UNECE

REN21
RENEWABLES NOW

UNECE RENEWABLE ENERGY STATUS REPORT

2022

PARTNER ORGANISATIONS

REN21 is the only global renewable energy community of actors from science, governments, non-governmental organisations and industry. It provides up-to-date and peer-reviewed facts, figures and analysis of global developments in technology, policies and markets. The goal: to enable decision makers to make the shift to renewable energy happen – now.

REN21 creates an enabling environment to support renewables. It offers a platform for a variety of stakeholders to engage and collaborate. Armed with knowledge and tools, supported by a culture of dialogue and debate, and augmented by new ecosystems, this community of change strategically drives the deep transformations needed to make renewables the norm.

The United Nations Economic Commission for Europe (UNECE) was set up in 1947 by the United Nations Economic and Social Council (ECOSOC) and is one of five regional commissions of the United Nations. UNECE's major aim is to promote pan-European economic integration. To do so, it brings together 56 countries of Europe, but also countries of North America, Central Asia and Western Asia. Over 70 international professional organisations and other non-governmental organisations take part in UNECE activities.

Dena, the German Energy Agency, is Germany's centre of expertise for energy efficiency, renewable energy sources and intelligent energy systems. As the "Agency for the Applied Energy Transition" it contributes to the attainment of energy and climate policy objectives. dena develops solutions and put them into practice, both nationally and internationally.

SUPPORTED BY

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on the basis of a decision by the German Bundestag

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Note: All references to Kosovo in the report are made in the context of United Nations Security Council Resolution 1244 (1999).

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The REN21 community is at the heart of REN21's data and reporting culture. Collectively, hundreds of experts make REN21 reports among the world's most comprehensive crowd-sourced and peer-reviewed publications on renewables. This unique reporting and verification process makes REN21 a globally recognised data and knowledge broker.

REN21 reports that carry the *REN21 Crowd-Sourced Knowledge and Data* stamp verify that the following collaborative process was applied:

REN21 CROWD-SOURCED DATA AND KNOWLEDGE

- Developing **data collection** methods that build on a global multi-stakeholder community of experts from diverse sectors, enabling access to dispersed data and information that frequently are not consolidated and are difficult to collect.
- Consolidating **formal** (official) and **informal** (unofficial/unconventional) data gathered from a wide range of sources in a collaborative and transparent way, for example, by using extensive referencing.
- Complementing and validating data and information in an open **peer-review** process.
- Obtaining expert input on renewable energy trends through **interviews** and personal communication between the REN21 team and authors.
- Using validated data and information to provide fact-based evidence and to develop a supportive narrative to **shape the sectoral, regional or global debate** on the energy transition, monitor advancements and inform decision processes.
- Making data and information **openly available** and clearly documenting our sources so they can be used by people in their work to advocate for renewable energy.
- Using crowd-sourced data to develop a **shared language** and create an understanding as the foundation for collaboration.

Over **260 experts** contributed to the REN21 UNECE report 2022, working alongside an international authoring team and the REN21 Secretariat.

A **variety of sources** were used to compile this report, including interviews with experts in the region.

For more information, see the Methodological Notes section.

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FOREWORD

UNECE

Olga Algayerova
Executive Secretary, United Nations Economic Commission for Europe (UNECE)

Since 2018, the UNECE region has observed a noticeable scale-up in the uptake of renewable energy technologies. Renewables are becoming a mainstream solution to provide sustainable, affordable and reliable power supply to the region's 310 million people. The accelerated transition to low-carbon energy in the region reflects an increasing recognition of the multiple benefits that renewable energy provides for national energy security, greenhouse gas emission reduction, and enhanced access to and resilience of the energy supply, along with the improvement in environmental quality and people's health.

The *2022 UNECE Renewable Energy Status Report* examines in detail the progress made by 17 UNECE countries in harnessing their abundant renewable energy resources to decarbonise power, heat and mobility. It also offers a comprehensive overview of the region's journey towards achieving the United Nations Sustainable Development Goal 7 on "Affordable and Clean Energy" by looking at renewable energy alongside improvements in energy efficiency and energy access.

By delivering detailed analysis of the national policy frameworks and investment flows for a low-carbon energy transition, the report provides valuable insights on the future development of the renewable energy sector and recommendations for both public and private actors to scale up actions towards achieving the goals of the Paris Agreement and the 2030 Agenda for Sustainable Development.

UNECE would like to thank the German Federal Ministry for Economic Affairs and Climate Action (BMWK) for its support that resulted in this report as well as targeted events in the region. We would also like to thank the Renewable Energy Policy Network for the 21st Century (REN21) for putting together this report for the third time in the last seven years. Last, but not least, we are grateful to all experts involved for providing their data, information and expertise that served as the basis of the report.

REN21

Rana Adib
Executive Director, REN21

Energy is the lifeblood of the modern economy and society and is deeply embedded in many of the contemporary global challenges we face today – from markets and poverty to environmental degradation, social justice, and security and geopolitics. With fossil fuels responsible for more than 75% of global carbon dioxide emissions, transitioning away from fossil fuels and increasing renewable energy uptake is non-negotiable.

The focus countries of this report have significant potential for renewable energy deployment, yet most countries continue to depend heavily on fossil fuels, with relatively smaller shares of renewables in their total final energy consumption. As the need for energy security gains momentum in the focus region, especially following the Russian invasion of Ukraine in early 2022, countries must urgently invest in renewables to end their dependence on fossil fuels.

The REN21 *2022 UNECE Renewable Energy Status Report* examines the status of renewables in 17 UNECE focus countries plus Kosovo, focusing on South-East and Eastern Europe, the Caucasus, Central Asia and the Russian Federation. It represents the third edition of this regional report, following previous editions in 2015 and 2017. Significant progress in renewables has been achieved since the 2017 edition of this report. The focus region added more than 20 gigawatts (GW) of renewable power capacity between 2017 and 2021, resulting in a total installed renewable power capacity of more than 100 GW.

Not all countries were able to contribute equally to this success, however, and even in the most successful locations the renewable energy potential remains largely untapped. The economic crisis associated with the COVID-19 pandemic has offered an opportunity to include renewable energy development in national recovery plans. Such measures could bring numerous co-benefits such as better health, new economic opportunities, additional jobs and improved energy security.

This report aims to promote the development of renewable energy in the region, examining the evidence and raising awareness about the vast potential of renewables and their benefits in the focus countries. It provides the most recent statistics and trends, and their assessment and interpretation, at both the country and the regional level. We trust that you find the analysis in this report useful for your policy and decision making.

Documenting the continual evolution and uptake of renewables in a timely manner is challenging. We acknowledge that data gaps exist in this report. Nevertheless, it provides a starting point to better understand regional developments. It also highlights where data are missing and need to be collected. Given the importance of the region in transitioning to renewable energy and the current speed of change, a continual process for data and information collection is key. I hope that this report is just the beginning of this process.

The report also illustrates the power of a collective intelligence. I extend our gratitude and thanks to UNECE, dena and the German Federal Ministry for Economic Affairs and Climate Action for their support and contribution to the report. This year, more than 260 experts contributed data and information. I thank all of them and extend particular gratitude to the Project Management Team of Vibhushree Hamirwasia and Anastasia Ioannou; our lead author, Aleksandra Novikova, and the entire team at AvantGarde Energy; our editor, Lisa Mastny; our designers, Ruzica Pavlovic, Aleksandra Joksovic and the team at Future by Design Studio; and all those who provided data and participated in the peer-review process.

I hope that you will find in this report the knowledge, data, perspective and inspiration to help and support you in your efforts to make renewable energy the undisputable backbone of our economies and societies.

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PROJECT MANAGEMENT

REN21 Secretariat
Vibhushree Hamirwasia
Anastasia Ioannou (University of Glasgow)

UNECE
Gianluca Sambucini
Lisa Antonia Amend

AUTHORING TEAM

Aleksandra Novikova (AvantGarde Group), Lead Author
Alexandr Belyi (AvantGarde Group)
Erik Grigoryan (AvantGarde Group)
Tsimafei Kazlou (AvantGarde Group)
Anastasia Pavlenko (AvantGarde Group)
Anton Pushko (AvantGarde Group)
Lea Ranalder (REN21)
Nicolae Zaharia (AvantGarde Group)
Liliya Zavyalova (AvantGarde Group)

RESEARCH AND PROJECT SUPPORT (REN21 SECRETARIAT)

Thomas André
Ines Benachir
Aishwarya Dhar
Duncan Gibb
Stefanie Gicquel
Nathalie Ledanois
Fabio Passaro
Lea Ranalder
Nematullah Wafa
Hend Yaqoob
Yu Yuan-Perrin

COMMUNICATIONS SUPPORT (REN21 SECRETARIAT)

Yasmine Abd-El-Aziz, Elizabeth Canavan, Janice Chantre Raposo, Joanna Croft, Assia Djahafi, Vincent Eke, Jessica Jones-Langley, Tammy Mayer, Komila Nabiyeva (Consultant), Laura E. Williamson, Shiyao Zhang

EDITING, DESIGN AND LAYOUT

Lisa Mastny, Editor
Future by Design Studio: Ružica Pavlović, Isidora Bjeljac, Aleksandar Subašić

PRODUCTION

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Over 260 experts and reviewers from across South-East and Eastern Europe, the Caucasus, Central Asia, the Russian Federation and elsewhere contributed to the report's content.

Note: Some individuals have contributed in more than one way to this report. To avoid listing contributors multiple times, they have been added to the group where they provided the most information.

CONTRIBUTORS AND REVIEWERS

LEAD COUNTRY CONTRIBUTORS

Albania: Adrian Bylyku, Artan Leskoviku (National Agency of Natural Resources); Rezart Çela, Ermela Hoxha (Statkraft Albania); Adil Hanif (European Bank for Reconstruction and Development – EBRD); Besim Islami (Energy Environmental Consulting Group); Zija Kamberi (Legal and Regulatory Consultant); Xavier Mulliez (Voltalia Albania); Elton Radheshi (Energy Regulatory Authority); Rudina Xhelilaj (Ministry of Infrastructure and Energy)

Armenia: Ruzanna Voskanyan (Environment Group)

Azerbaijan: Jahangir Afandiyev (energy efficiency expert)

Belarus: Andrei Kosko (energy efficiency expert)

Georgia: Giorgi Abramishvili (Georgian Renewable Energy Development Association); Margalita Arabidze, Tornike Kazarashvili (Ministry of Environment and Sustainable Development); Irakli Galdava (Georgian Energy Exchange); Luka Garibashvili, Nugzar Khaindrava (Georgian Energy Development Fund); Liana Garibashvili (Energy Efficiency Centre and Covenant of Mayors, Caucasus); Murman Margvelashvili (World Experience for Georgia); Nani Meparishvili (Georgian Technical University); Rakesh Naik (Adjaristsqali Georgia LLC); Dan Potash (Securing Georgia's Energy Future Program of the US Agency for International Development); Keti Sandroshvili, Tea Avazashvili (EBRD)

Kazakhstan: Ainur Adilova (National Statistical Service); Erlan Dairbekov (United Nations Development Programme – UNDP)

Kyrgyz Republic: Tatiana Vedeneva (Center for Renewable Energy and Energy Efficiency Development)

Moldova: Constantin Borosan, Nicolae Magdil (Ministry of Infrastructure and Regional Development); Octavian Calmac (National Agency for Energy Regulation of Moldova); Octavian Ciobirca (IS Moldelectrica); Marcela Lefter (American Chamber of Commerce in Moldova); Igor Mîrza (Premier Energy Distribution); Vitalie Nadjmacov (Südzucker); Eduard Pulbere (RED Nord); Sergiu Robu (Institute of Power Engineering of the Ministry of Education, Culture and Research); Denis Tumuruc (Energy Community Secretariat)

Montenegro: Igor Lukšić (former Prime Minister)

Russian Federation: Georgy Ermolenko (Electric Power Council of the Commonwealth of Independent States)

Serbia: Jovanka Atanacković, Natalija Luković (Ministry of Mining and Energy); Ivan Gazdić (CMS Belgrade); Francoise Jacob (UN Serbia); Branislava Jovic (Balkan Green Energy News); Milos Kostić (MT Komex); Dusan Opacić (Elicio NV); Dejan Stojadinović (renewable energy expert); Maja Turković (CWP Global)

Ukraine: Maryna Hritsyshyna (Hydrogenious LOHC Technologies GmbH); Iryna Krymus, Oleksandr Kozakevych (Ukrainian Association of Renewable Energy); Kirill Trokhin (Power Generation Business Unit); Galyna Trypolska (Institute of Economics and Forecasting)

Uzbekistan: Shirin Alijonova, Shukhrat Isaev (Ministry of Innovative Development); Almaz Urazgulov (Electric Power and Energy Saving Development Institute – JSC)

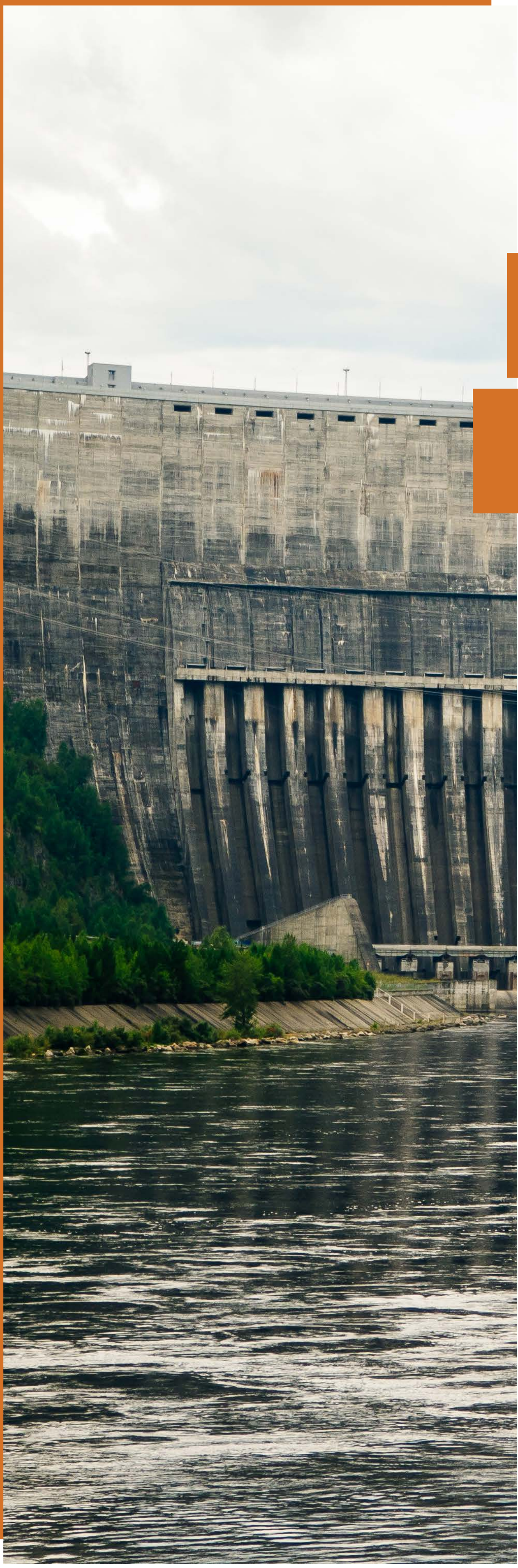
LEAD REGIONAL AND TOPICAL CONTRIBUTORS:

Ana Amazo Blanco (Guidehouse); Maria De Melo, Zsuzsanna Hargitai, Tiago Oliviera, Marianna Wiedenbeck (EBRD); Oleg Dzioubinski (UNECE); Tibor Fischer, Laurence Green, Joscha Müller, Philine Wedell (German Energy Agency – dena); Petya Icheva (International Renewable Energy Agency –IRENA); Naida Taso (Energy Community Secretariat); Matija Vajdić (Energy Institute Hrvoje Požar); Rastislav Vrbensky (former UN Resident Coordinator and UNDP Deputy Director for Europe and Central Asia)

PEER REVIEWERS AND OTHER CONTRIBUTORS:

