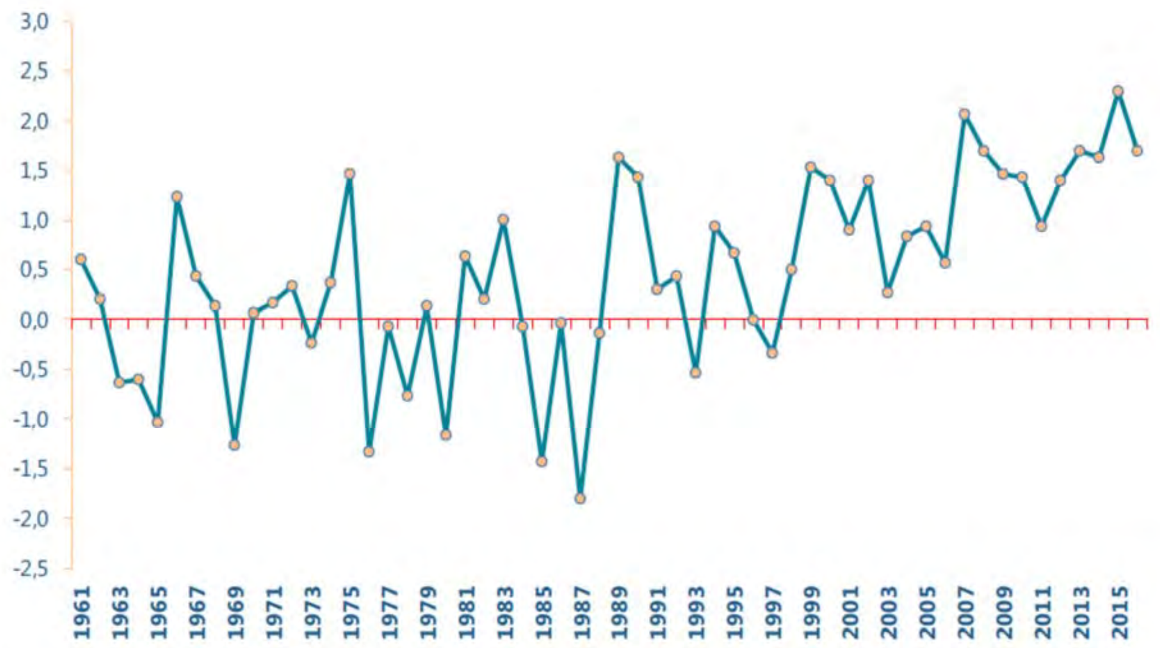
Data source: (Borys Buznytskyi, B., 2018)

Changes in mean annual temperature

There was an evident increase in air temperature in Ukraine over the period from 1991 to 2010 compared to the period from 1961 to 1990. More recent data, unfortunately, were not found. The average annual air temperature over the 1991 to 2010 has increased by 0.8°C compared to the 1961 to 1990 average. The Fifth National Communication on Climate Change states that the highest increase in air temperature occurred in January (approximately by 2°C). In July the air temperature increased throughout Ukraine by 1.0–1.5°C. In the west the isotherm is equal to 19°C instead of 18°C; in the south the isotherm reached the unprecedented value of 22°C as never observed before during the standard climatic period. Extreme temperatures have changed as well. The minimum temperature increased in most months and the whole year. Maximum temperatures in winter months also had a tendency to increase (Climate Forum East (CFE) and NGO Working Group on Climate Change, 2014).

Compared to the period 1961–1990 the annual average temperature has increased from +7.8°C to +8.8°C in 1991–2016 and to +9.4°C in 2007–2016 (Ukraine, 2017).

Figure 35: Ukraine – Anomalies in annual average air temperature compared to the climate norm.



Data source: (Ukraine, 2017)

2.2 CLIMATE CONDITIONS SUMMARY

Europe has diverse climate. Many countries comprise two or more climate zones. Even within the smallest countries, weather patterns might change in span of tens of kilometres. It is therefore difficult to describe the region's climate without dwelling into regions' specifics.

However, there is a common trend that is more or less visible in all the countries. The trend is warming and subsequent changes. Most of the countries described above saw increases in average temperatures in the last three decades. Winters are warmer on average and summers are hotter than was the case thirty or sixty years ago. Historical temperatures from countries with the longest records show even bigger increase.

Temperature increases are followed by changes in weather patterns. A global prediction of precipitation distribution changes seems to be confirmed by the data. Even though the yearly totals remain unchanged, rainfalls often concentrate into short time periods, making it harder for water to soak into the soil.

Photovoltaic power potential is one of the key statistics, in terms of climate, as it represents the potential utilization rate of the renewable energy source – solar energy. Following table presents power output of a PV system (specific yield), i.e. *"the long-term power output produced by a utility-scale installation of monofacial modules fixed mounted at an optimum tilt*" (World Bank Group, 2020). It can be assessed that all states are above the average annual value of 1,000 kWh/kWp, which is suitable for the economic use of photovoltaics. Countries with values above 1,200 kWh/kWp should focus on increasing the use of photovoltaic energy, preferably in areas with higher values.

Table 3 Practical photovoltaic power potential, long-term

	Daily totals (kWh/kWp/day)			**Yearly totals (kWh/kWp/year)**		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Austria	2.79	3.26	3.74	1 017	1 189	1 365
Bulgaria	3.41	3.70	4.02	1 244	1 352	1 468
Croatia	3.34	3.63	4.18	1 218	1 325	1 524
Czech Republic	2.85	3.05	3.22	1 041	1 113	1 175
Germany	2.75	2.96	3.33	1 003	1 081	1 214
Hungary	3.29	3.44	3.53	1 200	1 256	1 290
Romania	3.19	3.52	3.71	1 165	1 286	1 355
Slovakia	2.92	3.27	3.42	1 067	1 192	1 250
Slovenia	3.10	3.43	3.73	1 131	1 254	1 361
Bosnia and Hercegovina	3.22	3.57	4.10	1 177	1 303	1 497
Moldova	3.28	3.45	3.61	1 197	1 259	1 317
Montenegro	3.36	3.82	4.12	1 225	1 393	1 503
Serbia	3.32	3.52	3.77	1 212	1 285	1 376
Ukraine	2.99	3.30	3.67	1 090	1 203	1 340

Source: (World Bank Group, 2020), (World Bank Group, 2021)

3. RESIDENTIAL BUILDING STOCK

The chapter describes the current state of the housing stock. Depending on the availability of information, the housing stock is described in terms of:

- number of buildings or dwellings;
- types of buildings;
- occupancy of buildings;
- other available information (e.g. age of the housing stock, share of non - renovated buildings, energy performance of buildings, etc.).

AUSTRIA

The Register-based Census 2011 (reference day: 31 October) counted 2,191,280 buildings and 4,441,408 dwellings. This signifies an increase of 7.1% in the number of buildings compared with the Census in 2001 when 2.05 million buildings were captured, and related to the number of 3.86 million dwellings in 2001 a rise of 15.0%. Because of the fact that these figures are not compiled solely for the entire country but also for municipalities and even smaller areas, the results of the Census serve as basis for many measures implemented by public authorities.

Table 4: Austria - Total number of buildings 1951–2011

Land	1951	1961	1971	1981	1991	2001	2011
Austria	**896 030**	**1 049 953**	**1 281 114**	**1 586 841**	**1 809 060**	**2 046 712**	**2 191 280**
Burgenland	58 504	66 617	76 978	93 413	103 529	114 403	123 109
Carinthia	69 767	84 795	105 024	126 574	143 929	162 075	172 465
Lower Austria	259 037	293 843	355 398	437 075	494 198	553 604	591 433
Upper Austria	150 518	180 788	222 548	269 652	307 850	352 326	383 429
Salzburg	44 683	55 867	69 516	87 259	102 691	119 818	129 233
Styria	150 087	176 329	213 121	257 046	288 802	325 822	350 651
Tyrol	58 193	72 000	91 332	116 874	138 537	161 261	177 745
Vorarlberg	32 293	40 680	50 988	64 627	75 831	89 236	98 469
Vienna	72 948	79 034	96 209	134 321	153 693	168 167	164 746

Data source: (Statistics Austria, 2021)

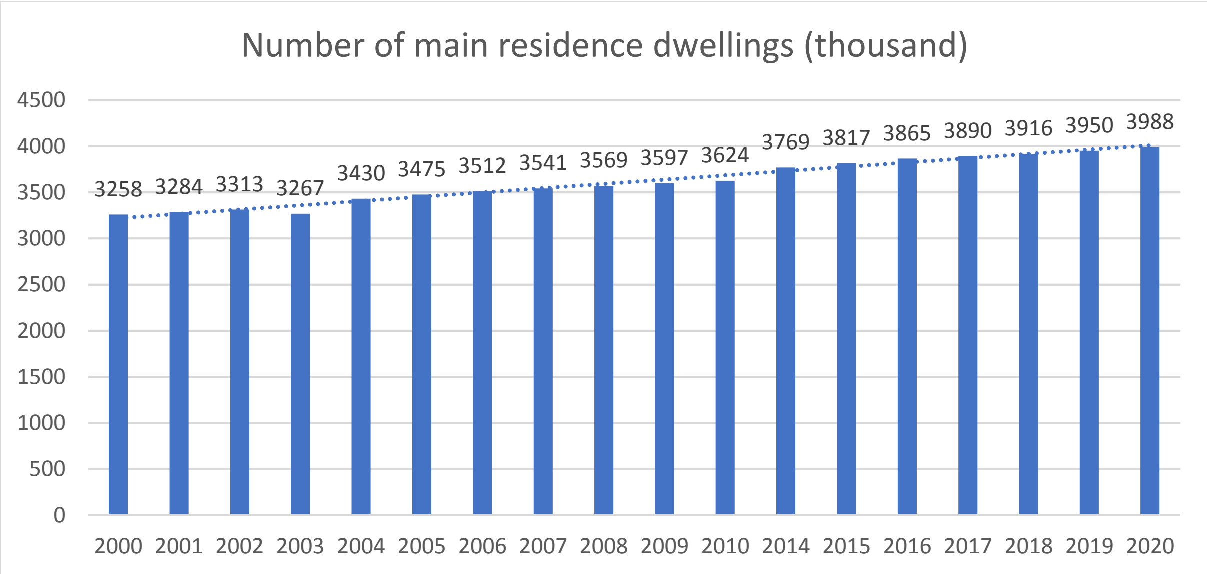
Slightly less than four fifths of all buildings in Austria are residential buildings with one or two dwellings. One building out of nine is a residential building with three or more dwellings, 9.9% are non-residential buildings. By contrast only 45.3% of all dwellings are located in residential buildings with a maximum of two dwellings. 21.6% are located in residential buildings with three to ten dwellings, 29.9% are in residential buildings with 11 or more dwellings, and only 2.9% of the dwellings are located in buildings that primarily serve commercial, industrial or cultural purposes or the provision of services.

Table 5: Austria - Total number of Conventional dwellings[2] 1951–2011

Land	1951	1961	1971	1981	1991	2001	2011
Austria	**2 138 001**	**2 249 678**	**2 666 048**	**3 052 036**	**3 393 271**	**3 863 262**	**4 441 408**
Burgenland	72 592	76 205	85 195	99 956	110 920	126 269	147 376
Carinthia	127 224	127 281	160 698	189 603	223 267	260 541	301 096
Lower Austria	443 733	450 735	515 945	591 164	648 471	738 235	852 574
Upper Austria	312 315	324 923	383 483	451 122	513 150	604 299	699 956
Salzburg	96 452	96 384	129 693	168 971	200 860	238 480	282 847
Styria	304 824	318 270	372 028	425 076	469 527	532 470	616 801
Tyrol	113 650	121 072	160 196	203 761	249 774	303 632	375 583
Vorarlberg	52 986	58 034	77 292	101 209	124 211	148 591	181 335
Vienna	614 225	675 774	781 518	821 174	853 091	910 745	983 840

Data source: (Statistics Austria, 2021)

Figure 36: Austria - Number of main residence dwellings 2000–2020



Data source: (Statistics Austria, 2021)

BULGARIA

Bulgarian residential building stock has expanded in the last decade. A little more than 150,000 rooms, or 4.75%, were added. This amounted to 49 million square meters increase between 2010 and 2020. Interestingly, a trend of urbanization can be seen clearly. The bulk of the increase can be attributed to towns with more than 200,000 new rooms and additional 40 million sq. meters. Rural building stock has in fact seen a decrease of the total number of the rooms accompanied, nonetheless, by floor area increase of 10 million sq. m. Living in the country thus became more spacious. Detail figures are depicted in Table 6.

[2] Includes main residence dwellings and other dwellings (for temporary use such as hotels, pension or other buildings for holiday accommodation or without permanent occupation).

Table 6 Development of the housing stock of Bulgaria in 2010–2020

	2010	2015	2018	2019	2020
Total					
By rooms (number)	3 804 081	3 935 105	3 959 285	3 970 719	3 985 172
Useful floor space (m^2)	243 457 571	287 932 638	290 094 062	291 166 536	292 540 258
Living floor space (m^2)	156 539 409	218 401 395	219 770 797	247 764 374	248 804 919
In towns					
By rooms (number)	2 432 627	2 613 418	2 634 151	2 644 375	2 657 721
Useful floor space (m^2)	157 833 248	193 399 769	195 107 052	195 999 682	197 173 997
Living floor space (m^2)	98 485 703	145 534 189	146 611 756	166 449 378	167 343 434
In villages					
By rooms (number)	1 371 454	1 321 687	1 325 134	1 326 344	1 327 451
Useful floor space (m^2)	85 624 323	94 532 869	94 987 010	95 166 854	95 366 261
Living floor space (m^2)	58 053 706	72 867 206	73 159 041	81 314 996	81 461 485

Data source: (National Statistical Institute, 2021)

CROATIA

In 2020, the national building stock of Croatia covered a total useful floor area of 237,315,397 m^2, of which 178,592,460 m^2 in residential buildings and 58,722,937 m^2 in non-residential buildings. The floor area of permanently occupied residential buildings in 2020 was determined based on the 2011 census data, increased according to statistics on buildings completed and demolished between 2011 and 2018, and modelled for 2019 and 2020 data (Ministry of Physical Planning, Construction and State Assets, 2020b).

Table 7 Total gross floor area of buildings in Croatia (m^2)

	2011	2013	2015	2016	2017	2018
Residential	**146 561 449**	**146 694 496**	**146 782 378**	**146 821 550**	**146 875 125**	**146 924 679**
Multi-apartment	56 566 680	56 618 031	56 651 950	56 667 068	56 687 746	56 553 324
family	89 994 769	90 076 466	90 130 429	90 154 482	90 187 379	90 371 355
Non-residential	**51 571 744**	**53 004 401**	**54 244 761**	**55 414 108**	**56 440 826**	**57 493 554**
Private residential	**142 176 678**	**142 305 745**	**142 290 997**	**142 428 997**	**142 480 970**	**142 529 041**
Public residential	**4 384 771**	**44 388 751**	**4 391 381**	**4 392 553**	**4 394 155**	**4 395 638**

Data source: (Ministry of Physical Planning, Construction and State Assets, 2020b)

Verified data are from 2011 based on the CENSUS survey. In Croatia there were total of 2,246,910 dwellings with floor area of 168,651,195 m^2 (Croatian Bureau of Statistics, 2011).

- Dwellings for permanent residence: total of 1,912,901 dwellings amounting to 149,140,244 m^2 of which only 1,496,558 (121,125,768 m^2) were occupied (occupancy of 78.2%) and the rest was temporally unoccupied (17.9%) or abandoned (3.9%) .
- Dwellings used occasionally (e.g. for vacation and recreation and agricultural activities): 262,769 with floor area of 15,496,372 m^2.
- Dwellings for business activity only (for tourist renting and other activities): 71,240 with floor area of 4,014,579 m^2.

CZECH REPUBLIC

Housing stock is monitored by the Czech Statistical Office within the statistical survey "Census of Population, Housing and Dwellings" (SLDB). The census of population, houses and flats is administered every ten years. The last two were carried out in 2001 and 2011. Current census took place in the first half of 2021 with results expected to be available in 2022.

Table 8 Comparison of the increase in the number of houses between 2001 and 2011

Source	Houses total	Occupied houses	Of which		
			In family houses	In apartment buildings	Other
Census 2001	1 969 018	1 626 789	1 406 806	195 270	24 713
Census 2011	2 158 119	1 800 075	1 554 794	211 252	34 029
Increase pcs	189 101	173 286	147 988	15 982	9 316
Increase %	9.6%	10.7%	10.5%	8.2%	37.7%

Data source: (Czech Statistical Office, 2021)

Out of a total of 4,756,572 dwellings in 2011, 4,104,635 were occupied. Of these, 43.7% dwellings were in family houses and 55% in apartment houses. This number represented 456 of all occupied and unoccupied dwellings per 1,000 inhabitants of all inhabitants usually residing in the Czech Republic, or 393 occupied dwellings per 1,000 inhabitants. According to the 2001 census, there were an average of 427 all occupied and unoccupied dwellings per 1,000 inhabitants, or 374 permanently occupied dwellings per 1,000 inhabitants. In a pan-European comparison, the Czech Republic is around average, which is 483 dwellings per 1,000 inhabitants.

Table 9 Average living areas of dwellings divided into BD and RD in 2011

	Average living area	Average living area in apartment buildings	Average living area in family houses
Dwellings total	65.3	52.6	80.9
Occupied dwellings	86.7	68.5	109.1

Data source: (Czech Statistical Office, 2021)

Table 10 Housing stock of the Czech Republic in 2001

Dwellings	Dwellings total	of which		
		In family houses	In apartment buildings	Other
Dwellings total	4 366 293	2 005 122	2 310 641	50 530
Occupied dwellings	3 827 678	1 632 131	2 160 730	34 817
of which legal reason for using the dwellings:				
in own house	1 371 684	1 351 508	16 595	3 581
in personal ownership	421 654	107	421 547	0
in rent	1 092 950	60 103	1 013 031	19 816
In cooperative dwelling	652 028	2 895	545 917	103 216
other or unidentified	289 362	217 518	163 640	11 420

Data source: (Czech Statistical Office, 2021)

Table 11 Housing stock of the Czech Republic in 2011

Dwellings	Dwellings total	of which		
		In family houses	In apartment buildings	Other
Dwellings total	**4 756 572**	**2 256 072**	**2 434 619**	**65 881**
Occupied dwellings	**4 104 635**	**1 795 065**	**2 257 978**	**51 592**
of which legal reason for using the dwellings:				
in own house	1 470 174	1 444 476	21 140	4 558
in personal ownership	824 076	340	822 806	930
in rent	920 405	66 869	827 938	25 598
In cooperative dwelling	385 601	877	384 664	60
other or unidentified	504 379	282 503	201 430	20 446

Data source: (Czech Statistical Office, 2021)

The increase in the total number of occupied and unoccupied dwellings between 2001 and 2011 amounted to a total of 390,279 dwellings. The increase in occupied dwellings was 276,957 dwellings, of which 162,934 in family houses and 97,248 in apartment houses. In 2001, the number of unoccupied dwellings was 538,615 dwellings; in 2011, it increased to 651,937 dwellings. Among unoccupied dwellings, dwellings in family houses predominate (461,007) compared to dwellings in apartment buildings (176,641).

The territorial distribution of unoccupied flats also plays an important role. One third of all unoccupied apartments are in small villages, i.e. in municipalities with a population of less than 1 thousand. Almost half (46.6%) of all unoccupied dwellings are located in municipalities with less than 2,000 inhabitants, in which only less than a quarter (24.1%) of all occupied dwellings are located.

The share of rental flats in the Czech Republic is about 21.0%, which is almost 9.0% below the EU average of 29.9% as of SILC 2014 (Czech Statistical Office, 2021).

GERMANY

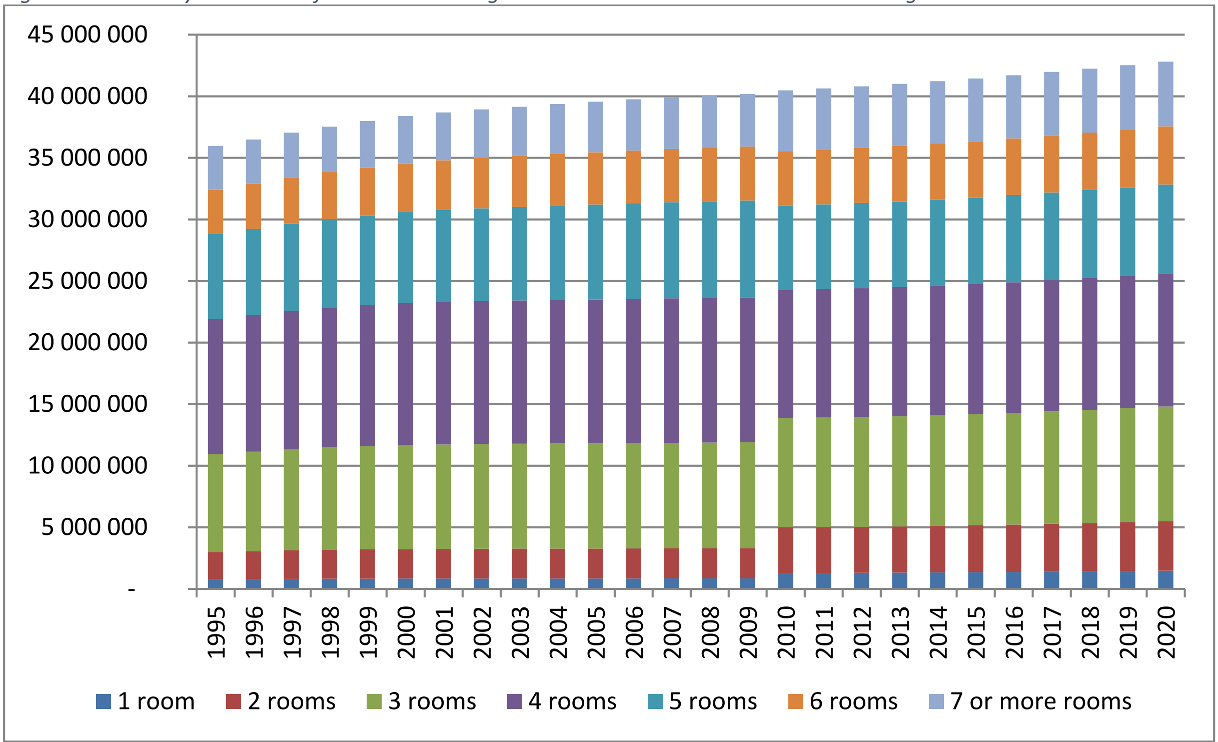
By the end of 2020, the number of dwellings in residential and non-residential buildings amounted to 42.8 million in Germany. The Federal Statistical Office (Destatis) also reports that the stock of dwellings rose by 0.7%, or 290,966 dwellings, on the previous year. Compared with 2010, the stock of dwellings increased by 5.7% or 2.3 million. This means that, at the end of 2020, there were 515 dwellings per 1,000 inhabitants, that is 20 dwellings more than ten years earlier (Federal Statistical Office, 2021).

At the end of 2018 there were over 19 million residential buildings in Germany; this corresponds to an increase of almost 730,000 compared with the building and apartment census of May 9, 2011. The largest percentage increase can be observed in residential buildings with one apartment, which are usually single-family houses. Irrespective of the region, this stock has increased significantly more than the stock of residential buildings with several apartments. Clear regional differences can be observed in the development of residential buildings with three or more apartments. In the western German states there was a significant increase in this type of building from 2011 to 2018, whereas this stock in the eastern German states shows only a slight change. This means that Germany continues to be a country of single and two-family houses. At the end of 2018, 83% of the residential buildings had only one or two apartments, with only minor differences between the eastern German states (82%) and the western German states (84%). Even in the city-states, it was around two-thirds of all residential buildings with the level of 65%. Number of dwelling in residential building reflects the growth of one-person households, especially in the southern states (Danube region) of Germany. In Baden-Württemberg, the share of one-person households in the total number has increased from 20% in 1950 to 40% in 2019 (Statistisches Landesamt Baden-Württemberg, 2021).

Based on the final results of the 2011 census of buildings and housing, the dwelling stock in 2016 was structured as follows: most of the dwellings in Germany (25%) consisted of 4 rooms. The percentage share of dwellings with 3 rooms was under 22%, respectively 17% within the dwellings with 5 rooms.

At the end of 2020, the living floor area of the housing stock totalled a little over 3.9 billion square meters. This number has increased by 7.0% compared to 2010. The living floor area per apartment averaged 92.0 m^2 at the end of 2020, in Baden-Württemberg - 97.5 m^2, the living area per resident was 47.4 m^2. This means that the living floor area per apartment has increased in Germany by 1.1 m^2 and the living floor area per resident by 2.4 m^2 since 2010. The average number of residents per apartment decreased from 2.02 to 1.94.

Figure 37: Germany – Number of rooms in dwellings in residential and non-residential buildings



Data source: (Federal Statistical Office, 2021)

Table 12: Germany – Number of dwellings and residential buildings in 2020

Reference date Länder	Number of dwellings in residential buildings									
	1 dwelling		2 dwellings		3 or more dwellings		Residential establishments		Total	
	Residential buildings	Dwellings	Residential buildings	Dwellings	Residential buildings	Dwellings	Residential buildings	Dwellings	Residential buildings	Dwellings
2020-12-31										
Baden-Württemberg	1 504 045	1 504 045	512 392	1 024 784	436 168	2 550 689	3 555	82 154	2 456 160	5 161 672
Bayern	2 102 661	2 102 661	568 649	1 137 298	438 111	2 974 758	3 540	102 282	3 112 961	6 316 999
Berlin	171 177	171 177	17 437	34 874	141 069	1 717 985	673	29 029	330 356	1 953 065
Brandenburg	527 821	527 821	67 547	135 094	87 249	642 575	402	11 592	683 019	1 317 082
Bremen	94 674	94 674	13 708	27 416	32 340	225 923	150	5 431	140 872	353 444
Hamburg	152 237	152 237	20 456	40 912	83 130	752 548	450	10 299	256 273	955 996
Hessen	871 954	871 954	295 791	591 582	233 883	1 456 480	3 593	55 459	1 405 221	2 975 475
Mecklenburg-Vorpommern	297 359	297 359	38 570	77 140	65 071	516 892	211	5 185	401 211	896 576
Niedersachsen	1 690 869	1 690 869	332 018	664 036	254 300	1 525 682	2 306	37 496	2 279 493	3 918 083
Nordrhein-Westfalen	2 443 048	2 443 048	653 906	1 307 812	816 758	4 960 569	4 589	94 045	3 918 301	8 805 474
Rheinland-Pfalz	874 580	874 580	189 268	378 536	135 258	766 769	1 101	22 137	1 200 207	2 042 022
Saarland	212 752	212 752	64 635	129 270	29 806	157 002	133	3 507	307 326	502 531
Sachsen	502 534	502 534	132 279	264 558	199 005	1 518 530	527	23 065	834 345	2 308 687
Sachsen-Anhalt	411 800	411 800	71 496	142 992	97 298	696 499	353	7 999	580 947	1 259 290
Schleswig-Holstein	655 894	655 894	81 769	163 538	93 817	639 015	719	10 328	832 199	1 468 775
Thüringen	354 042	354 042	93 745	187 490	86 210	598 618	398	10 598	534 395	1 150 748
Total	**12 867 447**	**12 867 447**	**3 153 666**	**6 307 332**	**3 229 473**	**21 700 534**	**22 700**	**510 606**	**19 273 286**	**41 385 919**

Data source: (Federal Statistical Office, 2021)

Table 13: Germany – Living floor area in different kinds of residential buildings

Reference date	**Number of dwellings in residential buildings**														
	1 dwelling			**2 dwellings**			**3 or more dwellings**			**Residential establishments**			**Total**		
	Residential buildings	**Dwellings**	**Living floor space**	**Residen. buildings**	**Dwellings**	**Living floor space**	**Residential buildings**	**Dwellings**	**Living floor space**	**Resid. building**	**Dwellings**	**Living floor space**	**Residential buildings**	**Dwellings**	**Living floor space**
	number	**number**	**1000 qm**	**number**	**number**	**1000 qm**	**number**	**number**	**1000 qm**	**number**	**number**	**1000 qm**	**number**	**number**	**1000 qm**
2020-12-31	12 867 447	12 867 447	1 664 613	3 153 666	6 307 332	609 668	3 229 473	21 700 534	1 516 646	22 700	510 606	21 990	**19 273 286**	41 385 919	3 812 916
2019-12-31	12 786 505	12 786 505	1 651 599	3 141 027	6 282 054	606 470	3 210 933	21 529 478	1 502 983	22 512	502 291	21 694	**19 160 977**	41 100 328	3 782 746
2018-12-31	12 707 978	12 707 978	1 638 840	3 129 233	6 258 466	603 465	3 193 736	21 369 968	1 490 084	22 269	492 305	21 326	**19 053 216**	40 828 717	3 753 715
2017-12-31	12 631 222	12 631 222	1 626 456	3 117 408	6 234 816	600 500	3 177 459	21 222 311	1 478 065	21 892	477 996	20 881	**18 947 981**	40 566 345	3 725 902
2016-12-31	12 551 424	12 551 424	1 613 716	3 105 531	6 211 062	597 540	3 161 656	21 086 208	1 466 627	21 226	457 826	20 125	**18 839 837**	40 306 520	3 698 008
2015-12-31	12 469 955	12 469 955	1 600 835	3 094 269	6 188 539	594 702	3 147 290	20 961 863	1 456 026	20 399	435 081	19 308	**18 731 913**	40 055 436	3 670 870
2014-12-31	12 391 007	12 391 007	1 588 325	3 083 197	6 166 394	591 907	3 133 678	20 850 325	1 446 271	20 156	426 307	19 034	**18 628 038**	39 834 033	3 645 537
2013-12-31	12 308 985	12 308 985	1 575 439	3 071 623	6 143 246	589 028	3 120 696	20 743 263	1 436 835	19 959	416 694	18 736	**18 521 263**	39 612 188	3 620 039
2012-12-31	12 229 092	12 229 092	1 563 013	3 060 999	6 121 998	586 348	3 110 632	20 665 140	1 429 779	19 922	410 392	18 528	**18 420 645**	39 426 622	3 597 668
2011-12-31	12 150 800	12 150 800	1 550 855	3 051 041	6 102 082	583 839	3 101 574	20 596 184	1 423 436	19 830	405 879	18 407	**18 323 246**	39 255 020	3 576 539
2010-12-31	12 079 614	12 079 614	1 539 831	3 041 216	6 082 432	581 369	3 094 044	20 542 952	1 418 431	19 706	401 702	18 291	**18 234 580**	39 106 700	3 557 922
2009-12-31	11 369 349	11 369 349	1 375 251	3 588 297	7 176 594	639 930	3 071 611	20 844 525	1 394 638	-	-	-	**18 029 257**	39 390 468	3 409 819
2008-12-31	11 306 026	11 306 026	1 365 471	3 577 954	7 155 908	637 373	3 065 823	20 805 953	1 390 556	-	-	-	**17 949 803**	39 267 887	3 393 400
2007-12-31	11 234 208	11 234 208	1 354 428	3 565 829	7 131 656	634 407	3 059 076	20 766 359	1 386 335	-	-	-	**17 859 112**	39 132 222	3 375 171
2006-12-31	11 140 552	11 140 552	1 340 319	3 549 843	7 099 686	630 595	3 052 018	20 731 024	1 382 203	-	-	-	**17 742 413**	38 971 262	3 353 117
2005-12-31	11 025 108	11 025 108	1 323 337	3 531 428	7 062 856	626 220	3 043 406	20 684 473	1 377 292	-	-	-	**17 599 942**	38 772 437	3 326 849
2004-12-31	10 911 888	10 911 888	1 306 703	3 510 955	7 021 910	621 382	3 035 827	20 652 745	1 373 193	-	-	-	**17 458 670**	38 586 543	3 301 278
2003-12-31	10 779 406	10 779 406	1 287 450	3 487 318	6 974 636	615 890	3 026 954	20 615 923	1 368 628	-	-	-	**17 293 678**	38 369 965	3 271 962
2002-12-31	10 657 819	10 657 819	1 269 352	3 463 646	6 927 292	610 378	3 017 614	20 572 800	1 363 639	-	-	-	**17 139 079**	38 157 911	3 243 361
2001-12-31	10 533 739	10 533 739	1 251 807	3 437 440	6 874 880	604 397	3 006 483	20 512 534	1 357 772	-	-	-	**16 977 662**	37 921 153	3 213 967
2000-12-31	10 402 244	10 402 244	1 232 938	3 408 857	6 817 714	597 858	2 991 158	20 409 568	1 348 941	-	-	-	**16 802 259**	37 629 526	3 179 728
1999-12-31	10 240 332	10 240 332	1 210 094	3 372 869	6 745 738	589 817	2 969 852	20 254 220	1 336 752	-	-	-	**16 583 053**	37 240 290	3 136 656
1998-12-31	10 076 700	10 076 700	1 187 253	3 332 524	6 665 048	580 933	2 943 667	20 054 916	1 321 636	-	-	-	**16 352 891**	36 796 664	3 089 809
1997-12-31	9 931 167	9 931 167	1 166 784	3 292 679	6 585 358	572 200	2 913 483	19 814 323	1 304 221	-	-	-	**16 137 329**	36 330 848	3 043 199
1996-12-31	9 799 030	9 799 030	1 148 201	3 250 600	6 501 200	563 081	2 874 673	19 488 930	1 281 221	-	-	-	**15 924 303**	35 789 160	2 992 490
1995-12-31	9 688 214	9 688 214	1 132 483	3 209 755	6 419 510	554 336	2 834 453	19 158 899	1 258 008	-	-	-	**15 732 422**	35 266 623	2 944 812

Data source: (Federal Statistical Office, 2021)

HUNGARY

Hungarian housing stock saw steady increase since 2011. The number of dwellings rose from 4.39 million in 2011 to 4.47 million in 2020, increasing by 1.82%. The bulk of the increase can be attributed to larger dwellings with 3 and more rooms. Rise in the number of apartments eased the occupancy rate from 2.26 person per dwelling to 2.18 in 2020. Transdanubia region shows slightly higher occupancy rate but share the trend in both indicators.

Table 14 Residential building stock in Hungary

	2011	2013	2015	2018	2019	2020
Number of dwellings – Total	**4 390 302**	**4 402 008**	**4 414 684**	**4 439 959**	**4 455 491**	**4 474 531**
Dwellings – with 1 room	456 125	455 813	455 945	455 940	456 022	456 458
Dwellings – with 2 rooms	1 675 417	1 676 704	1 678 694	1 681 734	1 683 966	1 687 127
Dwellings – with 3 or more rooms	2 258 760	2 269 491	2 280 045	2 302 285	2 315 503	2 330 946
Number of dwellings – Transdanubia region	**1 283 467**	**1 287 041**	**1 291 087**	**1 300 858**	**1 306 141**	**1 312 663**
Occupancy (per dwelling) – Total	**2.26**	**2.25**	**2.23**	**2.20**	**2.19**	**2.18**
Occupancy (per dwelling) – Transdanubia region	**2.34**	**2.32**	**2.29**	**2.25**	**2.24**	**2.23**
Municipally owned dwellings*	116 715	115 028	111 482	106 413	105 174	104 377

Not: * – Data of municipalities with 10 or more rentals.

Data source: (Hungarian central statistical office, 2021)

ROMANIA

Table 15 Dwellings stock in Romania

	2011	2013	2015	2016	2017	2018	2019	2020
Dwellings stock at the end of the year (thousands)								
Total	8 722	8 800	8 882	8 929	8 977	9 031	9 093	9 156
Public ownership	98	102	106	107	110	112	112	113
Private ownership	8 624	8 698	8 776	8 822	8 867	8 919	8 981	9 043
Living floor at the end of the year (thousand m^2)								
Total	407 437	413 764	419 860	423 174	426 411	430 009	434 017	438 015
Public ownership	3 150	3 302	3 515	3 551	3 690	3 801	3 817	3 878
Private ownership	404 287	410 462	416 345	419 623	422 720	426 208	430 201	434 137

Data source: (National Institute of Statistics, 2021)

Romania is currently facing a significant decline in its population, which is expected to exceed 15% by 2050. According to the 2011 Population and Housing Census, the number of dwellings exceeds the number of families – approximately 8 million dwellings to 7.2 million families, with a dwelling vacancy rate of 16% at that time. The extensive migration in recent years has led to massive depopulation of rural or even urban localities in areas fallen into economic decline. In this context, policies designed for energy renovation of the building stock will have to take into account a complex set of criteria which, in addition to the technical characteristics of buildings, cover all economic, social and spatial conditions as well (Romania, 2020b).

Most Romanians live in small dwellings, either in single-family houses or in apartments in multi-family buildings. More than 63 % of these dwellings have a useful floor area of less than 50 m², which is much smaller than in most EU countries; less than 5% of dwellings in the Netherlands, Spain, Denmark and Luxembourg are of similar size. Almost half of all dwellings (47.5%) are located in rural areas, where 95% of the housing spaces are individual houses, and in urban areas 72% of the housing spaces are located in multi-family buildings. Multi-family buildings have an average heated area of 48 m² compared to 73 m² for single-family houses. The vast majority of people in Romania live in owner-occupied dwellings (94.7%), which is one of the highest rates in Europe (Romania, 2020b).

There are approximately 5.6 million buildings in Romania, covering 644 million m^2 of heated useful floor area. Residential buildings make up 90% of the whole building stock (Figure 5), representing 582 million m^2, and non-residential buildings make up the remaining rate (approximately 62 million m^2, or 10%). In residential buildings, single-family houses account for the highest share, representing approximately 58% of the total, followed by multi-family buildings with approximately 33% (Romania, 2020b).

SLOVAKIA

Data availability on the housing stock is rather limited in Slovakia. Verified data are for 2011 according to the Census 2011, detailed data on the development of the housing stock from the following years are limited. The availability of updated other statistics is also limited.

Table 16 Summary of houses and apartments based on the 2011 Census

	Single-family houses	Multi-apartment buildings	Total
Number of houses/buildings	969 360	64 846	1 034 206
Number of apartments	1 008 795	931 605	1 940 400
Of which Number of occupied apartments	856 147	877 993	1 734 140

Data source: (Statistical Office of the Slovak Republic, 2021) based on Census 2011

In addition to apartments in multi-apartment buildings and single-family houses, apartments are also located in other buildings (such as ecclesiastical entities, nursing and retirement homes and others). There are 13,020 such buildings (i.e. 3.41%) with 54,497 apartments.

Table 17 Population and number of households in Slovakia

	2010	2013	2015	2017	2018	2019	2020
Households	1 911 664	1 852 059	1 852 059	1 852 059	1 852 059	1 852 059	1 852 059
Population	5 424 925	5 415 949	5 236 124	5 255 973	5 352 011	5 364 283	5 389 916
Occupancy rate	2.84	2.92	2.83	2.84	2.89	2.90	2.91

Data source: (Statistical Office of the Slovak Republic, 2021)

According to the Long-term renovation strategy, the average annual thermal consumption in heating in multi-apartment buildings between 1994 and 2003 was as follows: in those made of bricks and clay blocks: 131.7 kWh/(m^2.a); single-panel (built between 1955 and 1983): 110.3 kWh/(m^2.a); layered panels: 119.0 kWh/(m^2.a); in panel prefabricated buildings built after 1983: 101.9 kWh/(m^2.a). Slovakia total average annual heat consumption is 114.8 kWh/(m^2.a). The values are related to the total floor area. As for the family houses, The assessments available suggest that the average annual thermal consumption of heating energy is 165 kWh/(m^2.a) (Ministry of Transport and Construction of the Slovak Republic, 2020).

SLOVENIA

According to data from Statistical Office of the Republic of Slovenia, there were 2,028,084 inhabitants in 824,618 private households in Slovenia in January 2018. The number of collective households increased (from 435 to 497), but the population numbers living in them are not significant (35,439). Most of them lived in homes for the elderly (18,000), student housing (10,700) and social welfare institutions for children, young persons and the elderly (4,400) (Government of the Republic of Slovenia, 2020).

Table 18 Household stock in Slovenia

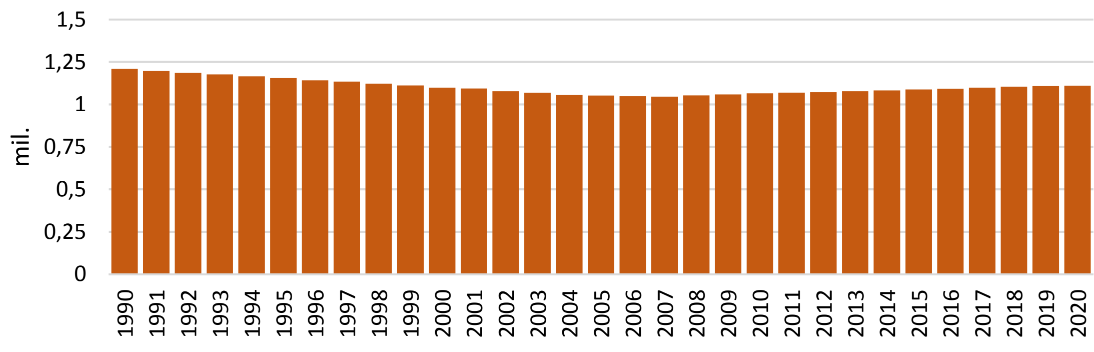
	2011	2015	2019
Households - TOTAL	**813 531**	**820 541**	**824 618**
One-person	266 489	267 523	269 898
Multi-person non-family	20 041	15 907	17 140
Multi-person one-family	450 262	461 080	460 727
Multi-person one-family extended	38 113	38 584	38 607
Multi-person two or more-family	36 047	34 730	35 389
Multi-person two or more-family extended	2 579	2 717	2 857

Data source: (Statistical Office of the Republic of Slovenia, 2021)

BOSNIA AND HERZEGOVINA

Number of households reached 1.12 million in 2020 in Bosnia and Herzegovina, according to the National Statistical Office. This is 0.46% more than in the previous year. Historically, number of households in Bosnia and Herzegovina reached an all-time high of 1.22 million in 1990 and consequently rather declined.

Figure 38: Development of the number of households in Bosnia and Herzegovina



Data source: (Helgilibrary.com, 2021a) based on the United Nations, National Statistical Office and Helgi Analytics

Table 19 Number of households in Bosnia and Herzegovina

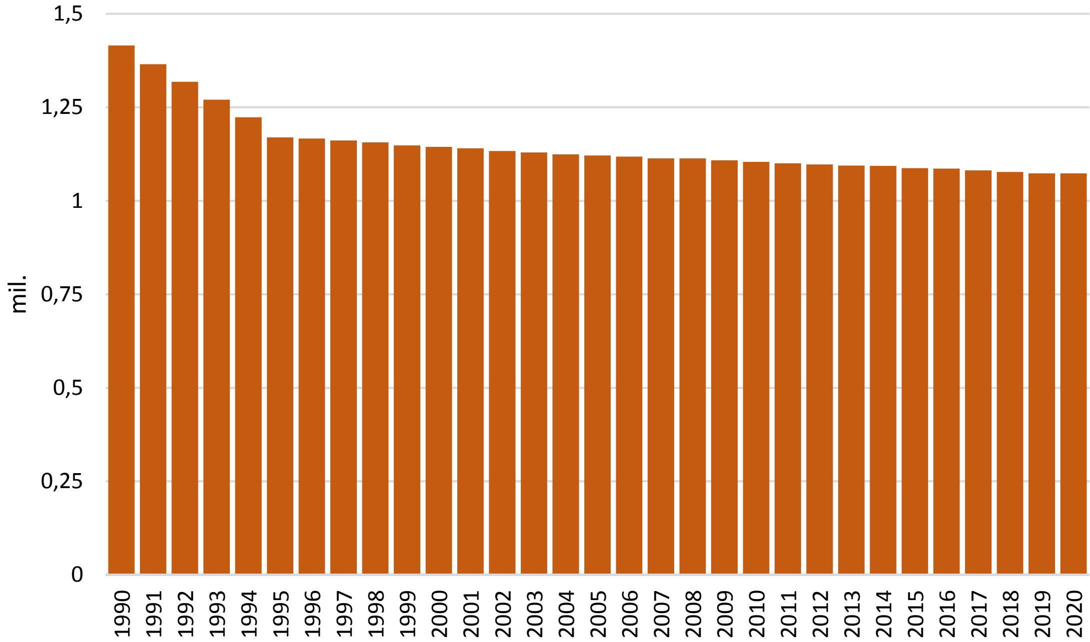
Year	2014	2015	2016	2017	2018
Number of Households	1,090,900	1,096,100	1,101,300	1,106,500	1,111,700

Data source: (Helgilibrary.com, 2021a)

MOLDOVA

Number of households reached 1.08 million in 2020 in Moldova, according to the National Statistical Office. This is 0.31% less than in the previous year. Historically, number of households in Moldova reached an all-time high of 1.42 million in 1990 and an all-time low of 1.07 million in 2020.

Table 20 Number of Households in Moldova



Data source: (Helgilibrary.com, 2021b) based on the United Nations, National Statistical Office and Helgi Analytics

Table 21 Number of households in Moldova

Year	2014	2015	2016	2017	2018
Number of Households [mil.]	1.0985	1.0951	1.0918	1.0885	1.0851

Data source: (statbank.statistica.md, 2021a)

Table 22 Dwelling stock (units), end-year by Localities, Indicators and Years in Moldova

	2015	2016	2017	2018	2019	2020
Apartment buildings and specialized houses	12,911	11,536	11,557	11,642	11,727	11,810
Flats in apartment buildings	413,616	381,803	390,670	396,444	404,528	410,305
Individual houses	909,659	898,473	896,612	896,051	897,632	899,532
Flats and individual houses	1,323,275	1,280,276	1,287,282	1,292,495	1,302,160	1,309,837

Data source: (statbank.statistica.md, 2021a)

MONTENEGRO

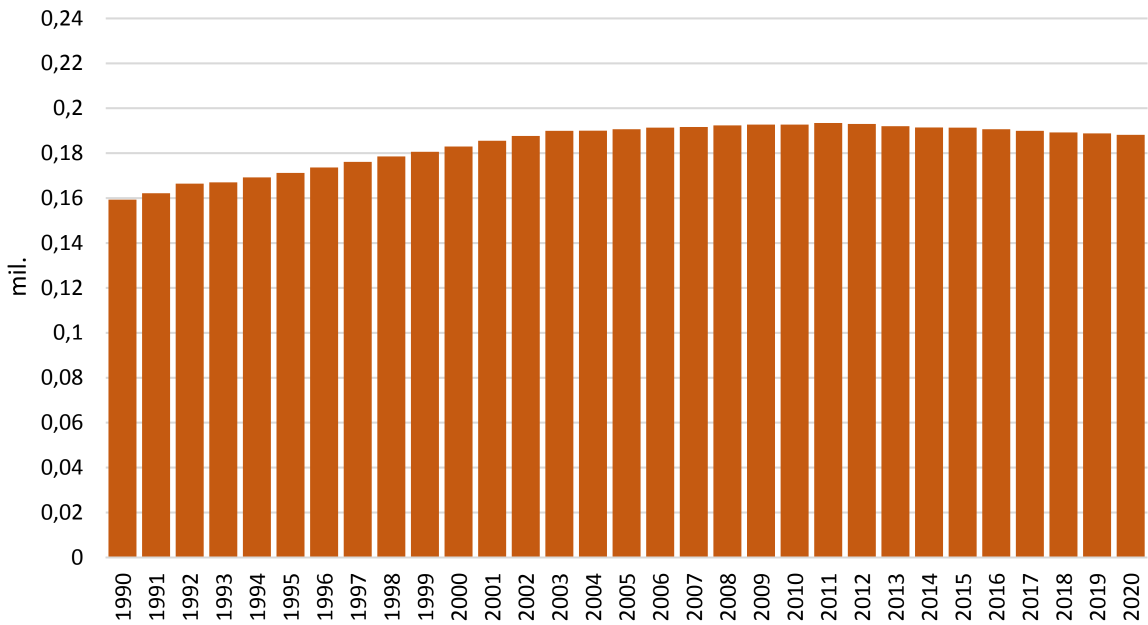
Data availability on the housing stock is rather limited in Montenegro. Historically, number of households in Montenegro reached an all-time high of 0.193 million in 2011.Number of households reached 0.188 million in 2020 in Montenegro, according to the National Statistical Office. This is 0.3% less than in the previous year. The number of households was increasing between 1991 and 2011, but in period of 2011 to 2020 it had a declining trend.

Table 23 Estimated number of households in Montenegro

Year	1991	2003	2011
Estimated number of households	163 274	180 517	192 242

Data source: (Monstat, 2021)

Figure 39: Number of households in Montenegro between 1990 and 2020



Data source: (Helgilibrary.com, 2021c) based on the United Nations, National Statistical Office and Helgi Analytics

Table 24 Number of households in Montenegro

Year	2014	2015	2016	2017	2018
Number of Households (mil.)	0.1929	0.1923	0.1917	0.1911	0.1905

Data source: (Helgilibrary.com, 2021c)

SERBIA

The largest part of buildings built during last decade in Serbia are residential buildings, in 2020 the share of building permissions issued for residential buildings was over 72% in the total amount of buildings. Most of residential buildings built in the last years are one-dwelling buildings. In 2020 over 13 thousand building permissions were issued for residential buildings; that is 7 thousand more compared to 2007.

Table 25 Serbia - Number of issued building permits for buildings

Period	Buildings	Residential buildings	One-dwelling buildings	Two-dwelling buildings	Three- and more dwelling buildings	Residences for communities
2007	8 597	6 088	4 034	692	1 337	25

2008	8 660	6 295	4 267	628	1 380	20
2009	6 546	4 831	3 168	595	1 050	18
2010	5 197	3 802	2 665	360	764	13
2011	5 588	3 842	2 752	411	659	20
2012	5 689	3 969	2 898	442	605	24
2013	5 601	3 850	2 879	385	557	29
2014	5 676	3 863	2 913	378	547	25
2015	7 671	4 763	3 696	369	659	39
2016	9 498	5 751	4 457	353	867	74
2017	14 002	8 523	6 874	420	1 139	90
2018	15 148	9 392	7 246	414	1 646	86
2019	17 034	11 358	9 074	442	1 762	80
2020	17 982	13 022	10 546	491	1 926	59

Data source: (Statistical Office of the Republic of Serbia, 2021)

Over 25 thousand dwellings were completed in Serbia in 2020, this corresponds to an increase of about 7% or 6,877 completed dwellings compared to 2011. Thirty percent of the total amount of dwellings are built in Beograd region. According to 2011 census there were 3,231,931 dwellings in Serbia that is 446.6 dwellings per 1,000 inhabitants, this number has increased to 489 in 2020. The size of finished apartments was 73 m^2 per dwelling in 2020, that is, 9 m^2 more per dwelling than in 2011.

More than 70% of housing stock was built before 1991, in the period when no energy efficiency requirements were in force.

Table 26 Serbia – Dwellings according to the type of buildings and period of construction

Type of dwellings	Period of construction Type of building	Total	1919–1945	before 1919	1946–1960	1961–1970	1971–1980	1981–1990	1991–2000	2001–2005	2006 or later
Total dwellings	**Total**	3,231,931	206,365	115,879	328,962	531,274	661,530	532,563	265,840	139,538	188,017
	Residential building with 1 dwelling	1,931,183	141,077	87,893	221,104	282,900	364,249	309,204	162,187	61,673	58,614
	Residential building with 2 dwellings	268,346	13,365	9,030	22,613	48,632	68,987	51,124	25,476	9,987	7,955
	Residential building with 3 and more dwellings	1,023,596	51,126	18,319	84,115	198,487	226,953	171,178	77,445	67,536	121,090
	Other residential building	3,248	174	183	394	654	674	447	259	180	150
	Non-residential building	5,558	623	454	736	601	667	610	473	162	208
Occupied dwellings	**Total**	2,423,208	143,192	85,418	244,091	441,932	557,203	441,579	205,757	103,025	118,891
	Residential building with 1 dwelling	1,375,768	94,091	63,408	156,689	232,353	298,016	246,858	123,172	47,812	42,770
	Residential building with 2 dwellings	223,601	10,823	7,415	18,387	42,081	59,812	43,388	20,800	8,159	6,116
	Residential building with 3	818,885	37,893	14,280	68,334	166,638	198,449	150,660	61,391	46,858	69,853

and more dwellings										
Other residential building	2,581	139	158	332	510	573	374	204	124	78
Non-residential building	2,373	246	157	349	350	353	299	190	72	74

Data source: (Statistical Office of the Republic of Serbia, 2021)

Overview of the changes in housing stock since 2011 till 2020 in different regions of the country is presented in the table below. The Danube regions (where the Danube flows or forms a border of region) are highlighted.

Table 27 Serbia - Serbia – number of completed dwellings

Year/ region	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020*
REPUBLIC OF SERBIA	**18 449**	**15 223**	**13 505**	**11 097**	**10 306**	**11 332**	**14 080**	**18 051**	**24 803**	**25 326**
SRBIJA – SEVER	***11 048***	***11 062***	***10 048***	***7 008***	***5 721***	***5 824***	***8 656***	***10 509***	***13 877***	***15 147***
Beogradski region	6 416	8 096	7 596	4 755	4 014	3 167	4 478	5 929	7 611	7 674
Beogradska oblast	6 416	8 096	7 596	4 755	4 014	3 167	4 478	5 929	7 611	7 674
Region Vojvodine	4 632	2 966	2 452	2 253	1 707	2 657	4 178	4 580	6 266	7 473
Zapadnobačka oblast	177	91	72	86	74	101	212	193	193	280
Južnobanatska oblast	694	342	140	327	192	359	364	527	527	605
Južnobačka oblast	2 344	1 460	1 375	1 229	852	1 500	2 686	2 779	3 566	4 438
City Novi Sad	2 122	1 288	1 222	1 147	705	1 291	2 440	2 515	3 282	4 130
Severnobanatska oblast	75	24	18	22	41	51	56	38	65	33
Severnobačka oblast	269	213	199	173	95	261	175	173	365	572
Srednjobanatska oblast	96	105	61	101	117	66	129	140	284	313
Sremska oblast	977	731	587	315	336	319	556	730	1 266	1 232
SRBIJA – JUG	***7 401***	***4 161***	***3 457***	***4 089***	***4 585***	***5 508***	***5 424***	***7 542***	***10 926***	***10 179***
Region Šumadije i Zapadne Srbije	5 276	2 625	1 986	2 023	2 897	3 936	3 628	5 113	7 525	6 808
Zlatiborska oblast	478	322	271	418	481	659	662	981	1 891	1 627
Kolubarska oblast	226	173	104	248	170	230	227	359	781	876
Mačvanska oblast	498	349	242	297	359	595	518	607	950	700
Moravička oblast	654	265	135	58	332	316	194	346	568	468
Pomoravska oblast	1 112	234	138	359	347	406	386	482	555	490
Rasinska oblast	399	230	246	123	221	342	293	372	397	277
Raška oblast	1 027	598	436	208	651	761	772	1 148	1 364	1 303
Šumadijska oblast	882	454	414	312	336	627	576	818	1 019	1 067
Region Južne i Istočne Srbije	2 125	1 536	1 471	2 066	1 688	1 572	1 796	2 429	3 401	3 371
Borska oblast	38	43	37	117	141	13	86	120	169	150
Braničevska oblast	255	254	117	260	120	228	355	417	621	522
City of Pozarevac	186	199	54	153	59	156	222	202	239	214
Zaječarska oblast	199	53	80	52	87	91	84	108	151	171
Jablanička oblast	163	90	80	84	125	133	147	206	145	124
Nišavska oblast	888	579	555	1 017	652	595	617	916	1 102	1 181
City of Nis	849	529	522	980	616	571	579	892	1 042	1 119
Pirotska oblast	111	71	103	55	79	23	138	78	144	112
Podunavska oblast	264	281	184	239	181	153	123	200	325	368

Pčinjska oblast	165	130	289	213	245	326	232	346	658	655
City of Vranje	91	63	72	87	112	131	70	144	306	304
Toplička oblast	42	35	26	29	58	10	14	38	86	88

*Data source: (Statistical Office of the Republic of Serbia, 2021), * - provisional values*

UKRAINE

At the end of 2020 there was almost 9.2 million of residential buildings and over 17.4 million dwellings in Ukraine. Compared to 2014, it is an increase of almost 4% or 623 thousand dwellings. The stock of dwellings rose by 0.2% or 28,000 dwellings in the year 2020. Number of dwellings per 1,000 inhabitants was 418.5 in 2020 and 391 in 2014.

Table 28: Ukraine - Number of residential buildings and dwellings as of January 1, 2021.

	Number of res. buildings	Including		Number of apartments in res. and non-res. buildings	Floor area of apartments, m^2	
		urban areas	rural areas		total	residential
Ukraine	**9 163 897**	**3 340 425**	**5 823 472**	**17 407 702**	**999 454 108**	**628 106 173**
Vinnytsya	561 625	131 735	429 890	834 474	48 546 283	32 274 804
Volyn	245 520	60 636	184 884	387 822	25 165 982	15 521 187
Dnipropetrovsk	606 997	358 701	248 296	1 565 549	81 106 345	50 841 114
Donetsk	443 463	311 940	131 523	1 037 701	51 454 148	32 592 045
Zhytomyr	381 578	114 574	267 004	584 994	33 301 647	21 188 822
Zakarpattya	330 648	89 749	240 899	438 995	32 799 531	19 090 616
Zaporizhzhya	346 817	167 337	179 480	752 597	39 869 556	24 632 624
Ivano-Frankivsk	368 082	83 491	284 591	555 311	38 500 595	23 641 649
Kyiv	576 046	177 058	398 988	937 658	64 439 017	37 832 609
Kirovohrad	306 818	125 887	180 931	503 985	25 416 001	16 462 225
Luhansk	196 847	102 521	94 326	364 436	18 547 752	11 497 296
Lviv	481 428	126 640	354 788	994 517	63 609 504	39 330 366
Mykolayiv	259 002	110 683	148 319	465 961	24 834 111	16 112 417
Odesa	485 694	171 867	313 827	975 796	58 349 175	37 681 559
Poltava	408 994	132 056	276 938	681 988	35 323 970	22 505 928
Rivne	271 610	59 022	212 588	428 687	27 459 395	17 634 992
Sumy	326 120	134 115	192 005	543 889	28 039 036	18 280 686
Ternopil	289 822	58 244	231 578	428 331	28 355 584	17 861 421
Kharkiv	495 256	260 630	234 626	1 276 406	66 014 387	41 913 177
Kherson	285 746	134 749	150 997	476 650	26 309 761	17 289 157
Khmelnytskiy	382 946	88 291	294 655	645 271	37 615 424	24 115 136
Cherkasy	427 507	120 316	307 191	622 056	34 166 731	22 434 900
Chernivtsi	257 975	56 333	201 642	344 536	22 844 033	13 945 024
Chernihiv	391 436	127 930	263 506	565 703	30 206 840	19 194 542

Kyiv	35 920	35 920	x	994 389	57 179 300	34 231 877

Note: Highlighted areas belongs to Danube region.

Data source: (State Statistics Service of Ukraine, 2021)

Size of the housing stock available per person has slightly increased from 22.6 m^2 in 2014 to 24.5 m^2 in 2020. Total size of the housing stock has increased for 118.3 million m² of total space from 1995 till 2013 and for 48.7 million m² from 2014 till 2020.

Table 29: Ukraine – Size of the housing stock and number of apartments in 1995–2020.

	Total housing stock, million m² of total space	Average per person, m²	Total number of apartments, (thousands)
1995	978.3	19.2	18,303
1996	995.2	19.7	18,565
1997	1,002.6	20.0	18,784
1998	1,008.4	20.2	18,858
1999	n/a	n/a	n/a
2000	1,015.0	20.7	18,921
2001	1,026.1	21.0	18,960
2002	1,031.7	21.3	19,023
2003	1,035.7	21.6	19,049
2004	1,040.0	21.8	19,075
2005	1,046.4	22.0	19,132
2006	1,049.2	22.2	19,107
2007	1,057.6	22.5	19,183
2008	1,066.6	22.8	19,255
2009	1,072.2	23.0	19,288
2010	1,079.5	23.3	19,322
2011	1,086.0	23.5	19,327
2012	1,094.2	23.7	19,370
2013	1,096.6	23.8	19,368
2014*	966.1	22.6	16,785
2015	973.8	22.9	16,886
2016	977.9	23.1	16,912
2017	984.8	23.3	16,987
2018	993.3	23.7	17,100
2019	1,011.4	24.2	17,380
2020	1,014.8	24.5	17,408

*Data source: (State Statistics Service of Ukraine, 2021), * - since 2014 data exclude the Autonomous Republic of Crimea, the city of Sevastopol and a part of Donetsk and Luhansk regions.*

SUMMARY

The reported statistics on the housing stock vary in quality and detail from country to country. In addition, some countries have published validated statistics only for the last census, i.e. year 2011. Therefore it is difficult to compare countries.

The only common statistic is the number of dwellings and even there are differences in approach (with/without unoccupied dwellings, only main residences without short-term accommodation, only private residences without public flats, etc.) and year of statistic. A certain solution would be to calculate the number of dwellings on the basis of trends in construction (new dwellings, removed dwellings), however, some statistics for the calculation were not available or are not detailed enough.

Statistics on number of residential buildings, useful/living floor space area or average living space per person/household were not available for all countries.

Table 30: Ukraine – Size of the housing stock and number of apartments in 1995–2020.

Country	Households / dwellings	Statistic Year
Austria	3 916 092*	2018
Bulgaria	3 959 285	2018
Croatia	1 912 901**	2011
Czech Republic	4 756 572	2011
Germany	40 828 717	2018
Hungary	4 439 959	2018
Romania	9 031 000	2018
Slovakia	1 852 059	2018
Slovenia	824 618	2018
Bosnia and Hercegovina	1 104 000	2018
Moldova	1 077 000	2018
Montenegro	190 500	2018
Serbia	3 231 931	2011
Ukraine	17 100 000	2018

* only principal dwellings (main residences - private);** only permanent occupied residences

Data source: based on the statistics above for individual countries

4. TRENDS IN THE CONSTRUCTION OF RESIDENTIAL BUILDINGS

This chapter describes the trends in the construction of residential buildings – the number and types of newly built buildings per year. Depending on the data availability, additional information are provided, such as energy class, energy performance or size of new buildings.

AUSTRIA

From a regional perspective, the federal capital is gaining in importance because, unlike in the other federal states, construction activity here is largely concentrated on multi-storey residential buildings. Between 2011 and 2015, almost 27% of all apartments' construction permits, to be built in larger residential buildings, were approved in the federal capital alone. In the period from 2016 to 2020 this increased to almost 39% (Statistics Austria, 2021).

The share of building permits for new single and two-family houses in Austria was a little higher than in a quarter of 2020. Less than 1% of the entities were in new, mostly non-private residential buildings. The apartments approved in existing properties through extension, construction or renovation activities (apart from Vienna) made up a slightly more than 19% of the total. Within this group, most of the permits were related to enlargements (almost 43%) followed by completely new units (more than 35%). Subsequent reductions in size in 2020 were approved for around 13% of all properties resulting from additions, construction and renovation activities. Other renovation activities that were notifiable by the building authorities were registered for 6% of the apartments. About 2% of the units were created through splits (Statistics Austria, 2021).

The table below summarizes the trends in residential construction in Austria from the perspective of building permits.

Table 31: Approved apartments and new buildings from 2014 to 2020

Building property	2014	2015	2016	2017	2018	2019	2020
New buildings	**25 126**	**25 288**	**26 633**	**26 519**	**27 436**	**28 152**	**29 102**
new residential buildings	18 792	18 738	19 984	19 920	20 343	20 980	21 550
with 1 or 2 apartments	15 909	15 859	16 956	16 594	17 361	17 756	18 662
with 3 or more apartments	2 883	2 879	3 028	3 326	2 982	3 224	2 888
new non-residential buildings	6 334	6 550	6 649	6 599	7 093	7 172	7 552
New apartments	**63 871**	**66 764**	**74 873**	**83 430**	**73 571**	**83 113**	**77 542**
in new buildings	50 451	52 651	61 556	70 018	60 037	68 157	62 597
in new residential buildings	49 873	52 084	61 033	69 356	59 415	67 595	62 200
with 1 or 2 apartments	16 743	16 669	17 900	17 548	18 405	18 832	19 775
with 3 or more apartments	33 130	35 415	43 133	51 808	41 010	48 763	42 425
in new non-residential buildings	578	567	523	662	622	562	397

through add-on, construction, conversion work	13 420	14 113	13 317	13 412	13 534	14 956	14 945
completely new	5 156	5 485	4 967	5 407	5 366	5 956	5 286
other	8 264	8 628	8 350	8 005	8 168	9 000	9 659

Data source: (Statistics Austria, 2021)

BULGARIA

The permits issuance in Bulgaria has stagnated close to six thousand a year for residential buildings. Administrative buildings and others fell significantly from 128 to 95 and from 4,826 to 3,944 respectively (see Table 32). Floor area as well as number of dwellings of the buildings in permission process decreased in all sectors indicating smaller scale of pending projects.

Table 32: Buildings permits issued for construction of new buildings

	2018	2019	2020
Residential buildings			
Number	5,774	5,980	5,860
Number of dwellings	35,526	32,783	29,438
Gross building area (m^2)	4,471,065	4,117,599	3,745,739
Administrative buildings			
Number	128	103	95
Gross building area (m^2)	504,341	209,017	158,021
Other buildings			
Number	4,826	4,608	3,944
Gross building area (m^2)	3,086,603	2,454,014	1,920,269

Data source: (National Statistical Institute, 2021)

Regarding technology, steel-concrete structure clearly dominates the new buildings with solid structure buildings share steadily increasing since 2010 as can be seen in Table 33.

Table 33: Newly built residential buildings completed by structure of building

	2010	2012	2015	2016	2017	2018	2019	2020
Total	2350	2399	2263	2161	2205	2324	3052	3376
Panel	23	18	27	20	20	17	24	12
Steel-concrete	2228	1803	1585	1602	1662	1730	2342	2623
Solid structure	82	531	592	491	478	514	604	649
Others	17	47	59	48	45	63	82	92

Data source: (National Statistical Institute, 2021)

CROATIA

After a drop in new construction permits between 2013 and 2015, the rate of new permits has returned to around 13,000 a year with considerable variation. Also the ratio of single one-dwelling buildings to two and more dwelling buildings remain roughly the same over time. No clear trend can be seen in the newly added floor area.

Table 34 Trends in construction of residential buildings in Croatia

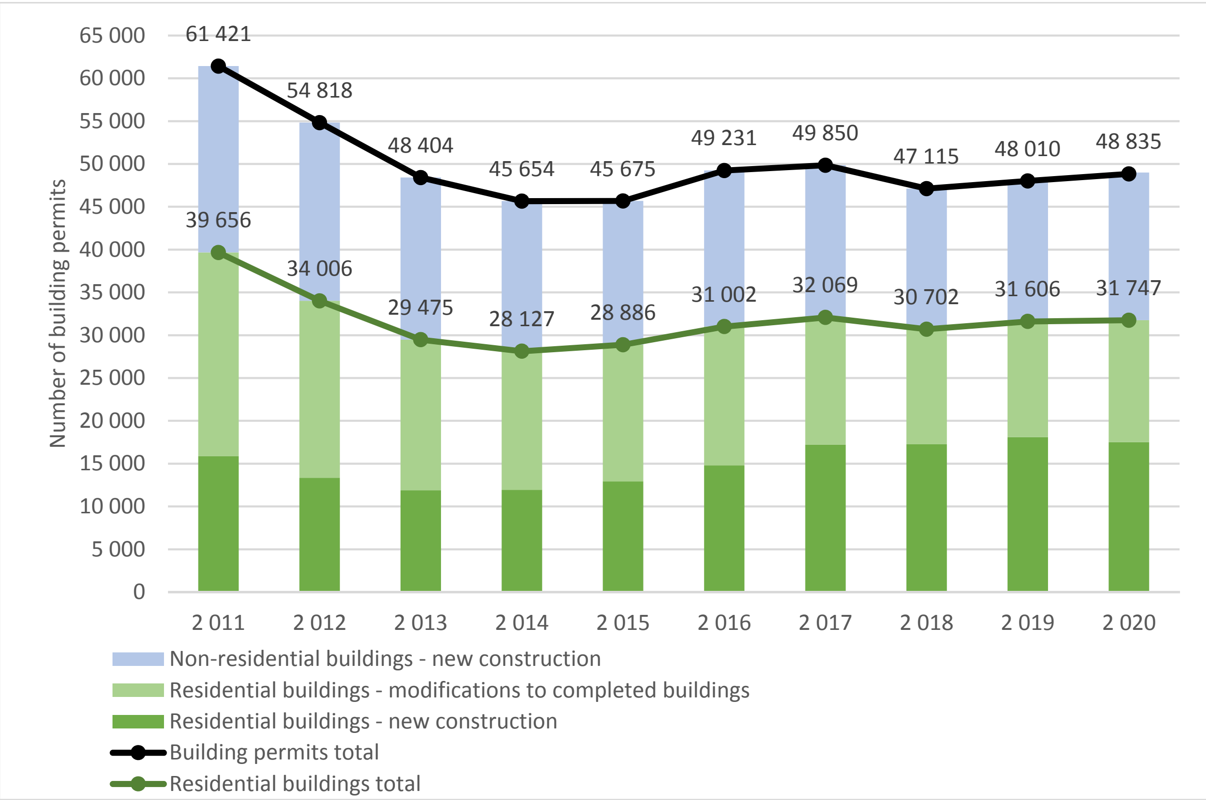
	2011	2013	2015	2017	2018	2019	2020
Residential buildings - building permits issued	13,358	7,535	6,876	12,253	11,584	15,202	13,906
One-dwelling buildings	4,025	2,496	2,070	3,392	3,534	3,749	3,747
Two- and more dwelling buildings	9,373	5,042	4,808	8,847	8,045	11,411	10,139
Residential buildings - useful floor area (thousand m²)	1,369.1	766.6	681.5	1,226.7	1,219.0	1,517.5	1,435.9
One-dwelling buildings (thousand m²)	560.3	344.6	287.3	493.0	534.4	562.5	569.0
Two- and more dwelling buildings (thousand m²)	808.7	422.0	394.3	733.7	684.6	954.9	866.8

Data source: (Croatian Bureau of Statistics, 2021)

CZECH REPUBLIC

The chart below shows the number of building permits issued between 2011 and 2020. Construction of buildings represents on average 57% of all building permits, of which residential buildings accounts for 64%, i.e. residential buildings accounts about 36% of all building permits.

Figure 40: Comparison of the number of building permits for individual types of constructions



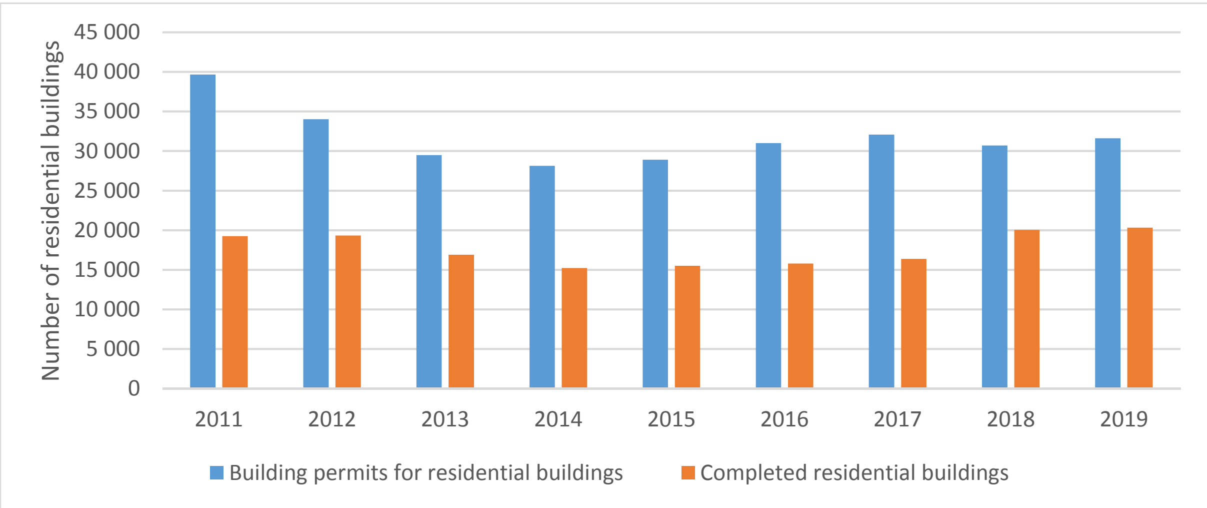
Data source: (Czech Statistical Office, 2021)

Between 2011 and 2014, probably due to the economic crisis, building permits issued fell by as much as 41%. Since 2015, there has been a gradual increase in the number of building permits issued. Nevertheless, in 2019, an average of 25% fewer permits were issued than in 2011. There was an increase of 12% in new construction and a decrease of 76% in modifications to completed building.

The share of new family houses to all completed residential buildings in the years 2011 to 2019 is 88.8%, while the apartment buildings accounts for 1.7%. Modifications to completed buildings in family houses accounts to 4.6%, respectively 2.3% for apartment buildings. The rest 2.4% consists boarding houses, retirement homes and converted non-residential rooms.

Statistics of started and completed houses and dwellings offers alternative perspective on the housing stock trends. In contrast to the number of building permits, starts and completions show the constructions that are actually finished and also takes into account their size. Occupied family houses usually have 1-2 dwellings (according to SLDB 2011 an average of 1.15 dwellings per house), apartment houses can have more than 50 dwellings (according to SLDB 2011 an average of 10.68 dwellings per house).

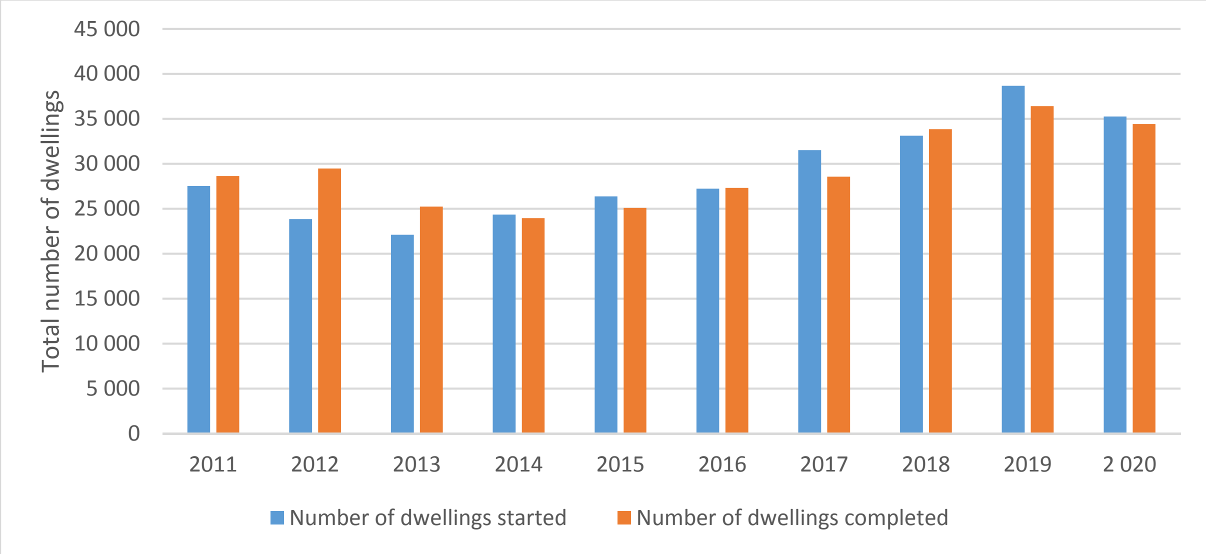
Figure 41: Comparison of the number of building permits issued for residential buildings and the number of completed residential buildings



Data source: (Czech Statistical Office, 2021)

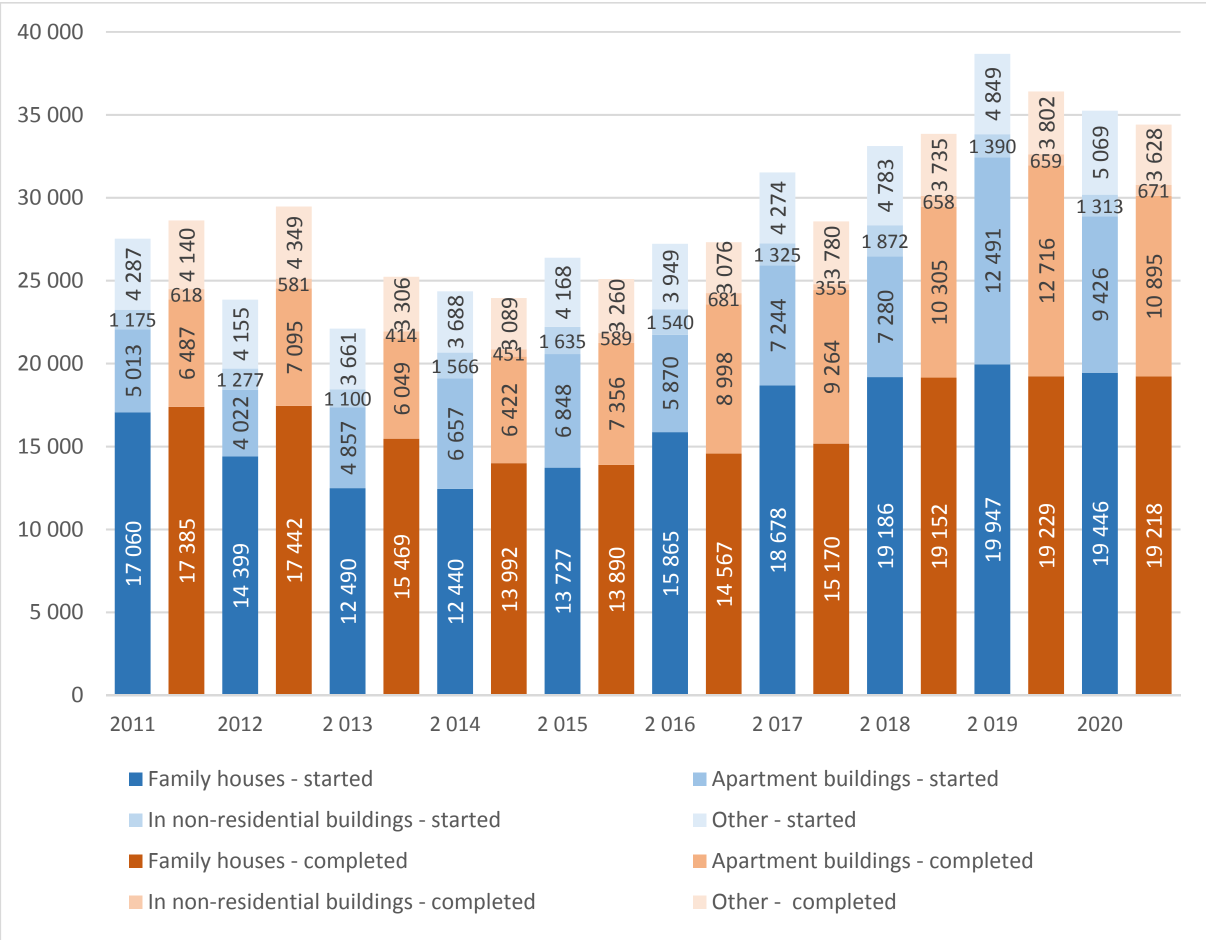
The total balance is relatively even, with the total number of started dwellings in the years 2011 to 2022 amounting to more than 290 thousand dwellings, while the total number of completed dwellings is around 293 thousand dwellings. However, note that the construction of flats can take in the range from a few months (renovations) to several years (new apartment buildings). Therefore, there is a certain time shift in the statistics, i.e. construction of dwellings completed in 2011 could begin between 2006 and 2010.

Figure 42: Comparison of the number of started and completed dwellings in the years 2011 to 2020



Data source: (Czech Statistical Office, 2021)

Figure 43: Comparison of the number of started and completed dwellings divided into family houses, apartment houses, dwellings in non-residential buildings and others



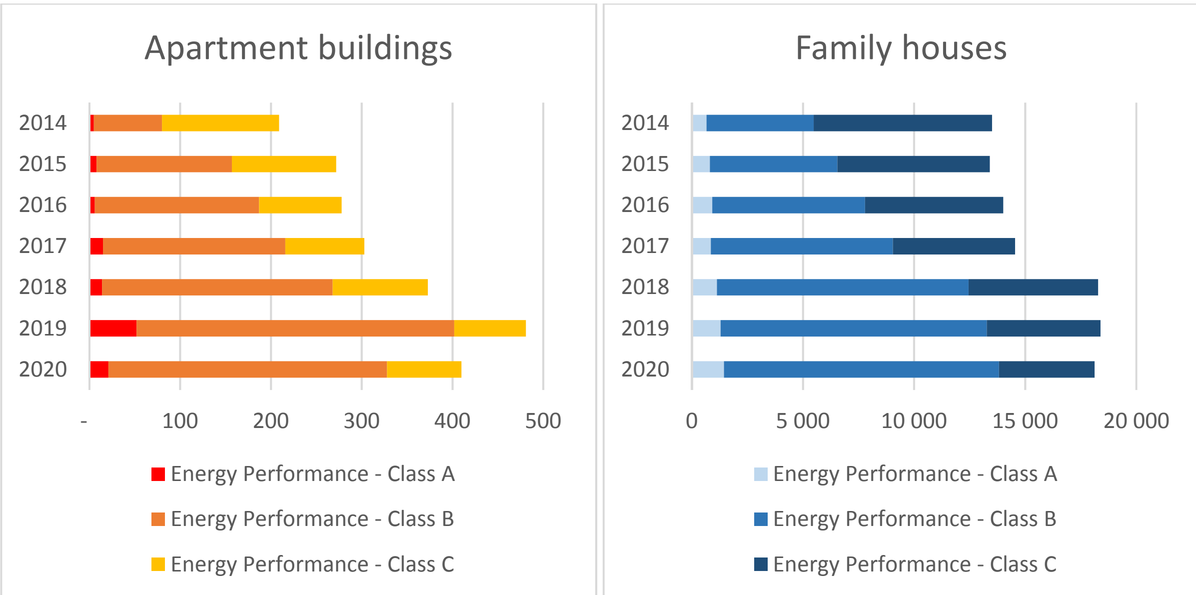
Data source: (Czech Statistical Office, 2021)

The number of dwellings in family houses accounts for about 56.4% of the total number in the case of started dwellings and 56.7% in the case of completed dwellings. In case of apartment buildings, the shares are 23.6% for started and 28.9% for completed dwellings. Dwellings in non-residential buildings accounts for 5.0% of started dwellings (average 1,419 dwellings per year) and only 1.9% of completed dwellings (average 568 dwellings per year). The category of others, which accounts for 15.0% of started dwellings and 12.5% of completed dwellings, includes dwellings not further identified and not divided into previous categories.

Of the total number of started dwellings, on average 17.3% were modifications to completed buildings (approx. 4,959 dwellings per year), while the share of completed dwellings was 12.2% (approx. 3,997 dwellings per year).

A useful indicator is the statistics of completed houses and dwellings in the classification based on the achieved energy class according to energy performance certificate. The graphs below show that construction in energy class B predominates. Nevertheless, the number of buildings built in energy class A increases in recent years.

Figure 44: Development of completed buildings by Energy Performance



Data source: (Czech Statistical Office, 2021)

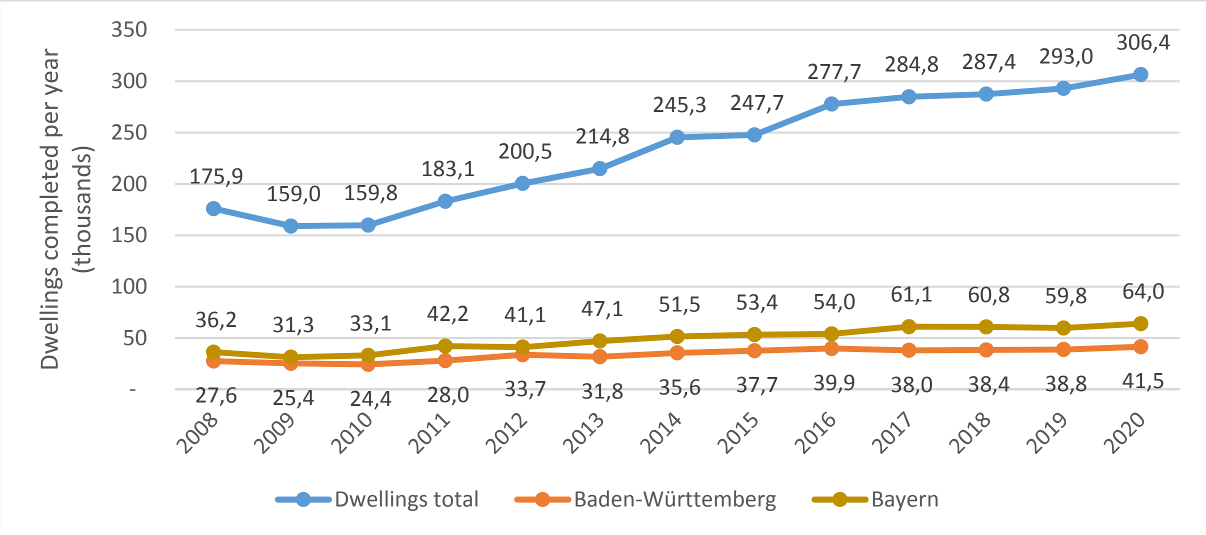
GERMANY

Construction of a total of 306,376 dwellings, both new buildings and work on existing buildings and in residential and non-residential buildings, was completed in Germany during the year 2020, of which 41,501 in Baden-Württemberg and 64,013 in Bayern. Compared with the year 2019, this is an increase of 4.6% or 13,374 respectively 6.9% (2,676) in Baden-Württemberg and 7.1% (4,234) in Bayern. After a decrease in the years 2006–2009, a stable increase can be seen in annual construction of new dwellings since 2010 (see Figure 47).

Construction in the regions of Baden-Württemberg and Bayern is very important as it traditionally accounts for more than a third of all building construction in Germany (i.e. of 16 regions). The same shares apply also to sub-categories – new buildings, work on existing buildings, residential buildings.

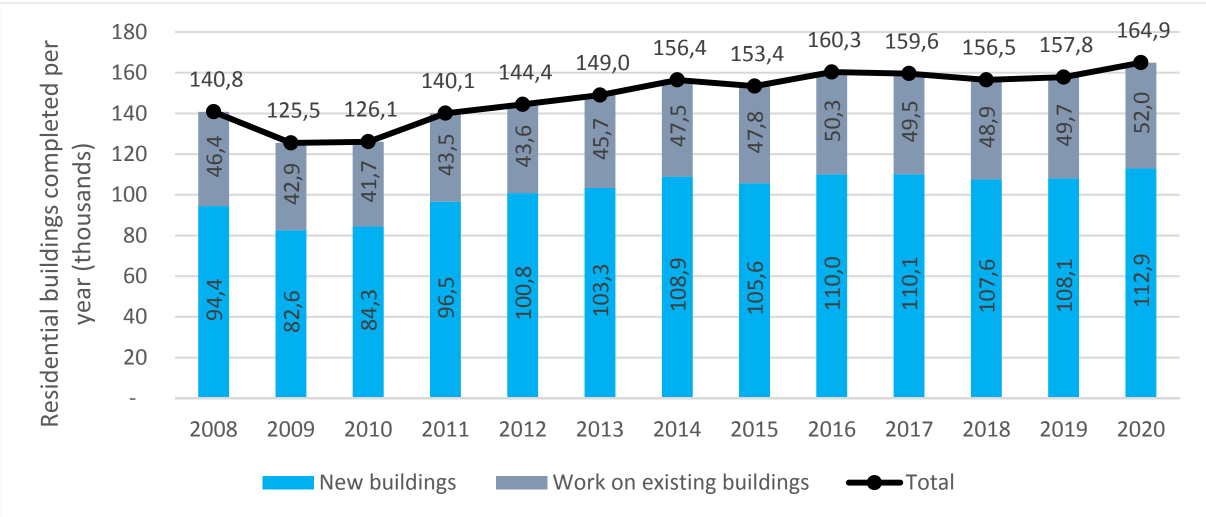
Although there is significant proportion of construction works on existing buildings, they represent only smaller share in the number of all dwellings. In 2020 there were total of 68,031 construction projects in residential and non-residential buildings, which were related to 32,607 dwellings.

Figure 45: Dwellings completed (in new buildings and work on existing buildings) in res. and non-res. buildings per year



Data source: (Federal Statistical Office, 2021)

Figure 46: Residential buildings completed (new buildings and work on existing buildings) per year



Data source: (Federal Statistical Office, 2021)

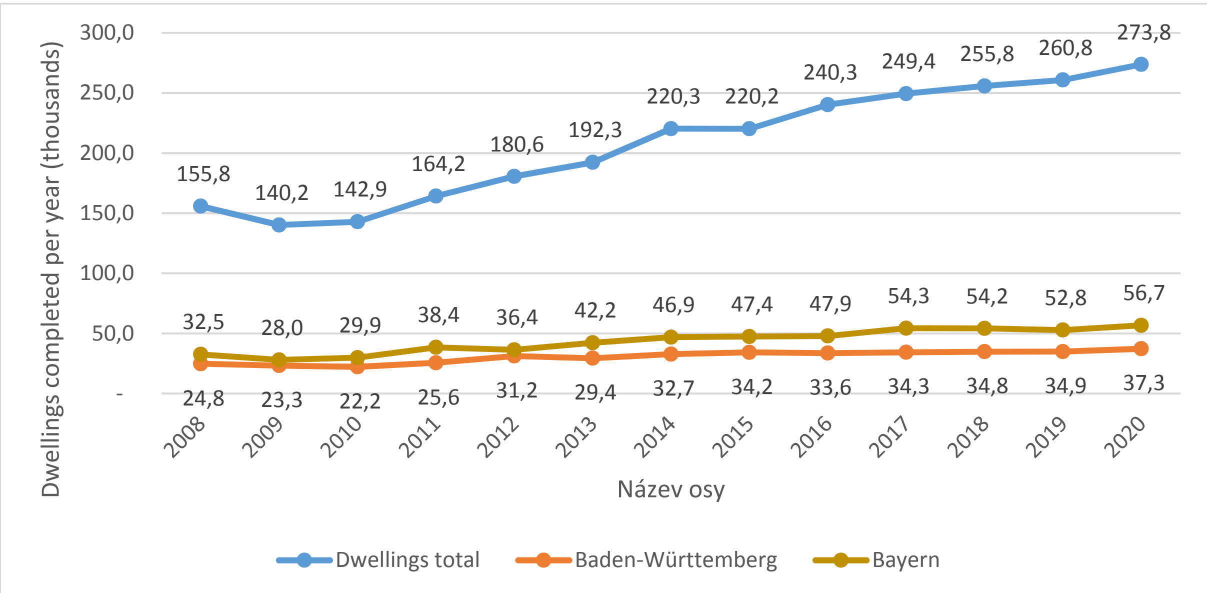
Almost 98% of the dwellings are constructed in residential buildings. About 274 thousand dwellings were constructed in 2020 in residential and non-residential buildings with 102.7 m^2 of living floor area completed per dwelling. The development shows that the living floor space per apartment is increasing constantly and that there is a direct connection to the year of construction of the building. In 2018, for example, only 37% apartments that were built up to 1990 had the size of more than 100 square meters. In the case of apartments built between 1991 and 2010, this proportion has already risen to 56% and in new buildings beginning from 2011 it has increased to 59%.