Mohammed Abdalghafoor (UPG Sustainability Leadership); Ahmed Abuhassira; Aishwarya Rao (analyst); Melek Akay (Ministry of Agriculture and Forestry of Turkey); Esteban Albarracin (Florida International University); Mariia Alipatova; Sami Alnabulsi (Alnabulsi Co.); Jil Amine (United Nations Economic and Social Commission for West Asia); Andrzej Ancygier (Climate Analytics); Anna Arkhangelskaya (independent energy consultant); Arman (Arek); Emmanuel Arriola (De La Salle University); Eros Artuso (TERRA Consult Sarl); Rebecca Askins-Gast (EBRD); Tamara Babayan (World Bank); Helena Barbosa (EcoSolar); Robert Bbosa (University of Ibadan); Pep Puig i Boix (Eurosolar); Roberta Boscolo (World Meteorological Organization); Vitaliy Butuzov (Energy Technology Services Ltd.); Joakim Byström (Absolicon Solar Collector AB); Daniel Chavez (Plp); Sammy Jamar Chemengich (Alexandria University); Sreenivas Chigullapalli (Indian Institute of Technology Bombay); Mario Contreras (Kratos Capital Partners); Toby Couture (E3 Analytics); Muhammad Dabbour (Al Qamar); Yerlan Dairbekov (policy expert); Mariam Darchia (Ministry of Economy and Sustainable Development Georgia); Alekhya Datta (KPMG India); Ryan Davidson (CalWave Power Technologies); Derrick (consultant); Pedro Dias (Solar Heat Europe); Max Bonnier Eklund (Absolicon); Malin Emmerich (Frankfurt School – United Nations Environment Programme (UNEP) Collaborating Centre for Climate & Sustainable Energy Finance); Aurelio Escobar (consultant); Anibal Espinoza; Ashkan Etemad (LEEDinIran); Faisal (Alfaisal); Maria Laura Fiorotto (UN Moldova Resident Coordinator Office); Jacob Frandsen (Heliac); Fromet (Akuo); Maria Frommann (dena); Zarif Garaev (JV LLC "SKB"); Leila Ghomri (University Abdelhamid Ibn Badis Mostaganem); Patricia Gimenez; Vladimir Grebnev (CCA expert); Irina Guban (United Nations Regional Commissions); Zeliha Gülmez; Luis Carlos Gutierrez-Negrin (Geoconsul, SA de CV); Azhan bin Hasan (consultant); Ralf Heidrich (UNEP); Adam Hinge (Sustainable Energy Partnerships); Howard Hornfeld (Fusion Advocates); Narmin Huseynova (Permanent Mission of the Republic of Azerbaijan); Minsoo Hwang (Keca); Zartab Jafri (Maksus Mimer Energy Solutions India Pvt. Ltd.); Akshay Anil Jamdade (Central European University); Egill Júlíusson (UN Framework Classification for Geothermal Energy); Željko Jurić (Energy Institute Hrvoje Požar); Calin Jurma (European Investment Bank); Chisakula Kaputu (Sustainable Energy & Environment LTD); Bekzod Karimov (SEEP MOLME RoT); Bakyt Kartanbaev; Srinivas Kasulla (Arka Brenstech Private Limited); Kamil Kaygusuz (Karadeniz Technical University); Garry M. Keegan (Infrastructure Projects Consulting); Sivadasan Kesavan (Kerala State Electricity Board Ltd.); Shahnawaz Farhan Khahro (Energy Department, Sindh); Nazar I. Khan (Jamia Millia Islamia); Varun Khanna (Clean Energy 4 Africa); Manfred Kiefer (Asian Development Bank – ADB); Ånund Killingtveit; Nadejda Komendantova (International Institute for Applied Systems Analysis); Michael König (Frankfurt School of Finance and Management); Siddhesh Suresh Kotavadekar (IRB Infrastructure Developers Ltd); Marcus Lehmann (CalWave Power Technologies, Inc.); Juan Roberto Lozano-Maya (Emerging Leaders in Environmental and Energy Policy); Lyn; Abubakar Musa Magaga (Nigerian institute of Transport Technology); Julie Mai (CalWave Power Technologies, Inc.); Zach Malik (Baringa Partners); Paul Mbuthi (Ministry of Energy Kenya); Yury Melnikov (independent policy expert); Sabina Anokye Mensah (Anomena Ventures); Jonathan Mhango (financial analyst); Constance Miller (Global Bioenergy Partnership Secretariat); Shahrokh Mohammadi (NS Innovations); Vladimir Momcilovic (University of Belgrade, Faculty of Transport and Traffic Engineering); Gad Mugagga (Kenyatta University); Pritchard Mukuka (SNV Zambia); Ali Naghdbishi (Islamic Azad University); Jean de Dieu Nguimfack Ndongmo (University of Bamenda, HTTTC Bambili); Paul Nduhuura (United Nations University Vice-Rectorate in Europe); BS Negi (former Ministry of New and Renewable Energy India); Victoria Novikova (UNDP); Jesse Nyokabi (Quaise Energy Limited); Monica V. Oliphant (University of South Australia; International Solar Energy Society); Marina Olshanskaya (AKDN Climate Change Coordinator); Akshay Pandey (WWF-India); Manuel Paredes (Mexican Energy Association – AME); Nikshan Paudel (Université de Lorraine); Dan Petcovic (CalWave Power Technologies, Inc.); Kristian Petrick (Airborne Wind Europe); Ranjan Prakash Shrestha (Delegation of the European Union to Nepal); Ramesh Poluru (INCLEN Trust International); Poujade (ScienceEnVie); Alejandro Galvez Prieto-Moreno (AG Consulting S.L.); Azamat Rakhimov (CIS Electric Power Council); Nizomiddin Rakhmanov; Julio Antonio Raul (Ministry of Energy, Guinea-Bissau); Clare Richardson-Barlow (CO2RE Hub, University of Leeds); Sasha Rodi; Njoke Mbanda Lionel Romeo (North China Electric Power University); Frank Rosillo-Calle (Imperial College London); Horst Rüter (Bundesverabnd Geothermie); Tamar Sabelashvili (Ministry of Environment and Sustainable Development Georgia); Jack Saddler (University of British Columbia); Carmen Avellaner de Santos; V. Saravanan

(Arunai Engineering College, Tiruvannamalai); Irina Savitskaya (National Statistical Committee of Belarus); Kamel Sayahi; Ali Shahhoseini (Qazvin Islamic Azad University); Rui Shan (University of North Carolina at Chapel Hill); Vishal Sharma (Maulana Azad Memorial College Jammu); Bakhtiyor Shodiev (Wemax); Akhwand Shujaan (General Electric); Edwin Sierra (Andritz Hydro); Sunil Mohan Sinha (GAES India); George Sizoomu (Racell Uganda); Yuliia Solomakha (independent expert); Nicolae Soloviov (Energy Efficiency Agency of Moldova); Janos Szanyi (University of Szeged); Slawomir Szymanski (Saule S.A.); Masoud Taghavi (Technical and Vocational University Iran); Nigel Taylor (European Commission Joint Research Commission); Hannibal Tesfahunegn (Power for All); Daniele Testi (University of Pisa); Iida Tetsunari (Institute for Sustainable Energy Policies); Daniela Thrän (UFZ GmbH / DBFZ gGmbH); Ti'm'lu (CAREC Institute); Kirill Trokhin (IPP Ukraine); Kelly Trumbull (University of California at Los Angeles Luskin Center for Innovation); Galyna Trypolska (Institute for Economics and Forecasting, Ukrainian National Academy of Sciences); Ekaterina Tsvetkova (Schneider Electric); Kutay Ülke (Bural Solar); Gordhan Valasai (Quaid-e-Awam University); Rodrigo Valdovinos (Energía Solar); Nunzio Valentino; Thalia Valkouma (Development Faria Group); Lalit Kumar Varshney (Sterlite Technologies Ltd); Camila Vásquez (Ministry of Energy Chile); Victor Hugo Ventura (for UN Economic Commission for Latin America and the Caribbean); Tony Vermeire (HIPS Europe); Nicholas Wagner (IRENA); Jaclyn Webber; David Wood (Mae Fah Luang University); Yutong Xiang (Technical University of Denmark); Amin Yahya-Khotbehsara (Qazvin Islamic Azad University); Peter Yang (Case Western Reserve University); Ameera Yassin (Dubai Future Foundation); Marhabo Yodalieva (USAID Regional Water and Vulnerable Environment, Tetra Tech ARD); Samer Zawaydeh (independent energy engineer); Wilson Zhao; Margareta Zidar (consultant).



EXECUTIVE SUMMARY

The UNECE Renewable Energy Status Report 2022 reviews the progress made in harnessing renewable energy and energy efficiency in 17 member countries[i] of the United Nations Economic Commission for Europe (UNECE) as well as Kosovo[ii]. The report serves as an update to the previous edition released in 2017 and presents the most up-to-date data and analysis on the policy landscape, market developments, and investment in renewables and efficiency in the region. In doing so, it reviews the drivers, barriers, opportunities and needs for the development of renewable energy as well as the role that regional co-operation plays in facilitating the transition to a low-carbon future.

01 REGIONAL OVERVIEW

The focus countries are spread across the following five sub-regions and had a combined population of around 310 million people in 2020, representing around 4% of the global population:

- Southeast Europe: Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia;
- Eastern Europe: Belarus, Moldova and Ukraine;
- Southern Caucasus: Armenia, Azerbaijan and Georgia;
- Central Asia: Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan;
- The Russian Federation.

These countries have differing energy situations and vary in their potential for and progress in renewables and energy efficiency. Nearly all of the countries have large potential to deploy solar, wind, hydropower and/or bioenergy, yet most remain heavily dependent on fossil fuels. The average share of renewables in

i The 17 focus countries (out of a total of 56 UNECE countries) are: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kosovo, the Kyrgyz Republic, Moldova, Montenegro, North Macedonia, the Russian Federation Serbia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

ii Here and further, this designation is without prejudice to positions on status and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice opinion on the Kosovo declaration of independence.

total final energy consumption in the focus region in 2019 was 18.2%, a share that has not changed measurably since 2014.

Nevertheless, the region has made substantial progress in renewables. Between 2017 and 2021, the focus countries added an estimated more than 20 gigawatts (GW) of renewable power, to reach a total installed capacity of more than 100 GW. Ukraine, the Russian Federation and Kazakhstan ranked among the world's top 30 renewable energy investors in 2019. The region also has made great strides in reducing energy intensity, although levels remain higher than in member countries of the Organisation for Economic Co-operation and Development (OECD). Overall, the UNECE region continues to face critical energy challenges, thereby representing an opportunity to transition to sustainable and resilient energy systems, well-functioning energy markets, and stable and secure energy supplies.

Regional co-operation on renewables is evolving rapidly, driven by the requirements for integration for countries that are members of the European Union's (EU) Energy Community Treaty; by enhanced collaboration among Central Asian countries (facilitated by the Central Asia Regional Economic Cooperation Program, CAREC); and by other sectoral partnerships and initiatives, such as the EU4Energy programme. The UNECE Group of Experts on Renewable Energy supports the penetration of renewables and facilitates tracking progress, exchanging experiences and discussing best practices.

02 POLICY LANDSCAPE

The landscape of renewable energy policy and related energy efficiency and climate change policy has evolved greatly since the previous REN21/UNECE report. A notable shift in support policies for renewables occurred across the region, with changes in both the range of policy instruments being used and in country coverage.

In line with global policy trends, renewable energy targets continue to be a primary means for governments in the region to express their commitment to renewables. 16 of the focus countries have established national renewable energy targets, and several have launched the "second generation" of targets for renewables and energy efficiency, which would guide the evolution of these efforts to 2030. The targets vary greatly in their temporal scope, level of ambition and pace of achievement. For example, after Kazakhstan exceeded its 2020 target for solar capacity, it raised its target for the share of renewables in electricity production from 10% to 15% by 2030. Uzbekistan set a target for 8 GW of wind and solar power by 2030, which would entail doubling the country's renewable generation capacity.

All of the focus countries initiated the process of updating and enhancing their Nationally Determined Contributions (NDCs) towards reducing greenhouse gas emissions under the Paris Agreement. This creates an opportunity to align countries' national priorities for renewables and efficiency with their emission reduction goals and their net zero carbon commitments. Some of the region's largest emitters have made net zero commitments, including Kazakhstan, Ukraine and the Russian Federation.

Another major climate policy decision, and a widely debated topic of 2020-2021, was the introduction of the EU's Carbon Border Adjustment Mechanism. Although its impact will vary across sectors and countries, the measure is expected to greatly increase the deployment of renewable energy and energy efficiency technologies across Europe as a means to increase the competitiveness of goods in the EU market.

A key shift in renewable energy support policies has been the increasing use of auctions, as policy makers seek to procure renewable electricity at the lowest price. Auctions have been introduced in nearly half of the focus countries, including in some of the region's biggest electricity markets. The growth in auctions is attributed mainly to their ability to reveal competitive price trends and to achieve objections beyond price recovery. Despite the gradual shift to auctions, many renewable energy support schemes still rely on feed-in tariffs, although the focus of these is shifting towards small-scale renewable energy systems, as has occurred in Albania, Serbia and Moldova.

Another important policy trend in the region is the growing number of dedicated net metering schemes for decentralised small-scale renewables. Fiscal incentives, in the form of tax exemptions, premiums, and others, also are a widespread form of renewable energy support policies. In addition, nearly all of the focus countries have adopted a range of energy efficiency policies across the main sectors of energy demand (power, buildings, industry and transport), although additional action is needed to tap into the region's vast potential for energy efficiency.

03 RENEWABLE ENERGY MARKET AND INDUSTRY OVERVIEW

The focus countries greatly increased the pace of adoption of renewable energy technologies between 2017 and 2021. This expansion occurred mainly in the electricity sector, where more than 20 GW of renewable power capacity was added, reaching a total installed capacity of more than 100 GW. In contrast to the period covered in the previous report, when most of the installed renewable capacity additions were hydropower, the highest growth during 2017-2021 was in solar power (58%) and wind power (25%).

The top three countries for non-hydropower capacity additions remained the same, although the rankings shifted. Ukraine became the leading country with 8.3 GW of solar and wind power capacity installed between 2017 and 2021, followed by the Russian Federation with 3.5 GW and Kazakhstan with 3.7 GW. These countries together surpassed the 1 GW thresholds for both solar power and wind power capacity.

Progress in renewables has been less pronounced in the heating sector. Most of the region's renewable heat came from biofuels and sometimes biogas. Solar thermal capacities for hot water production increased in only a few countries, including Albania, North Macedonia and the Russian Federation. Geothermal energy used directly as heat remained at the same level in most cases.

Renewable energy statistics for the transport sector were not available for all focus countries. Overall, however, the conditions for the transition to sustainable mobility continued to vary, with most countries still in the initial stages of decarbonisation of the sector.

04 DISTRIBUTED RENEWABLES FOR ENERGY ACCESS

The high rate of electrification in the focus region, at nearly 100%, does not tell the full story of the sustainability of energy access. Access to reliable and sustainable energy remains a challenge in some countries, areas and populations, which has implications for food security, economic development, human health and poverty reduction. Even in many areas connected to the electricity grid, insufficient generation capacity and deteriorating transmission infrastructure have effectively broken the link between grid access and reliable energy supply.

Access to a modern, sustainable and affordable heat supply also is a major environmental and energy challenge in the region, particularly in rural and mountainous areas where much of the population continues to rely on fuelwood for space heating, cooking and water heating. In Bosnia and Herzegovina, around 75% of households rely either partly or fully on traditional biomass for heating or cooking. Rural areas in the Southern Caucasus and Central Asia face similar challenges. In Georgia, an estimated 95.9% of rural households relied on fuelwood for heat in 2019, compared with only 25.7% of urban households.

Across the focus region, the incidence of energy poverty is high. This is due to a combination of low average household incomes, limited access to affordable energy, and the low thermal performance of homes and heating appliances. In Albania, a study of energy poverty found that 62% of surveyed households had difficulties paying energy bills. Across Ukraine, except for Kyiv, 40-50% of people could not afford to pay their electricity bills nearly every month or at least a few times a year as of 2020. In the Western Balkans countries, the share of households unable to keep their homes adequately warm is among the highest in Europe, reaching as high as 50% in Kosovo.

Distributed renewables for energy access (DREA) systems are critical to improve the reliability of the grid and to provide access to modern, sustainable, and affordable energy supply, particularly for the most vulnerable and poor households. DREA holds large potential across the focus countries. However, the sector has remained at a nascent stage. Early lessons from the development of the region's distributed renewable energy sector suggest that investment in such systems by households does not yet represent a viable business case for such consumers. Additional financial and technical support is required to scale up DREA and improve energy access.

05 ENERGY EFFICIENCY

All of the focus countries have seen dramatic decreases in their energy intensities in recent decades; however, these intensities (except in Albania) remain higher than in the EU-27. The region's large potential for energy efficiency has yet to be harnessed. Without taking steps to first improve the efficiency of energy use, the focus countries will face challenges addressing energy demand at affordable costs with the available energy supply options, including renewables. Governments have adopted a range of energy efficiency policies across all sectors, shaped largely by two regional entities: the European Commission and the Eurasian Economic Commission.

06 INVESTMENT FLOWS

Investment in renewables in the focus countries has been uneven. Regional renewable energy investment declined between 2013 and 2016, to USD 2.7 billion, and then returned to the 2013 level of USD 7.2 billion in 2018, contributing around 2.2% of the global total that year. Ukraine ranked 18th and the Russian Federation ranked 22nd among leading renewable energy investors globally in 2018. In 2019, both countries moved up in the ranking (to 17th and 20th respectively), and Kazakhstan entered the top 30 list at the 28th rank.

International development finance and dedicated international climate finance are important sources of renewable energy investment in the region. Between 2000 and 2019, a total of USD 5.0 billion in foreign aid was committed to support the development of renewables in the focus countries. Nearly half of this was registered between 2016 and 2019 (i.e., since the previous regional REN21/UNECE report in 2017) to support more than 200 projects and initiatives, with the largest share for the countries of Central Asia. At the country level, the largest volumes of foreign aid in absolute terms between 2016 and 2019 were committed to Kazakhstan, Tajikistan, Ukraine, Serbia, and Belarus, with each country attracting more than USD 100 million.

Five multilateral development banks committed a total of USD 1,732 million to support renewable energy projects in the focus countries, with the European Bank for Reconstruction and Development (EBRD) providing the largest share (54%), followed by the World Bank (18%), the European Investment Bank (12%), the Asian Development Bank (9%) and the Asian Infrastructure Investment Bank (6%). In Ukraine, the EBRD provided debt financing through the bank's Ukrainian Sustainable Energy Lending Facility (USELF), which disbursed USD 241 million of debt for 14 solar PV projects between 2017 and 2020. Among bilateral donors, the top supporter of renewables in the region was Germany, followed by Japan and Austria.

The region also has benefited from access to international climate finance through the Green Climate Fund (GCF), the Clean Investment Funds (CIF) and the Global Environmental Facility (GEF). Between 2016 and 2019, these institutions disbursed USD 191 million to support renewable energy projects in Armenia, Kazakhstan, Tajikistan and Ukraine, with the GCF contributing 56% of the total, followed by the CIF (42%) and the GEF. The GCF's largest renewable energy investment in the region was for the GCF-EBRD Kazakhstan Renewables Framework (KAZREF), aimed at supporting the construction of 8 to 11 renewable energy projects, with a total capacity of 330 MW, representing nearly half of the country's renewable capacity.

Several other environmental funds provided support for renewable energy projects during 2017-2021. These included the Green for Growth Fund, a specialised fund for financing renewables, which covers South-East Europe and the Caucasus, as well as the Western Balkans Investment Framework, an EU blending facility supporting EU enlargement in South-East Europe.

The region has been following global trends in accessing financing for climate and renewable projects from capital markets by issuing climate and green bonds. Of the seven countries worldwide that started issuing green bonds in 2020, three were from the focus region: Armenia, Georgia and Kazakhstan. The issuers were financial sector institutions based in Armenia and Kazakhstan and non-financial corporates based in Georgia. Several issuers in the Russian Federation also have issued green bonds since 2018, including a financial sector institution, a state-owned enterprise and a municipality of Moscow. Cumulatively, green bonds helped raise USD 658 million for environmental projects in these four countries in 2020.