Table 35 Germany – Construction of new buildings and dwellings

Year/ type of building	Buildings	Volume constructed	Useful floor space	Dwellings	Living floor space of dwellings	Other housing units	Living floor space of other housing units	Estimated costs of the construction
	number	1,000 m³	1,000 m²	number	1,000 m²	number	1,000 m²	1,000s EUR
Residential and non-residential buildings								
2010	111 330	260 194	29 636	142 891	16 415	3 739	104	40 266 745
2011	125 022	276 057	30 728	164 178	18 898	3 219	98	45 095 386
2012	128 458	295 905	31 615	180 611	20 475	-	-	47 672 936
2013	130 914	303 447	32 540	192 276	21 478	-	-	52 490 953
2014	135 733	313 032	32 327	220 293	24 072	-	-	56 077 367
2015	130 691	306 137	31 198	220 197	23 892	-	-	57 331 426
2016	134 392	312 754	31 798	240 255	25 228	-	-	61 387 919
2017	134 007	325 290	32 134	249 438	25 919	-	-	64 950 342
2018	131 902	326 766	32 437	255 805	26 107	-	-	67 682 680
2019	131 713	329 949	33 487	260 791	26 784	-	-	72 098 120
2020	137 245	334 710	33 707	273 769	28 104	-	-	78 102 810
Residential buildings								
2010	84 340	88 026	4 161	140 096	16 165	3 332	95	21 226 159
2011	96 549	100 959	4 728	161 186	18 636	2 855	88	25 055 800
2012	100 816	108 419	4 998	176 617	20 183	-	-	27 576 637
2013	103 331	113 787	5 310	188 397	21 181	-	-	29 892 704
2014	108 908	127 682	6 023	216 120	23 740	-	-	34 501 978
2015	105 568	127 305	6 121	216 727	23 613	-	-	35 455 013
2016	109 990	133 308	6 352	235 658	24 876	-	-	38 245 088
2017	110 051	137 861	6 552	245 304	25 602	-	-	40 921 116
2018	107 581	138 783	6 550	251 338	25 776	-	-	42 413 385
2019	108 071	142 140	6 779	255 925	26 401	-	-	44 915 038
2020	112 935	149 615	7 215	268 774	27 747	-	-	49 170 838

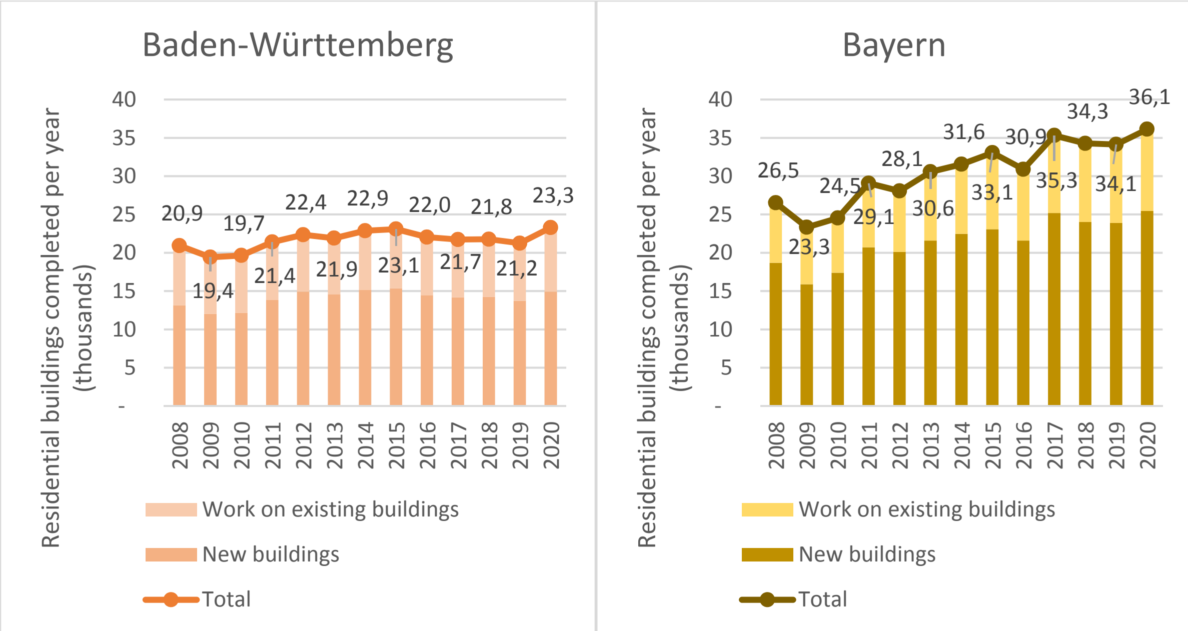
Data source: (Federal Statistical Office, 2021)

Figure 47: Dwellings completed in new buildings (residential and non-residential) per year, total, thousands



Data source: (Federal Statistical Office, 2021)

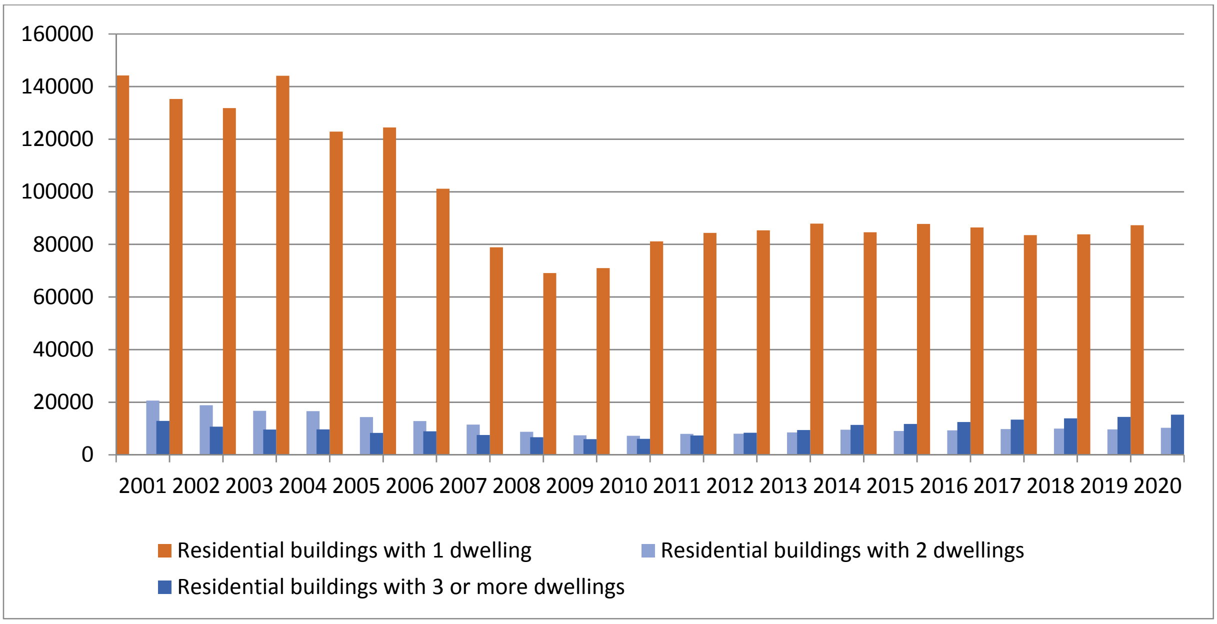
Figure 48: New residential buildings per year in Baden-Württemberg and Bayern



Data source: (Federal Statistical Office, 2021)

Whether a dwelling is occupied by the owner or rented is closely related to the size of the building. In 2018, four out of five owner-occupied apartments across Germany were located in a building with a maximum of two apartments. Exactly on the opposite was the situation with the so-called tenant apartments. Here, the proportion of dwellings in buildings with three or more apartments was 81% (Federal Statistical Office, 2021).

Figure 49: Annual construction of different types of residential buildings.



Data source: (Federal Statistical Office, 2021)

Hungary

Last three years saw massive increase in the number of issued construction permits. The number increased three folds between 2015 and 2018. The number of buildings behind the permits reflects the trend. Majority of new buildings are residential buildings evenly distributed among detached and multi-apartment houses (roughly in 3:2 ratio).

Table 36 Trends in construction of residential buildings in Hungary

	2010	2012	2015	2018	2019	2020
Dwelling construction permits issued	17 353	10 600	12 515	36 719	35 123	22 556
Residential buildings to be constructed, number	7 403	6 099	6 526	13 743	14 282	11 381
Residential buildings to be constructed, basic floor space, thousand m^2	1 677	1 148	1 376	3 925	3 856	2 560
Completed residential buildings	8 825	5 799	3 903	8 518	9 753	13 844
Number of dwellings to be built in new residential buildings	16 267	9 565	11 764	35 608	34 250	21 263
Built dwellings*	20 823	10 560	7 612	17 681	21 127	28 208
in new residential building	19 142	9 333	7 059	16 845	20 416	27 504
in new single-family detached house	8 814	6 003	4 204	8 996	10 116	14 384
in new multi-storey, multi-dwelling buildings	7 355	2 524	2 317	6 388	8 555	10 615
in residential park	1 874	329	335	850	782	1 633
Average floor space of dwellings built, m^2	92.0	107.2	101.4	99.3	96.6	98.0
Share of dwellings below 60 m^2, %	32.5	21.8	22.9	22.5	24.6	24.2
Share of dwellings 100 m^2 and more, %	33.1	45.6	41.1	40.4	38.1	40.3

Note: * – excluding holiday houses

Data source: (Hungarian central statistical office, 2021)

ROMANIA

The number of issued construction permits in Romania has shown steady albeit moderate growth since 2011. In 2017, the rate crossed 40,000 permits per year and has never dropped below that figure ever since. Interestingly, Romanian National Institute of Statistics shows figures for the residential collectives that represent a tiny fraction of all permits (four per thousand).

Table 37 Building permits trends in Romania

	2011	2013	2015	2016	2017	2018	2019	2020
Residential buildings (excluding collective buildings) – number	39,424	37,776	39,112	38,653	41,603	42,694	42,541	41,311
Residential buildings (excluding collective buildings) – useful area (thousand m^2)	6,792	6,883	7,874	8,910	9,744	10,673	10,965	10,484
Residential buildings for collectivity – number	141	142	188	73	113	193	152	40

Residential buildings for collectivity – useful area (thousand m²)	136	142	170	54	73	93	101	33

Data source: (National Institute of Statistics, 2021)

As is the case in other countries as well, more dwellings are built in urban areas with the ratio swinging towards urban area over time. In Romania, the average size of new dwellings decreases significantly and is now at an average of mere 54 m² of living area per dwelling from almost 72 m² ten years ago. Although the new rural dwellings shrunk somewhat as well, the change is not that significant – from 80.2 to 74.0 m² (see Table 38).

Table 38 Finished dwellings trends in Romania

	2011	2013	2015	2016	2017	2018	2019	2020
Finished dwellings	45,419	43,587	46,984	52,206	53,347	59,713	67,488	67,816
Urban area	19,988	20,533	24,804	27,878	29,312	34,896	40,564	42,238
Rural area	25,431	23,054	22,180	24,328	24,035	24,817	26,924	25,578
Useful area (thousand m² unfolded)	5,579.4	5,291.8	5,138.9	5,641.8	5,663.8	6,042.8	6,803.6	6,622.3
Urban area	2,354.1	2,293.9	2,351.3	2,434.6	2,439.3	2,772.5	2,836.5	3,149.6
Rural area	3,225.3	3,067.9	2,940.5	2,675.7	2,699.6	2,869.4	2,827.2	2,893.2
Living area (thousand m² unfolded)	3,472.8	3,316.4	3,176.0	3,468.0	3,508.0	3,789.1	4,257.1	4,172.1
Urban area	1,434.1	1,448.1	1,473.2	1,662.8	1,713.1	1,956.2	2,305.6	2,279.9
Rural area	2,038.7	1,868.3	1,702.8	1,805.1	1,794.9	1,832.8	1,951.5	1,892.2
Average living area per dwelling (m²)	76.5	76.1	67.6	66.4	65.8	63.5	63.1	61.5
Urban area	71.7	70.5	59.4	59.6	58.4	56.1	56.8	54.0
Rural area	80.2	81.0	76.8	74.2	74.7	73.9	72.5	74.0

Data source: (National Institute of Statistics, 2021)

SLOVAKIA

After stagnation in completion of new dwellings early in the decade, the number of completed buildings has increased in the last three years and in 2019 and 2020 it has surpassed the 20,000 figure. The share of family houses among the new builds is steady at around 60%. Although the size of newly built apartments decreases somewhat, the drop is just a 3% in ten years.

Table 39 Completed dwellings in Slovakia

	2010	2013	2015	2016	2017	2018	2019	2020
Completed dwellings total	17,076	15,100	15,471	15,672	16,946	19,071	20,171	21,490
Completed dwellings one-room and flat-lets	1,434	1,102	1,101	855	1,289	1,091	1,224	1,520
Completed two-room dwellings	3,834	2,479	2,689	2,299	2,660	3,164	3,499	3,944
Completed three-room dwellings	4,555	3,849	4,113	4,055	4,365	4,757	5,104	5,004
Competed four-room and more dwellings	7,253	7,670	7,568	8,463	8,632	10,059	10,344	11,022
Average floor area of completed dwelling (m²)	113.30	119.50	113.70	118.20	112.80	112.30	109.70	109.80

Average living area of completed dwellings (m^2)	71.50	73.70	71.40	73.80	70.40	70.90	69.60	69.40
Completed dwellings of which in family houses	9,136	10,208	9,860	11,195	11,547	12,687	13,338	13,421
Average living area of completed in family houses (m^2)	89.50	87.90	85.40	84.60	82.20	82.40	82.40	83.20

Data source: (Statistical Office of the Slovak Republic, 2021)

The increase in the completion rate is accompanied with corresponding increase in dwellings under construction in the beginning of year from 67,431 in 2010 to 78,085 in 2020. Distribution of constructions in progress among private and public sector remains steady with the majority of buildings built privately and the number of public construction diminishing over years.

Table 40 Construction of dwellings in Slovakia

	2010	2013	2015	2016	2017	2018	2019	2020
Dwellings - under construction as of Jan 1	67,461	61,724	62,099	65,812	71,990	74,789	77,629	78,085
Public sector in total	5,898	3,249	2,219	1,228	1,432	1,044	1,066	805
Private sector in total	61,563	58,475	59,880	64,584	70,558	73,745	76,563	77,280
Dwellings - started in a given year	16,211	14,758	19,640	21,441	19,930	22,055	21,516	19,744
Public sector in total	1,754	575	212	573	319	277	251	246
Private sector in total	14,457	14,183	19,443	20,868	19,611	21,778	21,265	19,498
Dwellings - completed in a given year	17,076	15,100	15,471	15,672	16,946	19,071	20,171	21,490
Public sector in total	2,519	1,065	354	336	226	202	205	250
Private sector in total	14,557	14,035	15,117	15,336	16,720	18,869	19,966	21,240
Dwellings under construction as of December 31	66,596	61,382	66,268	71,581	74,974	77,773	78,974	76,339
Public sector in total	5,133	2,759	2,077	1,465	1,525	1,119	1,112	801
Private sector in total	61,463	58,623	64,206	70,116	73,449	76,654	77,862	75,538

Data source: (Statistical Office of the Slovak Republic, 2021)

SLOVENIA

Number of construction permits in Slovenia increased between 2013 and 2015 and remained above 6,000 per year since 2016. Nonetheless, the floor area in question stagnated more or less at around 1,500 thousand square metres a year. Number of completed constructions stagnated with an outlying spike in 2011 and steadily at around 2,500 yearly figure since (see Table 42). Number unfinished buildings has dropped significantly between 2011 and 2016 from than 16,000 to less than 10,000 in a given year (see Table 43)

Table 41 Building permits trends in Slovenia

	2011	2013	2015	2016	2017	2018	2019	2020
Number of buildings	3,621	3,443	5,054	6,809	6,704	6,533	6,154	5,918
New construction	3,002	2,840	4,263	5,939	5,908	5,788	5,581	5,389
Extension	523	526	714	720	663	614	457	417
Conversion-improvement	96	77	77	150	133	131	116	112
Floor area of building [thousand m²]	1,611.2	1,300.5	1,174.8	1,599.6	1,702.1	1,727.9	1,563.6	1,550.0
New construction	1,370.9	1,031.1	933.1	1,254.0	1,396.7	1,436.3	1,268.1	1,278.0
Extension	196.4	230.8	212.8	260.5	245.6	237.5	224.1	220.0
Conversion-improvement	43.9	38.5	28.9	85.1	59.7	54.1	71.4	52.0
Number of dwellings	3,749	3,112	2,709	3,062	3,132	3,657	3,353	3,674
New construction	3,316	2,693	2,188	2,539	2,652	3,227	3,013	3,277
Extension	340	357	467	393	384	350	252	237
Conversion-improvement	93	62	54	130	96	80	88	160
Useful floor space of dwellings [thousand m²]	500.5	450.0	404.8	442.2	469.0	525.8	476.7	502.7
New construction	450.8	398.5	345.7	380.6	409.4	469.4	437.1	459.5
Extension	41.5	44.9	52.9	48.0	48.6	46.9	30.9	29.7
Conversion-improvement	8.2	6.6	6.2	13.6	11.0	9.5	8.6	13.5

Data source: (Statistical Office of the Republic of Slovenia, 2021)

Table 42 Completed residential buildings in Slovenia

	2011	2013	2015	2016	2017	2018	2019	2020
Number of completed buildings	3,494	2,717	2,437	2,566	2,537	2,509	2,492	2,605
Floor area of completed buildings [thousand m²]	1,262.8	791.4	615.8	675.1	652.5	663.0	727.7	756.6
Number of buildings under construction	6,851	5,873	5,771	5,822	5,998	6,323	6,403	6,381
Floor area of buildings under construction [thousand m²]	1,898.9	1,568.6	1,485.4	1,471.6	1,518.4	1,650.5	1,652.2	1,701.8

Data source: (Statistical Office of the Republic of Slovenia, 2021)

Table 43 Construction of dwellings in Slovenia

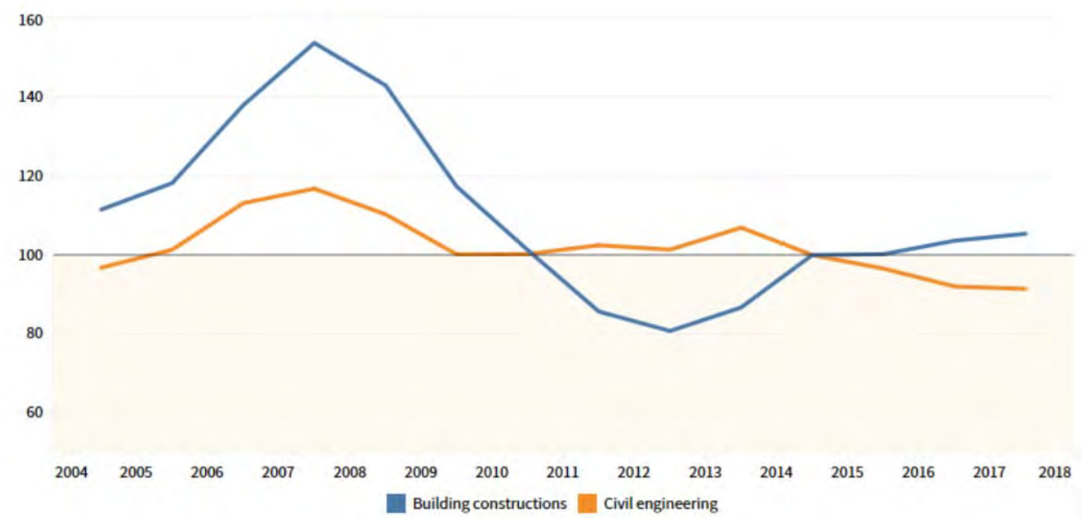
	2011	2013	2015	2016	2017	2018	2019	2020
Dwellings under construction - TOTAL								
Number	16 002	13 491	11 059	9 894	9 172	8 789	9 176	9 432
Useful floor space of dwellings [thousand m^2]	2 299	1 980	1 682	1 540	1 441	1 395	1 441	1 471
Construction of dwellings start in year								
Number	4 831	3 844	3 066	3 142	2 762	2 749	3 163	3 231
Useful floor space of dwellings [thousand m^2]	598	502	431	454	408	409	455	480
Dwellings under construction at the end of year								
Number	9 647	7 993	6 752	6 410	6 009	6 013	6 201	6 388
Useful floor space of dwellings [thousand m^2]	1 477	1 252	1 086	1 032	982	986	991	1 030
Dwellings completed - TOTAL								
Number	6 355	5 498	4 307	3 484	3 163	2 776	2 975	3 044
Useful floor space of dwellings [thousand m^2]	822	728	596	508	459	408	450	441

Data source: (Statistical Office of the Republic of Slovenia, 2021)

BOSNIA AND HERZEGOVINA

Companies from Bosnia and Herzegovina acquired a solid reputation in all aspects of construction projects. The country is rich in natural resources such as timber, stone, gravel, sand, clay and metal ores. Overall, the growth potential in BH construction market is considered high (Adriatic Appraisal, 2020).

Figure 50: Gross indices of production in construction



Source: (Adriatic Appraisal International 2020) based on the data from the Agency for Statistics

Construction indices measure the volume of production within the construction sector using 2015 as base two segments:

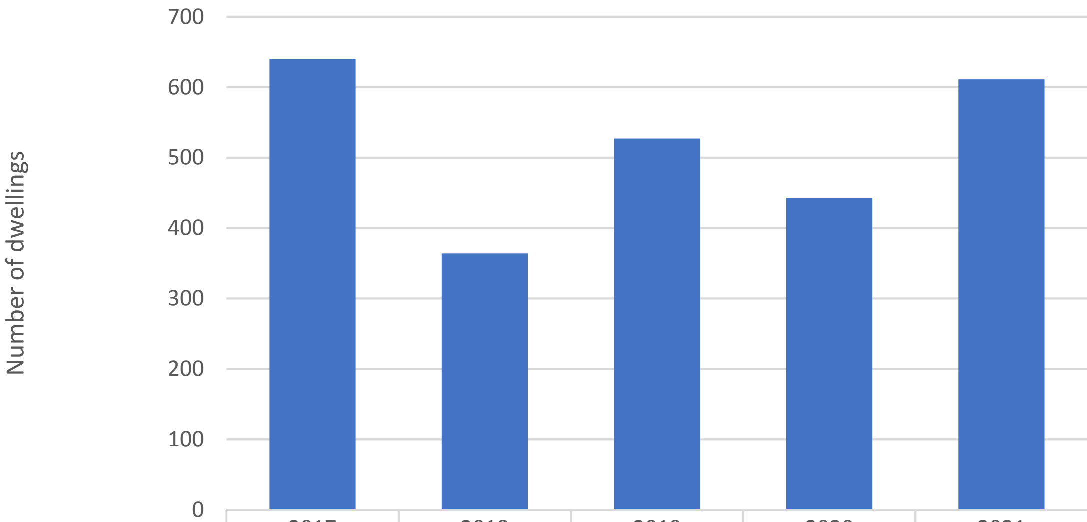
- building constructions production and
- ‘civil engineering’ production, i.e., infrastructural development.

Clearly, production in construction experienced its peak in 2008 after which it started declining. Since 2013, building constructions has recorded continuous growth, while infrastructural development has experienced a decline. Moreover, building constructions is experiencing a larger variation in its volume compared to the more stable infrastructural volume of production (Adriatic Appraisal, 2020).

Residential construction in Bosnia and Herzegovina

In the third quarter of 2021 number of completed dwellings was 611, which represents a nominal increase of 37.9% in comparison with the same period in 2020. Number of uncompleted dwellings at the end of the third quarter of 2021 was 4,563 and represents increase by 4.4% in comparison with the same period of last year (Agency for statistics of BH, 2021).

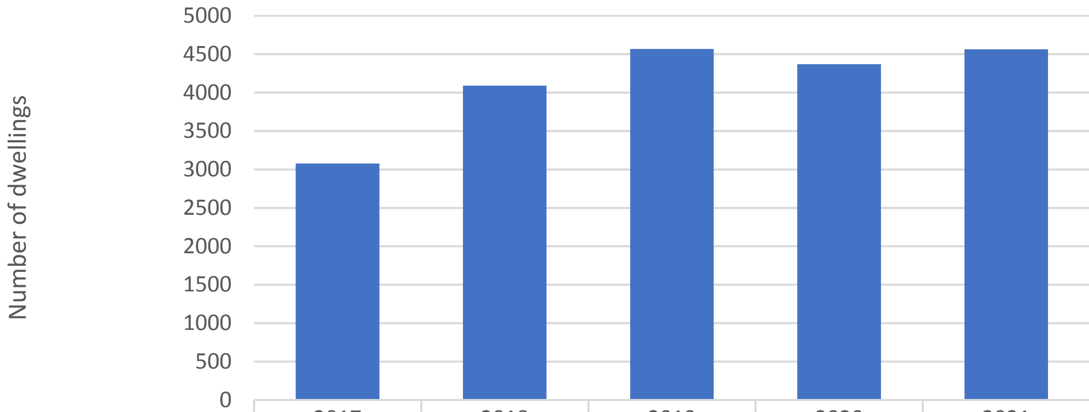
Figure 51: Number of completed dwellings in Bosnia and Herzegovina, third quarter 2021



	2017	2018	2019	2020	2021
Completed dwellings	640	364	527	443	611

Source: (Agency for statistics of BH, 2021)

Figure 52: Number of uncompleted dwellings in Bosnia and Herzegovina, third quarter 2021



	2017	2018	2019	2020	2021
Uncompleted dwellings	3077	4091	4568	4370	4563

Source: (Agency for statistics of BH, 2021)

MOLDOVA

The number of newly built dwellings in Moldova has risen in recent years, especially between 2015 and 2020 when the figure has surpassed the average of 5,000 and got close to 10,000 (actually reached in 2019). The increase was pulled by the apartment buildings with the family houses at a steady level below 2,000 a year. New constructions followed trends seen in other countries: the average size of a dwelling decreases over time from 110.7 m^2 in 2010 to 79.8 m^2 in 2020 (see Table 45).

Table 44 Construction works by Structure elements of the works, Years, Indicators and Construction objects in Moldova

	2015		2016		2017		2018		2019		2020	
	Construction works indices (percent to the previous year, comparable prices)											
Total	RB	T	RB	T	RB	T	RB	T	RB	T	RB	T
Total	87.3	110.1	91.9	91.4	103.6	92.7	117.6	105.3	112.8	122.7	111.8	113.1
New constructions	94.2	113.0	95.8	91.6	89.8	90.4	104.6	106.8	127.1	125.5	108.7	111.8
Capital repairs	80.2	68.2	84.6	97.2	123.6	127.0	136.5	86.1	101.7	86.9	110.2	84.9
Maintenance works and current repairs	77.8	105.7	89.0	78.2	134.1	121.7	127.7	97.4	99.5	94.4	120.3	187.8

Note: T…Total, RB…Residential buildings

Data source: (statbank.statistica.md, 2021b)

Table 45 Built dwellings and their average size by Indicators and years in 2010–2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Dwellings (flats/individual houses), thousand units	4.9	5.2	5.1	5.5	5.4	7.6	6.1	9.2	7.3	10.0	7.5

Individual houses, thousand units	1.7	2.0	1.8	1.6	1.6	1.5	1.3	1.0	1.5	1.9	1.9
Average size of dwellings (flats/individual houses), square meter	110.7	113.5	99.1	93.3	92.6	80.4	84.9	75.7	75.5	76.6	79.8
Average size of individual houses, square meter	154.1	154.8	146.6	149.0	145.0	147.3	140.1	141.2	123.4	120.1	121.0

Data source: (statbank.statistica.md, 2021b)

MONTENEGRO

The dwelling permits saw a sharp decline between 2018 to 2020 after a spike in 2017. More recently – during the year of 2020, the number of dwelling permits decreased by almost 18% from 1,580 to 1,297 units. Likewise, the floor area of permits issued also decreased by 16.7% year on year to 74,311 m^2 in Q1 to Q4 2020 (Monstat, 2021). The traditional trend of decreasing the average floor area of flats can also be observed.

Table 46: Dwelling Permits in Montenegro

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total permits	717	836	894	917	773	983	1 050	295	197	224
Number of dwellings	3 123	3 576	3 293	2 945	2 993	3 005	4 439	2 339	1 580	1 297
Floor area in m² (thousands)	230.6	243.9	235.6	211.9	204.0	215.2	295.9	133.8	89.2	74.3
Floor area per dwelling (m²)	73.9	68.2	71.6	71.9	68.2	71.6	66.7	57.2	56.4	57.3

Data source: (Monstat, 2021)

SERBIA

Construction of 4,409 new residential buildings and 24,803 dwellings was completed in Serbia during 2019. Compared to 2018, it is an increase of 27% or 6,752 dwellings, and about 20% increase in the number of residential buildings. Since 2009 till 2013 a large decrease in the volume of construction was observed. Only in 2019 the number of annually completed dwellings has almost reached the level of the year 2007. An average size of annually completed dwellings was almost constant during 2011–2014 and has significantly increased in 2015–2019, from 64 to 79 m^2.

Table 47: Serbia – construction of new residential and non-residential buildings

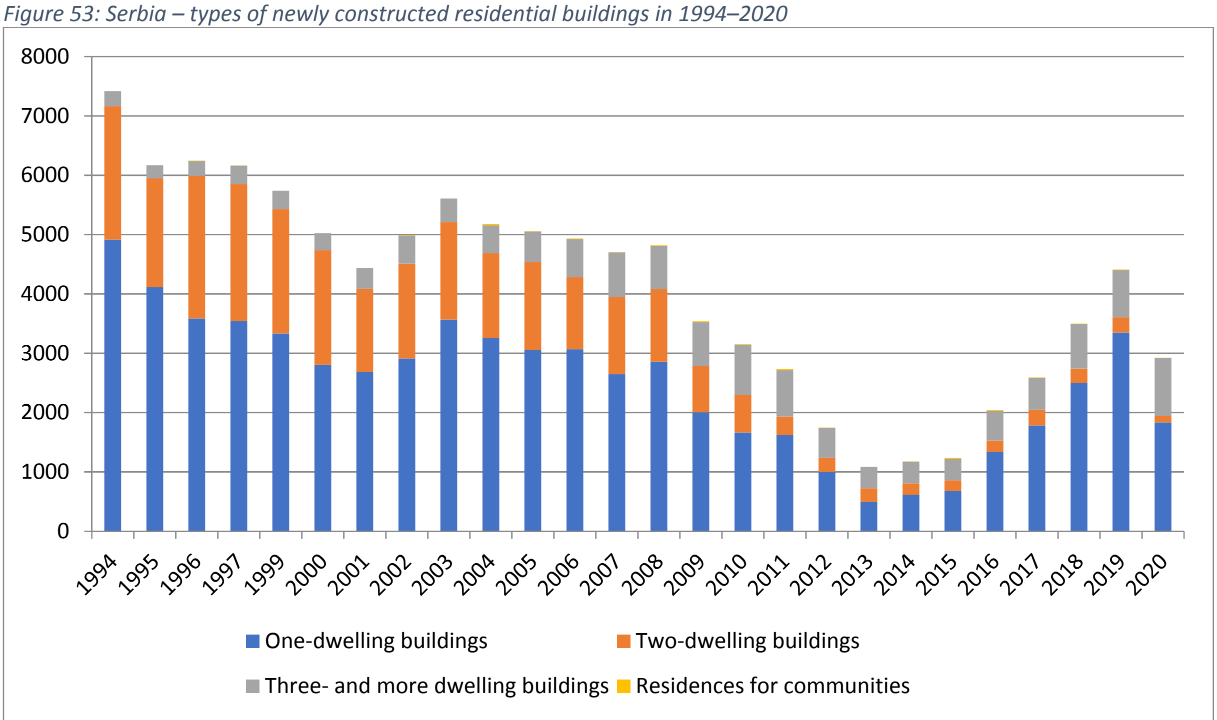
	Buildings		Residential buildings		Non-residential buildings	
Year	**number**	**m²**	**number**	**m²**	**number**	**m²**
1994	9 816	2 119 761	7 445	1 701 274	2 371	418 487
1995	8 379	1 795 836	6 183	1 382 216	2 196	413 620
1996	8 298	1 842 364	6 259	1 441 593	2 039	400 771
1997	8 606	1 817 613	6 205	1 397 952	2 401	419 661
1999	7 358	1 609 372	5 759	1 293 793	1 599	315 579
2000	6 614	1 592 131	5 046	1 181 349	1 568	410 782
2001	6 121	1 550 844	4 459	1 133 160	1 662	417 684
2002	7 258	1 725 508	5 111	1 145 870	2 147	579 638

2003	7 451	2 122 911	5 607	1 520 701	1 844	602 210
2004	6 971	2 331 281	5 177	1 732 792	1 794	598 489
2005	6 845	2 462 247	5 060	1 723 685	1 785	738 562
2006	6 844	2 548 158	4 933	1 779 370	1 911	768 788
2007	6 447	2 713 440	4 707	1 737 284	1 740	976 156
2008	6 602	3 309 648	4 820	1 918 375	1 782	1 391 273
2009	4 746	3 071 221	3 537	1 731 700	1 209	1 339 521
2010	4 126	2 492 146	3 154	1 615 269	972	876 877
2011	3 678	2 504 291	2 730	1 625 573	948	878 718
2012	2 792	2 186 428	1 747	1 348 768	1 045	837 660
2013	1 983	1 931 339	1 086	1 207 510	897	723 829
2014	2 099	1 778 226	1 176	989 521	923	788 705
2015	2 263	1 904 178	1 232	942 018	1 031	962 160
2016	3 320	2 043 968	2 037	1 111 538	1 283	932 430
2017	3 731	2 851 778	2 591	1 473 209	1 140	1 378 569
2018	4 880	3 208 343	3 499	1 839 666	1 381	1 368 677
2019	7 140	4 516 608	4 409	2 651 269	2 731	1 865 339
2020*	5 317	5 148 343	2 924	2 689 430	2 393	2 458 913

*Data source: (Statistical Office of the Republic of Serbia, 2021), * - provisional values*

Most of the newly built residential buildings are continually one-dwelling buildings. The share of two dwelling residential buildings has significantly decreased since 2011. The share of three- and more dwelling buildings has slightly increased in the last several years.

Figure 53: Serbia – types of newly constructed residential buildings in 1994–2020



Source: (Statistical Office of the Republic of Serbia, 2021)

UKRAINE

In 2000–2016, from 5.5 to 11 million m^2 of housing stock were built in Ukraine, an average of 8.6 million m^2 of housing annually. The lowest rate of housing construction was recorded in 2000, when only 5.5 million m^2 of housing were built. Since 2001, Ukraine has a tendency to gradually increase the volume of housing construction (Ukraine, 2017). Number of dwellings built annually per 1,000 inhabitants has increased from 1.6 to 2.8 in 2010–2015.

Table 48: Ukraine – total housing space commissioned and number of dwellings built annually

Housing stock commissioned	2010	2011	2012	2013	2014	2015
Total						
Housing stock commissioned, thousand m^2	8,604	8,685	9,770	9,949	9,741	11,044
including						
housing stock in urban arears	5,738	6,366	6,778	6,685	6,645	7,465
housing stock in rural arears	2,866	2,319	2,992	3,264	3,096	3,579
Number of dwellings built, thousand	71	77	83	93	105	120
including						
in urban arears	52	61	63	67	77	89
in rural arears	19	16	20	26	28	31
Per 1,000 inhabitants						
Housing stock commissioned, m^2	198	201	227	232	227	259
number of dwellings built	1.6	1.8	1.9	2.2	2.5	2.8

Data source: (State Statistics Service of Ukraine, 2021)

Most of dwellings built in recent years are in two- and more dwelling buildings, and about half of new buildings are one-dwelling.

Table 49: Ukraine – total area of residential buildings and number of dwellings commissioned in 2018-2019.

	Total area of residential buildings, putting into service				**Number of dwellings in residential buildings, putting into service**		
	Total	one-dwelling buildings	two-and more dwelling buildings	community residences	Total	one-dwelling buildings	two-and more dwelling buildings
2018	8 689 356	4 247 660	4 434 586	7 110	103 141	26 554	76 587
2019	11 029 327	5 847 163	5 176 389	5 775	125 986	37 741	88 245
2020*	5 749 921	3 092 248	2 651 954	5 719	65 371	20 670	44 701

*Data source: (State Statistics Service of Ukraine, 2021) * – partial data.*

In 2006–2012, there was a tendency to increase the average size of apartments in new buildings, due to the desire of developers to reduce the capital intensity of construction and thus increase their profits. The average size of new apartments in urban areas varied from 90 m^2 to 100 m^2. In 2010 it reached 117.9 m^2, although afterwards this number started to decrease to 80.2 m^2 in 2016, see below.

Table 50: Ukraine – average size of dwellings built

Year	The average size	The average size of apartments built (m^2)			
		One room apartments	Two-room apartments	Three-room apartments	Four and more room apartments
2004	104.6	43.7	65.4	93.3	132.5
2005	101.0	47.6	67.2	95.0	136.9
2006	102.8	50.0	69.3	98.0	144.7
2007	105.9	51.5	71.4	100.3	150.5
2008	109.1	51.0	71.8	103.9	159.3
2009	96.1	52.3	73.3	103.1	170.7
2010	117.9	51.3	74.6	111.5	168.7
2011	110.0	49.0	74.1	111.2	174.4
2012	113.5	48.3	73.8	110.1	166.2
2013	104.6	47.1	74.0	111.7	167.2
2014	89.2	43.9	70.3	99.4	148.8
2015	87.2	42.0	67.4	97.2	145.5
2016	80.2	40.0	63.2	89.4	133.8

*Data source: (State Statistics Service of Ukraine, 2021), * - since 2014 data exclude the Autonomous Republic of Crimea, the city of Sevastopol and a part of Donetsk and Luhansk regions.*

The following tables present statistics specific to the Danube regions of Ukraine and compare them with the whole Ukraine. From these, Odessa is the most important region in terms of construction, however, average size of dwelling here is significantly smaller than in other Danube regions.

Table 51: Ukraine – The total area of residential buildings, putting into service, by type by region

Year / Region	Total, m^2 of total area	Including in buildings			
		one-dwelling buildings		two-and more dwelling buildings	
		m^2 of total area	% to the total for the region	m^2 of total area	% to the total for the region
2020					
Ukraine	**5749 921**	**3 092 248**	**53.8**	**2 651 954**	**46.1**
Zakarpattya	284 880	245 617	86.2	39 263	13.8
Ivano-Frankivsk	393 305	235 940	60.0	157 365	40.0
Odesa	480 114	143 780	29.9	336 334	70.1
Chernivtsi	246 813	193 529	78.4	53 284	21.6
2019					
Ukraine	**11 029 327**	**5 847 163**	**53.0**	**5 176 389**	**46.9**
Zakarpattya	506 918	462 766	91.3	44 152	8.7
Ivano-Frankivsk	752 903	421 087	55.9	331 816	44.1
Odesa	1 087 227	n/a	n/a	811 260	74.6
Chernivtsi	490 224	394 599	80.5	95 625	19.5
2018					
Ukraine	**8 689 356**	**4 247 660**	**48.9**	**4 434 586**	**51.0**
Zakarpattya	428 736	389 367	90.8	39 369	9.2

Ivano-Frankivsk	404 164	316 955	78.4	87 209	21.6
Odesa	567 842	167 181	29.4	400 661	70.6
Chernivtsi	287 520	234 821	81.7	52 699	18.3
2017					
Ukraine	**10 206 044**	**4 231 428**	**41.5**	**5 934 865**	**58.1**
Zakarpattya	419 644	357 018	85.1	62 392	14.9
Ivano-Frankivsk	624 477	374 765	60.0	243 192	38.9
Odesa	720 470	147 184	20.4	572 866	79.5
Chernivtsi	202 326	129 520	64.0	72 806	36.0

Data source: (State Statistics Service of Ukraine, 2021)

Table 52: Ukraine – Number of dwellings in residential buildings, putting into service, by type by region and place

Year/Region	Number of dwellings, units	Total area, m^2	Including living area, m^2	Average size of dwelling, m^2 of total area		
	total	total	total	total	including	
					in urban areas	in rural areas
2020						
Ukraine	**65 371**	**5 744 202**	**2 665 638**	**87.9**	**78.9**	**105.9**
Zakarpattya	2 103	284 880	121 026	135.5	106.0	171.0
Ivano-Frankivsk	3 746	393 305	192 942	105.0	83.5	156.5
Odesa	6 736	480 114	216 391	71.3	71.1	71.5
Chernivtsi	1 889	246 813	113 481	130.7	101.4	161.9
2019						
Ukraine	**125 986**	**11 023 552**	**5 127 357**	**87.5**	**77.5**	**110.6**
Zakarpattya	3 264	506 918	216 598	155.3	135.8	170.1
Ivano-Frankivsk	7 616	752 903	355 794	98.9	82.6	122.5
Odesa	16 819	1 086 628	508 329	64.6	62.1	69.9
Chernivtsi	3 848	490 224	227 821	127.4	99.8	160.2
2018						
Ukraine	**103 141**	**8 682 246**	**4 062 604**	**84.2**	**74.1**	**112.7**
Zakarpattya	2 774	428 736	182 853	154.6	129.9	176.1
Ivano-Frankivsk	3 115	404 164	194 446	129.7	121.4	134.6
Odesa	8 569	567 842	266 248	66.3	61.9	77.2
Chernivtsi	2 105	287 520	133 135	136.6	109.0	163.6
2017						
Ukraine	**125 610**	**9 874 426**	**4 697 874**	**78.6**	**71.3**	**105.3**
Zakarpattya	2 508	367 992	155 128	146.7	124.0	170.4
Ivano-Frankivsk	5 796	617 957	301 272	106.6	92.6	126.8
Odesa	11 340	720 050	332 641	63.5	60.1	74.3
Chernivtsi	1 651	187 846	85 205	113.8	90.9	183.3

Data source: (State Statistics Service of Ukraine, 2021)

SUMMARY

The reported statistics on the trends in housing stock vary in quality and detail from country to country. Contrary to statistics on building (housing) stock, statistics on building trends are available for all the period of 2011 to 2020 (of course with a few exceptions, e.g. Bulgaria or Croatia).

Statistics on building trends cover three main categories

- building permits issued;
- started construction and
- finished construction.

Each of these categories can further focus on All buildings, Residential Buildings, Non-residential buildings, New Buildings, Modification to existing buildings, One-dwelling buildings, Two and more dwelling buildings, Total useful area and Total floor area. In the case of apartments it is similar.

As not all statistics are available in all countries, it is rather difficult to properly assess and summarize construction trends in all countries together. Therefore, take the comparison below with a pinch of salt.

Statistics on the number of building permits for new residential buildings were selected as the first for comparison. In few cases, only statistics for All buildings or only New buildings were available. Nevertheless differences between All buildings and Residential buildings are relatively small, usually only a few percent. Statistics are then standardized per 1000 thousand capita for a better comparison of residential construction performance.

Table 53: Summary of building trends – building permits issued for residential (dwelling) buildings

	2014	2015	2016	2017	2018	2019	2020	Stat*
Austria	18 792	18 738	19 984	19 920	20 343	20 980	21 550	RES
Bulgaria					5 774	5 980	5 860	RES
Croatia	7 694	6 876	9 145	12 253	11 584	15 202	13 906	RES
Czech Republic	28 127	28 886	31 002	32 069	30 702	31 606	31 747	RES
Germany	163 866	177 166	184 877	175 707	173 568	176 637	187 130	RES
Hungary	5 132	6 526	12 206	13 216	13 743	14 282	11 381	RES
Romania	37 672	39 112	38 653	41 603	42 694	42 541	41 311	RES
Slovakia	14 310	17 642	20 224	18 472	20 574	20 385	19 050	ALL**
Slovenia	2 359	2 441	2 617	2 713	2 834	2 572	2 583	RES
Bosnia and Hercegovina	2 559	2 736	3 218	3 537	3 548	3 492	3 204	ALL
Moldova	-	2 498	2 328	2 296	2 009	1 891	2 044	RES
Montenegro	917	773	983	1 050	295	197	224	ALL
Serbia	3 863	4 763	5 751	8 523	9 392	11 358	13 022	RES
Ukraine	-	-	-	-	-	-	-	-
Total	**285 291**	**308 157**	**330 988**	**331 359**	**337 060**	**347 123**	**353 012**	

Data source: based on the statistics above for individual countries or additional statistics from Statistical offices

*Indicates, if statistic of building permits is only for residential buildings (RES) or for all buildings (ALL)
** Building permits for new buildings (i.e. without modifications to existing buildings)

Table 54: Summary of building trends – building permits issued for residential (dwelling) buildings per 1000 capita

	2014	2015	2016	2017	2018	2019	2020
Austria	2,21	2,18	2,30	2,27	2,31	2,37	2,42
Bulgaria	-	-	-	-	0,82	0,85	0,84
Croatia	1,81	1,63	2,18	2,95	2,82	3,73	3,43
Czech Republic	2,68	2,74	2,94	3,03	2,89	2,97	2,97
Germany	2,03	2,18	2,25	2,13	2,10	2,13	2,25
Hungary	0,52	0,66	1,24	1,35	1,41	1,46	1,16
Romania	1,89	1,97	1,96	2,12	2,19	2,19	2,14
Slovakia	2,64	3,25	3,73	3,40	3,78	3,74	3,49
Slovenia	1,14	1,18	1,27	1,31	1,37	1,24	1,23
Bosnia and Hercegovina	0,67	0,72	0,92	1,01	1,01	1,00	0,92
Moldova	-	0,70	0,66	0,65	0,57	0,53	0,58
Montenegro	1,48	1,24	1,58	1,69	0,47	0,32	0,36
Serbia	0,54	0,67	0,81	1,21	1,34	1,63	1,88
Ukraine	-	-	-	-	-	-	-
Average	**1,35**	**1,48**	**1,58**	**1,58**	**1,61**	**1,66**	**1,69**

Data source: based on the statistics above for individual countries or additional statistics from Statistical offices, Eurostat

As second, comparison of statistics on the number of permits for new apartments/dwellings was made. Again, in several cases, these include apartments in all (new) buildings, nevertheless, we consider differences negligible. In case of the Czech Republic, only data on the dwellings started were available. These do not fully correspond to the number of dwellings related to building permits, however it is the closest relevant statistic available. In case of Croatia and Moldova, the number of apartments was estimated based on the own calculation from other statistics as the statistics for number apartments were not available.

Statistics are then standardized per 1000 thousand capita for a better comparison of residential construction performance.