07 CURRENT THINKING ABOUT THE FUTURE OF RENEWABLES

Building on the outcomes of a series of Hard Talks convened by UNECE in 2020 across the region, the UNECE Renewable Energy Status Report 2022 provides a forward-looking outlook on the development of renewables in the focus countries by analysing drivers, barriers, needs and opportunities in the sector. The report also reflects on the impact of the 2022 Russian invasion of Ukraine on the prospects for renewable energy growth in the country and in the region more broadly.

Drivers

Decarbonisation of the energy sector is central to achieving net zero emissions globally by mid-century. Renewables are destined to play the key role in this process. For the world to achieve net zero by 2050, annual renewable electricity installations must triple by 2030. The focus countries need to be in line with these acceleration trends in order to meet their international climate commitments.

All of the focus countries, whether they are net energy importers or exporters, place a high priority on energy security. This driver will play a growing role in national energy and development strategies, especially in light of the increasingly challenging regional security situation. Additional drivers for renewables are rising public awareness about the link between fossil fuels and local air pollution, and the need to address energy poverty and provide vulnerable groups with reliable, sustainable and affordable energy.

Barriers

In most of the focus countries, renewables still struggle to compete with conventional energy sources in the power and transport sectors due to low and subsidised tariffs for fossil fuels. Competition with other energy sources, such as nuclear power, also represents a barrier to renewables. In addition, some renewable energy projects face opposition from the public or local communities, for example in the case of new hydropower plants, where the objectives of protecting the local environment and promoting renewables may conflict. Investment risks and uncertainties add to the list of barriers faced by renewable energy developers in the focus countries.

Opportunities and Needs

Scaling up the deployment of renewables can be constrained by the capacity of national power grids to integrate rising shares of variable renewable electricity; key challenges include ageing infrastructure and the need to provide for sufficient capacity to balance variable supply with demand. There is also a need to develop domestic and regional technology supply chains for renewables. Currently only few of the focus countries possess industrial capacities for at least partial manufacturing or assembly of renewable energy technologies, such as solar panels, wind turbines, efficient stoves, and others, whereas most countries import these technologies.

Lastly, policy support is critical to unlock the renewable energy potential in the region and address barriers to deployment. The main existing policy gaps are related to the absence or vagueness of national strategy and targets for renewables and to insufficient implementation capacities to make those policies and regulations work.

Benefits

Renewable energy has the potential to deliver multiple socio-economic benefits to the focus countries. The transition to renewables can help narrow the gender gap in participation in the energy sector, since the share of women employed in renewables is noticeably higher than that in oil and gas. Job losses from the fossil fuel sector could be offset by job gains in the renewable energy sector. The biggest decline in employment related to decarbonisation and the transition to a green economy is expected to occur in the extractive sector (coal mining and oil and gas extraction), with the biggest gain in the solar and wind manufacturing sector.

Post-COVID and Post-Conflict Agenda

The economic crisis associated with the COVID-19 pandemic offers an opportunity to include renewable energy development in national recovery plans. However, in the focus countries, recovery plans have not yet had a positive effect on renewables, as these plans have not explicitly supported such measures.

At the time of writing this report, the renewable energy sector in the region was experiencing impacts related to the Russian Federation's invasion of Ukraine starting in February 2022. By June 2022, the conflict had resulted in partial or complete destruction of 5% of Ukraine's total power generation capacity, while nearly all of the country's wind power capacity (90%) was out of operation, as was more than 30% of its solar PV capacity and more than 50% of its thermal capacity. Given that in 2021 Ukraine accounted for 30% of the focus region's total wind power capacity and 60% of its total solar PV power capacity, the conflict has affected at least a quarter of regional wind power capacity and a fifth of solar PV capacity.

This unfolding security and political situation, which also affects neighbouring regions, could greatly undermine the investment environment and thus renewable energy development in the focus region. The actual and potential interruptions of energy supply – including of natural gas, oil and electricity – make the energy security challenge as critical as ever. This will likely boost the long-term prospects for renewable energy development both in individual countries and in the UNECE region overall.

01 REGIONAL INTRODUCTION

OBJECTIVE OF THE REPORT

The United Nations Economic Commission for Europe (UNECE) includes 56 member countries in Europe, North America and Asia. It promotes greater pan-European economic integration and co-operation among its member countries as well as sustainable development and economic prosperity. A key objective of the UNECE's energy programme is to facilitate the transition to a more sustainable energy future and to introduce renewable energy sources to reduce the health and environmental impacts from the production, transport and use of energy in UNECE countries.

In 2014, the UNECE established the Group of Experts on Renewable Energy (GERE), which serves as a collaboration platform among UNECE member countries to carry out result-oriented and practical activities to increase the uptake of renewables. Together with the Renewable Energy Policy Network for the 21st Century (REN21) and Deutsche Energy-Agentur (dena – The German Energy Agency), GERE holds Hard Talks, or multi-stakeholder dialogues on renewable energy challenges in different UNECE countries, apart from the REN21 UNECE Renewable Energy Status Report which tracks the progress in renewable energy development across the whole UNECE region and its parts.

The *2022 UNECE Renewable Energy Status Report* presents and interprets recent information and data on renewables in 17 UNECE countries, divided among the following five sub-regions:

- South-East Europe: Albania, Bosnia and Herzegovina, Montenegro, North Macedonia and Serbia;
- Eastern Europe: Belarus, Moldova and Ukraine;
- The Caucasus: Armenia, Azerbaijan and Georgia;
- Central Asia: Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan;
- and The Russian Federation.

The report also includes information and data for Kosovo[i], both individually and as part of total figures. Kosovo lies in the sub-region of South-East Europe but is not a member country of the UNECE.

The report aims to provide a comprehensive overview of recent trends in renewable energy in the UNECE region, covering the areas of market and industry, policy and investment *(→ see Sidebar 1)*. It also assesses data and information on energy efficiency and climate mitigation as relevant to the development of renewables.

The report updates two previous renewable energy status reports on UNECE countries published in 2015 and 2017.[1] Structurally, it differs from these earlier reports by adding a concluding chapter that reflects the current thinking of experts about the challenges and future of renewable energy development in the region (→ see Chapter 7). This edition also includes new commitments (such as net zero pledges) and the use of unconventional transport fuels such as renewable electricity, hydrogen and biofuels. In addition, the report reflects new circumstances in light of the COVID-19 pandemic, its impacts and subsequent recovery efforts. It also discusses the impacts of the Russian Federation's invasion of Ukraine, which began in February 2022, on renewable energy development in the region[ii].

The report is part of a series of regional status reports developed by REN21 on the UNECE countries, the Asia and Pacific region, the Economic Community of West African States (ECOWAS), the East African Community (EAC), the Southern African Development Community (SADC) and the Middle East and North Africa (MENA). It also bridges REN21's annual ***Renewables Global Status Report*** series.

SIDEBAR 1.
Data Collection, Analysis and Validation for the *UNECE Renewable Energy Status Report*

The information presented and analysed in this report was collected from various sources including reports, documents, and press releases of governments, international organisations, donors, and industry, as well as peer-reviewed publications. The data were obtained mainly from the databases of the IEA, reflecting valuable co-operation in analysing countries' energy statistics. The report further relies on data from the open databases of the World Bank, the International Renewable Energy Agency (IRENA) and the Organisation for Economic Co-operation and Development (OECD). These sources were complemented with the results of semi-structured interviews conducted with more than 20 experts from the focus countries and abroad. The report was validated by these and other relevant experts.

Despite efforts to produce the most comprehensive summary of renewable energy developments in the focus countries, the report preparation process revealed data gaps in key areas, including renewable heating and cooling, distributed renewables for energy access, energy poverty and investment. Thus, the conclusions are to be considered in light of the information available. The report serves as a reference for tracking not only progress in renewable energy, but also the status quo of the availability and quality of data and information.

The countries of the Caucasus, Central Asia, Eastern Europe, South-East Europe and the Russian Federation possess different geographical, economic, social and institutional characteristics.

i This designation is without prejudice to positions on status and is in line with UN Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo declaration of independence.

ii Throughout the report, this wording is without prejudice to positions on the incident and is in line with the Statements of the UN General Secretary (Secretary-General's opening remarks at press encounter with Russian Foreign Minister on 26 April 2022, https://www.un.org/sg/en/content/sg/speeches/2022-04-26/remarks-press-encounter-russian-foreign-minister and Secretary-General's opening remarks at press conference with President of Ukraine on 28 April 2022, https://www.un.org/sg/en/content/sg/speeches/2022-04-28/opening-remarks-press-conference-president-of-ukraine).

REGIONAL OVERVIEW

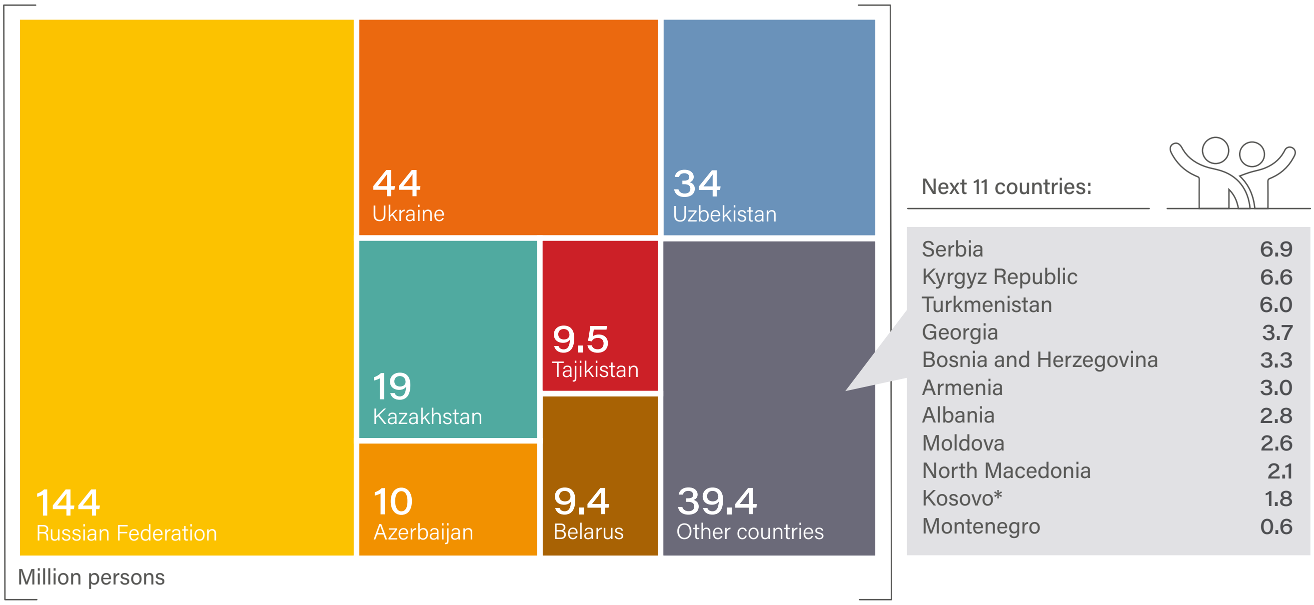
However, the focus countries (including Kosovo) share some similar features, having formerly been integrated under three socialist countries following the Marxist-Leninist model: the Union of Soviet Socialist Republics (USSR), comprising the Russian Federation as well as countries in the Caucasus, Central Asia and Eastern Europe; the Socialist Federal Republic of Yugoslavia, comprising Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia; and the People's Socialist Republic of Albania (now the Republic of Albania). Because of this decades-long shared past, commonalities exist among countries in both their energy systems and their challenges in deploying renewables.

Three key factors determine the size and sufficiency of a country's energy system: population size, human and economic well-being, and access to resources. In 2020, the focus countries had a combined population of 310 million, with the largest numbers of people in the Russian Federation (144.1 million), Ukraine (44.3 million) and Kazakhstan (18.8 million), and the smallest numbers in Montenegro (0.62 million), Kosovo (1.8 million) and North Macedonia (2.1 million) *(→ see Figure 1)*.[2]

Together, the focus countries represented only 4% of the global population in 2020, and this share has been declining, with the combined population of the countries growing only 0.33% annually between 2015 and 2020 compared with global growth of 1.1%.[3] However, population dynamics vary within the region, with the populations of Central Asian countries rising 1.8% annually and those of the Caucasus (except Georgia) rising 0.77% annually during this period.[4] The populations of Montenegro, North Macedonia and the Russian Federation remained steady, while those in the rest of the countries declined (with the highest annual declines in Moldova at 1.6% and Bosnia and Herzegovina at 0.89%).[5]

The relationships between per capita energy consumption (especially electricity use) and human and economic well-being are widely established.[6] The Human Development Index (HDI) of

FIGURE 1.
Populations of the Focus Countries, 2020



Source: See endnote 2 for this chapter.

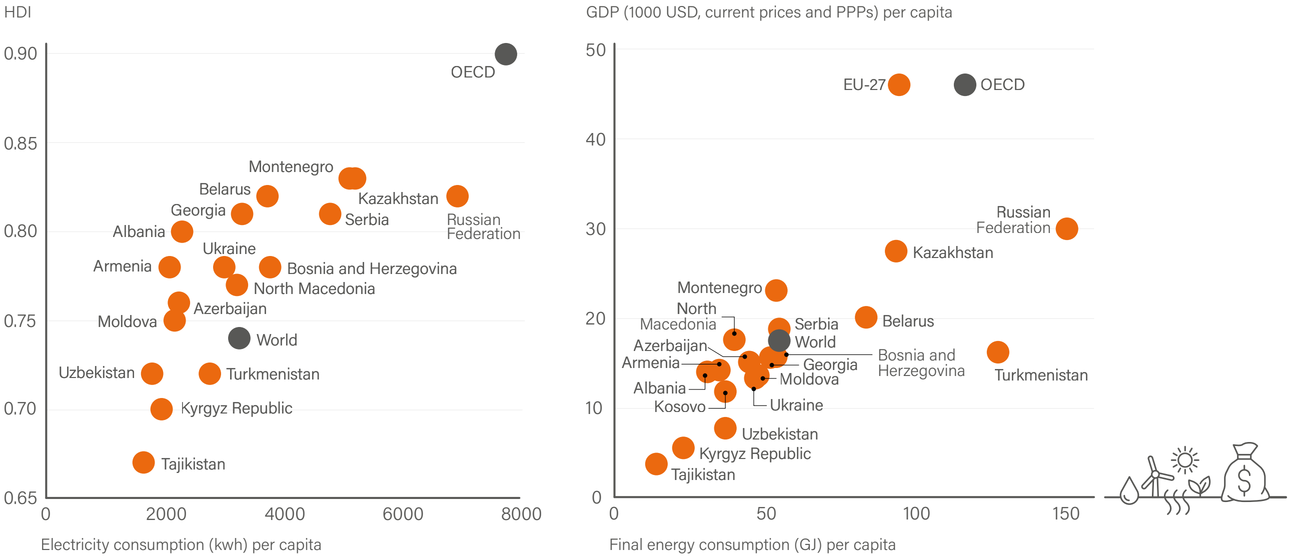
the United Nations Development Programme (UNDP) measures three key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. The relationship between HDI and energy consumption is four-staged, with nations from the low HDI category (HDI below 0.550) seeing a steep rise in human development with increased energy consumption, nations from the medium HDI category (0.550 to 0.699) seeing a moderate rise, nations from the high HDI category (0.700 to 0.799) seeing a low rise, and nations from the very high HDI category (0.800 to 0.100) having essentially no rise or recede.[7] Furthermore, within the latter category, per capita energy consumption varies up to factor ten.[8] The relationship between economic well-being (measured as per capita gross domestic product, GDP, or the amount of goods and services produced in a country per person) and energy consumption is similar to that between HDI and energy consumption. The differences in per capita energy consumption of countries with very high HDI or developed countries are explained by differences in their lifestyles, energy efficiency levels, and economic structure.[9] During the last decades, these nations have been increasing their share of high-value economic activities, while reducing the resource mining and energy intensive manufacturing.[10] In contrast, many developing and transitioning economies have been extracting vast amounts of resources and exporting large volumes of manufactured products to developed countries.[11] In effect, developed countries with low per capita energy consumption have managed to not only employ domestic energy efficiency measures but also at the expense of countries with higher per capita energy consumption exporting energy-intensive products.[12]

Figure 2 illustrates these relationships for the UNECE focus countries compared with the world and OECD averages, suggesting that an upward trend in human well-being and GDP per capita will likely increase electricity (and energy) consumption per capita.[13] Recently, economic growth in the focus countries has begun to decouple from energy consumption *(→ see Chapter 5)*. However, this process has not been completed for all countries, and growth in energy consumption will likely accompany growth in economic well-being for many years to come.

Renewable energy markets are influenced by a country's level of economic development, due to the significant investment required and the ability of households and businesses to afford renewables. Overall, the economic barrier to renewable energy deployment in the region remains high.[14] For most of the focus countries, per capita GDP in 2019 was between USD 10,000 and USD 25,000 *(→ see Figure 2)*.[15] Only the Russian Federation and Kazakhstan had higher figures, at nearly USD 30,000.[16] In three Central Asian countries, per capita GDP was below USD 10,000, reaching only USD 3,581 in Tajikistan.[17]

FIGURE 2.

Human Development Index versus Per Capita Final Electricity Consumption (left) and GDP Per Capita versus Per Capita Final Energy Consumption (right), 2019



Note: The Human Development Index (HDI) is the geometric mean of normalised indices for each of three dimensions: a long and healthy life, being knowledgeable and having a decent standard of living.
Source: See endnote 13 for this chapter.