Table 55: Summary of building trends – building permits issued for dwellings/apartments

	2014	2015	2016	2017	2018	2019	2020	Stat*
Austria	63 293	66 197	74 350	82 768	72 949	82 551	77 145	RES
Bulgaria	-	-	-	-	35 526	32 783	29 438	RES
Croatia**	9 408	8 425	11 178	15 145	14 409	18 529	17 164	RES
Czech Republic***	24 351	26 378	27 224	31 521	33 121	38 677	35 254	RES
Germany	278 412	307 485	365 335	339 811	339 623	351 991	360 588	RES
Hungary	9 114	11 764	30 252	36 749	35 608	34 250	21 263	RES
Romania	68 958	75 715	85 670	93 692	102 628	105 437	100 805	RES
Slovakia	10 728	12 226	14 247	14 956	15 689	15 007	14 482	ALL
Slovenia	2 641	2 688	3 034	3 116	3 637	3 314	3 667	RES
Bosnia and Hercegovina	4 651	5 866	6 391	6 843	7 291	7 654	8 563	ALL

Moldova**	-	6 994	6 518	6 429	5 625	5 295	5 723	RES
Montenegro	2 945	2 993	3 005	4 439	2 339	1 580	1 297	ALL
Serbia	8 858	11 474	14 459	19 382	21 162	27 306	29 281	RES
Ukraine	-	-	-	-	-	-	-	
Total	**483 359**	**538 205**	**641 663**	**654 851**	**689 607**	**724 374**	**704 670**	

Data source: based on the statistics above for individual countries or additional statistics from Statistical offices

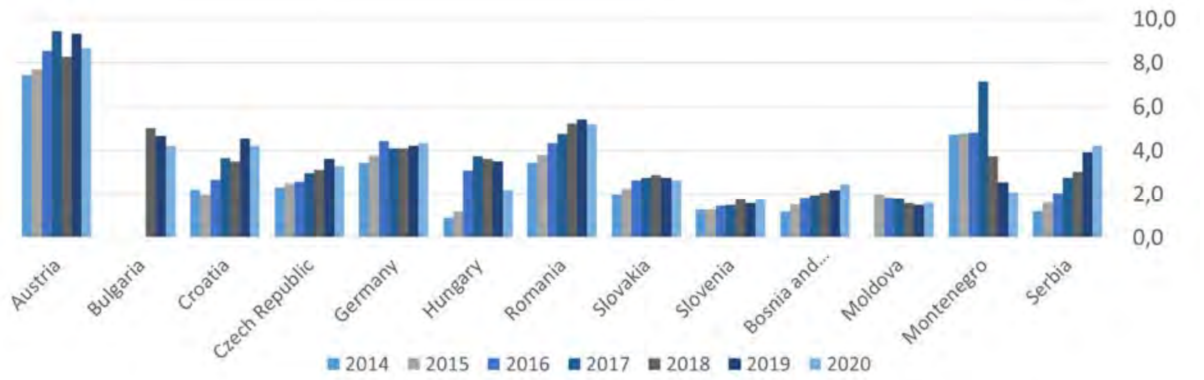
*Indicates, if statistic of building permits is only for residential buildings (RES) or for all buildings (ALL)
** Number of apartments was estimated based on the own calculation from other statistics as the statistics for apartments were not available
*** Number of dwellings started, does not correspond directly to the issued building permits.

Table 56: Summary of building trends – building permits issued for dwellings/apartments per 1000 capita

	2014	2015	2016	2017	2018	2019	2020
Austria	7,44	7,71	8,55	9,43	8,27	9,32	8,67
Bulgaria	-	-	-	-	5,04	4,68	4,23
Croatia	2,22	1,99	2,67	3,65	3,51	4,55	4,23
Czech Republic	2,32	2,50	2,58	2,98	3,12	3,63	3,30
Germany	3,45	3,79	4,45	4,12	4,10	4,24	4,34
Hungary	0,92	1,19	3,08	3,75	3,64	3,50	2,18
Romania	3,46	3,81	4,34	4,77	5,25	5,43	5,22
Slovakia	1,98	2,26	2,63	2,75	2,88	2,75	2,65
Slovenia	1,28	1,30	1,47	1,51	1,76	1,59	1,75
Bosnia and Hercegovina	1,21	1,53	1,82	1,95	2,08	2,19	2,45
Moldova	-	1,97	1,83	1,81	1,59	1,49	1,61
Montenegro	4,74	4,81	4,83	7,13	3,76	2,54	2,09
Serbia	1,24	1,61	2,04	2,75	3,02	3,92	4,23
Ukraine	-	-	-	-	-	-	-
Average	**2,29**	**2,58**	**3,07**	**3,13**	**3,30**	**3,47**	**3,38**

Data source: based on the statistics above for individual countries or additional statistics from Statistical offices, Eurostat

Figure 54: Summary of building trends – building permits issued for dwellings/apartments per 1000 capita from 2014 to 2020



Data source: based on the statistics above for individual countries or additional statistics from Statistical offices, Eurostat

5. ENERGY CONSUMPTION TRENDS

The chapter describes the energy consumption of countries in the breakdown into total primary and total final energy consumption in recent years (based on the data availability). The trends of energy consumption in the household and commercial sector are compared.

Trends in energy consumption are processed in the form of comparisons between countries. In the case of some countries, energy consumption statistics are described in more detail.

Table 57: Primary energy consumption (Europe 2020-2030) from 2014 to 2020 in PJ

Country / Time	2014	2015	2016	2017	2018	2019
Bulgaria	722.53	751.87	739.61	767.10	769.06	762.79
Czechia	1 632.05	1 651.18	1 663.85	1 689.57	1 694.83	1 666.44
Germany	12 292.46	12 389.97	12 460.96	12 481.74	12 231.24	11 836.29
Croatia	318.10	333.19	336.87	348.78	342.30	343.75
Hungary	920.88	975.44	990.38	1 024.20	1 024.90	1 028.86
Austria	1 289.39	1 325.29	1 341.43	1 373.83	1 331.56	1 348.07
Romania	1 258.78	1 287.36	1 283.34	1 358.89	1 363.79	1 338.54
Slovenia	267.62	265.65	274.17	281.70	278.43	273.08
Slovakia	620.88	637.15	643.40	676.10	661.10	669.22
Montenegro	39.62	41.50	40.17	41.93	43.38	44.87
Serbia	537.29	594.84	610.57	623.54	619.05	616.27
Bosnia and Herzegovina	248.54	255.98	280.15	280.14	308.96	298.18
Moldova	106.30	107.43	111.86	117.83	123.12	116.56
Ukraine	4 255.68	3 732.26	3 698.64	3 629.96	3 796.86	3 607.08

Data source: (Eurostat, 2021a)

Table 58: Final energy consumption (Europe 2020-2030) from 2014 to 2020 in PJ

Country / Time	2014	2015	2016	2017	2018	2019
Bulgaria	376.22	397.34	404.00	414.18	415.05	411.83
Czechia	987.20	1 013.00	1 039.22	1 067.54	1 060.29	1 059.52
Germany	8 789.16	8 904.52	9 077.22	9 151.13	9 019.13	8 980.68
Croatia	261.22	275.74	277.99	289.92	286.87	289.37
Hungary	679.14	728.50	744.26	773.79	775.08	779.00
Austria	1 121.55	1 151.38	1 175.28	1 194.39	1 165.33	1 184.05
Romania	907.93	914.81	931.00	976.59	987.76	999.62
Slovenia	193.15	197.30	204.38	207.20	207.25	203.03
Slovakia	416.87	421.39	435.56	465.86	465.28	467.62
Montenegro	27.06	28.53	29.67	31.40	31.55	32.90
Serbia	328.49	342.48	360.88	369.78	376.77	377.23
Bosnia and Herzegovina	137.34	146.43	156.05	153.82	184.30	184.33
Moldova	97.17	99.72	104.29	110.46	115.65	110.30
Ukraine	2 580.46	2 149.05	2 214.44	2 121.62	2 171.82	2 088.14

Data source: (Eurostat, 2021a)

Table 59: Final consumption - other sectors - households - energy use from 2014 to 2020 in PJ

Country / Time	2014	2015	2016	2017	2018	2019
Bulgaria	90.64	91.81	94.29	97.08	93.35	90.43
Czechia	274.41	283.43	296.85	301.57	294.86	293.36
Germany (until 1990 former territory of the FRG)	2 246.14	2 301.06	2 384.95	2 367.34	2 338.07	2 417.24
Croatia	93.30	101.73	100.86	100.18	96.25	93.73
Hungary	229.75	249.94	258.44	263.52	243.59	237.68
Austria	261.25	277.67	289.29	291.22	273.93	280.32
Romania	310.23	308.78	310.45	323.72	325.53	324.61
Slovenia	44.41	48.83	49.68	48.41	45.41	44.27
Slovakia	81.72	83.22	85.00	88.28	86.14	110.67
Montenegro	10.73	11.11	11.08	11.02	10.38	10.21
Serbia	115.25	118.33	122.43	119.47	118.84	119.52
Bosnia and Herzegovina	41.06	46.60	47.70	43.78	71.99	70.61
Moldova	48.98	49.40	51.65	55.13	56.81	51.82
Ukraine	852.32	692.99	726.36	690.12	669.31	586.81

Data source: (Eurostat, 2021a)

Table 60: Final consumption - other sectors - commercial and public services - energy use from 2014 to 2020 in PJ

Country / Time	2014	2015	2016	2017	2018	2019
Bulgaria	41.53	45.16	48.44	48.87	51.55	53.09
Czechia	122.36	124.66	129.43	133.17	130.95	133.64
Germany (until 1990 former territory of the FRG)	1 286.03	1 349.19	1 331.59	1 340.54	1 215.98	1 137.03
Croatia	29.02	31.95	32.67	34.23	34.86	34.98
Hungary	88.54	92.26	91.71	90.23	87.87	86.15
Austria	101.47	103.78	101.94	109.91	108.01	111.72
Romania	74.04	73.77	75.63	77.81	82.74	82.15
Slovenia	17.89	19.03	20.62	20.13	19.87	18.87
Slovakia	51.64	54.41	54.78	59.73	55.04	51.17
Montenegro	2.89	2.95	3.32	3.62	3.68	4.56
Serbia	32.34	36.62	37.11	39.35	37.32	36.15
Bosnia and Herzegovina	6.85	14.98	18.23	14.89	14.59	17.04
Moldova	9.94	10.32	10.83	10.74	11.44	11.01
Ukraine	195.31	162.80	195.60	181.58	197.64	202.34

Data source: (Eurostat, 2021a)

CZECH REPUBLIC

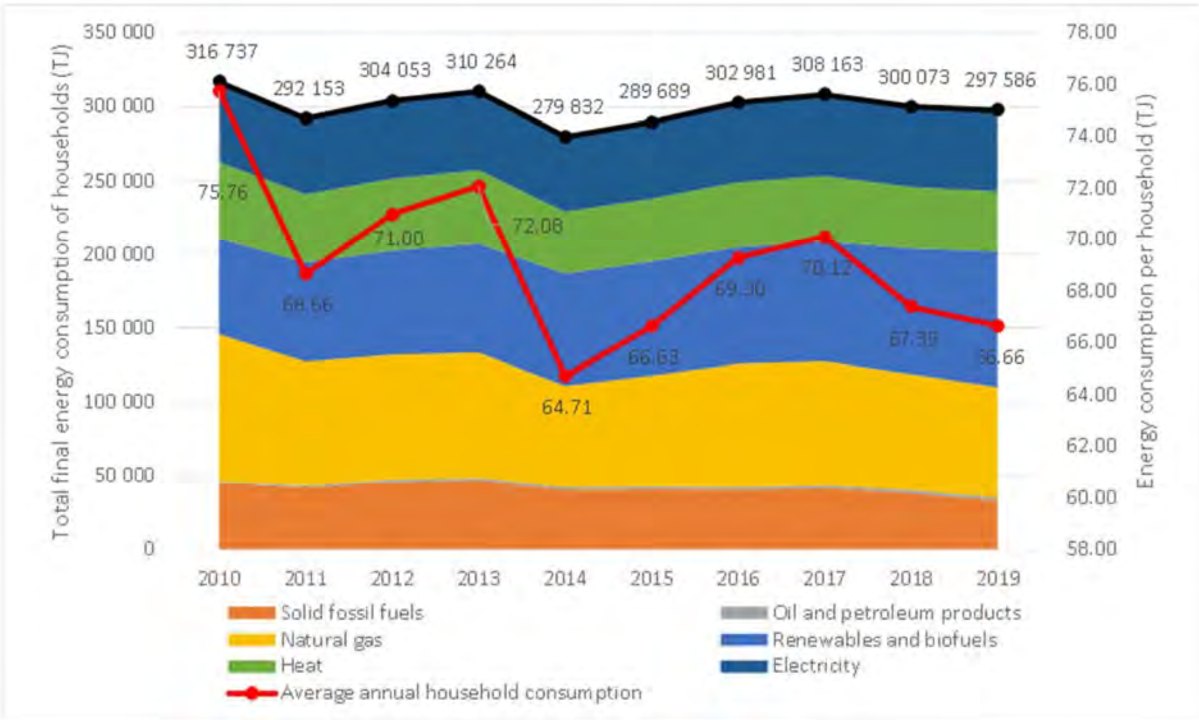
The largest share, namely 30% of the total final consumption in the Czech Republic, is consumed by households, i.e. single-family houses and apartment buildings. The household's final consumption represents the amount of energy needed to cover the energy needs associated with the use of the building, in particular for heating, cooling, ventilation, air humidity control, hot water production and lighting, but it also includes consumption by household appliances. The primary share of final consumption in households is used for heating, which accounts for more than 69% of final energy consumption (Ministry of Industry and Trade, 2020b).

Between 2010 and 2019, the total annual final energy consumption of households decreased by "only" 6%. This is due to an increase in the living standard of households and an increase in the number of households. The increase in number of household between 2010 and 2019 was almost 7% (app. 284 thousand households), while the population between 2010 and 2019 increased only by 0.2%. This only confirms the decrease in the average number of members per household (from 2.50 to 2.34 per household).

On the other side, average annual final energy consumption per individual household decreased by 12%, which means that there is an overall improvement in the energy efficiency of housing. Average annual final energy consumption per person decreased by 6.3% from 30.35 GJ to 28.45 GJ.

In terms of fuel consumption, there is a significant decrease in the usage solid fossil fuels (by 26%), natural gas (by 25%) and heat (by 22%) and an increase in the consumption oil and petroleum products (from 1008 TJ to 1883 TJ) and especially in the consumption of renewable resources (by 41%). Electricity consumption basically remained the same (there was increase just by 1.5%).

Figure 55: Total final energy consumption of households and average energy consumption per household in 2010–2019



Data source: (Czech Statistical Office, 2021), (Ministry of Industry and Trade, 2021)

GERMANY

The primary energy consumption of residents, i.e. private individuals and companies based in Germany, fell from 14,531 to 13,170 PJ between 2003 and 2018. This corresponds to a decrease of 9.4%. One third of the total energy consumption is consumed by private households, the remaining part by the companies. The industry, i.e. the manufacturing and mining sectors, accounts for 39%, the private households for 33%, the services sector for 26%, and agriculture, forestry and fishing for 1% of the total consumption.

Energy consumption in private households

The energy consumption of private households is mostly accounted for the residential area. In 2018 residential stock made almost two-thirds (64%) of the energy consumption of private households. The remaining part (36%) people have used for private transport.

In Germany a kind of trend reversal has taken place in the energy consumption of private households in recent years: from 2003 to 2013, slight savings were recorded (- 5.5%). However, from 2013 consumption increased again noticeably (2013 to 2018: + 8.9%), so that in 2018 private households consumed 2.9% more energy than in 2003. In total, the consumption in residential area increased over a period of last 15 years for 2.2%. This is mainly due to the growing number of households (in particular single-person households). At the same time, the energy consumption per household fell by 5.0%. The proportions of the energy sources used have changed more clearly than the total energy consumption in residential stock (Federal Statistical Office, 2021).

In Baden-Württemberg and Bavaria the energy consumption in private households per one resident has decreased, by about 5% and 13% accordingly, within the last twenty years.

Table 61: Energy consumption in private households per one resident in Baden-Wurttemberg and Bayern.

Federal state	Gigajoule per resident						
	1995	2000	2005	2010	2015	2016	2017
Baden-Württemberg	31.4	31.5	35.0	32.7	26.1	27.2	27.3
Bavaria	33.0	32.6	30.5	33.2	27.5	29.2	30.9

Data source: Statistical Offices of the federal states

Renewable energies gained significantly in importance between 2003 and 2018. Their share grew from 7% to 14%. This mainly saved heating oil, which in 2018 only accounted for 18% - compared to 26% in 2003. The most important energy source in 2018 still was natural gas; its share in the total energy consumption for residence has remained almost constant since 2003 at around 40%.

Around 2.9% of private households in Germany (1.2 million households) had income from the sale of solar power in 2018. In 2013 this share was 2.4% (927,000 households). The income of these households averaged EUR 243 per month in 2018 and has thus decreased by 26% compared to 2013 with EUR 328 per month. On the one hand, this is due to the decline in the feed-in tariff that households had gained before from the network operator for each kilowatt hour of electricity. On the other hand, increasing self-consumption of self-generated electricity – and thus lower feed-in into the network – can also be the cause (Federal Statistical Office, 2021).

ROMANIA

At national level, final energy consumption in the building sector accounts for 42% of total final energy consumption, of which 34% are residential buildings, with the remaining rate (approximately 8%) being commercial and public buildings. The residential sector has the highest share of energy consumption (approximately 81%), while all other buildings (offices, schools, hospitals, commercial premises and other non-residential buildings) account for the remaining 19% of total final energy consumption (Romania, 2020b).

BOSNIA AND HERZEGOVINA

The most important measure in the energy balance of Bosnia and Herzegovina is the total consumption of 11.87 billion kWh of electric energy per year. Per capita this is an average of 3,618 kWh.

Bosnia and Herzegovina could provide itself completely with self-produced energy. The total production of all electric energy producing facilities is 17 billion kWh, which is 143% of the countries own usage. Despite this, Bosnia and Herzegovina is trading energy with foreign countries. Along with pure consumptions the production, imports and exports play an important role. Other energy sources such as natural gas or crude oil are also used (WorldData.info, 2021a).

Table 62 Energy consumption in Bosnia and Hercegovina in 2019

Electricity	Total	Bosnia and Herzegovina per capita
Own consumption	11.87 bn kWh	3,618.00 kWh
Production	16.99 bn kWh	5,178.59 kWh
Import	3.08 bn kWh	940.01 kWh
Export	6.01 bn kWh	1,830.95 kWh

100.0% of the country's population (as of 2019) has access to electricity.

Source: (WorldData.info, 2021a)

Production capacities per energy source

The given production capacities for electric energy have a theoretical value, which could only be obtainable under ideal conditions. They are measuring the generateable amount of energy that would be reached under permanent and full use of all capacities of all power plants. In practice this isn't possible, because e.g. solar collectors are less efficient under clouds. Also wind- and water-power plants are not always operating under full load. All these values are only useful in relation to other energy sources or countries (WorldData.info, 2021a).

Table 63 Energy production

Energy source	Total in Bosnia and Herzegovina	Percentage in Bosnia and Herzegovina	Per capita in Bosnia and Herzegovina
Fossil fuels	20.07 bn kWh	49,0 %	6,117.77 kWh
Nuclear power	0.00 kWh	0,0 %	0.00 kWh
Waterpower	20.89 bn kWh	51,0 %	6,367.47 kWh

Renewable energy	409.62 m kWh	1,0 %	124.85 kWh
Total production capacity	40.96 bn kWh	-	12,485.24 kWh
Actual total production	16.99 bn kWh	41.5 %	5,178.59 kWh

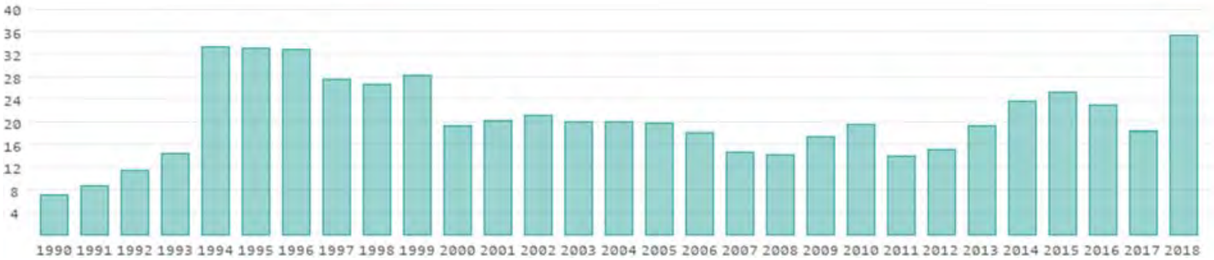
Source: (WorldData.info, 2021a)

Usage of renewable energies

Renewable energies include wind, solar, biomass and geothermal energy sources. This means all energy sources that renew themselves within a short time or are permanently available. Energy from hydropower is only partly a renewable energy. This is certainly the case with river or tidal power plants. Otherwise, numerous dams or reservoirs also produce mixed forms, e.g. by pumping water into their reservoirs at night and recovering energy from them during the day when there is an increased demand for electricity. Since it is not possible to clearly determine the amount of generated energy, all energies from hydropower are displayed separately (WorldData.info, 2021a).

In 2018, renewable energies accounted for around 35.4 percent of actual total consumption in Bosnia and Herzegovina. The following chart shows the percentage share from 1990 to 2018:

Figure 56: Percentage share or renewable energies in Bosnia and Hercegovina



Source: (WorldData.info, 2021a)

MOLDOVA

Moldova can provide itself completely with self-produced energy. The total production of all electric energy producing facilities is 5 billion kWh, which is 125% of own requirements. The rest of the self-produced energy is either exported into other countries or unused. Along with pure consumptions, the production, imports and exports play an important role. Other energy sources such as natural gas or crude oil are also used (WorldData.info, 2021b). The values differ slightly from the Eurostat summary tables due to different methodologies.

Table 64 Final energy consumption (in TJ) in Moldova

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total (TJ)	98 652	100 127	100 810	103 142	107 790	114 088	119 944	114 885	111 950
Coal	4 769	5 920	3 902	4 216	3 059	4 305	3 259	4 290	3 248
Natural Gas	17 135	16 346	16 171	16 454	17 510	17 959	20 364	20 012	20 806
Oil Products	31 274	31 973	32 974	34 152	36 791	38 685	41 510	42 346	39 480
Biofuels and waste	23 862	24 127	25 851	26 409	28 417	31 272	32 006	26 323	26 777

Electricity	12 492	12 817	13 125	13 441	13 050	13 344	13 842	13 738	13 713
Heat	9 120	8 944	8 787	8 470	8 963	8 523	8 963	8 176	7 926

Source: (statbank.statistica.md, 2021b)

Table 65 Final energy consumption in residential sector (in TJ) in Moldova

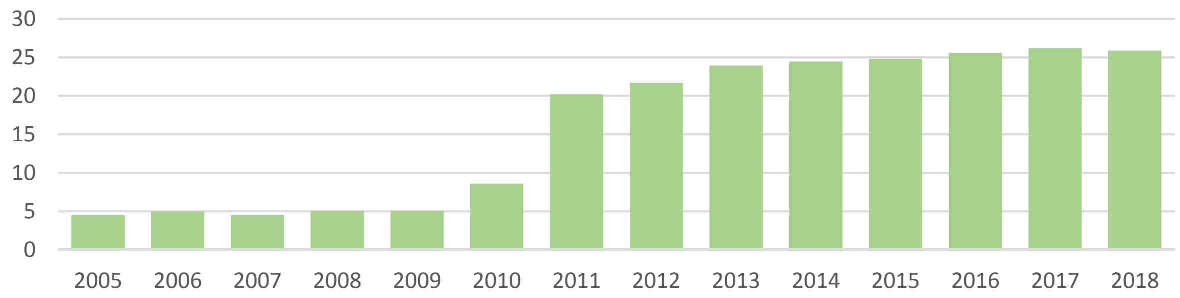
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total (TJ)	49 632	49 127	50 058	50 114	52 724	56 254	57 953	53 348	54 127
Coal	2 463	2 548	1 767	1 733	1 282	2 254	1 474	2 635	1 788
Natural Gas	10 498	9 788	10 012	9 442	9 899	10 476	12 004	12 276	13 645
Oil Products	2 592	2 661	2 665	2 312	2 912	2 642	2 610	2 410	2 296
Biofuels and waste	23 444	23 769	25 167	25 574	27 597	30 165	30 827	25 456	25 594
Electricity	5 679	5 805	5 976	6 118	5 887	5 895	5 916	6 019	6 233
Heat	4 956	4 556	4 471	4 935	5 147	4 822	5 122	4 552	4 571

Source: (statbank.statistica.md, 2021b)

Usage of renewable energies

In 2018, renewable energies accounted for around 25.7% of total final energy consumption in Moldova and almost half of the final energy consumption (47%) in residential sector.

Figure 57: Share of renewable energies on the final energy consumption in the period 1990 to 2018 in Moldova



Source: (Worlddata.info, 2021b)

MONTENEGRO

Primary production of electricity in Montenegro in 2020 was 1,770.2 GWh, transformation output was 1,615.4 GWh. Total import of electricity was 5,943.0 GWh and total export was 5,864,0 GWh. Consumption of the energy branch was 141.0 GWh and distribution losses 486.9 GWh. Total final consumption of electricity in 2020 was 2,836.7 GWh. The highest ratio in total consumption of electricity was in households 43.8%, in other sectors 31.5% and industrial activities 24.7% (Monstat, 2021b).

Table 66 Final Electricity consumption in Montenegro

	2014	2015	2016	2017	2018	2019*
Total Final Consumption [TJ]	9 397	9 645	9 615	10 278	10 248	10 995
Residential sector [TJ]	4 253	4 474	7 163	4 629	4 580	4 645

**preliminary data*

Source: (Monstat, 2021b)

Primary production of coal in Montenegro in 2020 was 1,665.4 thousand tons, 8.5 thousand tons brown coal and 1 656.9 thousand tons of lignite. Total final consumption of coal in 2020 was 26.6 thousand tons, 11.7 thousand tons consumed in industry, while 14.9 thousand tons consumed in other sectors. For electricity production, as transformation input was used 8.2 thousand tons brown coal and 1,558.8 thousand tons lignite (Monstat, 2021b). The following table shows coal consumption in the residential sector, with the trend of coal consumption decreasing being important.

Table 67 Final Coal consumption, excluding transformation processes, in Montenegro

	2014	2015	2016	2017	2018	2019*
Total Final Consumption [TJ]	478	508	397	273	317	307
Residential sector [TJ]	133	180	94	85	88	64

**preliminary data*

Source: (Monstat, 2021b)

Biofuels (wood) account for more than 50% of total household final energy consumption. The consumption of firewood has decreased significantly (almost by 18%) between 2015 and 2020.

Table 68 Final Fire wood Residential consumption in Montenegro

	2015	2016	2017	2018	2019	2020*
Firewood [TJ]	6 030	5 921	5 636	5 054	4 819	4 949
Wood residue and chips [TJ]	350	343	326	294	279	287
Wood pellets [TJ]	40	42	244	268	255	262
Charcoal [TJ]	16	17	17	18	20	19

**preliminary data*

Source: (Monstat, 2021b)

SERBIA

Energy consumption per capita in Serbia amounts to 2.2 toe (28% below the EU average in 2019), including 4 260 kWh of electricity (24% below the EU average, 2019). Total energy consumption has declined by 1% per year since 2017, reaching to 15.3 Mtoe in 2019, after growth of 5.6% per year between 2014 and 2017. It declined by 3% per year, compared between 2004 and 2014, reaching 13 Mtoe, its lowest level since 2000, mainly because of the 2014 floods that cut lignite consumption by 23% in 2014 (enerdata.net, 2021).

Despite of this decline, in 2018, the final energy consumption in Serbia amounted to 9.2 Mtoe, which is 30% more than in 2000. The largest share in the final energy consumption in 2018 was achieved, almost equally, by the household sector (34%) and the industrial sector (31%), which are followed by the transport sector (23%), services (10%) and agriculture (1.9%). Compared to 2000, there was an increase in final consumption in almost all sectors; in some sectors this increase is significant. The share of the transport sector has more than doubled, with an increase in agriculture (32.3%), industry (30.6%) as well as services and other sectors (35%). On the contrary, in 2018, the final energy consumption in the household sector (2.84 Mtoe) was 9.2% lower than in 2000. Energy savings in the mentioned period amounted to 0.61 Mtoe (Odyssee-mure.eu, 2021).

The National Action Plan for Renewable Energy (Ministry of Energy of the Republic of Serbia, 2013), set a target of 27% of renewables in the final energy consumption in 2020 (37% for electricity, 30% for heating and 10% for transport). However, Serbia is likely to miss its 2020 target, with only 21% in 2019 (of which 30% for electricity, 27% for heating, and 1.1% for transport).

UKRAINE

Ukraine's total energy consumption per capita has fallen from 4.9 toe in 1990 to 2.9 toe in 2010 and 2 toe in 2020, which is lower than the average for the EU (-34%).

The share of transport in oil consumption decreased from 69% in 2013 to nearly 59% in 2019. The share of the hydrocarbon industry increased from 3% in 2008 to 19% in 2020. The share of the residential sector in oil consumption is stable at around 11% since 1990. The residential and services sector is the main gas consumer since 2009 with a share of 36% (up from 22% in 2000), while that of district heating has shrunk from 46% in 2000 to 30% in 2020. The share of industry was 18% in 2020, followed by power plants (16%). Since 2012, electricity consumption has decreased on average by 2.8%/year (-22%) to 116 TWh in 2020. This trend is mainly due to the low economic activity and the sharp electricity price hikes. Previously, electricity consumption increased by an average of 2.4%/year between 2002 and 2011.

Ukraine approved its National Renewable Energy Action Plan (NREAP) in 2014. The NREAP aimed for renewables to account for 11% of final energy consumption by 2020 (from 3.8% in 2009), including an 11% share for electricity, 12.4% for heating, and 10% for transport (Ministry of Energy of the Republic of Serbia, 2013). These targets were likely missed in 2020, since renewables only accounted for 8.1% of final energy consumption in 2019 (including 10.9% for electricity, 9% for heating, and 3.1% for transport) (enerdata.net, 2021).

Energy intensity per GDP at purchasing power parity (PPP) is very high: at 0.25 tons of oil equivalent (toe) per thousand USD PPP, it is over twice the world average (0.11 toe /1000 USD) (IEA, 2020b).

SUMMARY

As absolute energy consumption may not be entirely clear in terms of comparability due to various differences between individual countries, it is possible to express energy consumption per capita, which can better compare the intensity of energy consumption.

The following table compares the development of final energy consumption per capita in the countries of the Danube region. The values for Moldova and Ukraine were additionally calculated as the Eurostat database does not presents these data. The last column of the table shows the progress between 2011 and 2019, respectively between the years with known statistics.

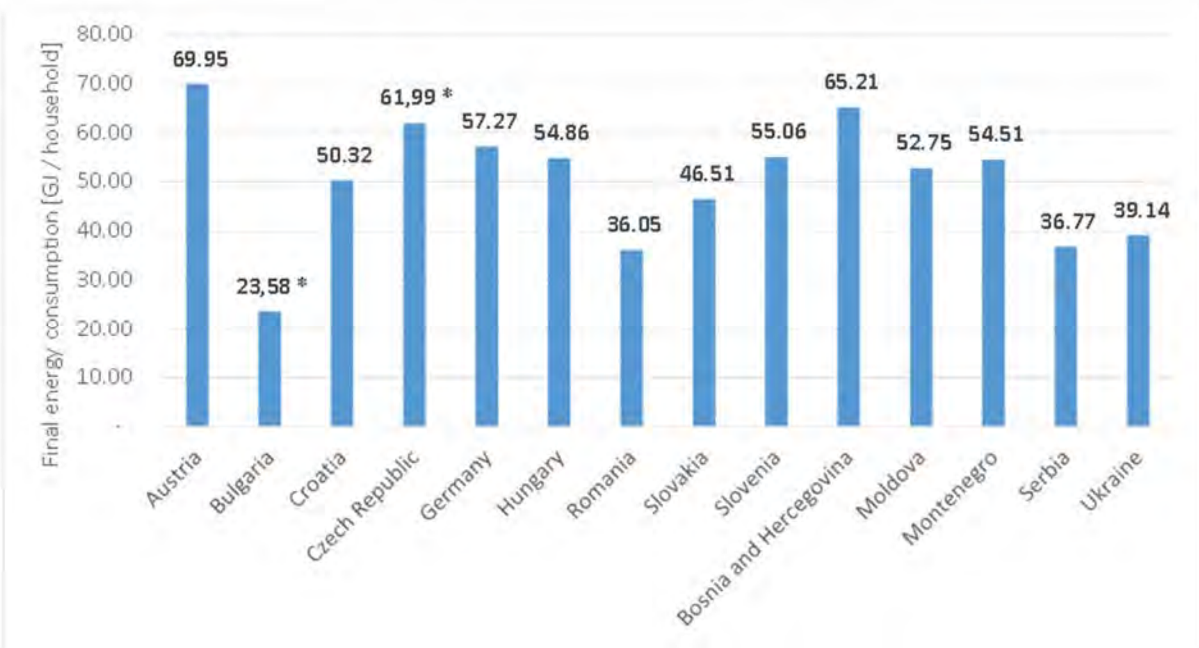
Significant reductions in final energy consumption per capita (more than 10%) have been achieved in Croatia, Hungary, Slovenia and Montenegro with exceptional reduction in Ukraine. On the contrary, final energy consumption increased in Slovakia, Moldova and very significantly in Bosnia and Hercegovina. In other countries, final energy consumption remained at about the same level over the evaluated period.

Table 69 Final energy consumption in households per capita

GEO/TIME	2011	2012	2013	2014	2015	2016	2017	2018	2019	Progress
Austria	9 083	9 211	9 490	8 490	8 920	9 199	9 199	8 606	8 723	4.1%
Bulgaria	3 756	3 745	3 582	3 489	3 559	3 675	3 815	3 687	3 605	4.2%
Croatia	7 176	6 978	6 815	6 117	6 711	6 711	6 734	6 536	6 397	12.2%
Czech Republic	7 606	7 874	8 036	7 245	7 466	7 804	7 908	7 711	7 641	-0.5%
Germany	8 118	8 560	9 013	7 699	7 827	8 048	7 990	7 827	8 083	0.4%
Hungary	7 664	7 478	7 304	6 466	7 059	7 315	7 478	6 920	6 757	13.4%
Romania	4 536	4 675	4 489	4 326	4 326	4 373	4 594	4 640	4 652	-2.5%
Slovakia	4 571	4 454	4 617	4 187	4 257	4 350	4 512	4 396	5 641	-19.0%
Slovenia	7 385	7 094	7 001	5 978	6 571	6 687	6 513	6 082	5 885	25.5%
Bosnia and Hercegovina	-	-	-	2 977	3 524	3 768	3 466	5 722	-	-48.0%
Moldova	7 697	7 484	7 567	7 587	7 792	8 153	8 641	9 055	-	-15.0%
Montenegro	5 047	5 268	5 036	4 792	4 966	4 943	4 919	4 640	4 559	10.7%
Serbia	5 036	5 047	4 617	4 489	4 629	4 815	4 722	4 722	4 780	5.4%
Ukraine	19 049	18 206	17 900	15 842	13 961	14 443	13 895	14 290	13 816	37.9%

Data source: (Eurostat, 2021)

Figure 58: Final energy consumption per household in 2018 (GJ)



*Building stock based on Census 2011, energy consumption from Eurostat 2018. The resulting value will be slightly lower due to new buildings over period 2011-2018.

Data source: based on the statistics above for individual countries

6. HEATING AND COOLING TRENDS

Trends in heating are described on the basis of energy balances of the country / typology of energy consumption. The information is supplemented by findings from the National Action and Climate Plans.

Trends in heating and cooling are processed in the form of comparisons between countries with a focus on residential sector. Data are available only for some countries.

Table 70: Final consumption - other sectors - households - energy use - space heating from 2014 to 2020 in PJ

Country / Time	2014	2015	2016	2017	2018	2019
Bulgaria	47.07	48.54	50.75	52.53	49.24	47.10
Czech Republic	-	191.28	203.32	209.31	205.45	205.13
Germany (until 1990 former territory of the FRG)	1 500.41	1 556.11	1 633.71	1 597.44	1 548.08	1 608.35
Croatia	62.30	70.19	69.83	68.25	64.92	62.86
Hungary	-	182.59	190.62	195.01	174.74	168.02
Austria	177.94	193.50	203.41	205.03	190.21	195.35
Romania	-	196.27	198.04	203.96	204.32	201.73
Slovenia	27.97	32.28	33.02	31.66	28.69	27.69
Slovakia	-	56.92	58.13	60.14	57.63	80.56
Montenegro	-	-	-	-	-	-
Serbia	68.58	71.23	75.96	72.65	73.46	73.53
Bosnia and Herzegovina	23.45	28.33	29.31	25.38	52.59	51.08
Moldova	-	-	-	38.81	39.82	35.26
Ukraine	-	-	409.22	356.94	370.64	310.20

Data source: (Eurostat, 2021b)

Table 71: Final consumption - other sectors - households - energy use - water heating from 2014 to 2020 in PJ

Country / Time	2014	2015	2016	2017	2018	2019
Bulgaria	16.45	16.26	16.49	16.71	16.80	16.42
Czech Republic	-	48.74	48.56	49.19	51.07	49.64
Germany (until 1990 former territory of the FRG)	354.84	347.23	357.79	377.41	394.48	403.10
Croatia	10.39	10.10	9.86	10.33	10.11	9.70
Hungary	-	31.45	31.65	31.49	31.27	31.23
Austria	43.06	42.49	41.92	41.84	39.54	39.71
Romania	-	40.74	41.12	43.08	43.95	44.28
Slovenia	7.59	7.55	7.54	7.52	7.46	7.42

Slovakia	-	11.69	11.99	12.57	12.09	13.90
Montenegro	-	-	-	-	-	-
Serbia	17.14	17.51	17.41	17.31	16.85	16.75
Bosnia and Herzegovina	6.41	6.67	6.69	6.71	6.88	6.96
Moldova	-	-	-	5.52	5.62	5.19
Ukraine	-	-	93.77	90.14	90.24	82.42

Data source: (Eurostat, 2021b)

Table 72: Final consumption - other sectors - households - energy use - space cooling from 2014 to 2020 in PJ

Country / Time	2014	2015	2016	2017	2018	2019
Bulgaria	0.38	0.42	0.43	0.44	0.39	0.43
Czechia	-	0.18	0.18	0.18	0.23	0.25
Germany (until 1990 former territory of the FRG)	4.18	4.15	4.45	4.62	4.45	4.60
Croatia	1.21	1.86	1.54	1.83	1.86	1.86
Hungary	-	0.27	0.27	0.31	0.42	0.57
Austria	0.03	0.03	0.02	0.03	0.03	0.03
Romania	-	0.99	0.99	1.03	1.05	1.06
Slovenia	0.11	0.33	0.20	0.33	0.25	0.34
Slovakia	-	0.12	0.12	0.12	0.13	0.13
Montenegro	-	-	-	-	-	-
Serbia	0.60	0.61	0.60	0.60	0.58	0.58
Bosnia and Herzegovina	0.42	0.44	0.44	0.44	0.43	0.44
Moldova	-	-	-	0.03	0.03	0.03
Ukraine	-	-	2.07	2.39	2.97	3.52

Data source: (Eurostat, 2021b)

Germany

Heating and cooling trends in residential stock

In 2018, as in previous years, most of the living spaces were heated with natural gas (52%). Around one third of the final energy consumption of Baden-Württemberg households was covered by natural gas in 2018. Natural gas is mainly used to generate heat or to heated water, electricity reached a share of 19%. (Statistisches Landesamt Baden-Württemberg, 2021). Almost a quarter (23%) of private households in Germany used oil for heating. However, there are clear regional differences. Heating oil as an energy source to heat living spaces was much rarer in the eastern German federal states than in other federal states. In Bavaria and Baden-Wuerttemberg in particular, over 30% of dwellings were heated with oil. From 2026, the installation of new oil heating systems in buildings, where more climate-friendly heat generation is possible, is to be banned in Germany.

The transition from oil heating systems to more climate-friendly systems is to be promoted with an exchange premium of up to 40% of the costs. That is why oil heating systems in new buildings have already become very rare. In 2018, the proportion of apartments heated primarily with oil in new buildings was only 2%. In 2018 around 2% of all inhabited apartments were heated predominantly with a renewable source of energy, such as biomass, solar energy, heat recuperation, geothermal and other environmentally-friendly heat source. In the dwellings completed after 2011 it was already about 25%.

This is also reflected in the types of heating systems used: between 2006 and 2018, the proportion of households with heating system on the basis renewable energies increased from 3.0 to 5.8%, while the share with oil heating systems fell from 30% to 23% (Federal Statistical Office, 2021).

The share of energy used for space cooling in dwellings is basically insignificant (space cooling represents only 0.19% of total final energy consumption in households) and shows a very slight increase in the last decade. Only 3% of newly built residential buildings in Baden-Wuerttemberg in 2019 were equipped with a cooling system. (Statistisches Landesamt Baden-Württemberg, 2021). This shows that cooling in residential buildings is not a very widespread trend, even in Germany.

Hungary

The objective of the District Heat Development Plan about to be accepted on the basis of Parliamentary Decision No 77/2011 of 14 October 2011 is to ensure the competitiveness of the district heating service, to improve its efficiency, and to involve renewable energy sources.

In Hungary, the heating of 648,712 household and domestic hot water supply for 599,980 dwelling is performed through district heating systems in 2015. The specific air pollution values and centralised, high altitude emission conditions of heat production in thermal power plants and heat plants under controlled conditions are much more favourable from an environmental health perspective than in the case of densely populated areas, the uncontrolled, untreated and decentralised exhaust gas emission from individual and central heating systems (Hungary, 2017).

Serbia

Averagely 65% of final energy consumption by households in Serbia is consumed for heating, which is close to the European average. Most of apartments, however, were built before 1980 in the buildings which are often characterized by oversized heating systems, lack of insulation, and rather high heating consumption. According to the information available, for space heating and heating of a domestic hot water in apartments in Serbia an average of 220 kWh/m^2 annually is consumed, which is far more than the average in the EU (168 kWh/m^2 of which 147 kWh/m^2 is for space heating and 21 kWh/m^2 for domestic hot water preparation) (Pezzutto, S., Toleikyte, A., De Felice, M, 2015).

The heating systems in Serbia in urban entities are mainly district heating, gas and electricity. According to the census of 2011, the share of certain energy sources used for heating of the residential buildings in Serbia was as follows: wood 43%, district heating 22%, electricity 15.5%, gas 10%, coal 9% (and all other fuels 0.5%). Traditionally Serbia consumes large amounts of wood for heating especially on the outskirts of cities and in rural areas (N. Lukic et al., 2015).

The share of energy consumption for space cooling in the households is rather small compared to heating (0.58 PJ in 2019 contrary to 73.53 PJ for heating or 119.52 PJ of total final energy consumption of households) and shows a very slight decrease during past years (from 0.60 PJ in 2014 to 0.58 PJ in 2019).

Ukraine

Industry accounted for the largest share of Ukraine's final energy consumption at 29%, while Buildings, transport, district heating and electricity were the other sectors with a share of at least 15%. Natural gas accounted for 1,700 PJ, or 36% of Ukraine's total energy supply. Coal and oil products accounted for 31% and 12% of the total in 2009, respectively. Nuclear accounted for 19%. The remaining 2% was related to the use of renewables (Gielen,D., Saygin, D. and Wagner, N. (IRENA), 2015).

The heating sector in Ukraine can be divided into two main components: the district-heat sector, owned and operated by municipal heating companies; and heating systems to serve industry, such as boilers or direct firing units.

In 2010, heat production from the district heat sector reached 640 PJ, with about one third of the total from combined heat and power plants. Residential and commercial buildings consume 60% of the total district-heat generated, with the remainder going to industry. District heat accounts for nearly a quarter of total final energy consumption in the buildings and industry sectors. About 39% of total households in Ukraine were connected to district heating, which is slightly lower than the 43% in 2011. However, 41% of the total number of households had individual gas-fired heating units, and 21% had other forms of heating based on either electricity or solid fuels such as coal or wood.

For the building sector the share of renewables in the mix in 2010 was about 11.5%, and in the overall heating sector less than 5%. About 15% of households used some type of biomass for space heating, cooking or water heating (Gielen,D., Saygin, D. and Wagner, N. (IRENA), 2015).

7. REGULATORY FRAMEWORK IN THE FIELD OF ENERGY PERFORMANCE OF BUILDINGS AND RENOVATION SUPPORTING SCHEMES

The analysis is based on the National Action and Climate Plans, which summarize legislative measures. In the case of non-EU countries, analysis is based also on other available data.

AUSTRIA

Regulatory framework

Table 73: Regulatory framework in the field of energy performance of buildings in Austria

Instrument	Date	Brief description
Federal Act on Support for Electricity Production from Renewable Sources (Green Electricity Act 2012 – ÖSG 2012) – BGBl. I No 75/2011	2012	Provides an ambitious basis for promoting green electricity in Austria
Energy Efficiency Act ([Bundes-Energieeffizienzgesetz]; BGBl. I No 72/2014	2014	Promotes basis for various energy saving measures including Strategic measures (including provincial support for housing construction, energy and environment, the Domestic Environmental Support scheme – see above) to promote energy efficiency measures. It also sets Austria's policy framework for the period to 2020 and transposes EU targets into national law.
OIB Guideline 6 "energy saving and heat insulation"	2015	Contains all relevant thermal-energetic building standards and is the main basis for the national implementation of the EU's Energy Performance of Buildings Directive. Guideline 6 has been transposed into law in all provinces, which allows the issuance of a single standardised building energy pass in all of Austria
Austrian Climate and Energy Strategy (#mission2030)	May 2018	Provides the framework for action in terms of Austrian climate and energy policy up to 2030
A modification of OIB Guideline 6	April 2019	The key purpose of the revision was to ensure that from 1 January 2021 onwards, all new buildings will be designed as nearly zero-energy buildings and to prohibit the use of fossil fuels for space heating and cooling and hot water
OIB Document on the long-term renovation strategy pursuant to Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings in the consolidated version of 30 May 2018	April 2020	The focus of the document is on aspects of thermal energy renovation and energy efficiency, as well as the use of renewable energy sources in the building sector.

Renewable Expansion Law (EAG)	2021	Replacement of Green Electricity Act. The law sets a 100% renewable electricity consumption goal by 2030 for Austria.

Data source: (Austrian Federal Ministry for Sustainability and Tourism, 2019b), (IEA, 2020a), (Austrian Institute of Construction Engineering (OIB), 2020)

In September 2018, Austria launched a process to redesign the Energy Efficiency Act, to align the national energy efficiency framework with recent legislative developments in the EU and with the Paris Agreement, so to ensure a return to the energy efficiency and emission-reduction target pathway to 2030 (IEA, 2020a).

Renovation support schemes

Renovation support schemes in Austria have a long tradition dating back to 1990s. A number of possibilities for obtaining cost-effective approaches to renovations for a building exist in Austria. These are mainly OIB Guideline 6 "Energy saving and heat insulation" and also the policies and subsidies of individual Austria provinces (Austrian Energy Agency – AEA, 2017b).

In Austria, each province, based on the general requirements of the Federal Government, issues its own requirements and policies for energy saving measures, especially in the case of building renovations. They use a mix of various measures like plans, strategies, regulations by law (including financial support for higher energy efficiency constructions and higher minimum energy performance standards), incentives systems, bonuses for deep renovations of use of ecological materials, consultancy support, networks for energy efficiency, training centres, etc.

Table 74: Overview of renovation support schemes in Austria

Land	Support scheme	Date
Austria	The Austrian federal government's Sanierungsoffensive (Refurbishment offensive) - e.g. Thermal renovation, renovation cheque for private individuals - e.g. Thermal building renovation for enterprises	2009
	klimaaktiv Bauen&Sanieren (Build & Refurbish climate-actively) programme	
Burgenland	The Burgenland Residential Building Subsidies Act 2005	2005
	Burgenland's Housing Support Act (Wohnbauförderungsgesetz 2018) – reorganisation of previous Act	2018
Carinthia	Residential building subsidies of the province of Carinthia	-
	Carinthia's Housing Support Act 2017 (Wohnbauförderungsgesetz 2017) – reorganisation of previous Act	2017
	Raus aus fossilen Brennstoffen (Leave fossil fuels behind) incentive scheme	
Lower Austria	Residential building subsidy system	2002
	Financial initiative for infrastructural construction measures by municipalities or their companies.	-
	Subsidies for advisory work – Energieberatung Niederösterreich (Energy Consultancy Lower Austria), initiative Ökomanagement (Eco-management), EnergieGemeindePaket (Energy municipality package)	-

Upper Austria	Subsidies for the construction of energy-efficient buildings (Upper Austrian Private Housing Ordinance, Upper Austrian Ordinance on Subsidies for New-Build Properties, Upper Austrian Young Living Ordinance, Upper Austrian Private Apartments Ordinance)	-
	Subsidies for the energy-efficient renovation of existing buildings (Upper Austrian Residential Building Renovation Ordinance, provincial environmental subsidies for thermal building renovation)	-
	Requirements in terms of energy for new-build properties and renovation of schools, kindergartens, nurseries and official buildings of the municipalities in the context of need-based allocations	-
	Subsidies for energy-efficient building-technology systems (Upper Austrian Energy Saving Ordinance, provincial environmental subsidies, biomass subsidy guidelines)	-
	Comprehensive and product-independent energy advice in relation to the construction and renovation of buildings for private individuals, companies and public bodies	-
	Energy consultation in relation to refurbishment and renovation for private individuals – free on-site consultation on energy efficiency	
Salzburg	Residential building subsidies	1993
	Subsidies for renewable energy sources in residential buildings	
	Central energy performance certificate database (ZEUS)	-
	Energy advisory body “Energieberatung Salzburg” (Energy Advice Salzburg)	-
	Energy-active management platform	-
Styria	Residential building guidelines in accordance with the agreement pursuant to Art. 15a of the Federal Constitutional Act	2009
	Subsidy variant of “Deep energy renovation”	
	New insulation standards	2010/2012
	Provincial environmental fund: systems for the use of renewable energies for non-commercial applicants	
	The Ich tu’s (I’m doing it) Energy consultation service	
Tyrol	Residential building subsidies	
	Independent advisory body “Energie Tirol” (Energy Tyrol)	1992
	e5 provincial programme for energy-efficient municipalities	
Vorarlberg	Residential building subsidies	
	Subsidies for renewable energy sources in residential buildings	
	Subsidies for thermal refurbishments and the redensification of residential buildings as part of Vorarlberg’s housing support	
	Building products database	
	The Sanierungslotse (Refurbishment coaches) project	
	Refurbishment consultation in accordance with the Province of Vorarlberg’s Residential Buildings Refurbishment Guideline (Wohnhaussanierungsrichtlinie)	
Vienna	Residential building subsidies	
	THEWOSAN – Thermal energy refurbishment of housing (Thermisch-energetische Wohnhaussanierung)	

Data source: (Austrian Energy Agency – AEA, 2017b), (Austrian Institute of Construction Engineering (OIB), 2020)

BULGARIA

Regulatory framework

Table 75: Regulatory framework in the field of energy performance of buildings in Bulgaria

Instrument	Date	Brief description
Energy Efficiency Act (promulgated in SG, No 105 of 30 December 2016)	2016	The objective of this Act is to promote energy efficiency as a part of country sustainable development policy by: • applying a system of activities and measures for improvement of energy efficiency for the production, transfer and distribution, and also end-use of energy; • introduction of schemes of obligations for energy savings; • development of the market of energy efficiency services and encouragement of provision of energy efficiency services; • introduction of financial mechanisms and schemes supporting the fulfillment of national objective of energy efficiency
Regulation on the methods of establishing the national energy efficiency target and of determining the overall cumulative target, introduction of a scheme for energy-saving obligations, and allocation of individual energy-saving targets between obligated parties	2016	See title
Regulation No Е-РД-04-3	May 2016	Regulation on the eligible measures to carry out energy savings at final consumption level, methods to verify the achieved energy savings, requirements to the methods of their calculation and verification
Energy Sector Act	2018	The Act regulates the social relations associated with the activities of generation, import and export, transmission, transit transmission, distribution of electricity, heat and natural gas, oil and oil product transmission through pipelines, trade in electricity, heat and natural gas, as well as the powers of state bodies in formulating energy policy, regulation and control
Energy from Renewable Sources Act	2018	The Act regulates the public relations associated with production and consumption of: 1. electricity, heating and cooling from renewable sources; 2. gas from renewable

		sources; 3. biofuels and energy from renewable sources in transport
Regulation No ЕРД-04-05	September 2016	Sets out the energy-demand parameters, energy performance of establishments, industrial systems or exterior artificial lighting systems, as well as the terms and arrangements for carrying out energy efficiency audit and assessment of energy savings
Regulation No РД-16-932	October 2009	Sets out the terms and conditions to carry out energy efficiency inspection of water-based heaters and air-conditioning systems
Regulation No Е-РД-04-1	January 2016	Sets out the energy efficiency audit, certification and calculation of energy savings in buildings
Regulation No Е-РД-04-2	January 2016	Sets out the energy-demand parameters and energy performance of buildings
Regulation No 7 on energy efficiency of buildings	2004, amended 2015	See title
Regulation No РД-16-301	2014	Sets out the information liable for registration in the registers of persons performing audits and certification of buildings and energy efficiency audits of industrial systems, the procedure for obtaining information from the registers, the terms and arrangements for the acquisition of a qualification and the technical devices required for the performance of audit and certification
Regulation No РД-16-347	April 2019	Sets out the terms and conditions establishing the amount and payment of the planned funds under energy-saving performance contracts leading to energy savings in buildings, government and/or municipality owned

Data source: (Ministry of Energy of the Republic of Bulgaria, 2017a), (Ministry of Regional Development and Public Works, 2021), (Ministry of Energy of the Republic of Bulgaria, 2021a), (Ministry of Energy of the Republic of Bulgaria, 2021b) (Ministry of Energy of the Republic of Bulgaria, 2020)

Renovation support schemes

Table 76: Overview of renovation support schemes in Bulgaria

Support scheme	Year of commence ment
National programme for energy efficiency of multi-family residential buildings - programme is aimed at the renovation of multi-family residential buildings	2015
Operational Programme 'Innovation and Competitiveness 2014–2020' (OPIC) - beneficiaries are the enterprises, measures include building renovations	2014
Operational programme 'Regions in Growth' 2014–2020 - beneficiaries are public bodies and house owners	2014
National Trust Ecofund	1995

- finances projects related to energy efficiency improvement in buildings and other sites, public governmental or public municipal property	
Residential energy efficiency credit line (REECL III) - supports complete renovation in the housing sector and other measures	2016 (first one from 2005)
Financial mechanism of the European Economic Area 2014–2021 - Programme area 'Renewable energy, energy efficiency, energy security – supports Energy efficiency improvement in production, distribution and/or final energy consumption (in the Industry and Housing sector)	2016
Project 'Demand Side Residential Energy Efficiency - through Gas Distribution Companies in Bulgaria' (DESIREE GAS) – incentives for increasing the share of household gasification across Bulgaria	2014
Programme BG04 Energy efficiency and renewable Energy - upgrading energy efficiency and use of renewable energy in buildings owned by the central government and local authorities and local heating systems	2012
Energy Efficiency and Renewable Sources Fund (EERSF) - functions as a financing/co-financing institution and provides low-interest loans, partial loan guarantees, portfolio guarantees and free-of-charge consultancy services for the development of energy efficiency investment projects	2004
Kozloduy International Fund - measures to mitigate the negative impact of the decision taken to close and decommission Units 1 to 4 in the energy sector, which support the necessary restructuring, rehabilitation and modernisation of the sectors of production, transmission and distribution of energy, as well as the improvement of energy efficiency (projects in the so-called 'non-nuclear' window)	2001

Data source: (Ministry of Energy of the Republic of Bulgaria, 2017a), (Republic of Bulgaria, 2021), (Ministry of Energy of the Republic of Bulgaria, 2020)

CROATIA

Regulatory framework

Table 77: Regulatory framework in the field of energy performance of buildings in Croatia

Instrument	Date	Brief description
Construction Act	-	The Act primarily includes the transposition of all the EPBD II requirements
Technical regulation on energy economy and heat retention in buildings (NN Nos 128/15, 70/18, 73/18, 86/18, 102/20)	-	See title
Ordinance on the energy audit of a building and energy certification (Official Gazette Nos. 48/14, 150/14, 133/15, 22/16, 49/16, 87/16, 17/17)	-	See title
Ordinance on the energy audit of a building and energy certification (Official Gazette Nos. 48/14, 150/14, 133/15, 22/16, 49/16, 87/16, 17/17)	-	See title
Ordinance on the conditions and method of issuing a certificate to persons from Contracting States to the Agreement on the European Economic Area for providing the services of energy certification and energy audits of buildings in Croatia, and the recognition of foreign professional qualifications for providing the services of energy	-	See title

certification and energy audits of buildings (Official Gazette No. 77/15)		
Energy Efficiency Act (Official Gazette 127/14)	-	See title
Regulation on contracting and implementation of energy services in the public sector (Official Gazette No. 69/12)	-	See title
Ordinance on persons authorised to conduct energy certification of buildings, energy audits of buildings and regular audits of heating and cooling or air-conditioning systems in buildings (Official Gazette Nos. 73/15, 133/15)	-	See title
Ordinance on the control of energy performance certificates and reports on regular audits of heating and cooling or air-conditioning systems in buildings (Official Gazette No. 73/15)	-	See title
Ordinance on conditions and criteria for establishing quality systems for services and works for the purpose of certifying installers of renewable energy sources (Official Gazette No. 56/15)	-	See title, deals with various resources – photovoltaic systems, solar thermal systems, small boilers and biomass furnaces, shallow geothermal systems and heat pumps
Ordinance on systematic energy management in the public sector (Official Gazette Nos. 18/15 and 06/16)	-	See title

Data source: (Ministry of Physical Planning, Construction and State Assets, 2020b), (Ministry of Protection of the Environment and Energy, 2017)

Renovation support schemes

Table 78: Overview of renovation support schemes in Croatia

Support scheme	Year of commencement
Energy renovation programme for multi-apartment buildings (2014–2016 and 2021–2030) - call for project proposals 'Energy renovation of multi-apartment buildings', Ref. No KK.04.2.2.01 – minimum 50% savings in heat energy	2014, 2021
Energy renovation programme for public buildings (2014–2020 and 2021–2030) - call for project proposals 'Energy renovation of buildings and use of renewable energy sources in public institutions performing educational activities', Ref. No KK.04.2.1.03 – minimum 50% savings in heat energy - call for project proposals 'Energy renovation and renewable energy sources use in public buildings', Ref. No KK.04.2.1.04 – minimum 50% savings in heat energy	2014,2021
Energy renovation programme for family homes (2014–2020 and 2021–2030)	2014, 2021
Operational Programme Competitiveness and Cohesion 2014–2020	2014
Energy renovation programme for commercial non-residential buildings 2014–2020	2014
Energy renovation programme for buildings with the status of cultural property for 2021–2030	2021
Energy renovation of buildings and replacement of lighting measure (2017–2019)	2017

Data source: (Ministry of Physical Planning, Construction and State Assets, 2020b), (Ministry of Protection of the Environment and Energy, 2017)

CZECH REPUBLIC

Regulatory framework

Table 79 Regulatory framework in the field of energy performance of buildings in the Czech Republic

Instrument	Date	Brief description
Act No. 406/2000 Coll. on Energy Management	2000	Last updated in 2020. The Act includes: • measures to increase the efficiency of energy use (implemented by the degree on energy performance of buildings) the obligations of natural and legal persons in energy management (energy audits, energy performance of building certificates…) • requirements for reducing the energy performance of buildings (nearly zero energy buildings; • rules for the creation of the State Energy Concept, the Territorial Energy Concept and the State Program for the Support of Energy Savings; • eco-design requirements for energy related products along with requirements for the indication of the consumption of energy and other major resources on the energy labels of energy-related products; • information and education requirements in the field of energy saving and the use of renewable and secondary resources (energy specialists); • certain rules for the provision of energy services (e.g. for ESCO market).
Decree No. 78/2013 Coll. on Energy Performance of Buildings	2013-2020	The decree is an implementing regulation for the Act No. 406/2000 and includes : • cost-optimal level of energy performance requirements for buildings (including nearly zero energy buildings – nZEB); • the method of calculating the energy performance of the building; • a template for assessment of technical, economic and ecological feasibility of alternative energy supply systems and recommended measures; • a template and content of the energy performance of building certificate along with requirements for its publication in the building.
Decree No. 264/2020 Coll. on Energy Performance of Buildings	2020	Same as above Updated to latest EU requirements
Decree No. 480/2012 Coll. on Energy Audit and Energy Assessment	2012	Specifies calculation of energy savings and stipulates the scope, content and processing method of the energy audit and energy assessment.
Decree No. 140/2021 Coll. on Energy Audit	2021	Stipulates the scope, content and processing method of the energy audit.
Decree No. 141/2021 Coll. on Energy Assessment and data kept in the Energy	2021	Stipulates the scope, content and processing method of the energy assessment and data kept in the Energy Consumption Monitoring System.

Consumption Monitoring System		
ČSN EN 0540-2 Thermal protection of buildings – Part 2: Requirements	2011	Specifies thermal technical requirements for the design and verification of buildings with the required state of the indoor environment within their use, which ensure compliance with the basic requirements for buildings, especially cost-effective compliance with the basic requirement for energy saving and thermal protection of buildings. An update of the standard is currently being prepared.

Data source: Act No. 406/2000, Degree No. 264/2020, Decree No. 480/2012, Decree No. 140/2021, Decree No. 141/2021, ČSN EN 0540-2

Renovation support schemes

Czech Republic is fulfilling the requirements of Article 7 (achieving new savings of 1.5% of the annual sales volume pertaining to energy sold to ultimate consumers) by means of various fiscal state aid schemes, focusing mainly on subsidy programmes.

Programmes support specific areas, together covering all economy sectors while there is a minimum of overlaps between programmes to avoid multiple support and to increase maximum effectivity.

Subsidy programmes in the Czech Republic are financially secured by the European structural funds, Czech state budget and sales of emission allowances within the EU Emissions Trading System.

The table below presents the main grant and subsidy programmes in the Czech Republic related to renovations of both residential and public buildings. In addition, there are a number of smaller/other support programmes in the Czech Republic that either complement the main programmes mentioned or focus on specific types of projects or targeted groups (e.g., vulnerable customers).

Table 80 Overview of renovation support schemes in the Czech Republic

Support scheme	Year of commencement
For households	
Regeneration of pre-fabricated concrete buildings – programmes: PANEL/NEW PANEL (MoRD)/PANEL 2013+ - provides low interest loans for energy renovation as well as maintenance and repair of apartment buildings	2001
Clean Energy Prague programme - provides subsidies for the improvement of heating systems and the use of renewable energy sources in apartments and family or apartment buildings in the capital city of Prague.	1994
Program JESSICA (2014–2015) - provides low interest loans for reconstruction and modernization of common parts of apartment buildings and for establishment or reconstruction of social housing.	2014
Integrated Regional Operational Programme 2014–2020 (IROP) - supports thermal insulation of apartment houses excluding Prague - the 2021 programming period no longer supports apartment buildings (these are addressed within the New Green Savings Programme)	2014
Joint Boiler Replacement Scheme (2013–2014)	2013

- supports replacement of non-ecological heat sources	
Operational Programme Environment 2014–2020 (Priority Axis 2 – SO 2.1) - Boiler replacement programme - until 2022, supports replacement of unsuitable heat sources (boilers with low emission class, e.g. solid fossil fuel boilers) - from 2021 provides increased support for lower income households (reimbursement of 95% of eligible costs)	2015
New Green Savings Programme 2014–2021 - supports the reduction of the energy intensity of residential buildings (complex or partial thermal insulation), construction of houses with very low energy intensity, environmentally friendly and efficient use of energy sources and renewable sources of energy (RES). - supports family houses in all the Czech Republic and apartment houses in Prague - The programme is funded from the sale of emission allowances within the European Union Emissions Trading Scheme (EU ETS)	2014
New Green Savings Programme 2021–2030 - same as above with the addition of support for charging stations for electric cars or water heating using heat pumps - The programme is funded primarily from the sale of emission allowances within the European Union Emissions Trading Scheme (EU ETS), secondary from the National Recovery plan - supports both family houses and apartment houses in all the Czech Republic	2021
Services (non-residential public and public institution buildings)	
State programmes to promote energy savings and the use of renewable energy sources (EFEKT) (2013–2016)	2013
State programme to promote energy savings (EFEKT 2) (2017–2021) - supports small-scale investment projects (sub-program 1) and non-investment projects in the form of energy consulting, implementation of energy management, preparation of energy saving projects, events and documents to support energy savings (sub-program 2)	2017
State programme to promote energy savings (EFEKT 3) (2022–2027) - the measure focuses on investment and noninvestment aid for energy efficiency support measures. The financial mechanism provides support for specific energy-saving measures with an emphasis on non-investment financial aid.	2022
Operational Programme Environment 2014–2020 (Priority Axis 5 - SO 5.1) - includes support for energy savings measures in the public sector	2014
Operational Programme Environment 2021–2027 - includes support for energy savings measures (Priority Axis 2.A.1 – SO 1.1) as well as renewable energy sources (Priority Axis 2.A.1 – SO 1.2) focused on the public sector	2021
Mixed focus	
Energy Consultation and Information Centres ('EKIS') - EKIS Energy Consultation is a free service for the public that serves to support the introduction of energy savings and renewables. - funds are provided through the EFEKT programme	-
Modernisation fund - generally focuses on the generation and use of energy from renewable sources, energy efficiency and facilities for the accumulation and distribution of energy - includes programmes supporting "Energy efficiency in public buildings and infrastructure" and "Community energy" (Energy communities)	2021

- primarily draws funds from the monetisation of 2 % of the total number of emission allowances in the EU ETS system for the period 2021-2030	
National Recovery Plan - includes measures for “Energy consumption reduction in the public sector” and “Building renovation and air protection” (includes households)	2021
Voluntary scheme for improving energy efficiency - The voluntary scheme for improving energy efficiency is an alternative policy measure on the basis of a voluntary arrangement between the State and stakeholders (energy distributors and / or energy sellers) to carry out end-consumer end-use activities aimed at reducing final energy consumption. Individual stakeholders will implement individual energy saving measures	2021
Voluntary agreement with distributors and sellers of energy receivers - The aim of the voluntary agreement is to implement measures to promote the replacement of high-energy appliances by distributors and retailers of such appliances.	2021

Data source: (Ministry of Industry and Trade, 2020a), (Ministry of Industry and Trade, 2020c), (Czech Republic, 2019), programme documents of mentioned measures

GERMANY

Regulatory framework

Table 81: Regulatory framework in the field of energy performance of buildings in Germany

Instrument	Date	Brief description
Law on saving of energy and using renewable energies for heating and cooling in buildings (Gebäudeenergiegesetz - GEG)	November 2020	This law has replaced the Energy Saving Act (EnEG), the Energy Saving Regulation (EnEV) and the Renewable Energy Heat Act (EEWärmeG). The GEG defines energy performance requirements for new buildings and for renovations/changes and extensions in existing buildings. The main goal of the law is to reduce the use of fossil resources to enhance climate protection, taking economic efficiency into account, through the economical use of energy in buildings and the increasing use of renewable energies for heating and cooling.
Renewable Energies Law (Erneuerbare-Energien-Gesetz - EEG)	2020	EEG regulates the feed-in of electricity from renewable sources into the electricity grid of the local operator and the refund for the fed-in electricity. The aim of the law is to promote “green electricity” and to increase its share in total electricity generation. By 2025 from 40 to 45 percent of electricity in Germany should come from renewable sources. The proportion is expected to rise to 55 to 60 percent by 2035.
Heating costs regulation (HeizkostenV)	August 2021	In 2021 the amendment to the Heating Costs Regulation was made with which the requirements of the EU Energy Efficiency Directive are implemented. By 2026 all devices for recording of energy consumption must be remotely readable. If devices that can be read remotely are installed, the building owners must provide their tenants with billing and consumption information at least twice a year; from 2022 this must be done monthly. By the end of 2031 all

		devices must be able to be connected to a smart meter gateway.
Energy efficiency strategy for buildings (Energieeffizienzstrategie Gebäude - ESG)	November 2015	The strategy paper of the Federal Ministry for Economic Affairs and Energy (BMWi) for the energy transition in the building sector, which contains technical and energetic aspects, as well as the first approaches to economic and socio-political issues in the building sector.
Municipal Investment Promotion Act (KInvFG)	2015	Provides promotion of municipal investment into measures for the energy efficient renovation of communal buildings and facilities, supplemented by measures for dismantling barriers and urban development.
Renewable Heat Act (EWärmeG) of Baden-Württemberg	2015	The Law is intended to contribute to a significant increase in the share of renewable energies in the heat supply (heating and hot water) and thus to a reduction in carbon dioxide emissions in Baden-Württemberg.

Data source: (Federal Ministry for Economic Affairs and Energy, 2015), (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2021), (Ministry of the Environment, Climate Protection and Energy Sector of Baden-Wuerttemberg, 2021)

Renovation support schemes

The main tool of support for building stock renovation in Germany is a new support programme Federal Funding for Efficient Buildings (*Bundesförderung für effiziente Gebäude* - BEG) which has recently replaced the existing state programmes to promote energy efficiency and renewable energies in the building sector - including the CO_2 building renovation program (Energy Efficient Building and Renovation Programs), the Heating Optimization Programme (HZO), the Energy Efficiency Incentive Program (APEE) and the market incentive programme for the use of renewable energies in the heating market (MAP).

The Federal Funding for Efficient Buildings (BEG) is basically divided into with three sub-programs:

- Federal funding for efficient buildings - residential buildings (BEG WG);
- Federal funding for efficient buildings - non-residential buildings (BEG NWG);
- Federal funding for efficient buildings - individual measures (BEG EM).

The BEG individual measures has started in January 2021 in the subsidy variant and regulated by Federal Office of Economics and Export Control (BAFA). The BEG residential and non-residential buildings (grant and loan variant) as well as the BEG EM in the loan variant are implemented through Reconstruction Credit Institute (Kreditanstalt für Wiederaufbau - KfW) from July 1, 2021. From 2023 onwards, the funding will be given either as a direct investment grant from BAFA or as a low-interest supporting loan with a repayment grant from KfW.

Besides the federal support, additional programmes are offed, as a rule, on the web of the Ministry responsible for economic affairs and energy in each federal state of Germany.

Table 82: Overview of renovation support schemes in Germany

State	Support scheme	Year of commencement

Germany	**Federal Funding for Efficient Buildings** (Bundesförderung für effiziente Gebäude - BEG) provides financial support for renovation to efficient building, as well as individual renovation measures through subsidy and loan.	2021
Germany	**Energy-efficient construction and renovation - Fuel Cell Subsidy** (Zuschuss Brennstoffzelle) provides support for installation of new efficient fuel cell in new or existing residential and non-residential buildings, full maintenance contract for the first 10 years and energy consulting. Support is made as direct investment grant with up to 40 percent of the eligible costs - maximum of 34,300 EUR per fuel cell.	2016
Each federal state	**Municipal investment program** (KIP), support for energy efficient renovation of municipal buildings and facilities.	2015
Germany	**Federal funding for energy consulting** for non-residential buildings, facilities and systems and residential buildings (EBN and BAFA) – covering of 50% up to 80% of the costs of energy consulting.	2021
Germany	**Bonus for replacement of oil heating**. Covering up to 45% of the investment costs by replacement of oil heating system by a climate- friendly system.	2020
Germany	**Tax incentive for building renovation**. Tax bonus of 20 % (maximum 40,000 euros) which is available for individual measures as well as complete renovation projects and is spread over a period of three years. Main condition is that the renovation property is at least ten years old and used by the owner.	2020
Berlin	**Effiziente GebäudePLUS**. Funding for energy efficient renovation of residential and non-residential buildings in Berlin which include from 10 % up to 30% (30,000 EUR maximum) grant for eligible costs by renovation.	2021
Baden-Württemberg	**Combo loan for living with a climate bonus.** For ambitious refurbishment projects of the Efficiency House 55 and 40, the applicants receive a climate bonus of 2,000 up to 4,000 EUR per housing unit from the federal state in addition to the federal funding.	2021
Baden-Württemberg	**Serial renovation of residential buildings.** The Baden-Württemberg Ministry of the Environment promotes the serial renovation of existing residential buildings the project or building notice of which took place before February 1, 2002. The production and installation of the components (external wall, roof, windows, French doors, skylights, and external doors), the insulation of the basement, technical systems, monitoring systems and ventilation systems are funded.	2019
Baden-Württemberg	**Living with a future.** Funding form the state L-Bank for the heating system based on renewable energies with a favorable loan of up to €50,000.	till 2021
Baden-Württemberg	**The program Future for Old Buildings (Zukunft Altbau).** Zukunft Altbau is a neutral marketing and information program funded by the Baden-Württemberg Ministry of the Environment. The declared goal: More and better energy-related renovations in the state. Zukunft Altbau informs and advises owners of residential and non-residential buildings, as well as everyone involved in construction and renovation, on questions, advantages and effects of energy-efficient renovation, free of charge, competent and neutral.	1999
Baden-Württemberg	**Klimaschutz-Plus program.** The program is aimed at municipalities, companies, associations, church organizations and municipal companies in order to support them in meeting the climate protection goals according to the Baden-Württemberg Climate Protection Act. Main areas of the program are: CO2 reduction program, structural, qualification and information program, and sustainable and energy-efficient renovation.	2016

Bavaria	**PV-SpeicherBonus program**. The PV storage bonus is intended to motivate building owners of owner-occupied detached and semi-detached houses to increase the share of renewable energies in the power supply and to reduce their own electricity costs. Overall, the program aims to advance the decentralized expansion of photovoltaic (PV) use in Bavaria. Self-consumption of the self-generated photovoltaic power can be increased with the help of a battery storage system. Depending on the capacity of the new battery storage (kWh) and the power of the new PV system (kWp), a subsidy of between 500 and 2,375 EUR can be gained.	2019
Bavaria	**Special program "Energy efficiency and renewable energies in companies".** Investment projects by SMEs are funded by the program, with the additional requirement that the project involves a significant reduction in primary energy consumption. The energy-efficient investment into measures related to technical systems (including building technology) and renovation of buildings are funded.	
Bavaria	**Funding programs of the LfA Förderbank Bayern.** LfA Förderbank Bayern provides long-term financing of investments into municipal infrastructure for general energy saving and transition to renewable energy sources. Municipalities and small and medium-sized commercial enterprises in Bavaria that invest in the areas of energy efficiency and energy saving are supported.	
Bavaria	**Pilot project "Check your house".** Aimed to motivate the property owners all over Bavaria to implementation of energy renovation measures. It offers inexpensive energy consultancy in communities, by which the owner can find out everything about the energy saving potential in the household and in the building. The possible use of renewable energies is examined by the experts and recommendations are made for reducing the use of electricity and heat, both through investment measures and through economical behavior of residents.	2020

Data source: (Federal Office of Economics and Export Control, 2021), (Federal Ministry for Economic Affairs and Energy, 2015), (Federal Office for Economic Affairs and Export Control, 2021) (Investitionsbank Berlin, 2021), (Bavarian State Ministry for Economic Affairs, Regional Development and Energy, 2019), (Ministry of the Environment, Climate Protection and Energy Sector of Baden-Wuerttemberg, 2021)

HUNGARY

Regulatory framework

Table 83: Regulatory framework in the field of energy performance of buildings in Hungary

Instrument	Date	Brief description
Government Decree No 256/2011 on housing construction assistance	December 2011	The decree regulated the energy efficiency bonus until the end of 2015 and specified the amount of state aid by taking into account the number of children, the floor area of the apartment and the energy class of the residential unit
Government Decree No 176/2008 on the certification of energy characteristics of buildings	June 2008	See title

Decree No 7/2006 of the Minister without Portfolio on determining the energy characteristics of buildings	May 2006	Stipulates that the energy class of individual residential buildings must be determined according to the calculation method (applicable in the relevant year)
Government Decision No 2010/2016 on policy measures resulting in energy savings	2016	
Energy Efficiency Act (Act No. LVII)	2015	
Amendment to the Energy Efficiency Act	2015	From 1 January 2017 the head of an organisation in charge of operation and maintenance of a building involved in public services owned and used by public institution to prepare an energy savings action plan according to a relevant template every five years.
Implementing Decree to the Energy Efficiency Act		
Government Decision 1215/2015	April 2015	Establishes the National Energy Network – a consulting network to promote energy efficient operation in public buildings and municipal / government institutions
Amendment to the Act LXXXI of 1996 on corporate tax and dividend tax	2017	Business organisation engages in an investment improving energy efficiency, they may utilise a tax relief in the tax year following commissioning of the investment projects, or even for a further five years if so decided by the company. The tax relief may amount to a total of 30 % of the eligible investment costs, but not more than EUR 15 million. This can be increased by 20 percentage points by small and 10 percentage points by medium enterprises
Government Decree 264/2008 on the energy inspection of heating installations and air-conditioning systems	2008	See title

Data source: (Hungary, 2017), (Ministry of Innovation and Technology, 2021)

Renovation support schemes

Table 84: Overview of renovation support schemes in Hungary

Support scheme	Year of commencement
Warmth at Home Programme (WAH) 2014–2020 – Includes sub-programmes focusing on a complex energy efficiency renovation of private and public buildings - Heating upgrades (furnaces replacement) (2014) - Replacement of large household appliances (2014, 2015, 2016, 2017) - Replacement of façade windows (2014) - Aid for the upgrading and refurbishment of apartment block (2015) - Refurbishment of individual homes, resulting in energy savings (2016) - Aid for upgrading the heating system (2017) - Replacement of gas convector heaters (2017)	2014

Environmental and Energy Efficiency Operational Programme (KEHOP) - measure "Modernising building energy efficiency by combining the use of renewable energy sources (5.2)" includes support for renovations of residential and public buildings	2014
Territorial and Settlement Development Operational Programme (TOP) - includes support for renovation of municipality and municipal budgetary organisation owned buildings	2014
Competitive Central Hungary Operational Programme (VEKOP) - includes support for renovation of buildings owned by companies/enterprise in the Central Hungary region and by financial institutions	2014
Economic Development and Innovation Operational Programme (GINOP) - Modernisation of energy efficiency in buildings for SMEs	2014
Rural Development Programme (VP) - includes support for "Development and renovation of agricultural buildings and facilities, promoting energy efficiency and the inclusion of renewable energy sources in food and wine processing plants" and "External reconstruction of buildings defining a settlement image, - creating, developing and energy-related modernisation of multifunctional community space"	2014
Home Renovation Programme - one-time grant support for families with at least one child for renovation / modernisation of their homes	2021
Examination of the possibility of extending the scope of eligible activities - measure will lead to a higher proportion of renovations reaching deep renovation target	2023
Modernisation Fund	2021
Establishment of a building renovation monitoring system (ÉMOR)	2023
Energy modernisation of health institutions under ESCO-type energy service contracts	2020
Green Capital Requirements for Housing Scheme - bonuses for financing green investments	2021

Data source: (Hungary, 2017), (Ministry of Innovation and Technology, 2021)

ROMANIA

Regulatory framework

Table 85: Regulatory framework in the field of energy performance of buildings in Romania

Instrument	Date	Brief description
Law No 121/2014 on energy efficiency, as amended by Law No 160/2016 and by Government Emergency Order No 1 of 6 January 2020 transposing Directive 2012/27/EU on energy efficiency (EED)	2014	See title
Law No 372/2005 on the energy performance of buildings, as republished, transposing Directive 2010/31/EU on the energy performance of buildings (EPBD)	2005	Requires owners to provide an energy performance certificate (EPC) when renting or selling the dwelling. At present energy auditing is not mandatory (sale/rental), however it is useful when building renovation is sought. The energy audit is required for energy renovation financed from national or EU public funds (National Programme and ROP). Renovation

		solutions must be developed by specialised designers
Law No 325/2006 on the public heat supply service, as subsequently amended and supplemented	2006	See title
Government Decision No 1215/2009 establishing the criteria and requirements for implementing the support scheme to promote high efficiency cogeneration based on useful heat demand, as subsequently amended and supplemented	2009	See title
Order No 2641/2017 amending and supplementing the technical regulation ‘Methodology for calculating the energy performance of buildings’, as approved by Order No 157/2007 of the Minister for Transport, Construction and Tourism	2017	See title
Rules on the thermotechnical calculation of building construction elements (C107-2005), as approved by Order No 2055/2005 of MLPDA, as amended by Order No 2513/2010, Order No 1590/2012, Order No 386/2016	2005	See title
Methodology for calculating the energy performance of buildings: Order No 157/2007 of the Minister for Transport, Construction and Tourism, as amended by Order No 1071/2009, Order No 1217/2010, Order No 2210/2013, Order No 2641/2017	2007	See title
Methodology for calculating the energy performance of buildings (code Mc 001-2006 of 1 February 2007), as subsequently amended and supplemented. Part III of the Methodology (Audit and Energy Performance Certificate) defines the content, calculation method, procedures and calculation models/examples.	2007	See title
Housing Law No 114/1996, as republished, as subsequently amended and supplemented	1996	Provides that owners’ associations may be set up for each residential block where owners live, or tenants’ associations to support their rights in relation to owners. The Housing Law lays down quality standards for dwellings (minimum areas and facilities) that must be complied with in the construction of new buildings or in the integrated refurbishment of the building stock, which do not only concern energy renovation

Data source: (Romania, 2020b)

Renovation support schemes

Table 86: Overview of renovation support schemes in Romania

Support scheme	Year of commencement
National programme for the improvement of energy performance of blocks of flats 2009–2016	2009
The Regional Operational Programme 2014–2020	2014
The Regional Operational Programme 2021–2027	2021
'District Heating 2006-2020: heat and comfort' programme - investments for the upgrading, rehabilitation and extension or deployment of centralised heat supply systems for localities - was updated to continue in period of 2019–2027	2006
National programme for energy efficiency 2016–2020 -includes support for retrofitting the heating system, retrofitting public buildings	2016
Casa Verde Classic programme 2010–2017 - supports the installation of heating systems using renewable - energy, including the replacement or completion of classical heating - systems for both natural and legal persons	2010
Casa Verde Plus programme - Green House programme, provides grant support for both new and existing constructions - Insulation for individuals; insulation, windows, LED lighting and consultancy for legal entities	2016
"Energy Efficient House" Program - includes support for thermal improvement of building envelope, technology system retrofitting and support for renewable energy sources	2020
Program on increasing energy efficiency and intelligent energy management in public buildings	2020
National Building Renovation Programme - in preparation	2021–2027
"Fund" - represents Financial mechanism selected for the LTRS (sources, management, operationalisation) - in preparation	2021–2027
Modernization fund 2021–2030 - includes improvement of energy efficiency in buildings	2021

Data source: (Ministry of Regional Development, 2017), (Romania, 2020b), (Administration of the Environmental Fund, 2021), (Romania, 2020c)

SLOVAKIA

Regulatory framework

Table 87: Regulatory framework in the field of energy performance of buildings in Slovakia

Instrument	Date	Brief description
Act No 535/2005 on the energy performance of buildings	2005	Specifies the requirements for the energy performance of buildings
Decree No. 364/2012 on the energy performance of buildings	2012	Specifies the requirements for the energy performance of buildings and is implementing regulation to the Act no 535/2005

STN EN 15459-1 Energy performance of buildings	-	Technical standard including procedures for assessing cost efficiency
STN 73 0540-2+Z1+Z2	-	Technical standard, which defines standardised requirements for the thermal performance of building structures and elements
Act No. 321/2014 Coll. on energy efficiency	2014	See title Based on the amendment from 2019, public administration bodies can use energy performance contracting including mobilisation of private capital to draft and finance projects
Act No 657/2004 on thermal energy	2004	Laid down obligations linked to the installation of means to measure the quantity of hot water and the quantity of heat used for heating at final consumers.

Data source: (Ministry of Transport and Construction of the Slovak Republic, 2020), (Ministry of Economy of the Slovak Republic, 2019), (Ministry of Economy of the Slovak Republic, 2017)

Renovation support schemes

Existing measures and planned support schemes presented in Long-term renovation strategy document are presented in the form of their general focus with description of activities and source of funding. These measures are then implemented via specific programmes, e.g., Operational programmes financed from the European Structural & Investment Funds (ESIF) or Housing Development Programme. However, specific programmes are not usually presented or it is difficult to link specific “focus” with specific programme. The measures already in place (e.g. Operational Programmes) are expected to continue beyond 2020 (Ministry of Economy of the Slovak Republic, 2019).

Table 88: Overview of renovation support schemes in Slovakia

Support scheme	Date
Allowance for thermal insulation of a single-family house - by Ministry of Transport and Construction of the Slovak Republic - includes thermal insulation including technology renovations	2005
Renovation of multi-apartment building - under the State Housing Development Fund and ESIF - e.g. Integrated Regional Operational Programme 2014–2020	2014
Renovation of a single-family house - under the State Housing Development Fund or Ministry of Transport and Construction of the SR - supports thermal insulation	2013
SlovSEFF III - includes Improving the thermo-technical properties of apartment buildings	2014
Measure to reduce dust particulate emissions – replacement of obsolete domestic solid fuel heaters (“boiler subsidies”) - Projects to replace obsolete domestic combustion heaters with low-emission and more energy efficient combustion heaters with conversion to a low-emission fuel, with the exception of biomass and other renewable energy sources	-
Operational Programme Quality of Environment 2014–2020 - by Private sector and ESIF 2021–2027 - includes improving energy efficiency of public buildings or equipment - will continue after 2020	2014
Green Households II - Support for renewable energy installations in residential buildings - part of the Operational Programme Quality of Environment 2014–2020	2014

Improving energy efficiency of existing public buildings, including thermal insulation - under the Environmental Fund - supports overall renovations (thermal insulation, technology)	-
Reducing the energy intensity of buildings – public buildings - Support for deep renovation of public buildings	2021
Reducing the energy intensity of buildings – residential buildings (multi-apartment buildings and single-family houses) - under the ESIF 2021–2027 - Support for deep renovation of residential buildings	2021
Recovery plan - includes Improving energy performance of public buildings, Improving energy performance of single-family house and Renovation of historic - public buildings and public buildings subject to heritage protection	2021
Improving energy efficiency in enterprises (buildings) - under the ESIF 2021–2027	2021
State support - direct: preferential loans provided through the State Housing Development Fund; allowances for thermal insulation of single-family houses for natural persons; subsidies under the housing development programme - indirect: mortgage financing in the form of a state mortgage contribution and a state allowance for mortgage for young citizens; a construction savings scheme with state support; the Programme of state support for the renovation of the housing stock in the form of the provision of bank guarantees for loans (the 'bank guarantees programme')	-
Support for measures to improve energy efficiency in apartment buildings, public buildings, small and medium-sized enterprises - under the Slovak Investment Holding as funding source	-
Regional Energy Centre - provides consultancy on the energy savings measures	-

Data source: (Ministry of Transport and Construction of the Slovak Republic, 2020), (Ministry of Economy of the Slovak Republic, 2019)

Support of the renovation of residential buildings including thermal insulation constitutes a significant share of the resources allocated to housing development. In the long term, the demand for renovation of multi-apartment buildings has been much higher than the demand for the support for single-family house renovation. The forms of state support for single-family houses have been re-evaluated. The introduction of new types of support for single-family houses since 2016 has significantly increased the interest of the owners of single-family houses in thermal insulation (Ministry of Transport and Construction of the Slovak Republic, 2020).

SLOVENIA

Regulatory framework

Table 89: Regulatory framework in the field of energy performance of buildings in Slovenia

Instrument	Date	Brief description
Energy Act (Official Gazette, No. 17/14 in 81/15)	March 2015	Generally addresses the issue of energy management; Amended in 2019
Decree on energy management in public sector	June 2016	The Decree is bringing obligation for all public bodies to perform energy bookkeeping and achieve EE and RES goals in the building owned and used by them

Rules on the Methodology for Compiling Energy Audits and the Content of those Audits	June 2016	See title
The decree on green public procurement	2011	Revised version from 1 January 2018. Determines the environmental aspects which must be taken into account by contracting authorities when awarding public contracts and determines the objectives to be achieved in each procurement procedure for ordering items from the recast regulation
Rulebook on Efficient Use of Energy in Buildings (UL RS No 52/10) (PURES)	2009	Sets minimal requirements of the main structural elements (for example, heat transfer coefficients)
Rules on efficient use of energy in buildings with a technical guideline	2010	Lays down technical requirements for new and reconstructed buildings in terms of their efficient use of energy
Technical guideline for construction: TSG-1-004: 2021 Energy efficiency	2021	Sets technical requirements in terms of efficient use of energy

Data source: (Republic of Slovenia, 2017), (CA EED, 2016), (Ministry of Infrastructure of Slovenia, 2018)

Renovation support schemes

Table 90: Overview of renovation support schemes in Slovenia

Support scheme	Date
Energy efficiency obligation schemes	2014
Ecological Fund - Eco-Fund - aims at improving energy efficiency through financing investments in energy efficiency, mostly in households. The funds for subsidies are collected from the contributions-fee for improving energy efficiency; from charges from district heating, electricity and solid, liquid and gaseous fuels, paid by final consumers on top of the price of energy or fuel to the operator or supplier of energy or fuels, which pays the funds collected to Eco-Fund. - includes grants for households (with bonuses for socially deprived households) and grants/loans and other financial incentives within other renovation/energy efficiency initiatives	1993
Operational Programme for the implementation of the European cohesion policy for the 2014–2020 - includes support for improvement energy efficiency (energy renovations) in public sector and in households	2014
ENSVET network (Slovenia's Energy Advisory Network) - provides residents with individual, free, independent energy consultation, informative education and awareness activities on promoting measures on efficient use of energy and on renewable energy sources in their local environment - founded under the Eco-Fund	1993
Life C4C project - will develop financing plan for the sustainable renovation - of buildings / Renovation financing instruments for multi-owner buildings	-
Household energy efficiency aid scheme for vulnerable population groups - uses cohesion funds from operational programme OP EKP - e.g. ZERO500 programme aim to support 500 households facing energy poverty	2020

Data source: (CA EED, 2016), (Ministry of Infrastructure of Slovenia, 2018), (Government Office for Development and European Cohesion Policy, 2014), (Government of the Republic of Slovenia, 2021)

Slovenia's strategic plans describe in detail the various policies and measures to achieve the set objectives (more than described in table above). Many measures continue from the previous period. It is clear from the texts that Slovenia has a good overview of possible solutions. However, in several cases it is more of a general description, which would need more details (e.g. activity "upgrade of the current regulation" from NECP does not specify these regulations and there are some very general texts in Long-term renovation strategy).

BOSNIA AND HERZEGOVINA

Regulatory framework

Bosnia and Herzegovina is divided into two Entities – the Federation of Bosnia and Herzegovina and the Republika Srpska, which are politically autonomous to an extent, as well as the Brčko District, which is jointly administered by both. Therefore, the implementation of strategic documents and projects takes place on 2 levels. The first is the level of the whole country (BiH level), the second level consists of the Federation of BiH and Republika Srpska levels. The implementation assessment is performed for each entity separately.

The energy efficiency targets and policy measures envisaged by the NEEAP 2019–2021 and the NECP have not been adopted. The Government of Federation of Bosnia and Herzegovina adopted its NEEAP 2019–2021 only in February 2021. The fifth Annual Progress Report under the Energy Efficiency Directive has not been submitted to the Secretariat (Energy Community.org, 2021a).

Long-term building renovation strategies have been drafted on state and entity levels, but not adopted. The necessary amendments to primary legislation have only been adopted in Republika Srpska. Both entities are currently working on updating existing legislation, including procedures for systems and certification of buildings.

Each entity has established an energy efficiency and environmental fund, covering monitoring of implementation and reporting on achieved savings. The energy efficiency laws of both entities and the draft law of Brčko District recognize ESCOs and energy performance contracting. However, the ESCO market is not functioning and important implementation gaps remain, e.g. in public procurement, multi-year budgeting and adoption of model ESCO contracts (Energy Community.org, 2021a).

Latest implementation updates

Table 91: Latest implementation updates in Bosnia and Herzegovina

Date	Description
Renewable energy	
June 2021	Bosnia and Herzegovina submitted its fourth Progress Report on promotion and use of energy from renewable sources.
July 2019	Third Progress Report on promotion and use of energy from renewable energy source submitted to the Secretariat.
Energy Efficiency	
October 2021	The fifth Annual Report under the Energy Efficiency Directive of Bosnia and Herzegovina was submitted to the Secretariat
August 2020	Bosnia and Herzegovina submitted its fourth Annual Report under the Energy Efficiency Directive to the Secretariat.