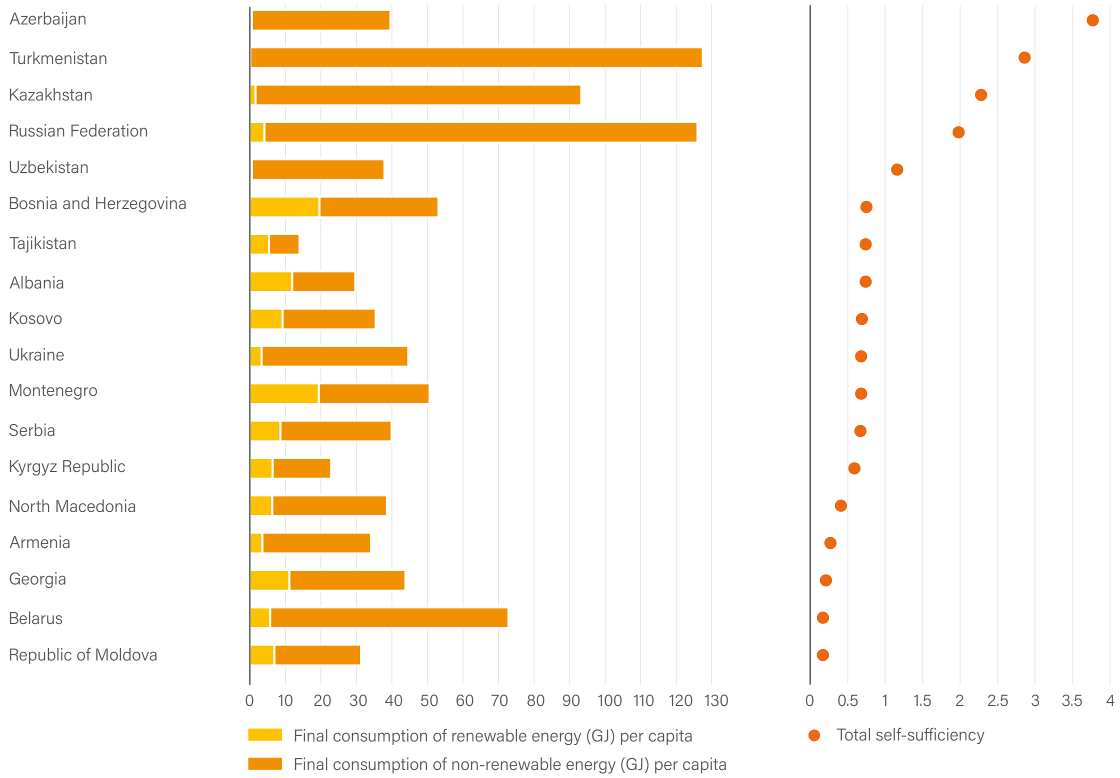
Economic well-being also depends strongly on the rate of urbanisation, because urban areas offer higher incomes and greater access to services, providing for higher consumption of food, water, housing, transport, entertainment and more. Higher consumption, in turn, drives demand for energy, especially electricity. In 2020, the UNECE focus countries were 57% urbanised, close to the world average.[18] However, the urban population share is expected to increase in line with growing economic well-being, as reflected in the urbanisation rates of OECD countries (81%) and the European Union (EU-27) (75%).[19] All of the focus countries except Moldova experienced rising urban shares during 2015-2020, reaching 80% in Belarus, 75% in the Russian Federation and 70% in Ukraine.[20] Urbanisation in countries of the Caucasus and South-East Europe was around 60%, whereas the highest rural shares were in Central Asia, at 73% in Tajikistan and 63% in the Kyrgyz Republic.[21]

For the focus countries, living in colder climates is more energy demanding than living in warmer climates, due to the requirements for space heating during the winter. The Russian Federation, Kazakhstan and the Kyrgyz Republic are among the world's coldest countries, with some areas in Russia requiring up to 12,000 heating degree days, as compared to less than 3,000 heating degree days in some locations in South-East Europe.[22] While recent evidence suggests that climate change may reduce the need for space heating, this same literature points to the growing demand for space cooling, with the highest needs in Central Asia and South-East Europe.[23]

Access to energy resources that could be used for economic production or consumption depends on a country's geography and climate. Fossil fuels are unevenly distributed across the focus region, with deposits dependent on past climate and geological processes.[24] The region's role in the global supply of fossil fuels has not changed since the previous analysis in 2017. Five countries – Azerbaijan, Turkmenistan, Kazakhstan, the Russian Federation and Uzbekistan – are net energy exporters *(→ see Figure 3)*, with high reserves of natural gas and oil.[25] Six countries – Bosnia and Herzegovina, Kazakhstan, Montenegro, the Russian Federation, Serbia and Ukraine – have significant coal reserves.[26] Belarus and the Russian Federation also have significant peat deposits.[27]

In contrast to fossil fuels, renewables such as solar, wind, hydropower, geothermal and bioenergy have significant deployment potential in nearly all of the focus countries.[28] Nevertheless, as of 2019 most countries were still heavily dependent on fossil fuels, with relatively small shares of renewables in their total final energy consumption. Net energy

FIGURE 3.
Energy Self-Sufficiency and Final Consumption of Renewable and Non-Renewable Energy in the Focus Countries, 2019



Note: Self-sufficiency is a ratio of a country's production of energy to its total energy supply. A figure greater than 1.0 denotes a net energy exporter, and a figure of less than 1.0 denotes a net energy importer. Renewable energy was estimated as the consumption of renewable electricity, renewable heat and renewable energy in transport. The consumption of renewable electricity covers the final consumption of renewable electricity in all sectors excluding transport. The consumption of renewable heating covers final consumption of renewable energy for heat raising purposes (excluding electricity) in manufacturing, construction and non-fuel mining industries, household, commerce and public services, agriculture, forestry, fishing and not elsewhere specified. The consumption of renewable energy in transport covers final consumption of renewable energy (including electricity) in the transport sector. For details, see the methodology of Tracking SDG7 and the REN21 Renewables Global Status Report.
Source: See endnote 25 for this chapter.

exporters tend to have lower renewable shares as compared to net energy importers; however, the share of renewables in total final energy consumption does not correlate with self-sufficiency in the net importing countries *(→ see Figure 3)*.[29] Although several countries show high renewable shares, these reflect either high shares of hydropower in electricity generation, the use of biomass in heating, or a combination of both – rather than extensive wind, solar or other renewable energy sources *(→ see Chapter 3)*. In 2019, the average share of renewables in total final energy consumption in the focus countries was 18.2%, a figure that has not changed much since the level reported for 2014.[30]

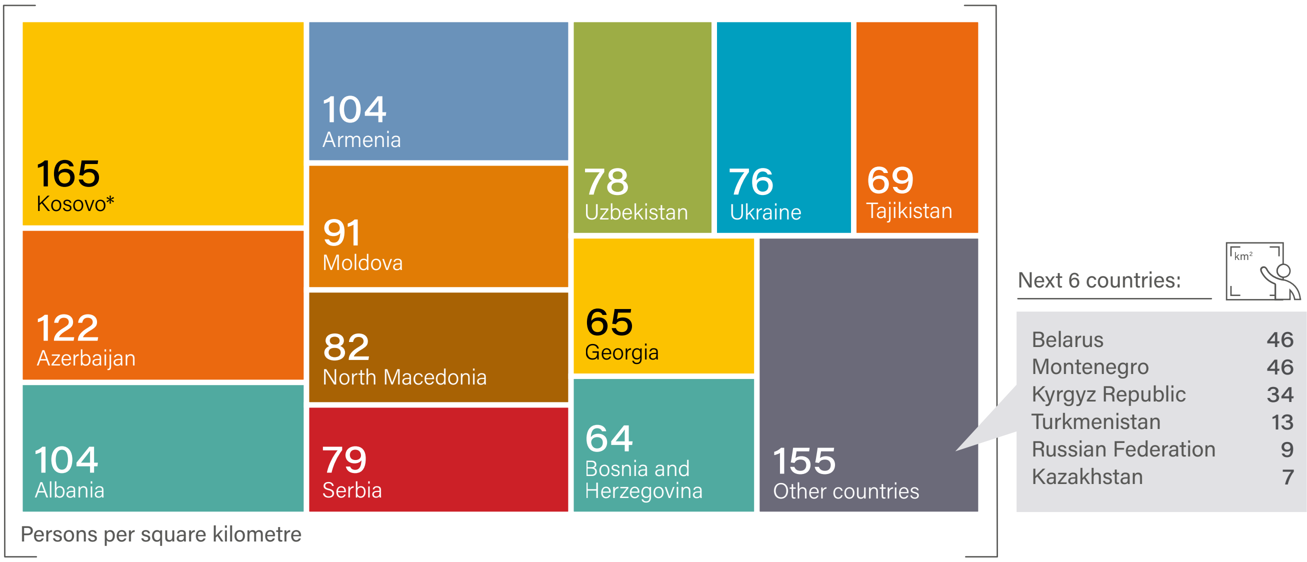
Population density reflects the human pressure on ecosystems and resources, which also defines access to renewable energy. Power density, measured as energy production per square metre, varies greatly by energy source, with nuclear, natural gas and coal being the most efficient, wind and solar showing medium efficiency, and biofuels being the least efficient[iii].[31] In addition to such geographical and technological limitations, many people are unwilling to live near large renewable energy installations, such as wind turbines. Therefore, opportunities for renewables are somewhat limited in crowded provinces, open landscapes or populated urban areas; however, the expansion of renewable energy in the focus countries is not yet close to reaching these limits.[32]

In 2020, population densities were lowest in the Russian Federation (8.8 persons per square kilometre) and Kazakhstan (6.6 persons), which are the largest and ninth-largest territories, respectively, among the focus countries.[33] The countries with the highest population densities, above 100 persons per square kilometre, were Kosovo, Azerbaijan, Albania and Armenia. *(→ see Figure 4)*.[34]

Investment in renewable energy in the region slowed between 2013 and 2016 but then rose to pre-2013 levels from 2018 on *(→ see Chapter 6)*. Given the declining cost of renewables, such investment volumes have made it possible to install much higher capacity. Cumulatively, across the focus countries, more than 20 gigawatts (GW) of renewable power was added between 2017 and 2020, resulting in a total installed renewable power generation capacity of more than 100 GW *(→ see Chapter 3)*.

iii Thus, energy production at nuclear, coal, and natural gas power plants, disregarding extraction and transport land use, is the most efficient, at 1,000 watts (W) per square metre (m^2), 100-1,000 W/m^2 and 4,000-5,000 W/m^2 respectively. Variable energy production is possible in the amount of 1.6-2.5 W/m^2 for wind turbines and 2.5-6 W/m^2 for solar photovoltaic (PV) panels. The least efficient is the production of biofuels, including ethanol production from corn at 0.3-0.36 W/m^2 and biomass burning at 0.17-2.7 W/m^2.

FIGURE 4.
Population Densities of the Focus Countries, 2020



*The data for Kosovo are for 2017.
Source: See endnote 33 for this chapter.

Ukraine, the Russian Federation and Kazakhstan ranked among the world's top 30 renewable energy investors in 2019 *(→ see Chapter 6)*.

Most of the focus countries have made progress in deploying renewables. The World Bank's Regulatory Indicators for Sustainable Energy (RISE) reflect multi-dimensional aspects of renewable energy policies and regulations. All of the focus countries except Turkmenistan improved their RISE renewable energy scores between 2015 and 2019 *(→ see Figure 5)*.[35] Four countries moved from the lowest tier to the middle tier, but no country moved from the middle tier to the highest tier.[36] Ukraine and Armenia were the top renewable energy performers in 2019, each with an indicator value of 66.[37]

Without first realising the potential for energy efficiency, addressing rising energy demand at an affordable cost will be challenging. The focus countries have made great progress in reducing their energy intensities, although these remained higher than in OECD countries for many sectors *(→ see Chapter 5)*. Similar to the RISE renewable energy indicators, the RISE energy efficiency indicators measure progress in efficiency based on 12 dimensions of policies and regulations. All countries except Tajikistan improved their rankings between 2015 and 2019 *(→ see Figure 5)*.[38] Four countries moved from the lowest tier to the middle tier, and one country (Belarus) moved from the middle tier to the highest tier.[39] Belarus was the top energy efficiency performer in 2019, with a score of 70.[40]

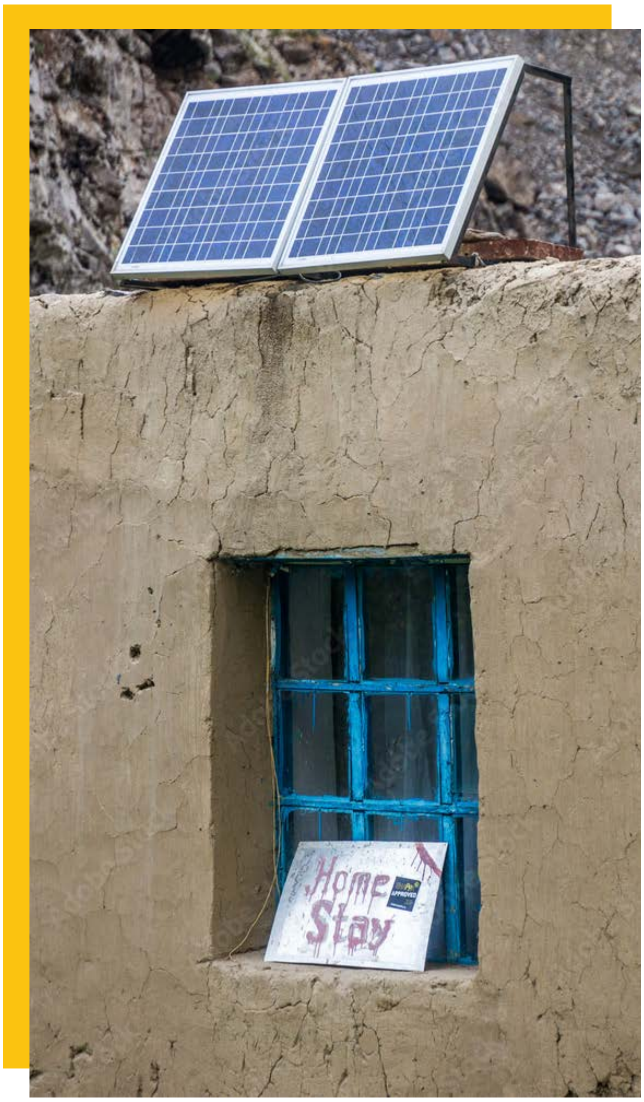
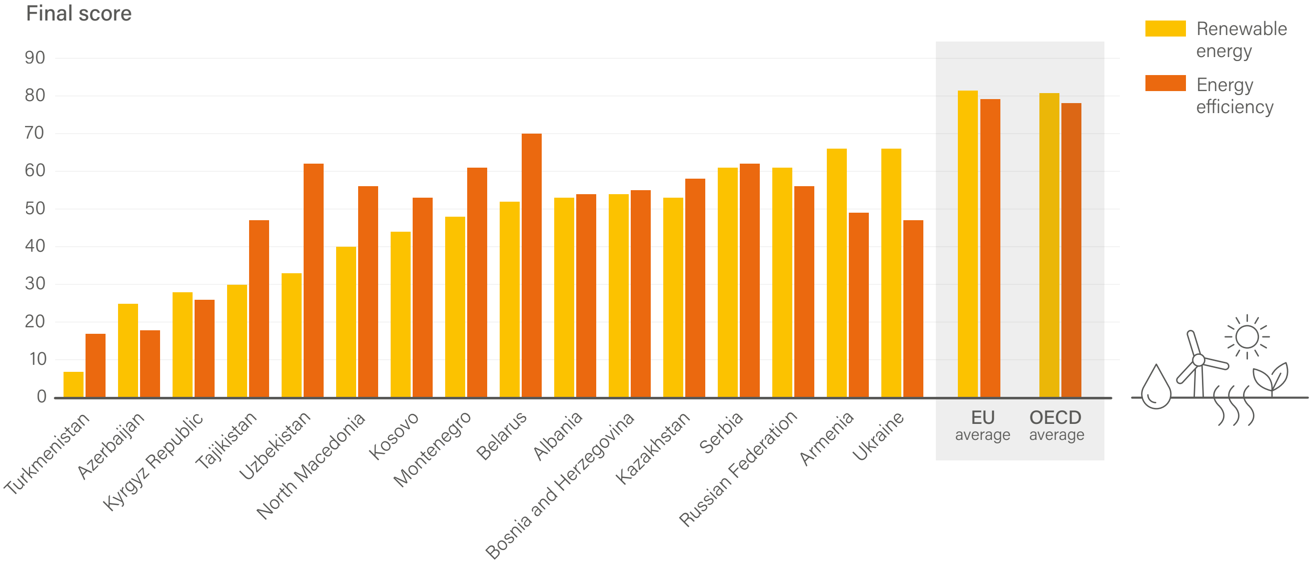


FIGURE 5.
RISE Renewable Energy and Energy Efficiency Multi-Dimensional Indicators in the Focus Countries, 2019



Note: For both indicators, the lowest tier values are 0-33, the middle tier values are 34-66, and the highest tier values are 67-100.
Source: See endnote 35 for this chapter.

REGIONAL ENERGY CHALLENGES

Although the focus countries have achieved great progress in both renewables and energy efficiency, many energy challenges remain. Addressing these is not easy but represents an opportunity for building sustainable and resilient energy systems, well-functioning energy markets, and stable and secure energy supplies.

High dependence on energy imports is a large constraint for 13 of the focus countries *(→ see Figure 3)*. Four countries – Armenia, Belarus, Georgia and Moldova – import more than 70% of their total primary energy supply.[41] Their reliance on a limited number of exporting countries, such as the Russian Federation and Azerbaijan, represents a risk for energy security. Both renewables and energy efficiency offer an opportunity to address this risk, even though their costs could be higher than those of conventional energy sources that achieved competitive prices in the past.[42]

In some countries, the deployment of renewables has slowed due to large-scale investment in competing conventional energy sources. In Belarus, ongoing construction of the 2.5 GW nuclear power plant in Ostrovets, with the first block commissioned in 2020, stalled the deployment of wind power and solar PV.[43] Further deployment of renewables in the country can only be expected in the case of sustainable economic growth.[44]

Another large barrier to renewables and efficiency is energy subsidies that favour fossil fuels, regardless of whether a country is a fossil fuel exporter or importer. Although the size of energy subsidies as a share of GDP has declined in all of the focus countries in recent years, these shares were still significant in 2020, particularly in Uzbekistan (6.6%), Turkmenistan (3.2%), Kazakhstan (2.6%), Azerbaijan (2.4%), Ukraine (1.3%) and the Russian Federation (1.0%).[45] Early during the COVID-19 pandemic, declining household and business incomes led some governments (such as Armenia and Kazakhstan) to adopt further subsidies, although in many cases these were later removed.[46]

The affordability of investing in renewable energy is a concern in the focus countries, not only because of their lower economic well-being (compared to OECD countries) and high energy subsidies, but also due to the riskier investment environment. In 2017, the UNDP and Global Environment Facility (GEF) project De-risking Renewable Energy Investment estimated that the financing costs for utility-scale wind power and solar PV in Kazakhstan were 16% for the cost of equity and 7% for debt.[47] These costs were more than two times higher than in Germany, where they were estimated at 7% and 3% respectively.[48] The higher financing costs reflect a range of investment risks and greatly impact the competitiveness of wind and solar PV power.[49]

The capacity of national power grids to integrate variable renewable electricity represents a growing challenge for energy systems.[50] Such integration implies new tasks such as modifying grid planning and operations to support greater flexibility, faster dispatch, and voltage control, among others. This barrier is universal across the UNECE region and, if not addressed, will become increasingly apparent with greater deployment of renewables *(→ see Chapter 7)*.[51]

Expanding the use of clean and renewable energy sources could mitigate the trade-off between energy security and air quality. For this reason, some international donors have limited the access to finance for new polluting energy generation plants. The UNECE sub-regions covered in this report include the most polluted spots in Eurasia, such as the Central Balkans, Eastern Ukraine and the southern part of Central Asia.[52] In Kosovo, two highly polluting coal plants produce nearly all of the country's electricity, leading to high particulate matter and other emissions in the capital city Pristina.[53] Because Kosovo has the fifth largest lignite reserves in the world and frequent power shortages, the government initiated a series of contracts to build and operate a new 450 megawatt (MW) lignite-based power plant.[54] However, the World Bank pulled out of the project in 2017, and the European Bank for Reconstruction and Development (EBRD) confirmed that it too would not support the plant, citing renewable energy as the preferred option and resulting in a halt in construction.[55]

The focus countries have among the highest rates of electricity access in the world, with near-100% electrification as of 2020.[56] However, in some countries power outages were more prevalent in 2018-2019 than in 2013-2014, resulting in higher losses of electricity sales.[57] Territories with ongoing armed conflicts, such as Ukraine, have been more vulnerable and more exposed to the risk of outages because of physical damage to energy infrastructure.[58] Access to clean fuels and technologies also remains constrained in the Western Balkans region: in Bosnia and Herzegovina, only 17.6% of the population was using clean fuels as of 2019 *(→ see Chapter 4)*.[59]

Social acceptance is a key factor in the transition to a renewable energy future and in the development of these technologies locally. Some projects in the region – especially new hydropower plants – have faced opposition from the public or local communities. In Georgia, many people rallied in 2021 against building two hydropower plants that critics said posed major environmental risks.[60] Raising public awareness and understanding of the benefits of renewables offers more space for such technologies to emerge in the public and political discourse.

Institutional frameworks and market structures also play an important role in the development of renewables and in the functioning of the energy sector overall. In some countries, institutional weaknesses and the presence of monopolies have sabotaged market liberalisation processes, slowing the development of the renewable energy market and the emergence of new technologies. Additional factors affecting the deployment of renewables include split responsibilities among institutions, ineffective communication among governmental bodies, and complex bureaucratic procedures (for example, for licencing and permitting) *(→ see Chapter 2)*.

Shifting from fossil fuels towards the development of a domestic renewable energy industry requires long-term vision, commitment and planning by governments to help ensure greater investment security for the private sector. The focus countries that are signatories to the EU's Energy Community Treaty[iv] have been required to adopt National Renewable Energy Action Plans (NREAPs), National Energy Efficiency Action Plans (NEEAPs) and National Energy and Climate Plans (NECPs). However, other countries in the region have not yet developed similar documents envisioning the long-term development of renewables. Some countries have adopted laws and strategies on renewables and energy efficiency, but with a low level of detail (e.g., no quantifiable targets), low ambition (e.g., no bylaws or action plans) and/or inadequate time frames (too short or too long). This has left potential investors with wide-ranging uncertainties. A long-term vision and planning should be considered as an important milestone for the deployment of renewables and should also address the growing challenge of integrating renewables with conventional energy sources. *(→ see Chapter 2)*.

The economic fallout from the COVID-19 pandemic will likely jeopardise the growth of renewables in the region, in the short term. Before 2019, most of the focus sub-regions enjoyed GDP growth of 1-4% annually over a five-year period (except for Central Asia, which experienced growth of 5-7% led by Tajikistan, Turkmenistan and Uzbekistan).[61] In 2020, GDP fell 2-8% in most countries and 15% in Montenegro.[62] More finance is now required to support renewable energy investments. International donors, such as the World Bank and the EBRD, introduced financial instruments to support a "green" recovery from the pandemic; however, as of early 2022 countries had yet to strongly integrate renewables in their recovery plans *(→ see Chapter 6)*.

The Russian Federation's invasion of Ukraine in February 2022[v] have affected the security and political situations in neighbouring countries and regions also undermining short-term investment prospects and thus the deployment of renewables. However, over the long term the actual and potential interruptions to the energy supply related to the conflict make energy security an even more critical driver of renewables boosting long-term renewable energy developments in both individual countries and regionally *(→ see Chapter 7)*.

Overall, while great progress has been made since 2017 in increasing renewable energy capacity and policy development in the UNECE region, numerous challenges remain. There is still a long road towards developing regulatory frameworks and functioning markets; making the region more attractive for investment; gaining public acceptance; and other factors related to renewables.

Despite great progress since 2017 to increase renewable energy capacity and develop policy, **numerous challenges remain.**

iv As of early 2022, nine of the focus countries were contracting parties of the Energy Community Treaty (Albania, Bosnia and Herzegovina, Georgia, Kosovo, Moldova, Montenegro, North Macedonia, Serbia and Ukraine), and Armenia was an observer.

v See footnote ii.

PLATFORMS FOR REGIONAL ENERGY CO-OPERATION

Several initiatives and organisations have supported greater co-operation within the region in the areas of renewables, energy efficiency and climate (→ see Table 1).[63] These include EU-related initiatives, organisations targeting various sub-regions, regional integration activities and city-related efforts, as described below.

As of early 2022, nine countries in the focus region that are neighbours of the EU had signed the Energy Community Treaty and had transposed selected EU legislation to make it legally binding.

The Energy Community aims to create an integrated pan-European energy market, with the goals of establishing a regulatory and market framework, enhancing energy security, fostering the penetration of renewables and energy efficiency, improving regional competitiveness and exploiting economies of scale. A dedicated Renewable Energy Coordination Group aims to support parties in achieving renewable energy targets, sharing best practices and accelerating renewable energy investments.[64]

A key element of international energy co-operation in the focus countries has been the Energy Charter Treaty, a multilateral legally binding framework that promotes energy security based on the principles of sustainable development and open, competitive markets. As of early 2022, most of the focus countries were Energy Charter members, except for Belarus (which has not ratified the Treaty but applies it provisionally), the Russian Federation (which has not ratified the Treaty), and Serbia, which is an observer.[65]

The UNECE Group of Experts on Renewable Energy supports the penetration of renewables with the goal of providing energy access for all across the UNECE countries. Its workplan includes tracking the progress of renewable energy development, exchanging experiences, and discussing best practices to accelerate the development, co-operation and integration of renewables in energy systems. The group also organises multi-stakeholder dialogues and Hard Talks, bringing together major public and private stakeholders to discuss developmental issues, future investment plans, priorities and solutions in the sector. Between 2016 and 2022, Hard Talks were conducted in Albania, Azerbaijan, Bosnia and Herzegovina, Georgia, Kazakhstan, Moldova, Serbia, and Ukraine, with a positive impact on sectoral development and policies. More recently, the group's aims have included facilitating regulatory and policy dialogues, implementation, and support for achieving the goals of the Paris climate agreement and the United Nations Sustainable Development Goals (especially Goal 7 on energy access).[66]

Regional co-operation could be accelerated through electricity trade and the creation of regional electricity markets. The project on Creation of a Regional Electricity Market in the Western Balkans, launched in 2015, was signed by Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia with the goal of advancing regional co-operation and integrating the Western Balkan and Pan-European power markets.[67] The countries committed to establishing spot markets (power exchanges) and a regional balancing market. They also agreed to effectively use the Coordinated Auction Office in Southeast Europe (SEE CAO) for regional capacity allocation. Countries agreed to work together on removing local obstacles to regional electricity market development by implementing relevant policies and market regulations.[68]

The Central Asia Regional Economic Cooperation (CAREC) programme is a partnership of 11 countries[vi] across Central Asia, 7 of them in the focus region. Member countries seek to accelerate regional economic growth and poverty reduction, facilitate regional projects and policy initiatives, and increase energy trade. The programme provides technical assistance for capacity development and aims to create a favourable environment for the deployment of renewables, to build or upgrade transmission lines and sub-stations, and to introduce CAREC as a single market to suppliers of clean energy technologies.[69]

The EU4Energy programme, funded by the EU, focuses on the countries of the Eastern Partnership and Central Asia, including Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan. The programme aims to help partner countries implement sustainable energy policies and foster regional co-operation on energy sector development. The programme has provided extensive assistance and advice to Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine to enhance their regulatory frameworks, energy policies and infrastructure investments.[70]

The Eastern Europe Energy Efficiency and Environment Partnership (E5P) is a multi-donor fund created to accelerate investment in municipal energy efficiency and environmental projects in Eastern Europe. The partnership initiated its activity in Ukraine in 2009 and then extended its work in 2014 to Armenia, Georgia and Moldova. Belarus joined in 2017 and Azerbaijan in 2019. The initiative collects finance from the EU and from a group of 24 nations, including the beneficiary countries, and disburses it to projects as co-financing in form of grants. These grants are blended with debt financing provided to municipal clients by participating implementing agencies, such as the Council of Europe Development Bank (CEB), the EBRD, the European Investment Bank (EIB), the International Finance Corporation (IFC), the Nordic Environment Finance Corporation (NEFCO) and the World Bank.[71]

The Central European Initiative is a regional intergovernmental forum working towards European integration and sustainable development through regional co-operation. The forum has 17 Member States in Central, Eastern and South-Eastern Europe, including Albania, Belarus, Bosnia and Herzegovina, Moldova, Montenegro, North Macedonia, Serbia and Ukraine. It aims to increase sustainable economic development for stability, social cohesion and environmental sustainability in a united Europe.[72]

The Central and South-Eastern Europe Gas Connectivity (CESEC) initiative aims to accelerate the integration of natural gas and electricity markets in Central-Eastern and South-Eastern

vi Afghanistan, Azerbaijan, the People's Republic of China, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan and Uzbekistan.

Europe. The CESEC high-level group, established by several EU Member States in 2015, was later joined by several Energy Community parties (Albania, Bosnia and Herzegovina, Kosovo, Moldova, Montenegro, North Macedonia, Serbia and Ukraine). The group seeks to implement cross-border and trans-European projects that help to diversity the gas supply, as well as to develop regional gas markets and adopt EU rules for the functioning of energy infrastructure. At the 4th CESEC ministerial meeting in Bucharest in 2017, energy ministers signed a Memorandum of Understanding extending the scope of CESEC co-operation. The memorandum establishes a joint approach on electricity markets, energy efficiency and renewable development; a list of priority projects to build an interconnected regional electricity market; and specific actions to boost renewables and investment in energy efficiency.[73]

The Global Covenant of Mayors for Climate and Energy unites thousands of regional and local governments that are voluntarily committed to accelerating initiatives that lead to an inclusive, just, low-emission and climate-resilient future, helping to meet and exceed the Paris Agreement objectives.[74] Signatories must establish targets and action plans for mitigation or low-emission development consistent with their countries' Nationally Determined Contributions (NDC) for reducing emissions to help meet the Paris goals. The targets and action plans should also be in line with National Adaptation Plans (where these exist) and should be consistent with the principles around energy access and urban sustainability embodied in the UN Sustainable Development Goals.[75]

The signatories of the Global Covenant of Mayors for Climate and Energy include many regions, cities and towns in Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kosovo, the Kyrgyz Republic, Moldova, Montenegro, North Macedonia, the Russian Federation, Serbia, Ukraine and Tajikistan.[76] The Global Covenant builds on and brings together the world's two leading initiatives of cities and local governments for climate action: the Compact of Mayors and the Covenant of Mayors – Europe (signatories of the Covenant of Mayors – Europe are also signatories of the Global Covenant of Mayors).[77] Most municipalities in the focus region have signed the Covenant of Mayors – Europe, committing them to implement measures consistent with EU climate and energy objectives. This includes developing a Sustainable Energy and Climate Action Plan, which would support implementation of the EU's greenhouse gas emission reduction target of 55% by 2030, and the adoption of a joint approach to tackling mitigation and adaptation to climate change.[78]

Another network of local and regional governments committed to sustainable development is ICLEI – Local Governments for Sustainability. ICLEI Europe works closely with an extended network of local and regional governments and partners on a broad range of topics, including renewable energy. Within the focus countries, the network includes the municipalities of Tirana and Yerevan (both in Albania) and the Standing Conference of Towns and Municipalities of Serbia (SKGO).[79]

The Eurasian Economic Union (EAEU) is an international organisation for regional economic co-operation organised by several post-Soviet states in Eastern Europe and Western and Central Asia. The signatories are Armenia, Belarus, Kazakhstan, the Kyrgyz Republic and the Russian Federation. The EAEU works on the close economic integration of members to enable the free movement of goods, services, capital and labour, with common standards for these commodities.[80] It also implemented an Action Plan before launching the EAEU common electric power market.[81]

Sustainable Energy for All (SEforALL) is an international organisation that aims to achieve Sustainable Development Goal 7 – focused on access to affordable, reliable, sustainable and modern energy for all by 2030 – in line with the Paris Agreement. SEforALL seeks to ensure universal access to such energy services, increase the share of renewables in the global energy mix and double the global rate of energy efficiency improvement. It works in partnership with the United Nations, national governments, the private sector, financial institutions and the public. Members from the focus countries include Armenia, the Kyrgyz Republic, Montenegro, North Macedonia, the Russian Federation and Tajikistan.[82]

The CIS Electric Power Council is a regional organisation that co-ordinates intergovernmental matters in the electric power industry of the Commonwealth of Independent States (CIS). Among the main tasks and functions of the council are providing collective energy security to CIS member states, developing proposals for the integration of their electricity systems and markets, establishing technical rules and economic and legal clauses for their joint operation, and managing international relations in the interests of all CIS member states.[83]

The International Renewable Energy Agency (IRENA) is an international organisation that supports its members in designing and implementing their energy transitions, in particular through the adoption and use of renewables. IRENA's membership covers more than 180 countries, including the 17 focus countries.[84]

Co-operation in the region could be accelerated through **electricity trade** and the creation of **regional electricity markets.**

TABLE 1.
Overview of Regional Collaboration on Energy Issues, as of October 2021

Country	CAREC	Central European Initiative	CESEC	CIS Electric Power Council	E5P	Energy Charter	Energy Community	EU4Energy	Eurasian Economic Union	ICLEI	IRENA	SEforALL
Albania		●	●			●	●			●	●	
Armenia				●	☐	●	○	★	●	●	●	★
Azerbaijan	●			●	☐	●		★			●	
Belarus		●		●	☐	●*		★	●		●	
Bosnia and Herzegovina		●	●			●	●				●	
Georgia	●				☐	●	●	★			●	
Kazakhstan	●			●		●		★	●		●	
Kyrgyz Republic	●			●		●		★	●		●	★
Moldova		●	●	●		●	●	★			●	★
Montenegro		●	●			●	●				●	★
North Macedonia		●	●			●	●				●	
Russian Federation				●		●**			●		●	★
Serbia		●				○	●			●	●	
Tajikistan	●			●		●		★			●	★
Turkmenistan	●			●		●		★			●	
Ukraine		●	●	●	☐	●	●	★			●	
Uzbekistan	●			●		●		★			●	

● Member

★ Partner

○ Observer

☐ Contributor

* did not ratify the Energy Charter Treaty but applies it provisionally; ** did not ratify the Energy Charter Treaty
Note: SEforALL = Sustainable Energy for All; CAREC = Central Asia Regional Economic Cooperation; E5P = Eastern Europe Energy Efficiency and Environment Partnership; CESEC = Central and South-Eastern Europe Gas Connectivity; ICLEI = Local Governments for Sustainability; IRENA = International Renewable Energy Agency. Data on SEforALL membership are from 2017.
Source: See endnote 63 for this chapter.

02 POLICY LANDSCAPE

OVERVIEW

The landscape of renewable energy policy, and of related energy efficiency and climate change policy, has improved greatly in the focus region since the previous REN21/UNECE report published in 2017. Several factors contributed to this change.

First, the year 2020 was **the final year for an initial set of renewable energy and energy efficiency commitments and targets**, as established under the United Nations and other national and international frameworks. Therefore, many of the focus countries measured their progress on these actions, assessed the lessons learned, and revisited their strategies and targets. Some countries began drafting or had already adopted the "second generation" of even more ambitious targets and implementation strategies for renewables and efficiency, which would guide their evolution in the decade to 2030.

Second, in 2020 all countries in the region initiated a process of updating and enhancing their **Nationally Determined Contributions** (NDCs) under the Paris Agreement.[1] This work created an opportunity to align countries' national priorities for renewables and energy efficiency with their international commitments to reduce greenhouse gas emissions. In line with the goals of the Paris Agreement, several of the focus countries, including some of the region's largest emitters (Kazakhstan, Ukraine and the Russian Federation), announced **net zero carbon commitments**. This positive development will directly influence markets and industries for renewables and efficiency in the region, although much depends on how "climate neutrality" and "net zero" are defined, and on the specific action plans that are drafted and adopted.

Another major climate policy decision, and among the most widely debated topics of 2020-2021, was the European Commission's introduction of the **Carbon Border Adjustment Mechanism**. Although still under development as of early 2022, this mechanism is anticipated to be an import levy that would equalise the emission content of imported goods with that of EU goods, considering the price of EU emission allowances paid by European producers and the carbon prices paid by foreign producers. In doing so, it would prevent carbon leakage to those countries that rely on the EU market for their exports and boost investment in industrial decarbonisation, renewables and energy efficiency in these countries.