November 2019	Rulebook on minimum requirements for energy performance of buildings was adopted in Federation of Bosnia and Herzegovina.
October 2019	The Law on Spatial Planning and Construction of Republika Srpska was amended to transpose requirements of Articles 4 of Directive 2012/27/EU on energy efficiency (building renovation).
October 2019	Ministry of Energy, Mining and Industry adopts the Rulebook on regular inspections of heating and air conditioning systems
Environment	
March 2021	Bosnia and Herzegovina complied with its emission reporting obligations.
February 2021	With the adoption of the new Law on Environmental Protection by Federation of Bosnia and Herzegovina, and the earlier adoption of the amendments to the Law on Environmental Protection by Republika Srpska, Bosnia and Herzegovina transposed the amending Directive 2014/52/EU.
August 2019	Bosnia and Herzegovina fulfilled its reporting obligations on pollutants under the scope of the Large Combustion Plants Directive by submitting the relevant information to the European Environment Agency.
Climate	
April 2021	Bosnia and Herzegovina submitted its NDC2 to the UNFCCC Secretariat.
November 2020	Bosnia and Herzegovina submitted draft chapters of the NECP to the Secretariat for informal review.
February 2019	Bosnia and Herzegovina officially launched a national working group to work on its NECP. The national working group is meeting regularly.

Data source: (Energy Community.org, 2021a)

General framework for implementation for implementation of EPBD

Obligations to transpose the EPBD Directive in Bosnia and Herzegovina are distributed according to the competencies of the state and entity levels. The state level ensures a uniform transposition methodology and provides technical assistance and reporting to the Energy Community Secretariat, while the entities implement the transposition of EPBD requirements into their own legal frameworks (Energy Community.org, 2020a).

Bosnia and Herzegovina

The Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina is in charge of coordinating the transposition of EPBD requirements into domestic legislation. To this end, MOFTER provided technical assistance to the entities on the following issues:

- National Energy Efficiency Action Plan 2019-2021 (GIZ);
- FBiH Energy Efficiency Action Plan 2019-2021 (GIZ) ;
- RS Energy Efficiency Action Plan 2019-2021 (GIZ) ;
- National Building Renovation Strategy (GIZ) ;
- FBiH Building Renovation Strategy (GIZ) ;
- RS Building Renovation Strategy (GIZ) ;
- updated climate data (GIZ Promotion of Energy Efficiency in BiH) ;
- Typology of residential buildings in BiH, FBiH and RS (GIZ) ;
- Cost-optimal analysis of residential buildings in BiH with testing of new climate data for residential and non-residential buildings (GIZ) ;

- Typology of Public Buildings of BiH (UNDP) ;
- Cost-optimal analysis of residential buildings in BiH with testing of new climate data for residential and non-residential buildings (UNDP) ;
- Feasibility Study for the application of highly efficient cogeneration and efficient district heating and cooling in BiH, FBiH and RS (GIZ) ;
- Assessment of the potential for the application of highly efficient cogeneration and cooling and heating in BiH, RS and FBiH, including accompanying maps, substrates, maps were collected from local communities during the drafting of documents (GIZ).

Federation of BiH

In 2017, The Federation of BiH passed the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17) in the Federation of Bosnia and Herzegovina, which regulates the EPBD requirements. Further harmonization was achieved through the following ordinances based on the mentioned Law, namely:

- Rulebook on minimum requirements for energy performance of buildings (Official Gazette FBiH 81/19);
- Rulebook on Energy Certification of Buildings in the Federation BiH (Official Gazette of the Federation BiH, no. 50/10);
- Methodology for calculation and declaration of energy characteristics of residential and non-residential buildings;
- Rulebook on Technical Requirements for Heat Insulation of Buildings and Rational Use of Energy (Official Gazette of the Federation BiH, no. 49/09);
- Rulebook on regular energy audit of heating system and air conditioning system (Official Gazette of the Federation BiH, no. 02/19) and
- Rulebook on the Energy Efficiency Information System of the Federation of Bosnia and Herzegovina.

Republika Srpska

In May 2013, the Republika Srpska passed the Law on Spatial Planning and Construction ("Official Gazette of the Republika Srpska" No. 40/13), and Art. 90-96., which addresses the area of energy efficiency in buildings, which are largely in line with Directive 2010/31/EU on the energy performance of buildings. Further harmonization was achieved through three ordinances adopted in 2015 on the basis of the mentioned Law, namely:

- Rulebook on performing energy audits of buildings and issuing energy certificates ("Official Gazette of Republika Srpska" No. 30/15 and 93/16) ;
- Rulebook on methodology for the calculation of energy performance of buildings ("Official Gazette of Republika Srpska" No. 30/15) ;
- Rulebook on minimum requirements for energy performance of buildings ("Official Gazette of Republika Srpska" No. 30/15).

Also, by adopting amendments to the Law on Spatial Planning and Construction in October 2019 ("Official Gazette of the Republic of Srpska", 84/19), additional harmonization was done with Directive (EU) 2018/884 amending Directive 2010/31/EU on energy performance of buildings and Directive 2012/27 / EU on energy efficiency, which created the legal basis for the adoption of the Strategy for long-term energy renovation of buildings in Republika Srpska, the Ordinance on regular inspections of technical heating systems, cooling and ventilation of technical building systems and the Ordinance on keeping a register on the energy characteristics of residential and non-residential buildings in public and private ownership (Energy Community.org, 2020a).

Table 92: An overview of the transposed EPBD requirements in Bosna and Herzegovina

Energy performance requirements
Article 4 (EPBD) – Setting of minimum energy performance requirements
• FBiH: Article 24 (2) of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 93 of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13) based on which the Rulebook on the methodology for calculating the energy performance of buildings was adopted ("Official Gazette of the Republic of Srpska" No. 30/15).
Article 5 (EPBD) – Calculation of cost-optimal levels of minimum energy performance requirements
• FBiH: n/a • RS: Article 90a (2b), Amendments to the Law on Spatial Planning and Construction in October 2019 ("Official Gazette of the Republic of Srpska", 84/19)
Article 6 (EPBD) – New buildings
• FBiH: Article 25 of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 90 (2) of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13)
Article 7 (EPBD) – Existing buildings
• FBiH: Article 25 of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 90 (2) of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13)
Article 8 (EPBD) – Technical building systems
• FBiH: Article 24 (2) of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 90 (5) of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13)
Article 9 (EPBD) – Nearly zero-energy buildings
• FBiH: Article 36-37of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: n/a
Article 11 (EPBD) – Energy performance certificates
• FBiH: Article 33 of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 90 (2f) of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13)
Article 12 (EPBD) – Issue of energy performance certificates
• FBiH: Article 33 of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 90 (2f) of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13)
Article 13 (EPBD) – Display of energy performance certificates

• FBiH: Article 34 of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 94 (3) of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13)
Article 17 (EPBD) – Independent experts
• FBiH: Article 31-32 of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 91 (3) of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13)
Article 18 (EPBD) – Independent control system
• FBiH: Article 38 of the Law on Energy Efficiency of the Federation of Bosnia and Herzegovina (Official Gazette of FBiH no. 22/17), • RS: Article 95 (1c) of the Law on Spatial Planning and Construction ("Official Gazette of the Republic of Srpska" No. 40/13)

Data source: (Energy Community.org, 2021a)

Renovation support schemes

Bosnia and Herzegovina is divided into two Entities – the Federation of Bosnia and Herzegovina and the Republika Srpska, which are politically autonomous to an extent, as well as the Brčko District, which is jointly administered by both. Therefore, the implementation of strategic documents and projects is adressed on 2 levels. The first is the level of the whole country (BiH level), the second level consists of the Federation of BiH and Republika Srpska levels (FBiH, RS). The implementation assessment is performed for each entity separately.

Bosnia and Herzegovina in the Energy Efficiency Plan and in the 5th annual report describes the savings achieved in each category of measures, which foreshadows that the measures exist and are implemented. However, specific measures (plans, programmes) are not described in detail. It can be also assumed that most of the older measures is extended in the years following the end of their programming period.

Table 93 Overview of renovation support schemes in Bosnia and Herzegovina

Support scheme category	Date
Renovation of the envelope of existing residential buildings and family houses in order to improve their energy performance (2010–2018)	2010
Improvement of energy performance of existing and installation of energy efficient technical systems in residential buildings and family houses (2010–2016)	2010
Production of energy from renewable sources in households (2010–2018)	2010
Renovation of the envelope of existing non-residential buildings in the public and commercial sector in order to improve their energy performance (2010–2018)	2010
Improving the energy performance of existing and installing new energy efficient technical systems in buildings (2010–2018)	2010
Renewable energy production in the public and commercial sector (2010–2018)	2010
Support scheme specific measures	
Operational plan for the renovation of central government buildings - based on the Article 5 of the EED BiH level: in progress, within the Green Economic Development	

project funded by Sweden, and implemented by the United Nations Development Program (UNDP) FBiH level: in progress RS level: no progress reported
Establishing sustainable financial mechanisms to improve energy efficiency in institutions
No progress reported on all levels.
Establishment and promotion of energy service systems for energy saving in public bodies
- Support ESCO markets No progress reported on all levels.

Data source: (Bosnia and Herzegovina, 2017), (5th annual report under the Energy Efficiency Directive – Bosnia and Herzegovina)

MOLDOVA

Regulatory framework

Moldova's reform process has almost stalled during the reporting period. Necessary updates of all energy-related laws have not taken place, and the unbundling of both incumbent transmission system operators has failed. The next step towards opening up the wholesale power market, the establishment of a functioning balancing mechanism, has been postponed. The gas market is even more foreclosed. Nevertheless, a new gas interconnector with Romania was completed and certified. Further progress in the areas of renewable auctions and energy efficiency depends on the adoption of new legislation. (Energy Community, 2021b)

Law of the Republic of Moldova of July 19, 2018 No. 139, About energy efficiency

The parliament adopts this organic law. This law shifts the Directive 2012/27/EU of the European parliament and Council of October 25, 2012 about energy efficiency, about change of Directives 2009/125/EU and 2010/30/EU and cancellation of Directives 2004/8/EU and 2006/32/EU, published in the Official magazine of the European Union by L 315 of November 14, 2012, in the option adapted and approved by the Decision of Ministerial council of Energy community No. D/2015/08/MC-EnC. (Cis-legislation, 2021)

Latest implementation updates

Table 94: Latest implementation updates in Moldova

Date	**Description**
Renewable energy	
October 2021	With the entry into force of new Electricity Market Rules, standard balance responsibility was extended to renewables producers.
July 2021	Moldova submitted its fourth Progress Report on promotion and use of energy from renewable sources under Article 22 of the Renewable Energy Directive to the Secretariat.
February 2020	A new Regulation regarding fixed tariffs and ceiling prices for electricity produced from renewable energy sources by producers who will obtain eligible producer status in 2020 is adopted by the regulator.
Energy Efficiency	
July 2021	Moldova submitted its 5th Annual Report under the Energy Efficiency Directive to the Secretariat.
July 2020	The Secretariat receives Moldova's fourth Annual Report under the Energy Efficiency Directive.

October 2019	Third Annual Report under the Directive 2012/27/EU on Energy Efficiency was submitted to the Energy Community Secretariat.
July 2018	Moldova becomes first Energy Community Contracting Party to adopt law transposing the Energy Efficiency Directive
July 2018	Moldova submits the Secretariat its second Annual Report under the Energy Efficiency Directive 2012/27/EU
February 2018	**The Law transposing the Energy Efficiency Directive 2012/27/EU was adopted by the Moldovan Cabinet of Minister.**
Climate	
June 2021	The Government updated its Low Emissions Development Strategy 2030, to align better with the more ambitious targets established in the NDC2, and submitted it for public consultations.
March 2020	Moldova submitted to the UNFCCC its updated Nationally Determined Contribution (NDC) as first Contracting Party.

Data source: (Energy Community.org, 2021b), (Energy Community.org, 2021c), (Energy Community.org, 2021d)

Policies on Energy Efficiency in Buildings

The Republic of Moldova has strong international commitment to achieve climate neutrality of the national economy, including the building sector.

The Ministry of Agriculture, Regional Development and Environment presented, in March 2020, to the Secretariat of the UNFCCC the second Nationally Determined Contribution3 (NDC2) of the Republic of Moldova. The country's new economy-wide unconditional target is to reduce its greenhouse gas emissions by 70 per cent below its 1990 level in 2030. As to the new economy-wide conditional target, the reduction commitment could be increased in NDC2 up to 88 per cent below the 1990 level. Achieving this target demands climate change mainstreaming into development policies, plans and programmes.

Moldova's Low Emissions Development Strategy (LEDS) 2030 establishes a GHG reduction target from the energy sector of 74 per cent as unconditional scenario and 82 per cent conditioned, compared to 1990. Thus, the energy sector is the one with the most ambitious GHG reduction targets, and building sector is the main energy consumer. The National Energy and Climate Plan (NECP) is under development by the Ministry of Economy and Infrastructure, and represents a tool for the strategic energy and climate policy planning for implementation of the Energy Union Strategy. (Sergiu Robu, 2021)

Framework legislation

Table 95: Regulatory framework in the field of energy performance of buildings in Moldova

Instrument	Brief description
Law No.139 on Energy Efficiency	This Law implements Directive 2012/27/EU of the European Parliament and the Council on energy efficiency and Directive 2009/125/EC of the European Parliament and the Council establishing a framework for the setting of eco-design requirements for energy-related products. The purpose of this Law is to create the legal framework necessary to promote and improve energy efficiency through the

	implementation of energy efficiency action plans, the development of 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 the European regulations and standards was adopted on 1 November 2014 (GD No. 933).
Law No.75 on Dwellings	The Law No. 75 on Dwellings was adopted on 30.04.2015 and entered into force on 29 November 2015, except for the provisions related to the energy performance of buildings with reference to ventilation, cooling and lighting (entered into force on 1 January 2017).
Regulation (GD No.1325 of 12.12.2016) on the "Periodic Inspection of the Heating Systems in Buildings"	Establishes the organization and conducting of the inspection process, its periodicity depending on the category of building, the type and nominal power of the heating system and other conditions, taking into account the costs of the inspection and the estimated energy savings that could result from the inspection.
Voluntary Energy Efficiency in Heating Utilities (2014)	Heating utilities have to choose either to implement Energy Audits every four years, or to implement the Energy Management Systems as per ISO50001.
Energy Strategy of the Republic of Moldova until 2030	The Energy Strategy of Moldova until 2030 provides guidelines for national energy sector development, in order to ensure the necessary grounds for economic growth and social welfare.

Data source: (Sergiu Robu, 2021)

Renovation support schemes

Update of measures implemented in last year

Legislative measures:

Within the years 2020-2021, the following activities could be reported, as follows:

- Drafting and promotion of the GD no. 372/2020 on approving the Program for the renovation of buildings owned and occupied by central government 2020–2022 (art. 5 EED);
- Drafting and promotion of the GD no. 676/2020 on approving the Regulation on energy auditors and energy audit. According to the Regulation, the Energy Efficiency Agency has:
    - drafted the „Code of Conduct for the Energy Auditor";
    - drafted the energy audit templates, according to categories, including audit requirements;
    - drafted the guide for performing quality control audits.
- Drafting and promotion of the Regulation on conducting energy audits by large enterprises;
- Drafting of the Long-term strategy for mobilizing investment in the renovation of the building national stock, the promotion of the strategy is expected after the conclusion of the energy

modelling exercise carried out in the context of drafting the Integrated National Energy and Climate Action Plan.

Worth mentioning that the Ministry of Economy and Infrastructure together with the consultants of the „STARS" technical assistance project have drafted the „energy" component of the Integrated National Energy and Climate Action Plan. The first drafts should be available until the end of 2021, while its promotion is planned for the year 2022 (Energy Community.org, 2021c).

Central Government buildings (Article 5)
The Ministry of Economy has elaborated the First Programme for renovation of the central government owned and occupied buildings for 2020–2022, which was approved by the Government Decision 372/2020 and corresponds to the first option provided by the EED. Currently, the central government buildings stock inventory contains 215 records (buildings) with total declared useful floor area of the building stock in the amount of 426.056 m2. The "First programme for renovation of the central government owned and occupied buildings for 2020–2022" targets two priority buildings with total useful area of 10 086 m2 which will result in fulfilling the one percent yearly obligation of Article 5 of the EED and Article 14 in new EE Law of Moldova. The total investments for the First programme is evaluated in the amount of 37 950 857 million MDL (about 1.2M EUR). Worth mentioning that the first buildings included in the program was rehabilitated. Nevertheless, given the pandemic and its impact, most of the information of the performance achieved will be collected and processed at a later stage (Energy Community.org, 2021c).

Energy efficiency obligations (Article 7)
With regard to the EEOS and energy savings to be achieved under art. 7 of the energy efficiency Directive/ art. 8 of the Law 139/2018 on energy efficiency, the Ministry of Economy and Infrastructure, has notified a cumulative target untill 2020 of 27.51 ktoe or 36.68 ktoe, without using exemptions. The analysis done by the MoEI showed that currently there are many ongoing initiatives (projects and programmes that finance the implementation of energy efficiency projects in public buildings, residential, industry, energy sector, etc.) that are contributing to the target set by national authorities, as alternative measures and, implicitly, reducing the need in operationalising the EEOS (at least by 2020). Thus, out of the notified expected saving of 28.87 ktoe, 0% will be delivered by the obligated parties and 100% by alternative policy measures. Table shown below present the result of calculations made in order to assess the energy savings target to be reached in 2019 and 2020 (Community.org, 2021c).

Table 96: Achieved energy savings in Moldova

Sectors	Planed energy savings (ktoe)				Achieved energy savings (ktoe)			
	2016	2017	2018	2019	2016	2017	2018	2019
Residential	40.1	48.12	56.14	62.33	15.87	20.33	26.33	31.82
Services	27.8	33.36	38.92	43.18	15.32	22.56	27.94	32.31
Industry	8.3	9.96	11.62	12.96	51.97	59.54	67.93	76.12
Transport	16.7	20.04	23.38	25.92	0.36	0.49	0.59	0.69
TOTAL	92.9	111.5	130.1	144.4	83.52	102.93	122.79	140.94

Data source: (Energy Community.org, 2021c)

Financial incentives and project finance

The Energy Efficiency Agency (EEA) finances projects in:

- 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.

The EEA5 offers financing in the form of grants, credits, leasing and guarantees. According to the Law on Energy Efficiency, the Government reorganized the Energy Efficiency Agency by merging (absorption) with the Energy Efficiency Fund (Energy Community.org, 2021c).

National Fund for Regional Development (NFRD) is a public entity whose objective is to strengthen institutional and financial capacity of regional government. The NFRD becomes operational from 2011 and has a 150–200 million lei annually (equivalent to 7–9 million Euro). It is the largest national source of funding for regional development projects. The fund is managed by Ministry of Agriculture, Regional Development and Environment.

Moldova Social Investment Fund had available budget in 2018: 106 million lei (equivalent to 5 million Euro). Total amount contracted at 31 December 2018 from Romania (the 1st tranche of GD No. 435 of 10.06.14 and II of Government Decision No 132 of 07.03.17) for the execution of the civil works and delivery of goods is 456 463 150 lei (equivalent to 21 million Euro), of which 370,754,849 (equivalent to 17 million Euro) lei were contracted to carry out civil works. Another 77,515,515 lei (equivalent to 3 million Euro) were contracted for the procurement of goods and 8,192,787 lei (equivalent to 380 thousand Euro) for consultancy services (technical evaluation, drafting of costs). The investment is carried out in the framework of “Technical and financial assistance program of the Government of Romania for pre-school institutions in the Republic of Moldova.”

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 Euro 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) (Energy Community.org, 2021c).

Table 97: Projects implemented in Moldova with international support

Title of the project	Project duration	Source of funding	Total amount invested	Currency
Moldova Sustainable Green Cities	2018–2022	GEF/UNDP	2 719 726	USD
ESCO Moldova project – Transforming the market for Urban Energy Efficiency in Moldova by introducing Energy Service Companies	2015–2018	GEF/UNDP	1 450 000	USD

Modernisation of Local Public Services in the Republic of Moldova phase 2	2016–2020	GIZ	14 616 762	EUR
GrCF-EE of public buildings in Chisinau	2017–2020	EBRD/EIB/E5P	25 000 000	EUR
Energy Efficiency Agency	2018+	Government of the Republic of Moldova		

Data source: (Sergiu Robu, 2021)

MONTENEGRO

Regulatory framework

Montenegro has achieved a relatively high level of transposition of the energy efficiency acquis. It submitted the Annual Progress Report under the Energy Efficiency Directive in June 2021. Progress in implementation has also been recorded in the reporting period (work on updates of the primary law, regulation and tools improving energy performance of buildings, financing, etc.).

Montenegro should continue with the adoption of the remaining secondary legislation on energy labelling of energy-related products and adopt an updated regulation and tools enabling effective certification of the energy performance of buildings. Notification on implementation of Article 7 (energy efficiency obligation scheme) should be submitted to the Secretariat without further delay.

After the Eco Fund's establishment, Montenegro should focus on increasing state financing for energy efficiency measures in cooperation with the Ministry of Capital Investments and local administrations. Finally, Montenegro should put in place a functional information system for energy efficiency indicators, energy management and monitoring of NEEAP implementation (Energy Community.org, 2021e).

Table 98: Latest implementation updates in Montenegro

Date	Description
Renewable energy	
July 2021	Montenegro submitted its forth Progress Report on promotion and use of energy from renewable sources
December 2020	As an obligation arising from the amendments to the Energy Law adopted in July 2020, the Montenegrin Electricity Market Operator adopted rules on the register of guarantees of origin. The Rules are needed to determine the content and manner of keeping the register
March 2020	The Ministry submitted to the Secretariat its third Progress Report on promotion and use of energy from renewable energy source.
Energy Efficiency	
June 2021	Montenegro submits its fifth Annual Report, under the Energy Efficiency Directive to the Secretariat.
June 2019	The fourth Energy Efficiency Action Plan for the period 2019–2021, in line with the requirements of Directive 2012/27/EU, was approved by the Government of Montenegro.

May 2019	The Law on Amendments to the Law on Efficient Use of Energy, adopted by the Parliament of Montenegro in April 2019, enters into force.
Environment	
October 2019	During the past year, fourteen environmental impact assessments were completed for different projects: seven for energy infrastructure, three for surface storage of natural gas, three for hydro power plants and one for a wind park.
June 2019	After designation as a Nature Park, the Ulcinj Salina was submitted to the Secretariat of the Ramsar Convention for designation as a wetland of international importance.
April 2019	Montenegro complies with its reporting obligations on pollutants under the scope of the Large Combustion Plants Directive by submitting the relevant information to the European Environment Agency. TPP Pljevlja was in operation 7.081 hours in 2018.
Climate	
October 2019	At its 139th session, the Government of Montenegro adopted the Law on Protection from the Negative Impact of Climate Change.
April 2019	Second Biennial Update Report was submitted to UNFCCC with well-defined reporting obligations and institutional roles.
November 2018	A national working group to work on the NECPs was officially set up and convened for the first time in November 2018.

Data source: (Energy Community.org, 2021e), (Energy Community.org, 2021f)

General framework for implementation for implementation of EPBD
Main requirements of the EPBD included in the National Law(s):

Process related to the transposition of the new EPBD in Montenegro was started by adopting Law on Efficient Use of Energy ("Official Gazette of Montenegro" 57/14 and 25/19) as well as by updating bylaws related to the energy efficiency of buildings as follows:

- Rulebook on Minimal Energy Efficiency Requirements in Buildings („Official Gazette of Montenegro" 75/15 of 25 December 2015) ;
- Rulebook on the Energy Performance Certification of Buildings („Official Gazette of Montenegro" 75/15 of 25 December 2015) ;
- Rulebook on Performing Energy Audits of Buildings („Official Gazette of Montenegro" 75/15 of 25 December 2015) determining the methodology for performing energy audits of buildings;
- Rulebook on Regular Energy Audits of Heating Systems and Air-conditioning Systems („Official Gazette of Montenegro" 76/15 of 28 December 2015) ;
- Rulebook on Conditions for Performing Training, Obtaining of Authorization and Manner of the Managing of the Registry for Energy Audits Performing („Official Gazette of Montenegro" 75/15 of 25 December 2015) (Energy Community.org, 2020b).

Update of measures implemented in last year
In accordance with the Law on Efficient Use of Energy, the Ministry of Capital Investments is continuously working on the harmonization of the legal framework in the field of introducing eco design requirements and energy labelling of energy-related products. In 2020, three rulebooks were adopted as follow:

- Rulebook on energy labelling of residential ventilation units (Official gazette of Montenegro 63/2020, as of 30 VI 2020);

- Rulebook on technical requirements of eco design for ovens, hobs and hoods (Official gazette of Montenegro 62/2020, as of 26 VI 2020);
- Rulebook on energy labelling of ovens and hoods (Official gazette of Montenegro 63/2020, as of 30 VI 2020) (Energy Community.org, 2021e).

Progress on EPBD implementation

Within the "Energy Efficiency Program in Public Buildings" which is implemented in cooperation with KfW Bank, support is provided for:

- Establishment of the national building inventory of and determination of cost-optimal levels;
- Development of national software for of energy performance calculation and certification of buildings.

The process of establishment of the national building inventory has been finalized together with definition of the reference buildings and activities on calculation of cost-optimal levels/minimum energy performance requirements which are ongoing.

The first operational version of the software for the calculation of energy performance of buildings (MEEC -Montenegrin Energy Efficiency Certification) was finalized in November 2020 and it is available for download (www.meec.me). The calculation methodology is based on DIN V 18599 with certain adjustments to Montenegrin legislation (climate data, user profiles, library on construction materials, conversion factors, etc.). Section which is still not completed in the software relates to energy performance certificates (reference values, energy classes, EPC layout, etc.) and it will be added as soon as the analysis on cost-optimal levels is completed. The process related to energy certification of buildings is planned for 2021, after completion of the training of authorized energy auditors for using the new software.

Renovation support scheme

Table 99 Overview of renovation support schemes in Montenegro

Support scheme	Date
Energy Efficiency Program in Public Buildings - Establishment of the national building inventory of and determination of cost-optimal levels, - Development of national software for energy performance calculation and certification of buildings.	-

Data source: (Energy Community.org. 2021e)

SERBIA

Regulatory framework

Table 100 Regulatory framework in the field of energy performance of buildings in Serbia

Instrument	Date	Brief description
The Law on Efficient Use of Energy	2013	Regulates policy of efficient use of energy; energy management system; labelling the energy efficiency of products that affect energy consumption; obliges local self-government units (LGU) to include in the tariff system for district heating services (as one of the elements for calculating the price of heating) the measured or actually delivered quantity of heat.

The Law on Energy	2014	Regulates the use of renewable energy sources, incentive measures, and organisation of the electricity market. The law enables heat consumers to get the status of energy vulnerable consumers, which secures subsidies for paying the bills, similar to the consumers of electricity and gas.
The Law on Planning and Construction	2013	Provides determination of allowed energy characteristics of the buildings and energy certification.
The Law on Housing and Maintenance of Buildings	2016	Regulates provision of state budget funds for energy efficiency improvement in the residential sector.
The Law on Energy Efficiency and Rational Use of Energy	2021	Initiates the roll-out of the subsidies for citizens to replace windows and doors, install wall and roof insulation, as well as to replace heating systems with devices that are more efficient and use less polluting fuels. The law also introduces regulations for eco-design including energy labels for household appliances.
The Law on Renewable Energy Sources	2021	Introduces auctions for the award of premiums, creates conditions for the development of the renewable energy market, and allows citizens and companies to produce electricity for their own consumption.

Data source: (London School of Economics and Political Science, 2014), (Spasić, V., 2021)

Renovation support scheme

The Budgetary Fund for Energy Efficiency was established in 2014 in Serbia to promote energy efficiency in buildings. In 2016 approximately €1.3 million was dedicated to funding technical measures including improving energy efficiency and developing energy management systems. The United Nations Development Programme is providing additional funding of US$ 500,000 for projects of energy efficiency improvement in public buildings in at least 10 municipalities from 2015–2020.

Table 101 Overview of renovation support schemes in Serbia

Land	Support scheme	Date
Serbia	Budgetary Fund for Energy Efficiency	2014
Serbia	Public call for financing programmes of Municipalities for energy rehabilitation of residential buildings. Support for the improvement of insulation, doors and windows as well as space heating devices which was implanted jointly with the Municipalities.	April – May 2021
Serbia	Programme of energy rehabilitation of residential buildings, individual houses and flats. Support for improvement of building envelope and HVAC systems and instalment of solar collectors for preparation of sanitary hot water, which is implanted jointly with the Municipalities.	2021
Belgrade city	The City of Belgrade Budget Fund for Energy Efficiency (BEEEF). Financial support for energy efficiency and renewable energy projects to save heat and electricity in the city of Belgrade	2018

Data source: (Republic of Serbia, Ministry of Mining and Energy, 2016)

UKRAINE

Regulatory framework

Table 102 Regulatory framework in the field of energy performance of buildings in Ukraine

Instrument	Date	Brief description
Law No. 4507 on Energy Efficiency	2021	Defines approaches to the formation of a strategy for energy efficiency of buildings and principles of energy saving in the buildings of central executive bodies.
Law on energy efficiency of buildings	2017	Defines legal, socio-economic and organizational principles for activities in the field of energy efficiency of buildings and aims at reducing energy consumption in buildings.
Order of the Ministry of Regional Development №169 on approval of the Methodology for determining the energy efficiency of buildings	2018	Defines national calculation methodology with national annexes for the energy performance of buildings.
Orders of the Ministry for Communities and Territories Development of Ukraine No. 260 and No. 261 on minimal requirements for energy efficiency of buildings	2020	The orders introduce formulas for the calculation of indicators relevant to energy efficiency of buildings and adopts minimum energy performance Requirements.
Order of the Ministry of Regional Development 70170 on approval of the Methodology for determining the economically feasible level of energy efficiency of buildings	2018	Calculation of cost-optimal level of energy Performance.
Order of the Ministry of Regional Development №172 on approval of the Procedure for certification of energy efficiency and form of energy certificate	2018	Regulation on Energy Performance Certification of buildings, incl. national values for each class (A, B, C, etc.).
Resolution of the Cabinet of Ministers of Ukraine №605 on approval of the Procedure for professional certification of persons who intend to carry out activities on certification of energy efficiency and inspection of engineering systems	2018	Training, examination and accreditation of Experts.

Data source: various sources, 2021

Renovation support scheme

The Energy Efficiency Fund was created by the Ukrainian Government, in order to support energy-efficiency initiatives, implement incentive tools, and support measures aiming to increase levels of energy efficiency in buildings and energy-efficiency measures in the residential sector. This is done with due consideration for the National Plan of Energy Efficiency, and with the aim of reducing CO_2 emissions to fulfil the Paris Agreement. The Fund provides support in the form of grants to homeowner associations for the implementation of comprehensive technical solutions for energy-efficiency renovations in multi-family buildings, while factoring in the best European thermal modernization practices. Activities are funded from the State Budget and supported by the European Union and the German Government. The Energy Efficiency Fund Programme is implemented in cooperation with the International Finance Corporation, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, and the United Nations Development Programme.

Table 103 Overview of renovation support schemes in Ukraine.

Land	Support scheme	Date
Ukraine	**The Energy Efficiency Fund** - Provides support in the form of grants to homeowners associations for the implementation of comprehensive technical solutions for energy-efficiency renovations in multi-family buildings	2017
Lviv city	**Flagship project Energy-Efficient District Lviv** - Support from German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) for implementation of thermal renovation of residential area in the district of Sykhiv in Lviv.	2018–2022
Ukraine	**Ukraine’s Public Buildings Energy Efficiency project** - Support from the European Investment Bank for the implementation of energy efficiency measures in hospitals in Ukraine.	2021

Data source: (Energy Efficiency Fund, 2021), (GIZ, 2021),(European Investment Bank, 2020)

8. RENOVATION RATE AND DEPTH

The building sector is still considered as one of the most relevant segments to meet energy efficiency goals through both, Energy Performance of Buildings Directive and Energy Efficiency Directive. The European Commission presented the effort to double renovation rate and to increase share of deep renovations in order to increase impact of renovations in general. The following chapter presents collection of the information on renovation rates and share of deep renovations. Specifically, data availability to the share of deep renovations was significantly lower across the states in the official documents.

AUSTRIA

Austria has an 'effective' thermal energy refurbishment rate of approximately 1.5%, which corresponds to around 4.3 km² of renovation floor area. This rate of 1.5% means an energy saving of approximately 1 TWh/a (Austrian Institute of Construction Engineering (OIB), 2020). It was assumed, that sole focus of the full-building refurbishments was thermal energy impact. Refurbishment rate used is based solely on the energy improvement as a result of refurbishment, specifically in terms of how buildings from the pre-1990 period have been brought into a thermal energy condition that at the very least complies with the requirements for major renovations from OIB Guideline 6 that have been in force since 2007.

In Styria region, the Climate and Energy Strategy 2030 was adopted. It promotes exemplary refurbishments of municipal and public buildings. The target refurbishment rate is 2% per year (Austrian Institute of Construction Engineering (OIB), 2020).

The depth or quality of renovations are not presented. The supporting schemes for renovations differ between Austrian regions. Nonetheless, based on the information from (Austrian Energy Agency – AEA, 2017b) and (Austrian Institute of Construction Engineering (OIB), 2020), Austria subsidy schemes preferably support or offer additional benefits for deeper renovations in long term.

BULGARIA

Current renovation rate or quality of renovations are not clearly presented within the Long-term national strategy issued in 2020 or National renovation strategy issued in 2017.

According to the Long-term renovation strategy, primary energy savings of more than 60% have been achieved in only 6% of the total number of renovated buildings. Between 55% and 60% of energy savings (with further potential for deep renovation) have been achieved in 8% of the total number of renovated buildings .

However, package of energy-saving measures were generated for single-family and multi-family residential buildings. These are able to safe from 41.06 to 79.08 % of primary energy as a result of the application of the energy consumption class package (Republic of Bulgaria, 2021).

CROATIA

The Ministry of Physical Planning, Construction and State Assets, as Interim Body Level 1 (IB1), has published four calls for energy renovation co-financing, requiring heating energy savings of at least 20% in one and 50% in the other three calls.

It was planned to renovate 3.5% of the building stock floor area or 6.7 mil. m² each year between 2014 and 2019 under the 2014 and 2019 Long-term strategy for mobilising investment in the renovation of Croatia's national building stock, however this ambitious one-year target has not been achieved in the five year period. Between 2014 and 2019 it was renovated just 5.7 mil. m². After recalculation, the renovation rate is about 0.6% per year. According to the Long-term renovation strategy, renovation rate was 0.7% per year.

For the period 2021-2030 Croatia plans to increase renovation rate from 1% in 2021 to 3% in 2030 (with a 10-year average rate of 1.6%) through subsidy programmes focused on the renovation of multi-apartment, family and public buildings (Ministry of Physical Planning, Construction and State Assets, 2020b).

CZECH REPUBLIC

Based on the Long-term renovation strategy (Ministry of Industry and Trade, 2020b), data for single-family houses were determined using available information on single-family houses renovations from the New Green Savings support programme and data from the ENEX database (contains information from documents prepared by the national energy experts, i.e. from energy audits, energy assessments, energy performance certificates of buildings and reports on the inspection of heating and air-conditioning systems).

In terms of apartment buildings, there is more accurate information on renovations. Details on implemented savings measures are read from the ENEX database and from information from support programmes used for the renovation of apartment buildings such as New Green Savings, Panel 2013+ or the Integrated Regional Operational Programme (IROP).

As for non-residential buildings, renovation rates were determined based on the building permits for major alterations to buildings and partially on the ENEX database. However, building permits also include renovations that do not have the character of energy savings measures.

The depth of renovations was determined with the help of the energy performance class of the building, i.e. which class was achieved through the renovation of the building. Building energy performance classes A and B were designated as thorough renovation depths, class C as moderate renovation depth and classes D, E, F and G were designated as shallow renovation depths.

Table 104 Annual renovation rates and depths of renovation in the Czech Republic in the period 2014–2018

	Residential sector		**Non-residential sector**	
	Single-family houses	Apartment buildings	Public buildings	Commercial buildings
Renovation rate	1.40%	0.79%	1.40%	
Depth of renovation*				

Shallow	35.0%	31.1%	28.08%	26.13%
Moderate	45.0%	49.6%	41.03%	44.67%
Thorough	20.0%	19.3%	30.90%	29.21%

** Weighted average for apartment buildings*

Data source: (Ministry of Industry and Trade, 2020b)

The definition of thorough renovation in the country is not in a full compliance with the term deep energy renovation used by EC. The thorough renovation presents more the standard reached than the level of improvement.

Table 105 Depths of apartment buildings renovations carried out in the period 2014–2018 according to ownership relations

Depth of renovation	Cooperative	Natural and legal persons	Associations of unit owners	Municipality/ State
Shallow	28%	34%	30%	33%
Moderate	57%	35%	58%	41%
Thorough	15%	31%	12%	27%

Data source: (Ministry of Industry and Trade, 2020b)

The proportion of buildings already renovated was estimated. For single-family buildings, this is 25%; for apartment buildings it is 40% (concerning prefabricated apartment buildings, 55% of them have been renovated). This was based on the author's own survey, estimates by consulting companies, the statistics of support programmes, the quantity of ETICS (external thermal insulation composite system) sold, and, for apartment buildings, the PanelScan study (Ministry of Industry and Trade, 2020b).

Total renovated floor area in 2018 was about 65 mil. m^2 out of 200 mil. m^2 for single-family houses, 125 mil. m^2 out of 250 mil. m^2 in apartment buildings and 130 mil. m^2 out of 250 mil. m^2 in non-residential buildings (Ministry of Industry and Trade, 2020b).

GERMANY

From the total of about 19 million residential buildings with about 41 million dwellings, half of the apartments are due to be refurbished during the next 20 years. This corresponds to around one million dwellings to be renovated annually (Federal Ministry for Economic Affairs and Energy, 2014). Since the renovation cycles for the building envelope are from 30 to 40 years. It is considered as important to use the need of envelope renovation (renovation cycles) as an opportunity to improve energy efficiency.

No official information is available on the energy performance quality of renovation and the depth of refurbishment. In the building model of Prognos AG, an energy efficient renovation rate of around 1.00 percent of the total stock was assumed. The renovation rate for multi-family houses was around 1.25 percent, slightly higher than for single-family houses at around 0.84 percent. The renovation rate depends also depends on the age of the building and is higher for the older than for newer buildings. In 2010 in a survey of around 7,500 building owners, the German Institute for Living and Environment determined a value of 0.83 percent renovation rate of the total stock (Institut Wohnen und Umwelt, Bremer Energie Institut, 2010).

In the period 2010–2012 thermal insulation measures carried out on the external wall averaged to 1.30 % of all residential buildings and 1.88 % of all „old“ buildings (built up to 1978) per year. In 2010–2016 the old buildings had an annual modernization rate of 1.12 % for external wall insulation, 2.27 % for the roof/first floor ceiling insulation, 0.54% for the floor/basement ceiling insulation, and 2.47% for the renewal of windows/glazing, that makes 1.6 % on average (Institut Wohnen und Umwelt, 2016) (Institut Wohnen und Umwelt, 2018).

Those numbers are in general in accordance with the official Energy efficiency strategy for buildings (Federal Ministry for Economic Affairs and Energy, 2015).

HUNGARY

The number of renovated dwellings was estimated in the specific years, taking into account the age of the dwelling and the income situation of the owner. In the event of renovation of public buildings, the document estimates renovation of 3% of their heated floor space annually, in accordance with the obligation under the Energy Efficiency Directive for buildings of the central government. Hungary has assumed a 1.5% renovation rate for non-governmental buildings owned by the municipality and belonging to the additional central budget (Hungary, 2017).

The renovation rate of the building stock, although showing an increasing trend, is still low, as the renovation rate for residential buildings is only around 1% per year (Ministry of Innovation and Technology, 2021).

By implementing the measures set out in the Strategy, the objective of achieving the renovation rate of 3% per year for the total residential stock by 2030 can be achieved. During the same period, the aim is to strengthen the annual renovation rate of the public buildings stock of 5% (Ministry of Innovation and Technology, 2021).

The values to the energy savings reached are not provided in the available documents.

ROMANIA

Long term renovation strategy identifies 3 renovation packages – Minimum package P1, Average Package P0 and Maximum renovation Package P3. Packages P2 and P3 could be considered deep renovations as their implementation can lead to a reduction of more than 60 % in the energy consumption. For single-family houses, the P1 Package is recommended as being cost-optimal, as P2 and P3 Packages may still be too costly for owners and require long payback periods. In other words, all renovated buildings could achieve energy performance levels corresponding to the current requirements for rating ‘A’, except for single family houses, for which rating ‘B’ is suitable (Romania, 2020b).

However, the regulations for enforcement of deep renovations as well as financing schemes are not fully resolved at the moment. Technical building regulations need to be revised in order to stimulate deep renovation of existing buildings, including periodic revisions and updates of energy performance standards, based on the total cost optimisation methodology. In this respect, a deadline will be set for meeting the requirements of the deep renovation standards, accompanied by staged renovation plans that can be outlined in the EPC/BRP report (Romania, 2020b).

The Long term renovation strategy identifies current state of renovation rate along with 3 possible scenarios to implement the renovation of the entire building stock by 2050.

The current scenario consists of an annual renovation rate of about 0.5% (business as usual scenario), which would enable Romania to renovate approximately 15% of buildings by 2050. Other scenarios represent more ambitious renovation paces and are designed to ensure that the entire building stock that needs to be energy renovated will be completed by 2050, as required by the revised EPBD.

However, more ambitious renovation rates "*would be very difficult to implement in the first decade[3], as the market might not be ready for such a high renovation pace. Funding would also be much more difficult to mobilise*." (Romania, 2020b). A barrier of the number of workers needed in the building sector to carry out the planned building renovation under each scenario are also discussed (Romania, 2020b).

Table 106 Annual building renovation rates per scenario in Romania

	Annual renovation rates from 2021 to 2030	Annual renovation rates from 2031 to 2040	Annual renovation rates from 2041 to 2050
State of play – current "Business as usual" scenario	0.5%	0.5%	0.5%
Scenario 1	Gradual increase from 0.53% to 1.56%	Gradual increase from 2.22% to 4.78%	Gradual increase from 4.85% to 6.41%
Scenario 2	Gradual increase from 0.69% to 3.39%	3.79%	4.33%
Scenario 3	3.13%	3.24%	3.62%

Data source: (Romania, 2020b) based on the World Bank Assessment from 2019

SLOVAKIA

Since 1992, targeted renovation of the housing stock has been underway, focusing on apartments older than 20 years, especially through a thermal insulation and remedy of structural deficiencies.

The 2011 Census data (Annex 3) suggest that, as of 21 May 2011, renovation (at least partial) had been carried out in 27% of single-family houses and 41.04% of residential buildings. The figures were distorted to some extent due to the number of unoccupied apartments and houses, specifically 15% and 5.75% of single-family houses and multi-apartment buildings, respectively.

The 2011 Census data are then compared with the expert estimate of renovation of buildings that was obtained by a progressively refined method of monitoring consumption of thermal insulation material on vertical building envelopes until 2019. It is concluded that renovation was carried out in Slovakia as a whole in more than 67.87% of apartments in multi-apartment buildings and 44.97% of apartments in single-family houses. The number of renovated single-family houses as well as multi-apartment buildings also includes houses/buildings with partial renovation only. It is estimated, that stock of

[3] 2021-2030

multi-apartment buildings will be renovated (i.e. at least 1 renovation per building) by the 2029, respectively 2040 in case of single-family houses.

According to the Long-term Renovation strategy, the renovation rate for non-residential buildings is lower due to the lack of system support in the past (Ministry of Transport and Construction of the Slovak Republic, 2020).

Based on the presented data, the renovation rates were calculated to about 2% per year in the case of single-family houses, respectively almost 3% per year in the case of multi apartment houses.

SLOVENIA

The current rate and quality of renovations is not clear from the text of NECP or Long-term strategy, or it would have to be calculated on the basis of data provided. However, very detailed estimates are given for the period up to 2050 in Long-term renovation strategy (they include breakdown of energy savings to the individual types of buildings). The calculation of the number of renovations takes into account all forms of renovations, i.e. small, comprehensive and nearly zero-energy (weighted in calculation). Estimates are broken down for residential buildings and 3 categories of public buildings. According to the Long-term renovation strategy:

- The baseline annual renovation for single-apartment buildings in the period 2020–2050 is 3.5–4.0 per cent and 5.0–5.5 per cent for multi-apartment.
- The baseline for renovation of public buildings in the period 2020–2050 is 3.0–3.4 per cent.
- Buildings owned and occupied by the narrower public sector, which are subject to energy renovation of three per cent of the buildings per year, comply with this quota.
- The baseline scope of renovations for private service sector buildings in the period 2020–2050 is 3.1–3.3 per cent (Government of the Republic of Slovenia, 2021).

Overall energy savings between 2020 and 2030 should be 25% (10.62 PJ) in residential buildings, 7% (0.52 PJ) in Public buildings, -1% (-0.013 PJ) in private public buildings (increase stems from an increase in the number of new buildings and from the restructuring of heating installations) (Government of the Republic of Slovenia, 2021).

However, NEEAP states that it will be necessary to maintain a rate of integrated energy renovations of over 2% per year (in order to fulfil the greenhouse gas emissions by 2030) and that it will be a major challenge, especially for the public sector, as it more demanding cases of reconstruction for economic, technical and other reasons will follow (Republic of Slovenia, 2017).

BOSNIA AND HERCEGOVINA

Long-term building renovation strategies have been drafted on state and entity levels, but not adopted. The necessary amendments to primary legislation have only been adopted in Republika Srpska. Both entities are currently working on updating existing legislation, including procedures for systems and certification of buildings (Energy Community.org, 2021a).

Renovation of buildings

The long-term strategy for the renovation of the BiH building stock covers the period up to 2050. In order to achieve the strategic goals of reducing energy consumption in buildings, the adoption of a key energy renovation programme for the period from 2021 to 2030 is envisaged for apartment buildings, family houses and public buildings, and guidelines for the development of these programmes are given below. As for the commercial sector of buildings, the adoption of a new programme based on co-financing and/or finding solutions for poor households is envisaged. It is also envisaged that this segment of the building stock will be covered by the activities of suppliers under the system of obligation schemes as well as the energy services market. In addition to these programmes, which are based on financial incentives, the implementation of a comprehensive programme for the promotion of nZEB construction and renovation standards is also planned.