Negative policy developments also have occurred. In Ukraine, the introduction of high feed-in tariffs (FITs) and attractive investment conditions boosted new renewable energy capacities between 2017 and 2019.[2] However, over time the FITs exceeded market prices, and the funds of the Ukrainian state-owned renewable energy off-taker were not sufficient to make FIT payments to electricity producers.[3] The government's reduction of FITs by a certain percentage every year retroactively from 2015 to reduce the payment burden and the cumulating debt led to an undermining of the renewable energy investment environment.[4] In another setback for renewables, protests against hydropower have arisen in Georgia, Bosnia and Herzegovina, and a few other Balkan countries due to public perceptions of the negative impacts of the technology on local communities and ecosystems.[5]

Despite the rising level of ambition and the ongoing push to raise targets for renewables and energy efficiency across the region, some countries are lagging. In some cases, their NDCs have been criticised as being unambitious and insufficient to meet the Paris Agreement goal of limiting the rise in the global average temperature to within 1.5 degrees Celsius (°C).

NATIONAL AND SECTORAL RENEWABLE ENERGY TARGETS

In line with global policy trends, renewable energy targets continued to be a primary means for governments in the region to express their commitment to renewables. As of year-end 2021, at least 16 of the focus countries had established national targets for renewable energy, formulated either: 1) as a targeted share of renewables in total final energy consumption or in total primary energy supply (or in a sector, such as electricity and heat), or 2) as technology-specific targets, such as for solar power *(→ see Table 2)*.[6] The targets vary greatly in their temporal scope, ambition and pace of achievement, although for many targets 2020 was the initial deadline year[i].

National Renewable Energy Targets

Progress towards achieving national renewable energy targets has varied within the region. Countries with high potential for hydropower development were most likely to achieve their 2020 targets for renewable energy consumption, or they achieved them before the deadline. For example, Bosnia and Herzegovina, Serbia and Georgia were very close to reaching their targets, which aimed for renewable shares in total final energy consumption ranging from 20% to 40% *(→ see Table 2)*.[7]

Several countries exceeded their commitments for renewables penetration. By 2020, Moldova reported that more than 24% of its total final energy consumption came from renewables (mainly biomass), exceeding its target of 20%.[8] Albania and Montenegro achieved 45% and 43.8% renewables in total final energy consumption in 2020, exceeding their respective targets of 38% and 20%.[9] Belarus reached its less ambitious target of 6% renewables in total final energy consumption.[10]

A few countries experienced difficulties reaching their targets. Azerbaijan failed to achieve its target of 9.7% renewables in final energy consumption by 2020, reaching only 1.6% in 2019.[11] North Macedonia also missed its 2020 target, reporting 19.2% versus the targeted 23%.[12]

Progress towards sectoral targets has been more difficult to measure than progress towards national targets. The greatest progress was achieved for targets focused on the

i Because national-scale data for 2020 were not always available, this chapter provides an analysis of the target achievement based on the latest data identified for each country.

Sectoral Renewable Energy Targets

share of renewables in electricity generation or consumption, while progress in other sectors was mixed, with the worst achievements in the transport sector.

Countries with high hydropower and bioenergy capacity – such as Albania, Bosnia and Herzegovina, and Moldova – have struggled to introduce other renewable energy sources, such as solar PV and wind power. However, Ukraine exceeded its target of an 11% renewable share in total electricity demand, reporting 13.9% in 2020, due mainly to solar and wind power.[13] Kazakhstan, where the penetration of solar PV and wind power has been slower, reached its less ambitious target of 3% renewables in electricity generation in 2020.[14]

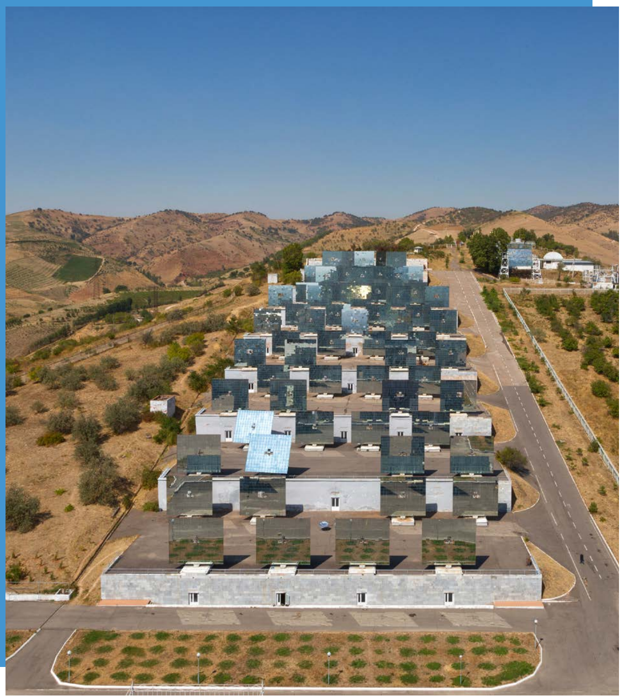
New long-term targets were set in the biggest electricity markets of the region. Kazakhstan increased its level of ambition from the initial target of 10% renewables in electricity generation to 15% by 2030.[15] Uzbekistan set a target to build 10 GW of new renewable power generating facilities by 2030, including 5 GW of solar PV, 3 GW of wind power and 1.9 GW of hydropower plants, which would entail increasing the country's renewable power capacity by more than a factor of six.[16]

In 2020, the Russian Federation's Energy Strategy 2035 acknowledged hydropower as the country's major renewable energy source and highlighted the positive trend in solar PV and wind power deployment, aiming for around 10 GW of power capacity by 2035 (significant compared to the status quo, but modest given the size of the market).[17] Armenia and Azerbaijan introduced new targets of 1.0 GW to 1.5 GW of renewable power capacity by 2030.[18] In Belarus and Turkmenistan, the ambitions regarding renewable electricity were modest.[19]

In the transport sector as well as the heating and cooling sectors, only those focus countries that were contracting parties of the EU's Energy Community Treaty targeted the deployment of renewables, as set in their national action plans for renewables and energy efficiency. No countries achieved the 2020 renewable energy target in the transport sector.[20] In the heating and cooling sector, Bosnia and Herzegovina, Moldova, Montenegro and Serbia reported success in achieving their renewable energy targets.[21]

Future Outlook: Renewable Electricity Gains Momentum

Since 2017, several of the focus countries have advanced their commitments to renewables and become new regional renewable energy leaders. These include Kazakhstan, the Russian Federation, Ukraine and Uzbekistan, as well as smaller markets such as Armenia and Moldova. Although the contracting parties of the Energy Community Treaty in the Balkan region previously relied mostly on hydropower, they have gained momentum in solar PV and wind power, also broadly targeting the deployment of renewables in heating and transport. The remaining countries of the focus region have focused on the electricity sector and on overall renewable energy consumption and supply, demonstrating a long-term commitment to renewables. As countries continue to update their National Renewable Energy Action Plans (NREAPs) and NDCs, their level of ambition in national decarbonisation and the uptake of renewables will likely increase.



While progress in the electricity sector was significant, progress in other sectors was mixed, with the **worst being the transport sector.**

TABLE 2.
Overview of Renewable Energy Targets in the Focus Countries, as of October 2021

Country	Scope	Renewable Energy Target	Status	Comments
Albania	Energy	38% of total final energy consumption by 2020	Achieved in 2018 (45% in 2020)	Albania submitted a draft NECP in 2021. The Consolidated NREAP called for 490 MW of solar PV and 150 MW of wind power capacity to be built by 2021. In 2018, the National Energy Strategy 2018-2030 set a new long-term target of 42% renewables in total primary energy supply, which has already been achieved.
		42% of total primary energy supply by 2030	Achieved	
	Transport	10% biofuels in fuel consumption by 2020	Not achieved (7% in 2019)	
	Solar power	490 MW by 2020	Not achieved	
	Wind power	50 MW by 2020	Not achieved	
	Waste-to-power	41 MW by 2020	Not achieved	
Armenia	Electricity	28% of generation by 2036, including small hydropower, wind, solar PV and geothermal, and excluding biofuels and large hydropower (old)	–	Armenia's Energy Sector Development Strategic Programme to 2040, adopted in 2020, highlighted the role of renewables in addressing energy self-sufficiency, energy security and climate neutrality and set new renewable energy targets. Armenia has been working on its National Energy Efficiency and Renewable Energy Programme 2021-2030, which has not been updated since 2007 and which would define new sectoral targets.
	Solar power	80 MW by 2025 (old)	Achieved (95 MW in 2020)	
		1 GW capacity or 15% of electricity generation (1.8 billion kilowatt-hours, kWh) by 2030 (new)	–	
	Wind power	50 MW by 2020, 100 MW by 2025 (old)	Not achieved (3 MW in 2020)	
		500 MW in 2025-2040 (new)	–	
	Geothermal power	100 MW by 2025 (old)	–	
	Small hydropower	397 MW by 2025 (old)	–	
Azerbaijan	Energy	9.7% in total final energy consumption by 2020	Not achieved (1.6% in 2019)	Azerbaijan's Action Plan of the Strategic Road Map on Public Utilities Development calls for installing 420 MW of renewable power capacity by 2020, including wind power, solar PV and biopower. In addition, it set renewable energy targets in total final energy consumption and in electricity consumption by 2020. The target of 30% renewables in power capacity by 2030 would double the current capacity.
	Electricity	19% increase in power capacity between 2015 and 2019 (old)	Not achieved (12% in 2019)	
		1,500 MW by 2030 (new)	–	
		30% of capacity by 2030 (new)	–	
	Solar power	50 MW of new capacity in 2017-2020	Not achieved	
	Wind power	350 MW of new capacity in 2017-2020	Not achieved	
	Biopower	20 MW of new capacity in 2017-2020	Not achieved	
Belarus	Energy	6% of total final energy consumption by 2020, 7% by 2025, 8% by 2030, 9% by 2035	Achieved (7.3% in 2018)	In Belarus, targets and policies have not changed a lot since 2015. New capacity is dependent on the consumption profile, including commissioning of the nuclear plant, whose first block started operating in 2020.

Country	Scope	Renewable Energy Target	Status	Comments
Belarus (continued)	Energy	6% of total final energy consumption by 2020, 7% by 2025, 8% by 2030, 9% by 2035	Achieved (7.3% in 2018)	The limited role of renewables is explained by the position of the Ministry of Energy's department for nuclear energy, which has existed for 30 years, whereas no dedicated renewable energy department exists.
Bosnia and Herzegovina	Energy	40% of total final energy consumption by 2020	Not achieved (37% in 2019)	Bosnia and Herzegovina targeted a 40% renewable share in total final energy consumption by 2020, which was translated into a 56.9% renewable share in electricity, 52.4% in heating and cooling, and 10% in transport. The NREAP set technology-specific targets by 2020 of 162 MW for small hydropower and 20 MW for solar PV, which were achieved, as well as 143 MW of wind power and 19 MW of centralised biopower.
	Electricity	56.9% of consumption by 2020	Not achieved (46% in 2019)	
	Heating and cooling	52.4% by 2020	Achieved (56.3% in 2019)	
	Transport	10% by 2020	Not achieved (0.4% in 2019)	
	Solar power	20 MW by 2020	Achieved	
	Wind power	143 MW by 2020	Not achieved (36 MW in 2019)	
	Biopower	19 MW by 2020	Not achieved	
	Small hydropower	162 MW by 2020	Achieved	
Georgia	Energy	30% of total final energy consumption by 2020	Not achieved (25% in 2019)	Georgia's NREAP adopted in 2019 targets 30% renewables in total final energy consumption by 2020. The Law on Promotion of Production and Utilization of Renewable Energy, adopted in 2019, set a target of 35% by 2030. The Climate Change Strategy and Action plan (CAP) aims at 89% renewables in electricity generation by 2030.
		35% of total final energy consumption by 2030	–	
	Electricity	89% of generation by 2030	–	
Kazakhstan	Electricity	3% of generation by 2020 for solar and wind (old)	Achieved in 2019	Kazakhstan's Law on Supporting the Use of Renewables and the Concept of Transition to Green Economy (2013) aim at 30% renewables in electricity generation by 2030 and 50% by 2050. The target includes all types of hydropower as well as nuclear. In 2019, Kazakhstan set a target of 10% renewables in electricity generation (excluding large hydropower and nuclear) by 2030; this was later updated to 15%.
		10% of generation by 2030 (old)	–	
		15% of generation by 2030 (new)	–	
		30% of generation by 2030 and 50% by 2050, for renewables including large hydropower and for nuclear	–	
Kyrgyz Republic	Energy	10% of total final energy supply, excluding large hydropower	–	In the Kyrgyz Republic, several renewable energy targets are mentioned in various documents, with the latest being a 10% share in total final energy supply in the National Development Strategy for 2018-2040 (the target year was unspecified). The targets are not consistent across the documents and are not supported with related action plans.

Country	Scope	Renewable Energy Target	Status	Comments
Moldova	Energy	20% of total final energy consumption by 2020	Achieved (25% in 2020)	Moldova's National Energy Strategy 2030 targets 20% renewables in total final energy consumption, which has been achieved due mainly to the revision of biomass data and the increased use of biomass in heating. The strategy is to be updated to include new targets for 2030. Moldova announced an intention to boost utility-scale renewables.
	Electricity	10% of generation by 2020	Not achieved (3.12% in 2020)	
		200 MW of utility-scale power by 2025; 400 MW by 2030	–	
	Heating and cooling	27% by 2020	Achieved (41.2% in 2020)	
	Transport	10% by 2020	Not achieved (0.18% in 2020)	
Montenegro	Energy	33% of total final energy consumption by 2020	Achieved (43.8% in 2020)	Montenegro achieved all targets set for 2020 except the renewable energy share in fuels used in the transport sector. This also was the case in other Balkan countries.
	Electricity	51.4% of consumption by 2020	Achieved (61.5% in 2020)	
	Heating and cooling	38.2% by 2020	Achieved (64.8% in 2020)	
	Transport	10.2% by 2020	Not achieved (0.63% in 2020)	
North Macedonia	Energy	23% of total final energy consumption by 2020; 38% by 2030 (new); 45% by 2040 (new)	Not achieved (19.2% in 2020)	North Macedonia's Energy Development Strategy until 2040 anticipates that the share of renewables in total final energy consumption will reach 35-45% by 2040, with an installed capacity of 1.4 GW of solar PV and 750 MW of wind power.The draft NECP has set similar new targets.
	Electricity	66% of generation by 2030 (new)	–	
	Heating and cooling	45% by 2030 (new)	–	
	Transport	10% by 2030	Not achieved (0.15% in 2020)	
Russian Federation	Electricity	4.5% by 2024 and 6% by 2035, excluding large hydropower > 25 MW	–	The Russian Federation's Energy Strategy 2035, adopted in 2020, acknowledges hydropower as the major renewable energy source. Renewable energy support packages planned for the first phase (2014-2024) and second phase (2025-2035) envision increasing the renewable share in electricity generation to 4.5% by 2024 and at least 6% by 2035. This translates to new capacities of solar PV of 1.8 GW, wind of 3.4 GW and small hydropower of 210 GW, installed between 2014 and 2024. At the International Financial Congress in 2021, the Vice-Premier stated that the Russian Federation planned to increase the renewable share in total primary energy supply from 1% to 10% by 2040.
	Solar power	1.8 GW by 2024	–	
	Wind power	3.4 GW by 2024	–	
	Small hydropower (< 25 MW)	210 MW by 2024	–	
Serbia	Energy	27% of total final energy consumption by 2020; 40% by 2040	Not achieved (26.3% in 2020)	Among Serbia's renewable energy targets for 2020, only the heating and cooling target was met. Despite this trend, the Ministry of Energy and Mining announced a target of 40% renewables in total final energy consumption by 2040.
	Electricity	36.6% of generation by 2020	Not achieved (30.7% in 2020)	
	Heating and cooling	30% by 2020	Achieved (35.7% in 2020)	
	Transport	10% by 2020	Not achieved (1.2% in 2020)	

Country	Scope	Renewable Energy Target	Status	Comments
Tajikistan	Electricity	10% in generation by 2030	–	Tajikistan's National Development Strategy to 2030 (2016) aims at 10% renewables in electricity generation by 2030.
Turkmenistan	–	–	–	Renewable energy targets do not exist in Turkmenistan.
Ukraine	Energy	11% in total final energy consumption by 2020	Not achieved (9.19% in 2020)	Ukraine's National Energy Strategy to 2035, adopted in 2017, aims to increase the share of renewables in the primary energy supply to 12% in 2025 and 25% in 2035. In January 2022, Ukraine published its draft NREAP to 2030, which suggested raising its targets to 27% in total final energy consumption, 25% in electricity generation, 35% in heating and cooling, and 14% in transport by 2030.
		12% in total primary energy supply by 2025, 25% by 2035 (new)	–	
	Electricity	11% of generation by 2020	Achieved in 2020 (13.92% in 2020)	
	Heating and cooling	12.4% by 2020	Not achieved (9.28% in 2020)	
	Transport	10% by 2020	Not achieved (2.47% in 2020)	
Uzbekistan	Electricity	25% in generation by 2030	–	Uzbekistan's strategy for the transition to a green economy set a target of 25% renewables in electricity generation by 2030. The concept note for ensuring electricity supply for 2020-2030 envisions 3.8 GW of hydropower, 5 GW of solar PV and 3 GW of wind power capacity by 2030, representing a total of 10 GW of new capacity. The country is considering increasing these targets to 7 GW of solar PV and 5 GW of wind power.
	Hydropower	3.8 GW by 2030 (new)	–	
	Solar power	5 GW by 2030 (new)	–	
	Wind power	3 GW by 2030 (new)	–	

Note: NECP = National Energy and Climate Plan; NREAP = National Renewable Energy Action Plan.
Source: See endnote 6 for this chapter.

RENEWABLE ENERGY POLICIES

A notable shift in renewable energy support policies has occurred across the focus region, in terms of both the broadness of policy instruments used and the country coverage. A key trend has been the increasing use of auctions, as policy makers seek to procure renewables-based electricity at the lowest price that resonates with the global shift from feed-in tariffs (FITs) to auctions. Another trend in the region, in line with international trends, is the emergence of dedicated net metering schemes for small-scale renewables. Table 3 provides an overview of the main renewable energy support policies in the focus countries, based on the classification used in the previous report.[22]

Renewable Energy Auctions

Renewable energy auctions are increasingly popular in the region. As of 2021, they had been introduced in eight of the focus countries, including in the region's biggest electricity markets.[23] The growth of auctions is attributed mainly to their ability to reveal competitive trends in prices and to achieve objectives beyond price discovery.