Bosnia and Herzegovina, same as other EnCT (Energy Community Treaty) signatory countries, has until 1 December 2017 to identify and publish a list of all relevant buildings in this category and to start the process of renovation of 1% of these buildings per year. The rate of 1% is calculated against the total usable floor area of buildings larger than 500 m^2 owned and/or operated by state authorities. This threshold will be reduced to 250 m^2 as of 1 January 2019 (Bosnia and Herzegovina, 2017).

Table 107 Adoption of the Integrated Building Renovation Strategy in Bosnia and Herzegovina and entity strategies

Confirmation of key participants and data sources.		
BiH level	Federation of BiH	Republika Srpska
No State level working group was not established	Yes Entity working group established	No Entity working group was established
Adoption of technical and economic assessments listed in the strategy for entity levels.		
BiH level	Federation of BiH	Republika Srpska
Yes Through GIZ technical assistance	Yes Through GIZ technical assistance	Yes Through GIZ technical assistance
Determining the policy for the implementation of the strategy or program for the renovation of both residential and non-residential buildings.		
BiH level	Federation of BiH	Republika Srpska
No No formal decision on the strategy. No formal decision on the programme.	Partially The Government programs 2021 envisaged the drafting of the strategy The program is envisaged to be carried by the Fund of environmental protection – no formal decision up to date.	Partially The Law on Spatial Planning and Construction20 prescribed the adoption of the strategy The program is envisaged to be carried by the Fund of environmental protection and energy efficiency – no formal decision up to date.
Publication of the Strategy and its delivery to all participants in the process.		
BiH level	Federation of BiH	Republika Srpska
Not in that stage of the drafting process.	Not in that stage of the drafting process.	Not in that stage of the drafting process

Data source: (Bosnia and Herzegovina, 2021)

MOLDOVA

The Moldovan national energy targets for the year 2020 with an intermediate milestone in 2015 are coherently laid down by the National Development Strategy of the Republic of Moldova for 2012–2020 and the National Programme for Energy Efficiency 2011–2020, In the specific domain of energy efficiency Reducing energy consumption in buildings by 20% in 2020; A share of renovated public buildings of 10% in 2020 (Chisinau, 2012).

The Energy Strategy of Moldova (ES) until 2030 provides guidelines for national energy sector development, in order to ensure necessary grounds for economic growth and social welfare. The ES main targets, all for 2020, are: …, reduce energy consumption in buildings by 20% from the 2009 level; rehabilitate 10% of public building stock (iea.org, 2021).

MONTENEGRO

The 2016–2018 energy efficiency action plan aims to achieve 9% savings of the average five-year final energy consumption by 2018 and to renovate 1% of central government buildings by February 2016 (European Commission, 2018).

SERBIA

No official data are available on actual renovation rate and depth in Serbia. In a quantitative estimate of the renovation potential in Serbia provided by BPIE a renovation rate of 1% and 3% is assumed in Low Renovation and Medium Renovation Scenario till 2050 with energy savings in renovated buildings (renovation depth) of 15% and 45% accordingly (Bean, De Groote and Kockat, 2018).

Long Term Building Renovation Strategy of Serbia, which should provide the necessary data and should be ready for adoption in 2021, is still under development.

UKRAINE

No data on renovation rate and depth were available. However, a bit different indicator – the coefficient of housing renewal is published by the State Statistics Service of Ukraine. The coefficient is calculated as the share of commissioned housing in the total housing area (percentage). It can be assumed that the renovation rate is much lower, than the coefficient of renewal.

Table 108: Ukraine – housing renewal coefficient

Year	Total area (mil. m^2)	Commissioned housing (mil. m^2)	Coefficient of housing renewal (%)	The period of full renewal of housing (years)
1990	922.10	17.45	1.89	52.84
1995	978.30	8.66	0.89	112.97
2000	1015.00	5.56	0.55	182.55
2001	1026.00	5.94	0.58	172.74
2002	1031.70	6.07	0.59	169.97
2003	1035.70	6.43	0.62	161.07
2004	1040.00	7.57	0.73	137.38

2005	1046.40	7.82	0.75	133.81
2006	1049.20	8.63	0.82	121.58
2007	1057.60	10.24	0.97	103.28
2008	1066.64	10.50	0.98	101.58
2009	1072.24	6.40	0.60	167.54
2010	1079.54	9.34	0.87	115.58
2011	1086.04	9.41	0.87	115.41
2012	1094.24	10.75	0.98	101.79
2013	1096.64	11.22	1.20	97.74
2014	966.14	9.74	1.01	99.19
2015	973.84	11.04	1.13	88.21
2016	982.88	9.37	0.95	104.90

Data source: (State Statistics Service of Ukraine, 2021)

SUMMARY

The reported statistics on the renovation rate vary in quality and detail from country to country. The statistics are often not available, especially for non-European countries.

At the same time, the targets planned by some countries seem very ambitious (e.g. Hungary or Slovenia), while elsewhere the renovation plan seems greatly underestimated (e.g. Bulgaria and the Czech Republic). However, it is difficult to assess the feasibility of the plans and credibility of given numbers without further information. Therefore, it is appropriate to look at the statistics presented below with some oversight.

EU member states, according to Article 3 of the EED directive, are obliged to renovate 3% of the floor area of the public bodies' buildings per year. This renovation rate is not discussed in the text as it is assumed that this objective is met by the countries, respectively the opposite was not found. This value is reduced to 1% for non-EU countries that has signed Energy Community Treaty – this includes all non-EU countries belonging to Danube region. However, but due to the unavailability of data, the fulfilment of the goal cannot be assessed.

Table 109 Renovation rate by 2020 and planned/estimated renovation rates for the period 2021–2030

Country	**Current annual rate (until 2020)**	**Planned/estimated annual rate (2021–2030)**
Austria	1.50%*[1]	2.00%*[2] / 3.00%*[3]
Bulgaria	-	0.89%*[4]
Croatia	approx. 0.60%-0.70%	Gradual increase from 1% to 3% in 2030 (average of 1.6%)
Czech Republic	1.40% single-family houses 0.79% apartment buildings 1.40% non-residential sector	1.40% single-family houses*[5] 0.79% apartment buildings 1.40% non-residential sector
Germany	0.84% single-family houses 1.25% multi-family houses maximum of 1% on average	1.30 to 2.00% single/two-family houses*[6] 1.50 to 2.00% apartment blocks

Hungary	1.00% residential buildings 3.00% public buildings	3.00% residential buildings by 2030 5.00% public buildings by 2030
Romania	0.50% on average	Scenario 1: Gradual increase from 0.53% to 1.56% Scenario 2: Gradual increase from 0.69% to 3.39% Scenario 3: 3.13%
Slovakia	2.00% single-family houses 3.00% multi-apartment houses	*[7]
Slovenia	2.00%	3.50 to 4.00%*[8] single-apartment houses 5.00 to 5.50% multi-apartment buildings 3.00 to 3.40% public buildings 3.10 to 3.30% private service sector buildings 1.40% non-residential sector
Bosnia and Hercegovina	-	1.00/2.20/2.80%*[9]
Moldova	-	-
Montenegro	-	-
Serbia	-	1.00 to 3.00% based on scenario
Ukraine	Less than 1.00%*[10]	-

Data source: based on the statistics above for individual countries (primary Long-term renovation strategies)

*[1] referred to as ‘effective’ thermal energy refurbishment rate.
*[2] accord to action plan from August 2019 for Styria region.
*[3] stated goal in the Austria’s Legislative Programme 2020–2024.
*[4] based on indicator/milestones for housing stock – renovated area of existing housing stock of 8% for 2021–2030.
*[5] numbers for chosen ‘optimal’ scenario, with share of thorough renovations (reaching energy classes A and B accord to Energy performance building certificate) increasing to 40% in 2025 and 85% in 2030. Contrary, “hypothetical” scenario assumed renovation rates of 3.0%, 2.0% and 2.5%, but was evaluated as difficult to implement.
*[6] varies according to the type of possible scenario in relation to the Energy Efficiency Strategy for Buildings (ESG).
*[7] with forecast of 20% share of building deep/nZEB renovations.
*[8] forecast for the period 2020–2050, focused on older buildings (construction before 2002). Renovation rates for period 2020–2030 can be estimated at least around 1.0 to 1.2% of the building stock with construction before 2002.
*[9] varies according to the scenario, average depth of renovation 58 to 63%.
*[10] based on various sources it is assumed, that renovation rate is significantly below 1%, nearly to 0.1%.

9. COMPARISON WITH THE RENOVATION WAVE AND LONG-TERM RENOVATION STRATEGY REQUIREMENTS

The chapter compares findings from the Chapter 8 on Renovation Rate and Depth. However, level of compliance of the national strategies with the Renovation wave requirements id difficult to evaluate, due to the fact that on one hand the national long-term renovation strategies were issued during 2020 (i.e. developed in 2018–2020) following the requirements of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, as amended by Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018.

On the other hand, the renovation strategy may not currently be in line with the requirements of the Renovation Wave issued by the European Commission later, on 14 October 2020. Following subchapters assess the compliance of national strategy policies with Renovation wave and Long-term renovation strategy.

9.1 COMPLIANCE WITH THE RENOVATION WAVE

Based on the documents relevant to the Renovation wave, the following requirements were collected following the main objective of the Renovation wave:

1) Increasing the renovation rate from an average of 1% to at least 2% in 2030. Projections are for a 1% annual energy renovation rate for 2021–2022, an increase to 1.2% a year in 2023–2025 before stabilising at least 2% per year in 2026–2029[4]. The rate of renovations that concern the change of heating equipment only will have to reach around 4% in 2026–2030 in both the residential and services sector (European Commission, 2020).

Based on the Commission Recommendation (EU) 2020/1563 on energy poverty:

2) Use the indicators outlined in the Annex in their energy poverty assessments.
3) In line with Recital 60 of the recast Electricity Directive, produce integrated policy solutions as part of energy and social policy. These should include social policy measures and energy efficiency improvements that reinforce each other, especially in housing.
    a. Where Member States are affected by energy poverty and have not developed national action plans or other appropriate frameworks to tackle energy poverty, they should do so, with the aim of decreasing the number of energy poor customers. Low income, high expenditure on energy, and poor energy efficiency of homes are relevant factors in establishing criteria for the measurement of energy poverty. In any event, Member States should ensure the necessary supply for vulnerable and energy poor customers. In doing so, an integrated approach, such as in the framework of energy and social policy, could be used and measures could include social policies or energy efficiency improvements for housing. This Directive should enhance national policies in favour of vulnerable and energy poor customers (Directive (EU) 2019/944).

Based on the Commission Implementing Regulation (EU) 2020/2156:

[4] This means that by 2030, at least 13.6% of all buildings in the EU should be renovated.

4) (Optional) implementation of system of a readiness indicator for smart solutions (Commission Implementing Regulation (EU) 2020/2156) based on the (Commission Delegated Regulation (EU) 2020/2155).

Table 110: Renovation wave compliance assessment table

Country / criteria	1.	2.	3.	4.
Austria	X*	X	✓*	X*
Bulgaria	X	X	X	✓*
Croatia	✓*	X*	X*	X
Czech Republic	✓*	X*	X*	X
Germany	✓	X	✓	X
Hungary	✓	X	X*	✓*
Romania	✓*	X	✓*	X
Slovakia	✓*	X	✓*	X*
Slovenia	✓*	X	✓	X*
Bosnia and Hercegovina	X	X	X	X
Moldova	X	X	X	X
Montenegro	X	X	X	X
Serbia	X	X	X*	X
Ukraine	X	X	X*	X

Note: X - not implemented or information/evidence not found, *Further details below

AUSTRIA

The current contributions of renovations are quantified and the estimation of the development in expected energy savings is provided. However, further details on renovation rate and depth are not presented.

Integrated policy solutions for energy poverty

The Federal Act on increasing energy efficiency within companies and the Federal Government (Federal Energy Efficiency Act [Bundes-Energieeffizienzgesetz – EEffG]) stipulates that at least 40% of all efficiency measures must apply to the field of housing in households. Measures for low-income households must be weighted with a factor of 1.5. Weighting measures put in place for low-income households, as well as specific projects with social institutions and debt advice centres, by a factor of

1.5 is an incentive for obligated undertakings (energy suppliers) to become more active in this area in order to combat energy poverty. Examples of such measures include qualified energy consultations with consultants with social work experience or appliance replacement campaign (Austrian Institute of Construction Engineering (OIB), 2020).

In addition to Federal Energy Efficiency Act, some Austrian provinces also administer their own programmes and support measures to tackle energy poverty.

System of a readiness indicator for smart solutions

The Federal Ministry for Transport, Innovation and Technology (BMVIT) commissioned the Austrian Research Promotion Agency (FFG) to carry out a project entitled SRI Austria – Smart Readiness Indikator: Bewertungsschema und Chancen für intelligente Gebäude [SRI Austria – Smart Readiness Indicator: Evaluation framework and opportunities for intelligent buildings] for a term of 15 months (1 July 2018 – 31 October 2019).

The main result of the document will be a basis for decision-making and support for the national political implementation of an SRI Austria and possible integration into the process of issuing and using energy performance certificates (Austrian Institute of Construction Engineering (OIB), 2020).

BULGARIA

System of a readiness indicator for smart solutions

In the document (Ministry of Energy of the Republic of Bulgaria, 2020) it is presented, that Bulgaria, as one of the measures to support the achievement of a highly efficient and decarbonised building stock will implement the optional Smart Readiness Indictor for Buildings of the Community and adapting the methodology for SRI calculation established by the European Commission by taking national specificities into account, including an assessment of existing national schemes for energy performance certification with a time horizon 2021–2030.

CROATIA

Increasing the renovation rate

Several subsidy programmes (Energy renovation programme for multi-apartment buildings, Energy renovation programme for family houses, and Energy renovation programme for public buildings) for period of 2021–2030 are designed to meet 3% renovation rate by 2030. Within these programmes the savings were calculated assuming that the energy renovation of buildings will be achieved at the level necessary to meet the requirements of the Technical regulation on rational energy use and heat retention in buildings, by periods of building construction, at an annual renovation rate of 1% at the beginning of the period (in 2021) and rising gradually to 3% by 2030 (Ministry of Physical Planning, Construction and State Assets, 2020b).

Integrated policy solutions for energy poverty and energy poverty indicators

Croatia lacks both a definition of energy poverty and general criteria or methodology for determining energy poverty. Therefore, the Integrated National Energy and Climate Plan provides for the preparation, adoption and implementation of a comprehensive Programme to tackle energy poverty.

Also the "Programme to tackle energy poverty" including the use of renewable energy sources in residential buildings in assisted areas and areas of special state concern for 2021–2025 is in preparation (Ministry of Physical Planning, Construction and State Assets, 2020b).

On 14 May 2020, the Government adopted a Decision amending the Energy renovation programme for family houses. On 25 June 2020, based on the amendments to the Programme, the Environmental Protection and Energy Efficiency Fund issued a first ever public call in Croatia which included subsidies for the energy renovation of houses for citizens in danger of energy poverty, with a full funding rate (100%) covering the cost of the integrated energy renovation. Both documents address the issue of energy poverty and provide for the launch of pilot projects for the energy renovation of buildings occupied by vulnerable consumers (at risk of energy poverty) (Ministry of Physical Planning, Construction and State Assets, 2020b)(Ministry of Environment and Energy, 2019).

Based on the experiences acquired in the implementation of the two pilot projects, the definition of energy poverty in Croatia will be further elaborated, and criteria for establishing citizens who are at risk of energy poverty and require help with energy renovation will be expanded. A broad discussion among stakeholders on energy poverty criteria has already started through the 'Open partner dialogue' initiative, with its second working meeting focusing on energy poverty.

Note: It can be assumed that Croatia will use the energy poverty indicators based on the Commission Recommendation (EU) 2020/1563 on energy poverty.

CZECH REPUBLIC

Increasing the renovation rate

In the Long-term renovation strategy, the renovation rate in the Czech Republic in period 2014–2018 was calculated to 1.40% for family houses, 0.79% for apartment buildings and 1.40% for public and commercial buildings. It can be assumed that this rate will be kept also in the following years.

Within the Long-term renovation strategy, three basic renovation scenarios are defined – basic (business as usual), optimal (with additional measures beyond the current policies) and hypothetical (ideal scenario based on rapid and thorough renovations of the building stock).

The Czech Republic expects developments in the area of building renovation according to the 'Optimal Scenario', which consists of a renovation rate 1.40% for family houses, 0.79% for apartment buildings and 2.00% for public and commercial buildings. In the optimal scenario, there is a greater emphasis on the quality of renovation. Under this scenario, by the 2025 and onward, 40% of all the renovated buildings should undergo a thorough depth of renovation, 40% moderate renovation and rest 20% shallow renovation (Ministry of Industry and Trade, 2020b).

Integrated policy solutions for energy poverty

The definition of energy poverty is yet to be laid down in the Czech legislation (Czech Republic, 2019b)(Prague University of Economics and Business, 2021a).

In 2015 a working group to deal with energy poverty within the National Action Plan for Smart Grids was set up. Factors for identifying 'energy poverty' in the Czech Republic were defined. To better understand links between these factors and assessing the impacts of their combinations on households, an energy poverty project was awarded in a public tender. The output of the project is to set up a certified methodology for evaluating energy poverty and vulnerable customer in the Czech Republic and to propose measures to prevent and address these phenomena. Project outputs were completed in March 2021 and forms the basis for further solutions to energy poverty in the Czech Republic.

The Czech Republic does not currently have policies or measures specifically aimed at reducing energy poverty. This issue is primarily addressed by social policies or, where applicable, partially by consumer protection policies. However, the Czech Republic addresses this issue also with regard to the approved European legislation (Czech Republic, 2019b).

Long-running energy efficiency programmes until 2020 were generally targeted at all households instead of specific vulnerable households (EU Energy Poverty Observatory, 2020). Nevertheless, with regard to vulnerable customers, some energy efficiency subsidy programmes for period 2021–2027 already introduce benefits for low-income households (e.g. Boiler replacement programme offers reimburses of 95% of the eligible costs to low-income households instead of common 50%).

Aside from grant programmes, energy poverty in the Czech Republic is primarily addressed through social policies. The Living Allowance provides financial assistance to low-income households to cover their living expenses. The Housing Allowance and the Housing Supplement provide (additional) financial assistance to low-income households to cover their housing expenses, including energy and heating costs (EU Energy Poverty Observatory, 2020). However, above mentioned policy tools are more of an (long-term) instruments of national social policy than an instruments primarily designed to tackling energy poverty, although these issues are closely linked.

In 2021, a new Czech Republic Housing Policy was published. The Housing Policy newly identifies the improvement in energy performance of housing as a topic related to tackling energy poverty and quality of living (Ministry of Regional Development CZ, 2021).

Energy poverty indicators

Energy poverty indicators according to the Commission Recommendation (EU) 2020/1563 on energy poverty are used within the study “Vulnerable customer and energy poverty in the Czech Republic (project of the Technology Agency of the Czech Republic no. TK01010194) (Prague University of Economics and Business, 2021a). One of the outputs of this study is the methodology, which defines the terms energy poverty and vulnerable customers and proposes methods of measuring energy poverty and policies suitable for its elimination (Prague University of Economics and Business, 2021b). The study forms the basis for further solutions to energy poverty in the Czech Republic.

GERMANY

Increasing the renovation rate

The German Energy Efficiency Strategy for Buildings includes two target scenario – “renewable energies” scenario and “energy efficiency” scenario. In the “renewable energies” target scenario, the renovation rate increases more rapidly and will be around 1.3% to 1.5% for single and two-family houses from 2030 onwards. The annual renovations increase to around 55 million m^2 of living floor area each year. The renovation efficiency (full renovation equivalent) increases to medium efficiency of around 30% to almost 50%. In the “energy efficiency” target scenario, the renovation rate doubles to around two percent and annually refurbished living floor area increases from 45 million m^2 to over 80 million m^2. The renovation efficiency (full renovation equivalent) increases to medium efficiency of around 50% to almost 70% (Federal Ministry for Economic Affairs and Energy, 2015).

Taking into account that the current average annual renovation rate for old buildings is around 1.6% (see above) the “energy efficiency” scenario can be easily achieved till 2030.

Necessary energy supply for vulnerable customers

In its first draft report of the integrated National Energy and Climate Plan as a part of the EU Governance Regulation from January 2019, the Federal Government emphasizes that it is important for Germany that energy remains affordable even in the course of the energy transition. However, it notes, that the term energy poverty is not used as a stand-alone term. Rather, the Federal Government is pursuing a comprehensive approach to poverty reduction in social law that does not focus on individual elements of household needs. If financial support is required to secure a livelihood, benefits from the minimum income system according to the Social Security Code are granted. This includes the so-called regular needs, which also covers, for example, the general costs for household electricity. Expenses for heating energy are taken into account in the requirements for accommodation and heating in the amount of the appropriate actual expenses (Bundesverband Neue Energiewirtschaft, 2020).

Thus, despite a variety of factors, energy poverty in Germany has become, at the end, purely an income problem. Accordingly, the state social security system should ensure that households can also pay their electricity bills and cover their heating demands. The unequal treatment of electricity and heat in the security system must be abolished.

System of a readiness indicator for smart solutions

The definition of the Smart Readiness indicator and the determination of a method for its calculation will be carried out by the Commission. In addition, the Commission will set a schedule for a non-binding test phase at national level and should clarify the supplementary role of the system in relation to the energy certificates. Essential elements of the amending directive will be implemented in German law most probably within the Building Energy Act (GEG).

HUNGARY

System of a readiness indicator for smart solutions

Hungary is preparing the integration of standards related to the smart technologies, which is planned from 2023. Hungary shall launch the development of a new standards related to smart technologies and its integration into the domestic legal requirements. As a first step, the relevant international standards will be mapped, a situation analysis will be carried out, resulting in a list of standards proposed for implementation in the domestic legal order and, if necessary, a proposal for the development of new standards (Ministry of Innovation and Technology, 2021). Hungary also plans to enforce “Policy support for the development of demand-side regulation for utilities using smart meters” and “Obligation to install smart meters” in 2022–2023.

There is no information available on the implementation of a system for a readiness indicators for smart solutions, however, it can be expected this will be incorporated within the forthcoming national standards.

Integrated policy solutions for energy poverty

National Energy and Climate plan presents, that the programme to improve conditions for vulnerable customers along with other actions are in preparation (Ministry of Innovation and Technology, 2020b).

ROMANIA

Increasing the renovation rate

The Long-term renovation strategy discusses current state (renovation rate 0.5%) a three possible scenarios to increase renovation rate in order to have entire building stock renovated by 2050.

Considering the renovation pace, the useful floor area of renovated buildings, the number of beneficiaries, the model-based energy savings estimates, CO_2 emission reductions and impact on the building sector, Scenario 2 appears to be the most appropriate for the LTRS and is therefore recommended. This equates to an investment need estimate of approximately EUR 12.8 billion between 2020 and 2030, to be provided from both private and public funds.

Renovation rate of Scenario 2 for period of 2021–2030 is to gradually increase from 0.69% in 2021 to 3.39% in 2030 (further increase in the period) with approximately 18.77% of building stock renovated by 2030. This is in compliance with Renovation Wave requirements (see [4]).

Integrated policy solutions for energy poverty

Long-term renovation strategy presents actions needed to tackle energy poverty and vulnerable groups. The description is a bit general, but later in document, within legal implications, specific actions (Updating energy poverty legislation and Developing and approving the action plan on energy poverty) are presented.

SLOVAKIA

Increasing the renovation rate

According to long-term renovation strategy, the renovation rate of residential buildings in Slovakia is about 2% per year for single-family houses and 3% per year in the case of multi apartment houses. Renovation rate for non-residential buildings is lower due to the lack of system support in the past.

The Updated strategy for the stock of residential and non-residential buildings from 2017 suggests that, at this pace of renovation, all residential (multi-apartment) buildings where renovation is possible will be renovated in Slovakia as early as 2030. However, renovations will still need to be carried out after 2030 for buildings renovated a longer time ago and also due to stricter changes in energy performance requirements for buildings after 2020. In case of family-houses, renovations should be completed by 2040 (Ministry of Transport and Construction of the Slovak Republic, 2020).

Integrated policy solutions for energy poverty

The Slovak Republic has adopted national programmes and strategies that are secondarily aimed at addressing the problems of energy poverty. At its meeting on 8 March 2016, the Regulatory Council adopted a regulatory policy for the 2017–2021 regulatory period. A major difference from the previous regulatory framework is the emphasis on vulnerable customers in the electricity, gas and heating sectors, and also on the energy poverty issue.

Based on complete analyses and long-term preparation, the Regulatory Office for Network Industries submitted a proposal for a new concept for the protection of customers meeting the conditions of energy poverty for an interdepartmental comments procedure on 26 April 2019. After the evaluation of the comments, the material will be discussed by the Government of the Slovak Republic and all ministries concerned will participate in the implementation of the approved concept. The concept has the ambition to translate the proposed measures into the programme of the Government of the Slovak Republic through the partial policies and programmes of the relevant ministries.

In April 2018, the National Reform Programme of the Slovak Republic 2018 was adopted, describing the structural measures that the Government of the Slovak Republic plans to implement, especially in the next two years. This programme is being implemented and continuously updated with the aim of reducing unemployment, reducing poverty and material need as such, and thus reducing energy poverty (Ministry of Economy of the Slovak Republic, 2019).

System of a readiness indicator for smart solutions

Current Slovakia plans don’t address readiness indicator for smart solutions. Nevertheless, in long-term renovation strategy, Slovakia states that the use of smart technologies can be a cost-effective instrument to help in increasing healthier and more comfortable building with lower energy consumption and emissions. Renovation support schemes for period 2021 to 2027 are planned to include smart solutions Ministry of Transport and Construction of the Slovak Republic, 2020). Slovakia also focus on smart metering and there are also some ongoing or planned smart grid pilot projects like ACON smart grid project or Danube InGrid smart grid project, which is to increase the integration of renewable energy sources into the grid through the use of intelligent technologies at transmission and distribution level (Ministry of Economy of the Slovak Republic, 2019).

SLOVENIA

Increasing the renovation rate

Long-term renovation strategy presents rather ambitious scenario with renovation rates from 3% to 5% based on the category of buildings (residential, public, private public, governmental), for details see chapter 8.

Integrated policy solutions for energy poverty

On the basis of international comparisons, the NECPs conclude that energy poverty in Slovenia is not significant, but that the transition to a low-carbon economy must be accompanied by measures to prevent the most vulnerable sections of the population from being affected by the planned measures (Government of the Republic of Slovenia, 2021). Specific measures to tackle the energy poverty/vulnerable groups of population are presented.

System of a readiness indicator for smart solutions

In Slovenia´s strategy documents do not contain implementation of system of a readiness indicator for smart solutions, however Slovenia address advanced technologies along with smart solutions for interconnection of buildings.

BOSNIA AND HERZEGOVINA

Rate, depth or quality of renovations are not clearly presented within the Long-term national strategy to 2050. The long-term strategy for the renovation of the BiH building stock covers the period up to 2050. For commercial sector buildings, the adoption of a new program based on co-financing and / or finding solutions for poor households is envisaged. Programs, which are based on financial incentives, the implementation of a comprehensive program for the promotion of nZEB construction and renovation standards is also planned.

MOLDOVA

No official data are available on actual renovation rate and depth in Moldova. National energy targets have been set for 2011–2020 in the field of energy efficiency, a target of a 10% share of renovated public buildings has been set in 2020. The energy strategy does not specify precise targets for building renovation.

MONTENEGRO

No data are available to accurately determine the building renovation plan in Montenegro. The Energy Efficiency Action Plan for 2016–2018 aimed to renovate 1% of the buildings. The new action plans do not specify the exact values that should be achieved in the area of building renovation.

SERBIA

Integrated policy solutions for energy poverty

Several steps have been done in Serbia to tackle energy poverty. In 2013, Serbia adopted a decree on energy protected consumers, i.e. vulnerable consumers of thermal energy. The document defines vulnerable consumers and criteria, terms, conditions and procedures for determining vulnerable consumers, as well as the monthly deduction of their electricity, gas and heating bills. Vulnerable households are supported with a non-tariff based mechanism in the form of social allowances from state budget, according to their monthly income and household size. The Decree foresees eligibility for deductions of either electricity, gas or heating bills but not cumulatively (Ministry of Energy, Development and Environmental Protection of Republic of Serbia, 2013). Energy vulnerable consumers can receive discounts from the electricity power company under the condition that the bill payment is accurate (35% discount to consumers with consumption under 350 kWh/month), but there are no discounts provided to gas consumers; for district heating the discount is provided only in some municipalities.

The Poverty Reduction Strategy mentions the need to grant subsidies to the poor households in light of energy price increases (Government of the Republic of Serbia, 2003). In the attachment to the Strategy, the link between energy poverty and energy efficiency is mentioned, as well as the need for subsidies, direct assistance, awareness raising, building construction standards and micro-credits for energy efficiency investments.

The National Report on Social Inclusion mentions the establishment of mechanisms for small loans as important to improve housing conditions and reduce costs. Energy efficiency role in reducing housing costs of the poor households is acknowledged (Government of the Republic of Serbia, 2018).

UKRAINE

Necessary supply for vulnerable and energy poor customers

From the legal framework point of view, the term "energy poverty" is not officially defined in Ukraine, but certain aspects of reducing energy poverty have been identified. In particular, the term "vulnerable consumers" is determined, their rights and the order of protection are defined (Laws of Ukraine on the electricity market, 2017, and on the natural gas market, 2015), as well as the criterion by which the need for social security is assessed. The current legislation of Ukraine ensures the rights and procedure for protection of vulnerable consumers of energy resources, as well as the criterion for assessing the need for social security - subsidies for housing and communal services are provided to the population in case the housing expenditures exceed the basic rate of 15% of wage (Zavgorodnyaya, C.P., 2017).

9.2 COMPLIANCE WITH THE LONG-TERM RENOVATION STRATEGY

Based on the Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency each long-term renovation strategy shall be submitted in accordance with the applicable planning and reporting obligations and shall encompass:

1. An overview of the national building stock, based, as appropriate, on statistical sampling and expected share of renovated buildings in 2020 (Article 2a(1)(a) of the EPBD);
2. The identification of cost-effective approaches to renovation relevant to the building type and climatic zone, considering potential relevant trigger points, where applicable, in the life-cycle of the building (Article 2a(1)(b) of the EPBD);
3. Policies and actions to stimulate cost-effective deep renovation of buildings, including staged deep renovation, and to support targeted cost-effective measures and renovation for example by introducing an optional scheme for building renovation passports (Article 2a(1)(c) of the EPBD);
4. An overview of policies and actions to target the worst performing segments of the national building stock, split-incentive dilemmas and market failures, and an outline of relevant national actions that contribute to the alleviation of energy poverty (Article 2a(1)(d) of the EPBD);
5. Policies and actions to target all public buildings (Article 2a(1)(e) of the EPBD);

6. An overview of national initiatives to promote smart technologies and well-connected buildings and communities, as well as skills and education in the construction and energy efficiency sectors (Article 2a(1)(f) of the EPBD);
7. An evidence-based estimate of expected energy savings and wider benefits, such as those related to health, safety and air quality (Article 2a(1)(g) of the EPBD);
8. A roadmap with measures and domestically established measurable progress indicators, with a view to the long-term 2050 goal of reducing greenhouse gas emissions in the Union by 80-95 % compared to 1990. The roadmap shall include indicative milestones for 2030, 2040 and 2050, and specify how they contribute to achieving the Union's energy efficiency targets in accordance with Directive 2012/27/EU (Article 2a(2) of the EPBD);
9. To support the mobilisation of investments into the renovation needed to achieve the goals referred to in paragraph 1 (points 1 to 7 above), Member States shall facilitate access to appropriate mechanisms(Article 2a(3) of the EPBD);
    a. The aggregation of projects, including by investment platforms or groups, and by consortia of small and medium-sized enterprises, to enable investor access as well as packaged solutions for potential clients;
    b. The reduction of the perceived risk of energy efficiency operations for investors and the private sector;
    c. The use of public funding to leverage additional private-sector investment or address specific market failures;
    d. Guiding investments into an energy efficient public building stock, in line with Eurostat guidance; and
    e. Accessible and transparent advisory tools, such as one-stop-shops for consumers and energy advisory services, on relevant energy efficiency renovations and financing instruments.
10. Each Member State shall annex the details of the implementation of its most recent long-term renovation strategy to its long-term renovation strategy, including on the planned policies and actions (Article 2a(6) of the EPBD);
11. To support the development of its long-term renovation strategy, each Member State shall carry out a public consultation on its long-term renovation strategy prior to submitting it to the Commission. Each Member State shall annex a summary of the results of its public consultation to its long-term renovation strategy (Article 2a(5) of the EPBD).

Table 111: Long-term renovation strategy compliance assessment table

Country / criteria	1.	2.	3.	4.	5.	6.	7.	8.	9.	10	11
Austria	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bulgaria	✓*	✓	P*	P*	P*	P*	✓	✓	X*	✓	✓
Croatia	✓	✓	✓	✓*	✓	✓	✓	✓	✓*	✓*	✓
Czech Republic	✓	P*	P*	X	✓	✓*	P*	✓	✓*	✓	X
Germany	✓	✓*	✓*	✓	✓	✓	✓*	✓	✓	✓	✓

Hungary	✓	✓	✓	✓	✓	✓	✓	✓*	✓	✓	P*
Romania	✓	✓	✓	✓	✓	✓*	P*	✓	✓*	P*	✓*
Slovakia	✓*	✓	P*	✓	✓*	P*	✓	✓	✓	✓	✓
Slovenia	✓	✓	✓	✓	✓	✓	✓	✓*	✓*	✓	X
Bosnia and Hercegovina	X	X	X	X	X	X	X	X	X	X	X
Moldova	X	X	X	X	X	X	X	X	X	X	X
Montenegro	X	X	X	X	X	X	X	X	X	X	X
Serbia	✓*	✓*	X	X	✓*	X	✓*	X *	X	X	X
Ukraine	✓	✓	X	X	X	X	✓	X *	X	X	X

Note: P – partially covered, * – Further details below, X – not implemented/included or information/evidence not found

BULGARIA

1. Without clear expected share of renovated buildings in 2020.

3. Only a general description, no specific measures are given.

4. Only a general description, not specific enough.

5. Only a general description. The measure relies on the ESCO market. An online platform or aggregator for clustering and grouping projects will be created to boost uptake on the part of ESCOs.

6. A general description consisting of amendments to legislation and developing concepts, but a more detailed description or specific measures are missing.

9. Chapter on the issue is not presented. The issue is addressed partly in other chapters, however, it is difficult to assess whether everything required is resolved or whether it is addressed at a sufficient level of detail.

CROATIA

4. On 14 May 2020, the Government adopted a Decision amending the Energy renovation programme for family houses. On 25 June 2020, based on the amendments to the Programme, the Environmental Protection and Energy Efficiency Fund issued a first ever public call in Croatia which included subsidies for the energy renovation of houses for citizens in danger of energy poverty, with a full funding rate (100%) covering the cost of the integrated energy renovation.

9. Point e) was presented very generally, it should be further elaborated.

10. Annex not included, but main policy instruments were described within the text.

CZECH REPUBLIC

The long-term renovation strategy of the Czech Republic generally analyses well the condition of the building stock, possible development of energy intensity and possible renovation scenarios. The document follows a logical line in the analysis, proposals and conclusions following the selected renovation scenario. However, the structure of the document does not fully meet the requirement of the Directive 2018/844 in terms of topics addressed. Some topics would need more detailed elaboration. Most of them would need to be better consolidated as they are discussed in several places in the document and therefore they are more difficult to understand correctly and comprehensively.

2. Two standards were defined as cost-effective standards for the renovation of buildings. These are used for determining energy savings for modelling building renovation scenarios. However, cost-effective standards are described only in general, details are not provided. Potential trigger point within the life-cycle of the building was not addressed.

3. Overview of programmes to support the renovation of buildings available in the Czech Republic as of 2020 is provided. These are very well described. However, measures to stimulate cost-effective deep renovation of buildings, including staged deep renovation, and to support targeted cost-effective measures and renovation for example by introducing an optional scheme for building renovation are not addressed or are described very briefly.

Given the partly untapped potential of programs described, the market survey was conducted with aim to identify market barriers to implement a higher rate of renovation and to determine the real rate of renovations in the Czech Republic. In particular the survey also provides a basis for more effective policy settings to increase the number of renovations and the quality of their implementation in period after 2020.

Based on the identified barriers (e. g. high administrative burden associated with processing the subsidy or lower subsidy that do not motivate for more thorough renovation or insufficient overall awareness and motivation for energy savings), the necessary measures are generally discussed, but they are not addressed in detail.

Based on the above, it is considered that the topic should be elaborate in higher detail.

6. Initiatives to promote smart technologies are described, examples of specific projects are provided. Topic of communities is not addressed. Topic of skills and education is well described, however, it focuses only on energy specialists, authorized persons (certified civil engineer) and technologist for renewable energy sources. The topic of improving the education and skills of construction workers is missing.

7. Long-term renovation strategy states that when improving energy performance of buildings, it is important to implement solutions that ensures both the improvement of energy performance and the quality of indoor environment in order to be optimal for life and work. Renovation of buildings then have a positive impact on the increase of buildings with quality indoor environment, which is in compliance with legal requirements. Examples of projects dealing with the quality of the indoor environment are given. However, other benefits are not discussed in the text.

9. The topic does not follow the proposed structure, point e) is not addressed. However, the topic of mobilisation of investments into the renovation is overall discussed in detail within the document.

GERMANY

2. Energy efficient renovation as a return model is presented in the national Energy Efficiency Strategy for Buildings (Federal Ministry for Economic Affairs and Energy, 2015). In 2008, the cost of accommodation and heating/hot water equalled almost 230 billion euros. The energy efficient refurbishment, that is implemented in the “energy efficiency” target scenario, to be carried out by 2050, results, by expectation of a return of seven percent, to an increase in accommodation costs of almost 43 billion Euro per year. As there are energy cost savings of almost 19 billion Euro per year, in total, the housing costs will increase by around 24 billion Euro. If the housing costs are related to the living space, housing costs increase, under the assumptions made, is relatively moderate in all scenarios. The savings in all cases exceed the accommodation costs resulting from the rent increase after renovation.

3. In the national Strategy there is a detailed description of existing and new measures and options to increase energy efficiency of existing building stock, including legislative requirements, financial tools, knowledge dissemination, and professional consulting.

7. Two exemplary target scenarios were developed for the Strategy – “energy efficiency” and “renewable energies”, each running through the possible target paths. These two target scenarios open up a corridor that is determined through a different weighting of the factors energy efficiency and renewable energies. In total, this results in a target corridor of -36% to -54% of energy savings (energy efficiency) and an increase of renewable energy share to 57% up to 69% in final energy consumption by 2050.

8. The results of the forecast for both national target scenarios show that the building sector can make a contribution to reduction of greenhouse gases by at least 80 percent compared to. In relation to the Kyoto base year 1990 the contribution can be even over 80 percent (advance in the building stock from 1990 to 2008). This is mainly due to the extensive renovation measures in the building stock after reunification in the “new” federal states.

HUNGARY

8. The topic needs further elaboration or consolidation. Indicative milestones for 2030, 2040 and 2050 are provided, but it isn’t specified how they contribute to achieving the Union’s energy efficiency targets in accordance with Directive 2012/27/EU. Also the roadmap is missing. Specific measures and domestically established measurable progress indicators are incorporated in other chapters.

11. There is brief information about one consultation that took place in 2020, but no other details are provided.

ROMANIA

6. The topic of smart metering and smart systems is a bit scattered in various chapters and is addressed in general. In table 13 within chapter XI Legal implication presents “Ensuring the regulatory framework for the use of smart technology” as one of the secondary legislative requirements to be improved. The topic of skills and education in the construction and energy efficiency sectors is addressed in more

detail, specific programmes and initiatives are presented. The topic discussing Article 2a(1)(f) of the EPBD could be more consolidated.

7. The individual parts are discussed in various chapters of the Long term renovation strategy document. It would be appropriate to consolidate these parts.

Potential health benefits for Scenario 2 (see chapter 9) is on pages 68–69, for air quality indirectly by CO_2 reduction on page 68, for safety on page 48, overall benefits on page 77.

9. The topic does not follow the proposed structure, point e) is not addressed. However, the topic of mobilisation of investments into the renovation is overall discussed in detail within the document.

10. Topic is discussed very briefly. Table 13 presents legal implications/ main changes to the regulatory framework underpinning the implementation of the key measures proposed in the long term renovation strategy. However, additional details are missing.

11. In addition, Romania presents communication framework and plan with main actions for implementing its Long-term renovation strategy.

SLOVAKIA

1. The housing stock is well described, however, current data are missing, especially after 2011. It would be appropriate to focus on the analysis of the current situation, which would help to better understand the development of housing stock trends in latest years.

3. Description of policies and actions is general and a bit scattered. The Long-term renovation strategy, in the relevant chapter refers mainly to laws (without much detail) and technical standards, but does not mention (or mentions very briefly) other measures of a non-legislative nature. These are more described in later chapters, but still not in detail.

5. Brief description, but gives examples of specific measures and policies.

6. The topic of smart technologies is very general. It refers to two policies. First one is a law, under which the buildings' owners and designers are obliged to use smart technologies. The second one is the Construction Code, under which the designer is obliged to design new buildings and major renovations of existing buildings using automated control, regulating and monitoring systems within technical, functional and economic conditions of the building. No specific details (including which law) are provided.

The topic of skills and education in the construction and energy efficiency sectors is addressed in higher detail; specific programmes and initiatives are presented and well described.

SLOVENIA

8. The topic is not addressed in its own specifically dedicated chapter, but is discussed within various chapters through the document. Renovation analyses and proposed solutions for individual types of buildings (residential, public, etc.) contain indicators and targets for 2050.

9. The topic does not follow the proposed structure, not all points are addressed. However, the topic of mobilisation of investments into the renovation is overall discussed in detail within the document.

BOSNIA AND HERCEGOVINA

Long-term building renovation strategies have been drafted on state and entity levels, but not adopted. The necessary amendments to primary legislation have only been adopted in Republika Srpska. Both entities are currently working on updating existing legislation, including procedures for systems and certification of buildings (Energy Community.org, 2021a).

The utmost priority remains the adoption of the National Energy Efficiency Action Plan (NEEAP) and transposition of the Energy Efficiency Directive and the Energy Labelling Regulation through amendments of the existing primary legislation in the two entities, and the adoption of the draft Energy Efficiency Law in the Brčko District. The second priority remains the adoption of the draft long-term building renovation strategies and the secondary legislation on establishing an energy efficiency obligation scheme and a comprehensive energy management and information system, as well as adoption of the assessment of the potential for the application of high-efficiency cogeneration and efficient district heating. Energy efficiency criteria should be introduced in State public procurement procedures and public private partnership schemes made attractive for energy efficiency projects (Energy Community.org, 2021a).

MOLDOVA

Moldova has made significant progress in implementing European directives. There are proposed several missing regulations on energy efficiency. Moldova's main priorities are:

- Full implementation of the Energy Efficiency Act to bring the country fully in line with the new Directive 2012/27/EU by adopting statutes on mandatory energy audits for large companies and a long-term building renovation strategy, both have already been proposed.
- Achieve full compliance of the Energy Performance of Buildings Act with Directive 2010/31/EU by introducing a building certification system, including a calculation tool for energy performance certificates for buildings. The relevant by-law has already been drafted. (Energy Community.org, 2021b).

The rule of introducing nearly zero-energy buildings is applicable as of 2018. Since the newly-built public spaces make up only 0.05% of all constructions put into operation annually (2000-2010), the impact for 2018-2020 is negligible. The ratio of public buildings undergoing major renovation and falling under the incidence of this provision is to be set forth by the next NEEAP. Other buildings should comply with this provision as of 2020 (NEEAP, 2013).

In fifth Annual Report from June 2021, Moldova indicated that activities could be reported during the last 12 months, including a drafting of the Long-term strategy for mobilizing investment in the renovation of the building national stock, the promotion of the strategy is expected after the conclusion of the energy modelling exercise carried out in the context of drafting the Integrated National Energy and Climate Action Plan (Energy Community.org, 2021c).

The Ministry of Economy has elaborated the First Programme for renovation of the central government owned and occupied buildings for 2020–2022, which was approved by the Government Decision 372/2020 and corresponds to the first option provided by the EED. Currently, the central government buildings stock inventory contains 215 records (buildings) with total declared useful floor area of the building stock in the amount of 426,056 m^2. The “First programme for renovation of the central government owned and occupied buildings for 2020–2022" targets two priority buildings with total useful area of 10,086 m^2 which will result in fulfilling the one percent yearly obligation of Article 5 of the EED and Article 14 in new EE Law of Moldova. The total investments for the First programme is evaluated in the amount of 37,950,857 million MDL (about 1.2M EUR) (Energy Community.org, 2021c).

MONTENEGRO

The update document of the Montenegro Energy Efficiency Action Plan for 2019–2021 states that the biggest issue in the preparation of the building renovation strategy is in apartment buildings, because the lack of quality data can significantly affect the choice of cost-optimal option.

The Ministry of Economy provided support to the Government of the Republic of Germany, through KfW Bank, for the development of software for energy certification of buildings, as well as inventory of buildings in Montenegro in order to provide conditions for determining energy classes.

The implementation of these activities will create a strong basis for the preparation of a strategy for the renovation of buildings, which is planned in Montenegro through the development of a dedicated study to improve the energy efficiency of buildings in Montenegro.

Transposition of the Article 5 (Renovation of public buildings) is completed - On the basis of the Law on Efficient use of Energy (Article 8) Government of Montenegro has adopted:

- Decree on reconstruction of administrative buildings ("Official Gazette of Montenegro", 09/16);
- Plan for reconstruction of central government administrative buildings for 2017–2019 (expired);
- Plan for the reconstruction of central government administrative buildings for 2020–2022 (adopted in December 2019);
- Funds for the reconstruction of the buildings defined in the Plan was provided under Energy Efficiency Program in Public Buildings, which is being implemented based on a loan from the KfW bank.

Implementation of the Plan for reconstruction of administrative buildings is ongoing with certain delay related to completion of works on selected buildings. The total useful floor area of the buildings whose reconstruction is envisaged by the Plan is 13,365 m^2, which represents approximately 18.5% of the total floor area of all central government administrative buildings (Ministry of Capital Investments, 2021).