Kazakhstan has been a regional frontrunner in this trend. In 2018, it began shifting from FITs towards a transparent and competitive auction system, signalling the successful commercialisation of renewable energy technologies and rising interest from local and international actors. Kazakhstan also received technical assistance via a UNDP/GEF project to pilot the preparation of technical documentation for a site-specific solar PV auction, thus facilitating investment decision making. This test auction achieved the country's lowest renewable energy tariff, showing how additional technical support can reduce investment risks.[24] The practice was successfully continued by the Ministry of Energy of Kazakhstan, which with technical assistance from the EBRD prepared the country's first site-specific wind auction (with technical documentation), slated to conclude in November 2022.[25] Overall, 25 renewable energy auctions have been held in Kazakhstan, with a cumulative installed capacity of 1.5 GW and 172 participating companies from 12 countries.[26] This resulted in over USD 1 billion of investment in the country's renewable energy sector.[27]

Another emerging trendsetter is Uzbekistan, which successfully conducted its first online renewable energy auction in 2019 for a 100 MW solar project, with assistance from the World Bank's Scaling Solar programme.[28] This success allowed the country to replicate this practice and add 440 MW of capacity in 2021.[29] The EBRD in turn supported a 100 MW wind auction for which a winning bidder was selected in September 2021; it also supported follow-up auctions in the country.[30]

In April 2021, Serbia adopted four energy laws, including the Law on Use of Renewable Energy Sources, which together with relevant secondary legislation such as the Feed-in Premium Decree set a robust legal and regulatory framework for auctions to award Contracts for Difference.[ii] [31] The feed-in premiums are auctioned for wind power plants above 3 MW and for other renewable energy production plants above 500 kilowatts (kW).[32] FITs will remain for projects below this size; however, their amount will also be determined at auctions.[33] The first auction for 400 MW of wind power capacity was planned for late 2022 with technical assistance from the EBRD.[34] Many experts deemed the adoption of the law to be a big achievement that reflects the most recent recommended standards and practices in renewable energy policies in Europe and globally.[35]

Ukraine, once a regional renewable energy leader, had been planning a similar policy update. In 2019, the country's New Renewable Energy Law introduced an auction quota system that provided a guaranteed 20-year purchase of electricity at the tariff determined by the auction. The Law also established maximum bidding limits for renewable electricity to gradually replace FITs for solar and wind power.[36] In 2021, the Ukrainian Ministry of Energy submitted new draft legislation to support renewable energy plants under the auction models with technology-neutral, feed-in-premium payments, in addition to the wholesale electricity price under Contracts for Difference.[37]

North Macedonia was among the first countries in South-East Europe to promote renewables and to implement auctions. Initially, it also provided feed-in premiums through online auctions for producers of wind power (up to 50 MW) and solar PV (up to 30 MW).[38] Albania conducted two solar PV auctions, for the 140 MW Karavasta and 100 MW Spitalla plants; it also scheduled additional auctions for solar as well as for 100-150 MW of wind projects and hybrid-solar PV projects during 2021-2022, all with support from the EBRD.[39] As of June 2022, Moldova was revising its legal and regulatory framework for renewable energy auctions with a view to implementing its first auction shortly with support from the EBRD.[40] Montenegro was drafting its regulations for auctions, although it already conducted a tender for the 200 MW Briska Gora solar PV plant in the municipality of Ulcinj in 2018.[41]

Feed-in Tariffs

Despite the gradual shift to auctions, many renewable energy support schemes still rely on FITs, which as of September 2021 were present in 12 of the focus countries, the same number as in 2016 *(→ see Table 4)*.[42]

Ukraine introduced its first FITs in 2009, initiating the country's support for renewables. However, Ukraine's renewable energy boom, caused by high FITs, occurred only in 2017-2019, making it a regional leader in the deployment of renewables *(→ see Chapter 3)*.[43] Over time, Ukraine's FIT exceeded market prices, and by late 2019 the funds of the state-owned off-taker were insufficient to make FIT payments to electricity producers. At the same time, Ukraine's transmission system operator restricted generation from renewable energy producers due to an electricity surplus. To deal with the accumulating debt, the government retroactively reduced FITs by a certain percentage every year from 2015.[44] The size of the reduction depended on the source of energy, the plant's capacity and commissioning.[45] Despite these amendments, and other attempts by the government to generate more funds, the debt to renewable energy producers has only increased.[46] This has undermined the investment environment and resulted in a slowdown in deployment, with solar suffering the most.[47]

In Albania and Moldova, FITs were available for small wind power, solar PV and hydropower installations.[48] Until recently, FITs also were the main renewable energy support policy measure in Bosnia and Herzegovina and Serbia. They remain the top measure in Bosnia and Herzegovina, which has set FITs and 12-year power purchase agreements (PPAs) for small hydropower, the technology with which the country has the most experience.[49] Serbia introduced FITs in 2009, but due to the rapid exhaustion of FIT support, it completed the transition to a competitive auction scheme in 2021-2022, leaving FIT support only for small-scale projects, in line with the experience of EU countries.[50]

In 2020, the Georgian government introduced feed-in premiums for hydropower plants of more than 5 MW of capacity, a measure that was later extended to all renewables.[51] The Kyrgyz Republic also has continued to use FITs, after introducing new FIT regulations and amendments to the Renewable Energy Law in 2019, including renewable capacity quotas and unified FITs.[52] These are the only countries in the focus region where FITs are at the same level regardless of the technology.

In the Russian Federation, since 2019, the support mechanism on the federal wholesale market (for generation capacities of more than 5 MW) has been based on guaranteed premium payments, with a total allocated budget of EUR 3.6 billion (USD 4.0 billion).[53] Developers compete in annual auctions to offer the lowest capital expenditure per installed capacity. Once a project is secured, a capacity supply agreement or secured payment for 15 years is agreed upon and enters into force. The baseline value for return is typically 12%, but developers might reach higher values due to lower capital and operational expenditures, cheap debt financing, and higher capacity factors, among others.[54]

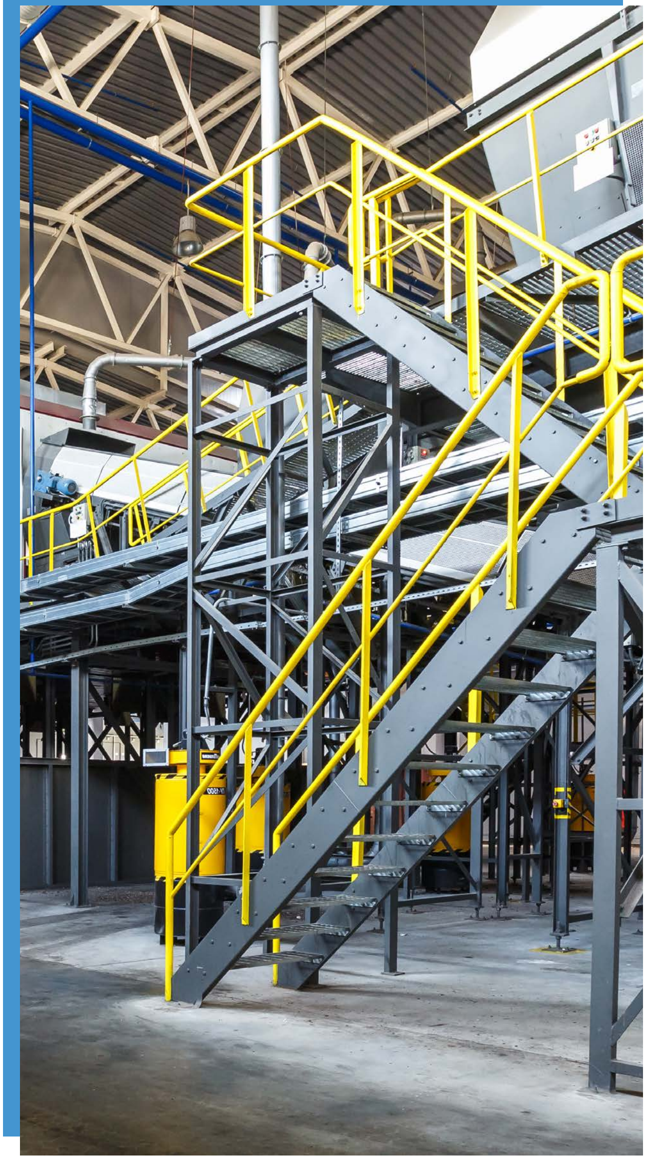
Belarus' FIT context is unique for the region, with the country's green FITs being lower than the average electricity tariffs since 2016.[55] This is a clear disincentive for renewable energy investment and reflects a change in the government's priorities towards nuclear power.

ii Under Contracts for Difference (CfD), green power producers sell electricity at market prices and enter into additional contractual agreements with the government or other market players, such as consumers, traders or suppliers. The producer will either receive compensation for a difference between a fixed tariff and a real sale price in a market or pay for this difference to the other party.

Net Metering

Net metering has gained in popularity across the region, with seven of the focus countries enforcing such schemes as of September 2021, with varying degrees of success. In the context of this report, net metering includes a range of different policies that belong to a broad subset of self-consumption policies; the actual compensation mechanisms differ by country. For example, Moldova's Law on the Promotion of the Use of Energy from Renewable Sources, adopted in 2016, puts a special emphasis on promoting distributed energy generation and the development of small-scale decentralised renewable energy projects by households and small and medium-sized businesses, recognising the high share (65%) of these sectors in the country's total electricity consumption.[56]

Montenegro's power utility introduced a dedicated net metering programme in 2021 covering 3,000 solar rooftops along with a financing support programme launched by UNDP and the Investment and Development Fund of Montenegro, which awards low-interest loans to households and small and medium-sized businesses for solar PV installations.[57] In 2021, Serbia adopted a decree on "prosumers"[iii] that, together with the Law on Use of Renewable Energy Sources, creates a comprehensive framework for net metering that was later backed by a rebate programme for rooftop PV.[58] The decree defines the criteria, conditions and billing method for different types of prosumers, such as single-family households, residential buildings, companies and power suppliers.[59] Kazakhstan is designing similar dedicated financial and technical support facilities to stimulate the wider uptake of net metering among households and businesses to improve the measure's performance.[60]



Fiscal Incentives

Fiscal incentives, in the form of tax exemptions, premiums, and others, have been a popular form of renewable energy support across the region; they were being used in 12 of the focus countries as of September 2021.[61] In Albania and the Kyrgyz Republic, renewable energy equipment is exempted from customs duties.[62] Renewable energy projects in Ukraine could receive a 5%-10% premium if they use domestic equipment.[63] However, discussions have been held in the country about re-introducing the excise tax for renewables, from which these technologies had been exempted.[64]

Kazakhstan considers renewable energy projects to be a national priority, thereby exempting projects from property, land and corporate income tax.[65] In Uzbekistan, the government offers a wide range of fiscal incentives and other state support, such as state loans and guarantees along with tax benefits; in addition, citizens are offered subsidies for transitioning to clean energy sources, such as installing solar PV panels.[66] Azerbaijan, in its recent Law on Renewable Energy, introduced a comprehensive package of fiscal incentives for renewables, including exemptions from import tax and value-added tax (VAT) for renewable energy equipment, exemption from property and land tax, and a 50% reduction in the income tax; however, the country has yet to develop a regulatory basis to implement the law.[67]

Renewable energy equipment is **exempted from customs** duties in Albania and the Kyrgyz Republic.

iii A prosumer is an individual or a legal entity that receives electricity in full or in part from renewable sources - which are installed directly at the place of consumption - and that has the ability to sell or supply this power to the national grid as well as to provide demand management services. For a prosumer, the production and sale of electricity is not their main activity.

TABLE 3.
Overview of Renewable Energy Policies in the Focus Countries, as of September 2021

Country	Renewable energy target	Feed-in tariff / premium payment	Net metering	Tendering/auctions	Grid preferential access	Priority dispatch	Tradable renewable energy certificates / guarantees of origin	Public financial support schemes	Fiscal incentives	Comments
Albania	+	+	+	+	+	+			+	The renewable energy law of **Albania**, adopted in 2017, partially transposed the EU Renewable Energy Directive of 2009/28. FITs, PPAs and net metering (for wind power and solar PV up to 500 kW) were available for small-scale projects. For utility-scale projects, auctions were implemented through a Contract for Difference scheme. Renewable energy technologies are exempted from custom duty. Two solar PV auctions conducted in the country, for the 140 MW Karavasta and 100 MW Spitalla plants, were supported by the provisions of 15-year land agreements and PPAs. In 2021-2022, Albania will continue implement auctions for solar PV as well as for 100-150 MW of wind projects and hybrid-solar PV projects.
Armenia	+	+	+	+					+	Small hydropower has neared its potential in **Armenia**, so policy support has focused on solar PV. This support has been realised mainly via FITs, competitive tendering and mid-term annual renewable portfolio standards (renewable portfolio standards, or renewable obligations, or quota policies). According to the Energy Sector Development Strategic Programme to 2040, around 300 MW of capacity (250 MW of solar PV and 50 MW of small hydropower) was to be added in 2022. PPP schemes also were considered for utility-scale solar PV projects.
Azerbaijan	+	+							+	Renewable energy support in **Azerbaijan** is gaining momentum. The Decree on Measures for the Implementation of Pilot Projects of Renewable Energy was adopted in 2019 in line with the Presidential Decree on the Acceleration of Reforms in the Energy Sector. In 2020, the government adopted the law on renewable energy, approved the Action Plan on Attracting Investments in the Renewable Energy Sector, and drafted its Long-term Energy Strategy. The previous support was limited to import tax and VAT exemptions for renewable energy equipment, exemptions on property tax, land tax and 50% of the income tax. The new law includes FITs, tendering and net metering, but it will take time to implement these changes. Projects under development receive a 20-year PPA. Several strategic roadmaps mention an increasing role of renewables.

Country	Renewable energy target	Feed-in tariff / premium payment	Net metering	Tendering/auctions	Grid preferential access	Priority dispatch	Tradable renewable energy certificates / guarantees of origin	Public financial support schemes	Fiscal incentives	Comments
Belarus	+	+	+						+	Support for renewables in **Belarus** has decreased since 2016. The commissioning of the nuclear power plant makes the need for new renewable capacity additions irrelevant. Willingness to invest in renewables has been low, since the FITs have been below the average electricity tariffs since 2016. Small incentives exist for land use and net metering for commercial producers, but these incentives do not create a stimulus due to the low tariffs.
Bosnia and Herzegovina	+	+			+	+			+	The main measures in **Bosnia and Herzegovina** are FITs and 12-year PPAs, which focus on small hydropower, a technology with which the country has experience. The country prepared a draft law for a new support scheme, which will include FITs for small plants and feed-in premiums or utility-scale projects, both through auctions. It also will introduce net metering for prosumers and renewable energy co-operatives. The government reviewed the Declaration on the Protection of Rivers, which, if adopted, would ban new small hydropower projects, which have faced strong public opposition. This would leave wind power as a technology frontrunner, which so far has an installed capacity comparable to solar PV. Lengthy permitting processes (up to 1-2 years) have been identified as a major barrier to wider deployment of renewables.
Georgia	+	+	+		+	+				**Georgia** is undergoing energy market liberalisation reform and recently introduced policy support for renewable energy. The first mechanisms have been PPAs for hydropower and net metering for self-consumption (applicable to all renewables, but used mostly by small-scale solar PV projects). In 2019, country adopted the Law on Promoting the Production and Use of Energy from Renewable Sources, providing more incentives for renewables and establishing a foundation for setting 2030 targets. In 2020, the government introduced feed-in premiums for hydropower plants with an installed capacity of more than 5 MW; in 2021, it extended the feed-in-premiums to all types of renewables. Georgia received technical assistance to harmonise its energy legislation with that of the EU. The government has shown interest in arranging public-private partnership projects.

Country	Renewable energy target	Feed-in tariff / premium payment	Net metering	Tendering/auctions	Grid preferential access	Priority dispatch	Tradable renewable energy certificates / guarantees of origin	Public financial support schemes	Fiscal incentives	Comments
Kazakhstan	+			+		+		+	+	The law on Supporting the Use of Renewable Energy Sources in **Kazakhstan** was adopted in 2009 and has been amended several times. It obliges a centralised utility to purchase renewable electricity for 20 years for a guaranteed tariff and priority dispatch. Renewable energy equipment is exempted from VAT and import taxes. Kazakhstan has fully transitioned from FITs to an auction system. A UNDP/GEF initiative helped test the system and practised releasing technical documentation around the site-specific solar PV auction. This auction achieved the lowest renewable energy tariff, showing the value of this approach. The practice was continued by the Ministry of Energy, which with the support of the EBRD prepared the first site-specific wind auction (with technical documentation), scheduled for 2022. In 2018-2020, 25 auctions were held with a cumulative capacity of 1.5 GW, 172 participating companies from 12 countries, and more than USD 1 billion invested. Since the law amendment in 2020, renewable energy projects have been considered a national priority, exempted from property, land and corporate income tax. The UNDP is working on the design of support for renewables in households and small and medium-sized businesses, aiming for its introduction by 2023. Bilateral energy contracts and tradable certificates also have been discussed. Net metering exists by law but has not worked in practice.
Kyrgyz Republic	+	+							+	The **Kyrgyz Republic** adopted its Law on Renewable Energy Sources in 2008 but has not yet adopted secondary legislation and bylaws. In 2019, the law was amended, introducing renewable capacity quotas and technology-neutral FITs. The latter mechanism has largely benefited small hydropower plants, the most developed renewable technology in the country. In 2020, the Kyrgyz Republic adopted a regulation on the Conditions and Procedures for the Generation and Supply of Electricity Using Renewable Energy Sources, which established procedures for investors under different legal regimes: within quotas, outside quotas, on a contractual basis and for their own needs. Renewable energy equipment is exempted from customs duty. Frequent institutional and legislative changes make the future of renewables in the country uncertain.