Building renovation strategy:

- Transposition: Preparation of a dedicated Study on improvement of the energy efficiency of buildings in Montenegro is recognized by the LoEUE – aligned with EED;
- Implementation: Development of the Study will be supported under KfW TA. So far several activities were conducted:
    - Development of the building inventory is finalized;
    - Cost optimal calculation is ongoing – preliminary results are delivered, revision is required by the Ministry;

- Upon completion of the cost-optimal levels estimation of the national energy saving potential in buildings and proposal of concrete measures/actions will be done with estimation of investment costs (MoCI, 2021).

SERBIA

The Long term Renovation Strategy has not been adopted in Serbia yet. The finalization of the document is expected in 2021. This Strategy analysed five possible scenarios for renovation of national building stock (base case Scenario 1 which represent the current situation, and four improved scenarios).

1. Without indication of the expected share of renovated buildings.

2. The cost effective approaches to renovation of residential building stock in Serbia were identified in the study. The typology of the residential building stock in Serbia and modelling of its low-carbon transformation (Regional Environmental Center, 2015) within the Support for low-emission development in South Eastern Europe.

5. Several actions were focused on renovation of public buildings in Serbia. For example, Serbian-German development cooperation Project „Energy efficiency in public buildings" implemented by GIZ. The Ministry of Mining and Energy of Serbia signed in 2021 an agreement with United Nations Development Program (UNDP) to provide technical assistance for an energy efficiency project for central government buildings, which is to provide for the renovation of 28 buildings. Government of Republic of Serbia has adopted decision 05 no. 337-6889/2018 on August 9, 2018 where default approach is chosen for the implementation of Art. 5 of EED, i.e. to rehabilitate annually 1% of the total floor area of heated and/or cooled buildings owned and occupied by central government.

7. Fulfilment of national energy efficiency targets is reported annually by Serbian Ministry of Mining and Energy.

8. In the Intended Nationally Determined Contribution, Serbia pledged to reduce its GHG emissions by 9.8% by 2030 compared to 1990 base year emissions.

UKRAINE

8. In 2019, Ukraine's GHG emissions were 62% lower than 1990 levels. In August 2021, Ukraine updated its First Nationally Determined Contribution (NDC), committing to cut its GHG emissions by 65% by 2030 compared to 1990 levels and to reach carbon neutrality by 2060. In 2016, in the previous version of its NDC, the country pledged to limit its GHG emissions to 60% of 1990 levels (enerdata.net, 2021).

10. IDENTIFIED BARRIERS AND MATRIX OF MEASURES

10.1 IDENTIFIED BARRIERS TO COMPLYING WITH THE REQUIREMENTS OF EU LEGISLATION

Within the analysis of core strategic documents (National energy and climate plans and Long-term renovation strategies) in the states of the Danube Region, attention was paid to the identified barriers in the implementation of EU legislation.

The results are described generally for all countries, as only few countries directly mentioned specific barriers. Most of the others did not pay much attention to them or described them just in general terms along with possible solutions. Nevertheless, categories of barriers are similar in general in all the countries – these are: **financial**, **legal**, **social** and **information barriers**.

Barriers in complying with the EU legislation requirements emerges both at the national level (laws) and at the specific local level (region, market segment, certain sector of the economy). For example, in case of building renovations, the renovation rate is a "theoretical" concept at the legislative level, a percentage point, but also a "practical" amount of activity and concrete projects at the level of implementation and the involvement of people and stakeholders.

It is also common that barriers usually occur only in some areas depending on whether the specific issue (e.g. improvements in building renovations) has already been introduced/addressed in the country or not, or on the implementation level.

Basic non exhaustive list of barriers' categories and examples of specific obstacles (related primarily to buildings) follows.

(Note that some of the presented barriers can fall under more categories.)

FINANCIAL BARRIERS

- Financial complexity of the introduction or implementation of certain measures;
- Insufficient public funds or high public debt (in case of the introduction of specific measures, such as the renovation of buildings);
- Insufficient funds to implement financial measures;
- The need for financial support from the EU and related conditions for drawing funds and their utilization (e.g. from the European structural and investment funds);
- Insufficient incentive systems (e.g. for the introduction of energy-saving technologies such as low-emission or electric vehicles or for deep renovation of buildings) and limited access to affordable sources of financing;
- High intensity of grant assistance (100 %) can create unrealistic expectations and acts as a barrier to the development and implementation of market mechanisms;
- Low creditworthiness or borrowing capacity of the building owners (due to lack of assets that can be used as collateral or income differences) is a barrier to the market funding of the renovation of buildings;

- High administrative burden, transaction costs and demanding conditions of subsidies/grants or financial incentives;
- Lack of guarantees or over-guaranteeing, high commercial interest rates;
- High initial costs of the energy-saving renovation of buildings (primarily for deep renovation) or energy saving measures also in other sectors;
- Long return-on-investments period of some energy saving measures ;
- Investment and cost barriers (e.g. for new and innovative solutions), reduction of organizational barriers (e.g. liabilities for renovation loans for vulnerable persons / households in energy poverty);
- Lack of an appropriate budget, procurement and budget law, lack of responsibility for or access to the properties in public sector.

LEGAL BARRIERS

- Gap between the national legislation and EU legislation requiring major changes in national regulations causes delays in the amendment / transposition of the legislation;
- Differences between individual national regulations, even if they comply with the EU law;
- Existing differences in national legislation resulting from different approaches taken to transposing EU legislation into national law;
- Insufficient use of all EU support mechanisms;
- Bureaucracy, high administrative burden or complicated procedures hinders the transposition of EU legislature (and also practically e.g. transformation of the energy system);
- Lack of clear definitions in regulatory framework or absence of regulatory framework and the complex administrative formalities;
- Higher requirements arising from European legislation (e.g. harmonization of the technical standards for energy performance of buildings or harmonization of laws) require adjusting relevant regulations at the national level. These can be intertwined with multiple other regulations, which can necessitate subsequent adjustments. This can result in delays;
- Transpositions can be difficult in some cases, which increases the risk of their correct and timely implementation;
- Operating exclusions, market entry barriers or obstacles to flexibility (e.g. pooling factor) can hinder the implementation of innovative solutions and practices (e.g. energy performance contracting);
- Cross-sectoral approach, necessary in some cases, is more difficult to process (for example, when several ministries or groups comment on the law);
- Public procurement barriers (low quality, administrative obstacles, lengthy public procurement, lengthy proceedings, etc.);

- Necessary amendments to applicable legislation/regulations can be missing, therefore they need to be developed and also tailored to the national specifics (e.g. for incentives for green mortgages, technical assistance, loans, etc.).

SOCIAL TRENDS

- Unpredictability of the legislation development or market environment, uncertainty surrounding the legislative framework;
- Favouring national interests over regional or European ones;
- Ownership of buildings (e.g. larger number of owners of one real estate – multi-apartment buildings – or mixed ownership of buildings) and related obligations and legislative options (can cause obstacles in decision-making process), tenant-owner dilemma;
- Behavioural barriers and personal attitude, lack of interest, lack of time, fear of stress;
- Country practices, historical background, path dependency;
- Lack of capacity, lack of human resources (availability of skilled labour);
- Stakeholder involvement (e.g. banks, investors, municipalities, etc), low participation in decision-making process.

INFORMATION AND CAPACITY

- Lack of information on available support tools (e.g. EU support tools);
- Insufficient or low (economic) motivation among the involved players, low awareness of the wider benefits or lack of comprehensive information on the specific issue (e.g. energy savings, importance of deeper renovations, climate protection, etc.);
- Lack of access to independent and public information and advice, education, information transparency;
- Insufficient public relations in the renovation and energy efficiency sector in general;
- Barriers to conducting analyses and reporting on the strategy plans and programmes at national and local level arising from insufficient capacity;
- Lack of competence;
- Lack of adequate data and/or understanding of data (e.g. on buildings, building stock, energy use, etc.).

Barriers can be divided according to whether a country is an EU Member State or a non-EU state. For non-EU countries, additional barriers may arise:

- They are not subject to EU legislation, so they do not have to fully comply with EU legislative requirements (e.g. the development of certain strategic documents or compliance with deadlines for transposition of EU legislation to national legislation).

- Long delays in policy implementation following the example of EU as they are not bound by requirements and deadlines typical for EU member states.
- The transposition of legislation and the elaboration of strategic documents are subject to scrutiny by the European Commission in the EU member states. In the case of non-EU member states, the control process may not be performed, so there is no pressure to implement above mentioned activities.
- Many EU membership benefits are unavailable or inaccessible, e.g. financial mechanisms, administrative mechanisms that would motivate or oblige them to adjust their own legislation and strategic plans according to EU requirements.
- Lack of long-term experience with developing of strategic documents and harmonization of legislation, as in the case of the EU MS, which can slow down the implementation process.

Despite the abovementioned extra barriers for non-EU member states, all said countries follows some kind of energy savings and climate protection responding to international developments and trends (e.g. climate protection). They also implement and adopt some elements of EU policies. Compliance with certain requirements also stems from the possibility and requirements of joining the EU (this requires the fulfilment of certain obligations according to Association agreement and Accession negotiations for candidate countries). Trade and visa agreements and economic links are also a strong motivation for improving energy and climate policy. There are also numerous activities designed specifically for neighbouring non-EU states – through various projects, initiatives, commitments, partnerships, agreements or programmes to support developing countries and regions. However, these may not be as effective as if these countries were a direct part of the European Union.

10.2 MATRIX OF MEASURES

Based on the information obtained within the study preparation, a matrix of key measures suitable for implementation in individual countries were identified. The identified measures include:

1. **Increasing the renovation rate according to the Renovation wave requirements**;
2. **Develop plans/framework to tackle energy poverty and address vulnerable customers** – based on the Recital 60 of the Directive (EU) 2019 on common rules for the internal market for electricity;
3. **Implement energy poverty indicators into the national practice** – according to annex in the Commission Recommendation (EU) 2020/1563 on energy poverty;
4. **Introduce the Smart Readiness Indicator for Buildings (optional)**;
5. **Ensuring full and detailed compliance of Long term building renovation strategy with EU requirements –** optional for non-EU countries.

Table 112: Matrix of energy saving measures with regard to building renovation

Country / Type of measure	1.	2.	3.	4.	5.
Austria	●	✓	●	(●)	✓
Bulgaria	●	●	●	✓	●
Croatia	✓	●	●	(●)	✓

Czech Republic	✓	●	✓*	(●)	●
Germany	✓	✓	●	(●)	✓
Hungary	✓	●	●	✓	●
Romania	✓	✓	●	(●)	●
Slovakia	✓	✓	●	(●)	●
Slovenia	✓	✓	●	(●)	●
Bosnia and Hercegovina	●	●	●	(●)	(●)*
Moldova	●	●	●	(●)	(●)*
Montenegro	●	●	●	(●)	(●)*
Serbia	●	●	●	(●)	(●)*
Ukraine	●	●	●	(●)	(●)*

Note: ● – recommendation to more address the topic, (●) – optional recommendation, * - further details below

* Energy poverty indicators according to the Commission Recommendation (EU) 2020/1563 on energy poverty are used within the study "Vulnerable customer and energy poverty" in the Czech Republic (project of the Technology Agency of the Czech Republic no. TK01010194), which form the basis for further work to tackle energy poverty.

*In case of Bosnia and Hercegovina, Moldova, Montenegro, Serbia and Ukraine, it is recommended to elaborate or adapt the Long-term renovation strategies for buildings in accordance with the EU requirements. This would ensure increasing the potential and effectiveness of these strategic documents and improving the overall state (quality and rate) of building renovations.

Apart from measures presented in the section above, it is also appropriate to focus on:

1. **Greater utilization of solar energy** – it is appropriate to maximize the use of photovoltaic power plant and solar thermal potential;
2. **Data on the building stock collected in higher detail** – general data on the number of buildings, households, floor areas, etc. (not only based on the Census);
3. **Heating and cooling data on the building stock** – more detailed data would allow better assessment and design of energy saving measures;
4. **Ensuring the compliance of legislative documents** with EU – timely and thorough transposition of European legislation is essential;
5. **Elaboration of the necessary legislation in the field of energy efficiency** – some countries lack legislation in certain areas (e.g. ESCO market, energy communities, etc.);
6. **Stimulation of energy renovation of buildings** – Building renovations have a significant contribution to energy savings, energy costs savings and reduction of greenhouse gas emissions in the long term. Therefore it is crucial to increase support for building renovations;
7. **Better data monitoring and reporting** – focused mainly on data related to energy renovation of buildings.

There are significant differences in the quality and level of approach between the Danube countries in these areas. However, an appropriate assessment of these areas was found to be difficult and complex to evaluate in a simple form.

11. GOOD PRACTISE EXAMPLES

The chapter deals with the selection of examples of good practice in the Danube region with regard to energy saving measures in residential building stock and the possibility of their implementation in other countries. Additional measures are proposed that could lead to an improvement in the efficiency and could increase the speed of renovation.

11.1 DEFINITION

First it is needed to define "best practices" sometimes also referred to as "good practice", there are several suitable definitions:

"*Good practice means best and verified procedures, descriptions of solved situations, processes or methods (hereinafter "procedures"), by means of which good results have been achieved and can therefore be recommended as suitable and exemplary for use by other potential implementers.*"[5]

In the case of measures to promote energy savings in the building stock, good practices may by represented by programmes that run for a longer period of time and are repeatedly extended, or shorter programmes or services with good results. These may be also programmes or services that are significantly preferred by customers over others. However, most countries tend to avoid overlapping the programmes, especially subsidy schemes, if possible (an exception may be consulting services and financing options, such as various interest-free and low-interest loans). Despite of that, now, with Recovery plans and other post-pandemic recovery strategies launched, there may be some overlaps (for example as in the case of the Czech Republic with several subsidy schemes currently focusing on the same areas).

11.2 METHODOLOGY

Examples of good practice were identified based on an analysis of available data sources, in particular strategic documents (NECP, LTRS). Subsequently, a more detailed information was found on the selected examples. The examples were then assessed to ensure that they comply with the principles of good practice. The following parameters were considered when selecting examples of good practice:

- high impact – compared to other support schemes in the country. Widely used or good results in relation to the objectives;
- good coverage – coverage throughout the country, well accessible to the general public or forms a comprehensive network;
- well established – in operation for a longer period of time (e.g. 10+years), with longer tradition or extended based on previous successes;

[5] Paraphrased on the basis of Rules for identifying good practice in social provision services for PS4 purposes. Available from: http://rpq.mpsv.cz/wp-content/uploads/2021/02/Pravidla_PS4_dobr%C3%A1_praxe_2_21.pdf
Another examples of definitions of good practice (best practice) are available from: https://en.wikipedia.org/w/index.php?title=Best_practice&oldid=1048434080; https://www.ecosave.com.au/news-insights/best-practice-energy-savings-projects-for-councils/ or https://www.etcc-ca.com/sites/default/files/OLD/images/stories/Common_EE_Terms__Definitions.pdf

- comprehensive – well-developed, comprehensive coverage of activities;
- high impact approach – good approach, good solution in the given area, prospect of high impact.

Examples of good practice were identified, mainly in the addressed countries of the European Union. In countries outside the European Union, no specific examples of good practice have been identified. Nevertheless, this does not mean that they do not exist in these countries. In this respect, it is more about the poorer data availability.

In addition, it is a common practise that countries outside of the EU are often inspired by successful EU measures and policies. These countries then introduce good practices used by the EU Member States (usually under various assistance and convergence programmes), but of course with some delay behind the Member States. Some of the solutions adopted in this way are in operation for a short time (compared to EU states), so it is not yet possible to evaluate properly their effect.

11.3 IDENTIFIED EXAMPLES OF GOOD PRACTICE

Within the analysis, from 1 up to 3 good practices focused on energy efficiency were selected for each country. Their summary is presented in the table below, followed by additional information.

Table 113: Good practice overview

Country / Type of measure	Good practice	Reason
Austria	Consultancy services	Good coverage, well-established, good conditions
Bulgaria	The National programme for energy efficiency in multi-apartment buildings	High impact and savings
Croatia	Rules of the owners' collective decision for energy renovations	High impact approach
Czech Republic	New green savings programme	High impact, comprehensive
	ESCO (Energy Service Companies) market	Well-established, increasing market
Germany	Federal Government's CO2 Building Modernisation Programme	High impact, good coverage
	The programme Future for Old Buildings (Zukunft Altbau)	Well-established
	Pilot project "Check your house" in Bavaria	High impact approach
Hungary	Warmth at Home Programme (WAH) 2014–2020	High impact

	Green Capital Requirements for Housing Scheme	High impact approach
Romania	Local energy planning	High impact approach
Slovakia	Green Households project	High impact
Slovenia	ENSVET network (Slovenia's Energy Advisory Network) – under the Eco-Fund	Well-established

Data source: Long-term renovation strategies, National energy and climate plans, other related documents

Austria

Consultancy services

In Austria, each federal state, based on the general requirements of the Federal Government, issues its own requirements and policies for energy saving measures, especially in the case of building renovations. Extensive networks of consultancy service providers and one-stop-shops for energy efficiency play an important role.

Consultancy services are usually provided by commercially licensed consultants, which are sometimes supported with additional training programmes to ensure high-quality of offered services.

Consultancy services are partially or fully subsidized, with possible benefits for vulnerable customers (free of charge consultancy). It is also a common practice, that first consultancy is free of charge.

The energy consultations usually last around 1.5 hours and tend to take place on site. The aim of every consultation is to achieve optimal energy cost savings step by step – identify potential for improvement, evaluate the planning concept and check for energy efficiency options, discuss support options, definition of quality criteria for soliciting quotations, analysis of the energy advantages and disadvantages of different offers (Austrian Institute of Construction Engineering (OIB), 2020). The full list of the consultancy centres in each federal state can be found on the webpage of the Austrian Energy Agency.[6]

The exact scope of the services and amount of the financial support differs among the Austrian federal states according to their energy policy and is always provided only on the territory of the respective federal state. For example, the Burgenland Energy Agency (Burgenländische Energieagentur[7]) provides an initial energy consultancy for private households free of charge with the aim of expanding and promoting energy efficiency funding, as well as energy-efficient projects and strategies in the state. The municipalities and enterprises are also supported in receiving the service of energy efficiency consulting, which is funded by the federal state for the duration of at least one day (or even larger number of days according to the complexity of the energy efficient or climate protection measure) (Forschung Burgenland GmbH, 2020)[8].

[6] More information available from: https://www.energyagency.at/fakten-service/verbraucherinfos/energieberatung.html
[7] More information available from: http://eabgld.at/index.php
[8] More information available from: http://eabgld.at/uploads/tx_mddownloadbox/Beratungsrichtlinie_EUB_2020v7_01.pdf

In the Lower Austria, the first consultation in energy efficiency is free of charge for the citizens of the federal state. A detailed renovation concept, in which the state of the building is assessed and the improvement measures are proposed can be developed for a small fee of 40 EUR[9].

The exact number of households and municipalities that have already received this partially funded service is unfortunately not publicly available.

Bulgaria

The National programme for energy efficiency in multi-apartment buildings

The National programme for energy efficiency in multi-apartment buildings ('the Programme'/NPEEMZhS) focuses on renovating multi-family residential buildings. The main goal of the Programme is to ensure better living conditions for citizens living in multi-apartment residential buildings, higher temperature comfort and higher quality living environment through the implementation of energy efficiency measures.

The programme is a part of the implementation of the National Energy Efficiency Action Plan 2014–2020 of Bulgaria and is one of the numerous measures laid down in the document. The programme is developed as a financial mechanism stimulating energy efficiency improvement measures and corresponds to Alternative Measure 2 of the energy efficiency obligation scheme set up in accordance with the requirements of Article 7 of the Directive 2012/27/EU.

All 265 municipalities in Bulgaria are eligible to participate in the Programme; actions have been implemented in 143 municipalities. Owners' associations registered under the Condominium Ownership Management Act in eligible buildings can receive grants of up to 100%. Taking part in the programme is voluntary for municipalities, the interest in energy efficiency improvement and the ability to co-finance or further develop the renovation measures is supposed to be the main reason of the involvement of municipalities into the programme.

Results achieved by the programme implementation in 2020: 101 renovated multi-apartment buildings put into operation with annual expected energy savings of 53.7 GWh, which makes 7.7% of the national energy savings achieved in 2020 (697.45 GWh). Expected total energy savings of the programme for 2014–2020 to be 975.6 GWh/year (Ministry of Energy of the Republic of Bulgaria, 2021c)[10].

Croatia

Rules of the owners' collective decision for energy renovations

In order to facilitate the renovation of multifamily buildings, Croatia amended the approval requirements to allow a simple majority (51%) of residents to take a decision for the implementation of the renovation measures, whereas previously such decisions needed to be unanimous (BPIE and partners, 2018). This is a significant change in legislation framework because the need for the unanimous consent of all building owners, as well as majority of more than 75% required for decisions

[9] More information available from: https://www.energie-noe.at/persoenliche-beratung
[10] More information available from: https://energy.ec.europa.eu/system/files/2022-01/2020%20Annual%20Progress%20Report%20of%20Bulgaria%20on%20implementation%20of%20NEEAP%202014-2020.pdf

on renovations, is an issue in many countries. As multi-family houses mainly are the unit owner associations, the governance and dynamics of collective decisions are in many cases major barriers to energy renovations. For example, collective decision problems for owner-occupied multi-family buildings were identified as a barrier to investments into renovation in nine EU-countries within the research based on the project ENTRANZE (www.entranze.eu), which has developed policy recommendations for increasing the number of nearly-zero energy renovations. These states include five of the DR countries – Austria, Bulgaria, Czech Republic, Germany, and Romania (Matchoss, K. et al., 2013). The change in the procedure of the decision-making will remove this significant barrier and substantially increase the number of energy renovations implemented in the country.

Czech Republic

New green savings programme

The programme[11] focuses on investment aid for improving energy performance of single-family houses and apartment buildings. Partial and comprehensive renovation of residential buildings are supported. Programme is funded from the revenues from emission trading and offers fixed subsidies depending on the implemented measures.

Specifically, the following measures are supported:

- improving the energy performance of buildings (building envelope, technical equipment);
- reconstruction and replacement of energy production equipment for own consumption;
- reconstruction of electricity, gas and heat distribution;
- construction of buildings in the passive standard;
- implementation of monitoring, automation and energy management features in buildings;
- introduction of elements of adaptation of buildings to climate change (e.g. water savings).

New green savings programme is acknowledged as very successful. The original program began in 2009 and has been extended several times. Within the programme period from 2014 to 2021 more than 77 thousand projects were supported with more than EUR 440 million investments triggered and about 4.4 PJ of new cumulated yearly energy savings achieved (Ministry of Industry and Trade, 2020b) (Ministry of Industry and Trade, 2020c).

ESCO (Energy Service Companies) market

In the case of renovations of public buildings, the ESCO[12] market plays an important role in the Czech Republic. The ESCO market has a long tradition in the Czech Republic – more than 25 years and hundreds of successfully implemented projects with satisfied customers. Accord to the Association of Energy Service Providers (APES) a total of 3 billion CZK (EUR 120 mil.) has been invested, whereby

[11] More information available from:
https://www.sfzp.cz/en/administered-programmes/new-green-savings-programme/
[12] More information available from: https://www.apes.cz/en/index.php

0.8 billion (EUR 32 mil.) has been in the last three years. Currently, these investments have brought 3.5 billion savings (EUR 140 mil.).

The Energy performance contracting (EPC) method is legally defined in the Czech Republic by Act No. 406/2000 Coll. on energy management. Energy performance contracting services are also well recognised by subsidy schemes, which usually offer concessional financing (greater level of funding) for projects applying EPC.

The Energy performance contracting is further supported by the Association of Energy Service Providers (APES) of the Czech Republic, which was established in October 2010 and unites practically all ESCO companies in the Czech Republic. The standardized procedures, exemplary documents, contracts and others are in place. Most of the ESCO companies in the Czech Republic are also signed under the European Code of Conduct for EPC (set of values and principles that are considered essential for the successful implementation of EPC projects).

Germany

There are various support programmes, consulting services and other energy sector-related policies at the national level in Germany. Federal laws set the basic legislative framework for energy efficiency increase, renewable energy usage and requirements on the energy performance of buildings. Additionally to the national level, there is also level of the federal states, which also offer a number of building-specific support programmes, consultancy services and other measures. Each federal state, based on the general requirements of the Federal Government, issues its own requirements and policies for energy saving measures.

Federal Government's CO_2 Building Modernisation Programme

The programme has been in place since 2006 until 2021 and under the guidance of the Credit Institute for Reconstruction (Kreditanstalt für Wiederaufbau – KfW) it includes both systemic and entry-level support (individual measures) for energy-efficient refurbishment of existing residential buildings and construction of energy-efficient new buildings. It consists of the KfW support programmes 'Energy-Efficient Construction' and 'Energy-Efficient Refurbishment' for private individuals, housing companies, housing cooperatives, developers and owners of residential homes. In addition, the 'Energy-Efficient Refurbishment – Monitoring of Construction' programme supports the monitoring of energy-efficient refurbishment measures.

There are also two energy-efficient refurbishment programmes for local municipal buildings and buildings used for social purposes: 'IKK/IKU – Energy-Efficient Urban Regeneration – Energy-Efficient Refurbishment'. The CO_2 building refurbishment programme consequently plays a key role in making homes and buildings more energy-efficient, far beyond the statutory requirements. There has also been an energy efficiency support programme for commercial buildings since 2015.

The investment support programmes mentioned above are therefore targeted at private house/apartment owners and housing owners' associations, housing companies and housing cooperatives, developers and businesses (e.g. in contracting), private and local authority companies, as well as local authorities and non-profit organisations. Support is provided under the programmes through low-interest loans, partly in conjunction with repayment grants or direct grants. Depending on the programme, up to 100% of the investment costs to a maximum of EUR 50 000 (individual measures) or EUR 120 000 (systemic refurbishments) are eligible. The programmes have been allocated with at least EUR 2 billion a year since 2015.

Federal Government's CO_2 Building Modernisation Programme is the most generously funded instrument in the field of energy efficiency in Germany and its all-around scope, which covers practically all areas related to energy performance of buildings, is indisputable. Since 2021, it has been replaced by the Federal Funding for Efficient Buildings (Bundesförderung für effiziente Gebäude, 2020).

The programme Future for Old Buildings (Zukunft Altbau)

Zukunft Altbau[13] is an independent marketing and information programme funded by the Baden-Württemberg Ministry of the Environment. Its goal is to increase number and quality of energy-related renovations in the state. Zukunft Altbau informs and advises owners of residential and non-residential buildings as well as everyone involved in construction and modernization on questions, advantages and effects of energy-related renovation - neutral, holistic and free of charge, since 1999. The platform on its website also offers a number of educational, informative materials and guides for specific energy efficiency measures.

Pilot project "Check your house" in Bavaria

The initiative is aimed to motivate the property owners all over Bavaria to implementation of energy renovation measures. It offers inexpensive energy consultancy in communities[14], by which the owner can find out everything about the energy saving potential of the household and of the building. The possible use of renewable energies is examined by the experts and recommendations are made for reducing the use of electricity and heat, both through investment measures and through economical behaviour of residents.

Hungary

Warmth at Home Programme (WAH) 2014–2020

The programme was launched in 2014, and various funding opportunities were used to improve the energy efficiency of residential buildings and households and to develop renewable energy systems. Programme is funded under the Green Economy Financing System (GEFS), which gets finances from the revenues from emission trading.

Programme ensures non-refundable funding for energy efficiency in the residential sector. It focuses on a wide range of energy saving measures – e.g. heating system modernization, replacement of old household appliances, improvement of thermal technical parameters of building envelopes and complex building modernization.

Total annual end-use energy savings achieved in 2017 was around 0.96 PJ with more than 70,000 tonnes of CO_2 emissions prevented per year and with around EUR 67 million of triggered investments. Expected energy savings for year 2020 are 5.21 PJ. Since the inception of the program until 2019, more than 310,000 families have received support from the programme.

[13] More information available from: https://www.zukunftaltbau.de/
[14] More information available from: https://www.kempten.de/check-dein-haus-18167.html

Green Capital Requirements for Housing Scheme

With a view to support the uptake of green financial products and to improve the energy efficiency of the domestic real estate stock, the MNB announced a capital reduction in December 2019 for loans granted to Hungarian credit institutions for green residential purposes between 1 January 2020 and 31 December 2023, fulfilling the conditions.

The measure can simultaneously support an increase in green risk awareness, the development of a green financial market, and support a lower credit risk hypothesis on a large sample.

Credit institutions shall transfer the savings from the lower cost of capital to their clients in the form of an interest rebate of at least 0.3 percentage points (green interest rebate). This constitutes a noticeable discount for customers.

The methodological basis for the application of the capital requirement relief is the “green hypothesis” that establishes a lower credit risk of loans for energy-efficient homes. That, due to lower overhead costs, ensures for the people living in green real estates a higher income available for repayment, which reduces the probability of default of loans. As well as changes in the regulatory environment and consumer attitude, green properties are expected to be more value-proof in the long term, so that their enforceability as collateral may be more advantageous (Ministry of Innovation and Technology, 2021).

Romania

Local energy planning

Romania had introduced a mandatory local energy planning for towns with more than 5,000 inhabitants and in addition to that a requirement for a local energy manager if the town has more than 20,000 inhabitants (Ministry of Economy, Energy and Business Environment, 2020).

- In accordance with the provisions of Law No 121/2014 on energy efficiency, as subsequently amended and supplemented, the local public administration authorities from the municipalities with a population exceeding 5 000 inhabitants are required to draw up energy efficiency improvement programmes with short-term measures and 3-6 year measures.
- Furthermore, local public administration authorities from municipalities with a population exceeding 20 000 inhabitants are required to draw up energy efficiency improvement programmes with short-term measures and 3-6 year measures, as well as to appoint an Energy Manager, who is certified in accordance with the legislation in effect, or to conclude an energy management contract with an authorized natural person, who is certified under the law, or with a legal entity acting as an energy services provider certified under the law (Ministry of Economy, Energy and Business Environment, 2020).

Romania has 669 localities with 5,000–20,000 inhabitants (as on 1 July 2018—according to the National Institute of Statistics) and almost all communities with the status of town have more than 5,000 inhabitants with only few exceptions, which means that, in general, all towns have to develop a mandatory energy efficiency improvement programme. The energy efficiency programmes were drawn up in observance of the template approved by the Decision No 7/2015 of the Romanian Energy Regulatory Authority. In 2019, Romanian Energy Regulatory Authority completed the updating of the

Template for the preparation of the Energy Efficiency Improvement Programme (EEIP) for the localities with more than 5,000 inhabitants. The exact content of the EEIP for the municipalities is not available.

Slovakia

Green Households project

Green Households project is a national project of the Slovak Innovation and Energy Agency (SIEA). Project is funded by the Operational Programme Quality of the Environment, managed by the Slovak Ministry of the Environment. The financial contribution is provided from the funds of the European Regional Development Fund and the state budget of the Slovak Republic. First Green Households project with budget of EUR 45 million was launched in 2014, its continuation “Green Households II” with budget of EUR 48 million was issued in 2019 (SIEA, 2021).

Within the Green Household project, family homes and apartment blocks can apply for support in the form of a voucher for the setting up of small installations for the use of renewable energy sources. The support is for small installations for the production of electricity up to 10 kW and for heat generating equipment covering energy consumption in a family house or apartment block. In addition to energy efficiency, there is also considered, whether the equipment meets the emission limits. Households can use the services of eligible contractors and can choose technology from the list of eligible devices, which meet the technical requirements (SIEA, 2021).

The aid of the project is set to give households the incentive to buy high-quality systems with reasonable performance, longer life and higher energy conversion efficiency, and not to underestimate the need for installation expertise. The aid may not exceed 50 % of the eligible expenditure. The vouchers cover part of the delivery and installation costs of the entire system. The voucher value will be determined automatically based on the type and output of the device. For individual device types, the rate is set per 1 kW of installed power as well as for the maximum amount of installation support (IEA, 2019) (SIEA, 2021).

By November 2018, 17,434 vouchers, worth more than € 38.8 million, were reimbursed (IEA, 2019). Within the Green Households II, more than 18 thousand vouchers worth of about € 45 million were processed by 24 January, 2022 (SIEA, 2021).

Slovenia

Energy advisory network for citizens – ENSVET

ENSVET Energy Advisory Offices Network has been active since 1993, providing citizens with independent energy counselling and information, educational and awareness-raising activities for the promotion of EE and RES measures in the local environment. Management, the organization of consulting and implementation of the programme, was taken over by the Eco Fund (the Slovenian Environmental Public Fund, which is also giving to the households financial assistance in form of grants and soft loans) in the second half of 2015. The ENSVET continues to operate after 2020, the services provided are further improved and expanded (Republic of Slovenia, 2017).

In 2016, 70 qualified independent energy advisors worked in 49 offices in the ENSVET network. Advisors undergo regular and additional trainings to ensure high quality of offered services. Offices are dispersed throughout Slovenia and operate as qualified, independent energy consultants who assist in selecting, planning and realising investment measures on efficient use of energy and on the use of renewable sources in apartment buildings (Republic of Slovenia, 2017) (Ministry of Infrastructure of Slovenia, 2018).

The main goal of the ENSVET is to increase interest and private investment in renewable energy sources and the rational use of energy through a network of regional advisory offices. ENSVET provides information, advice and assistance to help households to invest in EE measures and make use of RES, and develop applications to access financial support. Advice is tailored to each case based on the information provided by the owner or tenant and is offered free of charge to all citizens. ENSVET is also engaged in a wide range of awareness raising activities across the country. It has initiated a new scheme for low-income households called AERO, which is a service that is provided in cooperation with social work centres (European Commission, 2018).

ENSVET´s activities in 2013 to 2016, with average of more than 5,000 advisory sessions per year, led to average reported energy savings of almost 17 MWh/year. Besides, the advisory services also initiates energy savings from other reported areas due to its awareness and educational effects (e.g. grants for citizens under the Eco Fund's programme led to average energy savings of around 132 thousand MWh/year) (Republic of Slovenia, 2017).

Non-EU countries

As for the purpose of the study we mainly understand "best practice" as a programme that runs for a longer period and is repeatedly extended, or a shorter programme or service with exceptionally good results it was complicated to identify such examples in the non-EU countries. Given the less availability of information and quite short periods of the existing programmes in energy efficiency, as well as the fact that these countries tend to take over schemes, projects and ideas mostly from the EU member states, the examples of interesting initiatives in energy efficiency were identified for the non-EU countries.

Moldova

1. Construction of the photovoltaic park (312kWh, 1000 panels X 400W);

2. Construction of 3 on-grid photovoltaic systems at kindergarten, gymnasium, city hall (cumulative 40kWh);

3. Construction of 4 biomass-based boilers at the kindergarten, gymnasium, city hall, culture house (cumulative 561 kW);

4. Equipping the kindergarten with a system of solar panels for domestic hot water heating;

5. Construction of public street lighting and intelligent monitoring & management system STAGE I (265 LEDs installed on 10.5 km of network);

6. Energy efficiency of the city hall through thermal insulation and application of EE technologies (claimant to the nZEB labeling – building with energy consumption almost equal to zero);

7. Planting short rotation energy crops (5 ha);

8. Construction of the Center of Excellence in Energy Efficiency meetings' room;

9. Creation of the ECO Educational Center for kindergarten and its endowment with computers.

More information on the above projects and initiatives is available at: https://eu4moldova.eu/sharing-of-good-practices-at-the-center-of-excellence-in-energy-efficiency/.

Ukraine

1. City Energy Efficiency: Kiev, Ukraine - Energy Efficiency in Public Buildings[15];

2. Good Practices in City Energy Efficiency: Lviv, Ukraine - Energy Management Systems in Public Buildings[16].

Montenegro

1. Montenegro Energy Efficiency Project (MEEP) – funds for financing the works related to the implementation of energy efficiency measures in six healthcare buildings and nine educational buildings.[17]

2. Second Energy Efficiency Project for Montenegro[18] aims to improve energy efficiency in health sector buildings, and to develop and demonstrate a sustainable financing model. This project has three components:

a. energy efficiency investments in health sector buildings;
b. technical assistance, which aims to finance activities to enhance local enegy efficiency capacity;
c. project implementation support.

3. Support for residential consumers and SMEs – there are three recent projects supporting residential energy consumers financed with the support of donors and the state budget. These projects mainly target switching to more efficient technologies which use renewable energy sources (e.g. modern biomass systems, solar heating technologies, PV). Financing of energy efficiency projects within the residential sector is provided on a project-by-project basis through donors' support programmes and state budget annual allocation[19].

11.4 PROPOSED MEASURES

Given a high number of measures and policies related to energy efficiency used by individual states, it is difficult to assess which measures are used by certain states to a greater extent and which are not. The efficiency of a certain measure in a particular country is also difficult to estimate, as the quality

[15] More information available from: https://www.esmap.org/node/656
[16] More information available from: https://www.esmap.org/node/1246
[17] More information available from:
https://energetska-efikasnost.me/en/montenegro-energy-efficiency-project-meep/
[18] More information available from:
https://projects.worldbank.org/en/projects-operations/project-detail/P165509
[19] More information available from:
https://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-MontenegroEN_2018.pdf

and success rate of the measures vary between countries (for example, consulting services, which in some form are used by all of the states, do not play a significant role or have a successful implementation in every country). Therefore, the list of good practices presented in this chapter is not country-specific.

Table 114: Proposed good practice measures or focus areas

Name or category of measure
The „energy efficiency first“ principle
Effective combinations with renewables
Energy performance contracting and ESCO (Energy Service Companies) market
Energy poverty focused support
Newly introduced green financial instruments
Consultancy services and one-stop-shops for users
Comprehensive incentive system and less administrative burden
Support for energy communities

1) The „energy efficiency first“ principle – greater emphasis should be focused on the **reduction of basic energy consumption of the buildings**, which means in particular the improvement of the thermal-technical parameters of the building envelope prior to measures in technologies (e.g. new heat sources) and others. The renovation of building envelope should also be comprehensive, not only partial, if possible.

   As part of energy/GHG saving measures, the energy source is sometimes replaced without reduction of the basic energy consumption of the building. The new energy source in many cases leads to a reduction in primary energy consumption from non-renewable energy sources (and thus GHG reduction) as well as reduction of energy costs (due to better efficiency). For example, a heat pump can save more than a third of heating costs, or even more in combination with photovoltaics. This is very convenient for users.

   The implementation of the new heat source is also often cheaper than the insulation of the object, respectively economically more advantageous (it has usually a better payback time). And finances are for users or homeowners often the main decision-making criterion.

   In such a case, energy sources are designed to cover the original energy consumption. In the case the insulation is subsequently implemented to the building, the energy sources or other used technology (HVAC) can have excessive dimension, which can cause problems such as smaller system efficiency or increased maintenance costs.

   As we plan to achieve a carbon neutrality in the future, it will be necessary to increase the proportion of deep renovation implementations. To reach deep renovation level, it will be essential to implement also less economically advantageous measures to reduce the basic energy consumption of buildings (improvement of thermal parameters of building envelope usually has longer or disadvantageous payback period, e.g. overall building insulation, roof insulation or windows replacement). Applying measures efficiently and in the appropriate order will be a key factor (i.e. first improvement of the thermal-technical parameters of the building through construction measures, then solve the loss of heat by ventilation, subsequently addressing other technologies, such as an energy source). It can be assumed that without reducing the basic consumption, it will not be possible to cover the total consumption of the buildings only by renewable energy sources or more efficient technologies, as they have technological and spatial limits.

2) **Effective combinations with renewables** – it is necessary to maximize the synergy of combination of different energy sources. This includes primarily combinations of photovoltaics or wind power with electrical energy technologies (ventilation, cooling, heating – primary through heat pumps). This is about a conformance of technologies used in the building with the used source of energy and efficient use of renewables. For example, a combination of photovoltaic technology with cooling system in a building and a combination of photovoltaics with installation of heat pump have approved to be most advantageous.

3) **Energy performance contracting and ESCO (Energy Service Companies) market** had proven to be very effective tool for both reducing the energy performance of buildings and improving the quality of the indoor environment for building users, especially in public buildings. Guaranteed energy savings along with use of financing from the achieved savings opens the door to energy savings even if it has been closed so far. An important advantage is also the active implementation of energy management, which is often a part of the Energy performance contracting (EPC) projects.

   The level of ESCO market implementation varies from country to country. The biggest challenges lie in legislative support, overcome of market barriers and the credibility and routine of this method.

   Therefore, it is needed to focus on the overcoming of these barriers – introduce clear and supportive legislative framework and clear rules for ESCO market along with support on the level of policies supporting energy efficiency. It is also appropriate to establish standardized procedures for Energy performance projects, for example, a uniform procedure with minimum requirements (% of energy savings, payback period, guarantees), the application of strict professional qualification criteria towards subcontractors or introduction of the European Code of Conduct for EPC (set of values and principles that are considered essential for the successful implementation of EPC projects), which was created as part of a European project Transparense.

4) **Energy poverty focused support** – in recent years, the number[20] of vulnerable customers and households at risk of energy poverty has increased, particularly as a result of rising energy prices. It is estimated that over 34 million people in the European Union are experiencing energy poverty to various degrees, with the most vulnerable demographic groups being the

[20] None of the EU-countries publishes official data on the amount of the energy poor households, as it depends a lot on the indicator to measure energy poverty. As of 2020, most EU-states still lack both a clear definition of and an approach on how to assess energy poverty. In general, only self-reported experiences of limited access to energy services based on the data of EU Statistics on Income and Living Conditions (EU-SILC) can be followed.

most affected[21]. A common problem is that these households do not have enough finances to implement energy saving measures that would help them to reduce energy costs. A common issue is also lack of information about their possibilities and a sensitivity of the social aspects of energy use.

For example, in Germany the term energy poverty is not used as a stand-alone term. Rather, the Federal Government is pursuing a comprehensive approach to poverty reduction in social law that does not focus on individual elements of household needs. If financial support is required to secure a livelihood, benefits from the minimum income system according to the Social Security Code are granted. This includes the so-called regular needs, which also covers, among others, the general costs for household electricity and heating.

In addition, it is appropriate to introduce and focus a specialized support on the vulnerable customers and energy poor households. A support may consist of various informational and educational activities, financial bonus incentives (e.g. in the form of coverage of up to 100% of eligible costs for energy saving measure), support for the replacement of old and uneconomical household appliances or free consultation services, including active search and contacting of the energy poor households.

Many countries have already introduced some of the above-mentioned and other similar measures, although most of them do not have yet any official definition of energy poverty. Especially in the last case, it is appropriate to focus on the energy poverty issue and possibly be inspired by the countries where policies to tackle energy poverty are in place (first of all, the United Kingdom and Ireland).

5) **Newly introduced green financial instruments** – adequate financing is one of the most important elements to ensure that the various government strategies, policies and plans actually deliver the desired results. However, analysing all the various methods of financing energy saving measures would be a task for a separate study. Therefore, only some of the options (modern or smart ones) are described:

    a. Green-bonds to finance energy saving measures;

    b. Green financial products – e.g. reduced interest rates, interest rebates or capital reduction for loans for green project (building renovation of specific level, sale or construction of a residential building corresponding to the specific energy quality rating, renewable energy sources) due to “lower credit risk hypothesis”;

    c. Providing bank guarantees for energy saving projects;

    d. Partial financial coverage of the commercial loans for energy saving project by the National Bank in cooperation with other institutions based on an audit submitted to the bank, which confirms the prospects and parameters of the project;

    e. Taxes for GHG emissions in non-ETS sector;

    f. Tax benefits – VAT refunds or tax relief for energy efficiency or building renovation projects with a certain minimum investment amount financed from the own funds.

[21] More information available from: https://energy-poverty.ec.europa.eu/energy-poverty-observatory/what-energy-poverty_en

6) **Consultancy services and one-stop-shops for users** – with two areas of support:

   a. Extensive awareness-raising initiatives to familiarise all members of society with the importance of climate protection, energy efficiency and using energy resources carefully. Awareness-raising programmes and information campaign to assist the public and the business sector in obtaining technical information on energy-efficient renovations and the use of buildings including advice on financial possibilities. The possibility of an online processing is a matter of course. These can be done for example by consultancy networks or within one-stop shops;

   b. Independent and qualified energy efficiency consultation services with a various level of complexity (preliminary, thorough – for new construction or refurbishment, financial options), with a preference for consultation taking place on-site, with first consultancy free-of charge for users or with benefits for vulnerable or energy poor costumers. An advisory network should be available to cover the needs of the population.

   Promoting energy advisory services in all sectors will be a key to enable efficient use of energy. A good example is the approach of Austria and its federal states to energy consultation services.

7) **Comprehensive incentive system and less administrative burden** – non-overlapping policies or subsidy schemes covering all sectors. A good option is to create a comprehensive support programme that covers all possible energy efficiency measures of specific area, e.g. residential sector. The emphasis should also be placed on a further reducing the administrative burden, especially for customers applying for the support. Recent trends show that customers are looking for turnkey services – they demand a comprehensive service, but also want to spend as little time as possible on its solution.

8) **Support for energy communities** – energy communities can be understood as a way to "organise" collective energy actions around open, democratic participation and governance and the provision of benefits for the members or the local community. Energy communities represent a way for a clean energy transition. At the same time, they have the potential to provide direct benefits to citizens by advancing energy efficiency and lowering their electricity bills. The most widespread activities of the energy community goals are focused on the production of energy from renewable sources, but it is possible to go further. Energy communities represent a significant opportunity to expand decentralized energy production and thus also to increase an energy security. But they can also help in providing flexibility to the electricity system through demand-response and energy storage.

   Energy communities are already emerging in all countries, however the implementation degree and quality for their support varies, depending on addressing and overcoming challenges and barriers typical for this concept. The right approach to energy communities must address three key areas – legal, social and technical-economical. Both resolving and supporting (e.g. incentives or grants for energy communities) of these three key areas are a major step towards the successful implementation of energy communities.

   At the legal level, the legislative "anchoring" of energy communities needs to be addressed. Clear rules, requirements and rights regarding energy communities must be set (not all Danube region countries have resolved legal issues). Within the social level, it is necessary to acquaint citizens with the whole concept of energy communities. They must acquire a good understanding of its benefits, rules and requirements. The main goal is to actively involve citizens in the issue (this can be done via one-stop shops and consultancy services). At the technical level, it is necessary to address issues such as the technical solution of the renewable energy sources implementation, investment cost allocation among users, measurement and billing of produced / consumed energy among users, energy distribution solutions, energy overflows to the public distribution network or other administrative requirements. Ready-to-use concepts tailored to the (local) specific of a country or municipality can be of a great help.

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