Country	Renewable energy target	Feed-in tariff / premium payment	Net metering	Tendering/auctions	Grid preferential access	Priority dispatch	Tradable renewable energy certificates / guarantees of origin	Public financial support schemes	Fiscal incentives	Comments
Moldova	+	+	+		+	+			+	**Moldova** has adopted FITs and net metering for small producers and local investors, and tendering for large investors. As of June 2022, the country was in the process of revising its legal and regulatory framework for renewable energy auctions, with a view to implementing its first auction shortly with support from the EBRD. According to the Law on Promoting the Use of Energy from Renewable Energy, other instruments include certification, priority dispatch, and FITs for wind power plants of more than 4 MW, for solar PV plants of more than 1 MW, and for hydropower installations. Once a liquid market is in place, the FITs will be substituted with Contracts for Difference.
Montenegro	+	+	+	+	+		+	+		FITs were the main renewable energy support instrument in **Montenegro** for many years. In 2021, the government announced the transition away from FITs, and secondary legislation for the implementation of auctions is under development. So far, only locational auctions as well as a couple of tenders for solar PV projects have been conducted. The Energy Law also introduced guarantees of origin. The net metering programme covering 3,000 solar PV rooftops was started in July 2021. In August 2021, the Investment and Development Fund of Montenegro and the UNDP launched a new financing support programme that awards low-interest loans to households and small and medium-sized businesses.
North Macedonia	+	+		+	+	+			+	**North Macedonia** was among the first countries to promote renewables. It has conducted auctions and provided premiums for utility-scale projects and FITs to small-scale projects since 2019, after the adoption of the Decree on Support Measures for Electricity Production from Renewables. FITs are available for producers of hydropower (up to 10 MW), wind power (50 MW) and biopower from biomass or biogas (1 MW). Feed-in premiums are available through online auctions for producers of wind power (up to 50 MW) and solar PV (up to 30 MW). In 2018, the Parliament adopted the Energy Law and secondary legislation to transpose the EU's Third Energy Package. Premium agreements are signed for 15 years. Several auctions for utility-scale projects were held in 2019 and 2020, and since producers have three years to complete their projects, these capacities will be commissioned soon. Concessions are to be introduced for small hydropower.

Country	Renewable energy target	Feed-in tariff / premium payment	Net metering	Tendering/auctions	Grid preferential access	Priority dispatch	Tradable renewable energy certificates / guarantees of origin	Public financial support schemes	Fiscal incentives	Comments
Russian Federation	+	+		+				+		The **Russian Federation** is developing the second phase of its national renewable energy support programme (2025-2035), which plans to increase renewable power capacity by 6.7 GW. Since 2019, the support package has been reduced from EUR 7 billion (USD 7.8 billion) to EUR 3.6 billion (USD 4.0 billion). The main instruments used are 15-year power supply contracts, which guarantee a 12% base revenue and mitigate large investment risk. This support, however, would not be borne by the state budget but by consumers, and this system has been criticised for "tariff discrimination," even though it has proven to be effective. Overall, the support package for renewables is about five times smaller than that for the modernisation of natural gas and coal power plants. Cumulative quotas for the first period of the programme (2014-2024) envisaged 3.4 GW of wind power and 1.8-2.2 GW of solar PV. These quotas are realised via competitive auctions, which makes it possible to reduce the capital expenditures of renewable projects. Renewable energy investments come almost entirely from the private sector.
Serbia	+	+	+	+	+	+	+	+	+	**Serbia** introduced FITs in 2009, but bylaws and incentives were introduced only in 2016. In 2021, Serbia adopted four energy laws, including the Law on the Use of Renewable Energy Sources, which, together with relevant secondary legislation such as the Feed-in Premium Decree and the Decree on Prosumers, set a legal and regulatory framework for transitioning to auctions to award Contracts for Difference for utility-scale projects and FITs coupled with PPAs for small-scale projects. The feed-in premiums are obtained on auctions for plants with capacity above 500 kW, except for wind projects which are eligible if their capacity is larger than 3 MW. The FIT amount for small-scale projects also will be determined at auctions. The laws introduced guarantees of origin, net metering for prosumers, community-scale projects, and public tendering for strategic partnerships for investments in building renewable power plants. Incentives may be awarded to technologies using new renewable sources, such as green hydrogen.

Country	Renewable energy target	Feed-in tariff / premium payment	Net metering	Tendering/auctions	Grid preferential access	Priority dispatch	Tradable renewable energy certificates / guarantees of origin	Public financial support schemes	Fiscal incentives	Comments
Tajikistan	+									**Tajikistan** adopted the Law on Renewable Energy in 2009. The Programme for Deployment of Renewables and Construction of Small Hydropower Plants 2015-2020 acknowledged the potential of wind and solar energy and its importance for residential last-mile electrification, but did not define specific policies. According to the law, the system operator must purchase renewable electricity, but this had not been the case yet. Small solar PV demonstration projects (less than 1 MW) are being developed with support from the Japan international Cooperation Agency (JICA), the US Agency for International Development (USAID) and the Asian Development Bank (ADB).
Turkmenistan										**Turkmenistan** took its first strategic steps with the preparation of the National Strategy for the Development of Renewable Energy until 2030 and the Program for the Development of Energy Diplomacy 2021-2025. In February 2021, the head of state announced the adoption of the Law on Renewable Energy as a priority, but no specific support mechanisms have been introduced so far.
Ukraine	+				+	+			+	**Ukraine** introduced FITs in 2009, but they contributed to a boom in the renewable energy market only in 2017-2019. In 2019, the FITs exceeded market prices, thereby exhausting the funds of the state-owned off-taker making FIT payments to electricity producers; this caused the Ukrainian transmission system operator to restrict the generation of renewable power due to its electricity surplus. To deal with the debt, the government retroactively reduced FITs by a certain percentage for every year from 2015. Despite these and other measures, the debt has only increased. This has undermined the investment environment, with solar suffering the most. In 2019, Ukraine's new Renewable Energy Law introduced an auction quota system that provides a guaranteed 20-year purchase of electricity at the tariff determined by the auction. The Law also established maximum bidding limits for renewable electricity to gradually replace FITs for solar PV and wind power projects.

Country	Renewable energy target	Feed-in tariff / premium payment	Net metering	Tendering/auctions	Grid preferential access	Priority dispatch	Tradable renewable energy certificates / guarantees of origin	Public financial support schemes	Fiscal incentives	Comments
Ukraine (continued)	+				+	+			+	The implementation of auctions, however, did not work well. In 2021, the Ministry of Energy drafted new legislation on the auction models with technology-neutral, feed-in-premium payments, in addition to the wholesale electricity price under Contracts for Difference. Renewable energy projects in Ukraine could receive a 5-10% premium if they use domestic equipment; imported equipment is exempted from VAT. The government guarantees priority dispatch to renewables.
Uzbekistan	+			+				+	+	**Uzbekistan** adopted the Law on the Use of Renewable Energy Sources in 2019. The state guarantees the connection of renewables to the grid and provides tax breaks and exemptions. The latter include a land tax exemption for utility-scale producers for 10 years, and land tax and property tax exemptions for households for 3 years. Producers of renewable energy equipment are exempted from all taxes for five years. From 2020, households can obtain 30% capital subsidies for solar PV and solar water heaters; households and utility-scale producers can also obtain interest rate compensations of 8% and 5% respectively. Few utility-scale projects have been arranged through online tenders. PPAs are available for renewable projects, some of which have been developed through bilateral agreements. The country plans to use public-private partnerships.

Note: FIT = feed-in tariff; PPA = power purchase agreement
Source: See endnote 22 for this chapter.

TABLE 4.
Overview of Feed-In Tariffs in the Focus Countries, as of September 2021

Country	Scope	Feed-in Tariff
Albania	Solar	< 2 MW: USD 0.085
	Wind	< 3 MW: USD 0.090
	Hydropower	< 15 MW: USD 0.059
Armenia	Solar	< 5 MW: USD 0.050 (excl. VAT)
	Wind	> 30 MW: USD 0.050 (excl. VAT)
Azerbaijan	Wind	USD 0.032
	Hydropower	Small: USD 0.030
	Other	USD 0.034
Belarus*		None
Bosnia and Herzegovina	Solar	Micro: KM 0.49075 (approx. USD 0.328) per kWh Mini: KM 0.30696 (approx. USD 0.216) per kWh Small: KM 0.25971 (approx. USD 0.187) per kWh
	Wind	Micro: KM 0.37124 (approx. USD 0.211) per kWh Mini: KM 0.22140 (approx. USD 0.126) per kWh Small: KM 0.18917 (approx. USD 0.108) per kWh Medium: KM 0.16033 (approx. USD 0.091) per kWh Large: KM 0.14766 (approx. USD 0.084) per kWh
	Hydropower	Micro: KM 0.29036 (approx. USD 0.175) per kWh Mini: KM 0.18192 (approx. USD 0.110) per kWh Small: KM 0.13751 (approx. USD 0.083) per kWh Medium: KM 0.12373 (approx. USD 0.075) per kWh
	Biomass	Micro: KM 0.31292 (approx. USD 0.190) per kWh Mini: KM 0.24987 (approx. USD 0.151) per kWh Small: KM 0.24067 (approx. USD 0.145) per kWh Medium: KM 0.22706 (approx. USD 0.137) per kWh
	Biogas	Micro: KM 0.71160 (approx. USD 0.430) per kWh Mini: KM 0.66637 (approx. USD 0.403) per kWh Small: KM 0.27891 (approx. USD 0.169) per kWh
Georgia	All renewables	Feed-in premiums for plants > 5 MW: USD 0.015 (maximum premium for plants with the selling price < USD 0.053/kWh
Kazakhstan		None (replaced by auctions)
Kyrgyz Republic	All renewables	Co-efficient of 1.3 for all technologies

Country	Scope	Feed-in Tariff
Moldova	Solar	USD 0.108
	Wind	USD 0.089
	Hydropower	USD 0.056
	Biomass	USD 0.112
	Biogas	USD 0.105
Montenegro	Solar	< 1 MW (rooftop): USD 0.096
	Wind	USD 0.056
	Hydropower	Small (< 10 MW): USD 0.045
	Biomass	< 1 MW (agriculture and forestry): USD 0.115 (wood industry): USD 0.099
	Biogas	landfill gas < 1 MW: USD 0.048 biogas < 1 MW: USD 0.131
North Macedonia	Solar	According to the installed capacity: ≤ 0.050 MW: USD 0.189 per kWh > 0.050 MW: USD 0.142 per kWh
	Wind	Power plants ≤ 0.050 MW: USD 0.189 per kWh
	Hydropower	≤ 85,000 kWh of electricity delivered per block: USD 0.142 per kWh > 85,000 and ≤ 170,000 kWh of electricity delivered per block: USD 0.095 per kWh > 170,000 and ≤ 350,000 kWh of electricity delivered per block: USD 0.071 per kWh > 350,000 and ≤ 700,000 kWh of electricity delivered per block: USD 0.059 per kWh > 700,000 kWh of electricity delivered per block: USD 0.053 per kWh
Russian Federation		None
Serbia	Solar	Residential systems: Up to 50 kW: BAM 0.2734 (approx. USD 0.166) per kWh 50 - 250 kW: BAM 0.2341 (approx. USD 0.142) per kWh 250 kW - 1 MW: BAM 0.1856 (approx. USD 0.112) per kWh Ground-mounted systems: Up to 250 kW: BAM 0.2169 (approx. USD 0.132) per kWh
	Wind	Up to 10 MW: BAM 0.1466 (approx. USD 0.089) per kWh
	Hydropower	Up to 1 MW: BAM 0.1396 (approx. USD 0.085) per kWh 1 - 5 MW: BAM 0.1227 (approx. USD 0.074) per kWh 5 - 10 MW: BAM 0.1186 (approx. USD 0.072) per kWh
	Biomass	For solid biomass: Up to 1 MW: BAM 0.2413 (approx. USD 0.255) per kWh 1 - 10 MW: BAM 0.2261 (approx. USD 0.137) per kWh
	Biogas	For agricultural biogas up to 1 MW: Up to 1 MW: BAM 0.2402 (approx. USD 0.145) per kWh premium Up to 1 MW: BAM 0.1735 (approx. USD 0.105) per kWh
Tajikistan		None
Turkmenistan		None

Country	Scope	Feed-in Tariff
Ukraine (as of 1 April 2021)	Solar	< 1 MW (rooftop): USD 0.142 > 1 MW (rooftop): USD 0.054 < 1 MW: USD 0.125 > 10 MW: USD 0.051
	Wind	< 600 kW: USD 0.058 600-2,000 kW: USD 0.068 > 2,000 kW: USD 0.104
	Hydropower	Micro : USD 0.186 Mini : USD 0.148 Small : USD 0.111
	Geothermal	USD 0.160
	Biomass	USD 0.147
	Biogas	USD 0.161
Uzbekistan		None

*co-efficients are < 1 (i.e., renewable energy tariffs are lower than the baseline)
Note: KM = convertible mark, BAM = Bosnian Convertible Mark.
Source: See endnote 42 for this chapter.

ENERGY EFFICIENCY POLICIES

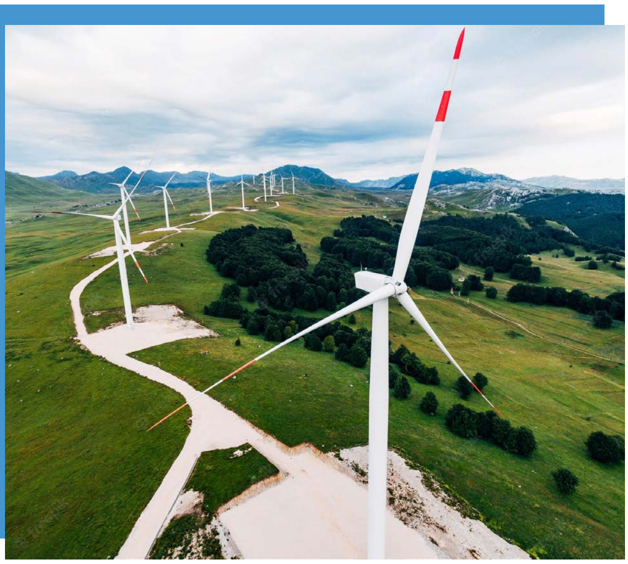
Without first realising the potential for energy efficiency, addressing energy demand at an affordable cost will be challenging with the available energy supply options, including renewables. To improve energy efficiency, the focus countries have adopted a range of policies across all sectors, including the energy sector, buildings, industry and transport. These policies are shaped largely by two regional entities, the European Commission and the Eurasian Economic Commission.

Georgia, Moldova, Ukraine and the countries of South-East Europe, as contracting parties of the EU's Energy Community Treaty, have committed to align their domestic policies with EU legislation. This implies the transposition of three key pieces of energy efficiency legislation: the Energy Efficiency Directive 2012/27/EU until 15 October 2017[iv], the Energy Performance of Buildings Directive 2010/31/EC until 30 September 2012[v] and EU Regulation 2017/1369 setting a framework for energy labelling until 1 January 2020.[68] EU energy efficiency legislation also includes Directive 2009/125/EC on eco-design requirements for energy-using products (the Ecodesign Directive), which many countries transpose voluntarily even though the Energy Community Treaty does not require this. Substantial progress in transposing the directives has occurred in the region, although with many challenges and delays. Compared to other policy areas (such as natural gas, oil and climate policy), the implementation of energy efficiency requirements is considered well advanced.[69]

The member countries of the Eurasian Economic Union (EAEU) – Armenia, Belarus, Kazakhstan, the Kyrgyz Republic and the Russian Federation – have adopted common regulatory policies related to energy efficiency, including technical regulations such as minimum energy performance standards and labels for appliances and equipment.[70]

Overview of Policies by Sector

Tables 5 and 6 provide an overview of policy and institutional frameworks on energy efficiency in the focus countries as of October 2021.[71] To address institutional and regulatory barriers, 8 countries have set up dedicated energy efficiency institutions, although 10 countries still lack them. The absence of a single co-ordinating body is often considered a barrier to energy efficiency because related measures are not well co-ordinated.[72] All focus countries, except Turkmenistan, have set energy efficiency targets and introduced regulations creating a framework for implementation. Nearly all focus countries have established or are in the process of finalising minimum energy performance standards (MEPS) and labelling for buildings (building codes), appliances and lighting.



iv The implementation deadline for Georgia is 31 December 2018.

v The implementation deadline for Georgia is 30 June 2019.

TABLE 5.
Overview of Energy Efficiency Policies in the Focus Countries, as of October 2021

Country	Energy efficiency target	Energy efficiency campaign	Energy efficiency regulation(s)	Energy efficiency institution (agency)
Albania	+	+	+	+
Armenia	+	+	+	-
Azerbaijan	+	+	+	-
Belarus	+	+	+	+
Bosnia and Herzegovina	+	+	+	-
Georgia	+	+	+	-
Kazakhstan	+	+	+	+
Kyrgyz Republic	+	+	+	-
Moldova	+	+	+	+
Montenegro	+	+	+	-
North Macedonia	+	+	+	+
Russian Federation	+	+	+	+
Serbia	+	+	+	+
Tajikistan	+	+	+	-
Turkmenistan	-	+	-	-
Ukraine	+	+	+	+
Uzbekistan	+	+	+	-

Source: See endnote 71 for this chapter.

TABLE 6.
Overview of Energy Performance and Labelling Policies in the Focus Countries, as of October 2021

Country	Buildings	Lighting	Appliances
Albania	+	+	+
Armenia	+	+	+
Azerbaijan	-	+	-
Belarus	+	+	+
Bosnia and Herzegovina	+	+	+
Georgia	+	+	+
Kazakhstan	+	+	+
Kyrgyz Republic	+	+	-
Moldova	+	+	+
Montenegro	+	+	+
North Macedonia	+	+	+
Russian Federation	+	+	+
Serbia	+	+	+
Tajikistan	+	+	+
Turkmenistan	+	+	-
Ukraine	+	+	+
Uzbekistan	+	+	+

Source: See endnote 71 for this chapter.

Renewable Energy Policy Landscape

Total final energy consumption

59% | 41%

Electricity

76% | 24%

Heating and cooling

35% | 65%

Transport

41% | 59%

Per technology (solar, wind, bioenergy, among others)

35% | 65%

Focus countries with a renewable energy target

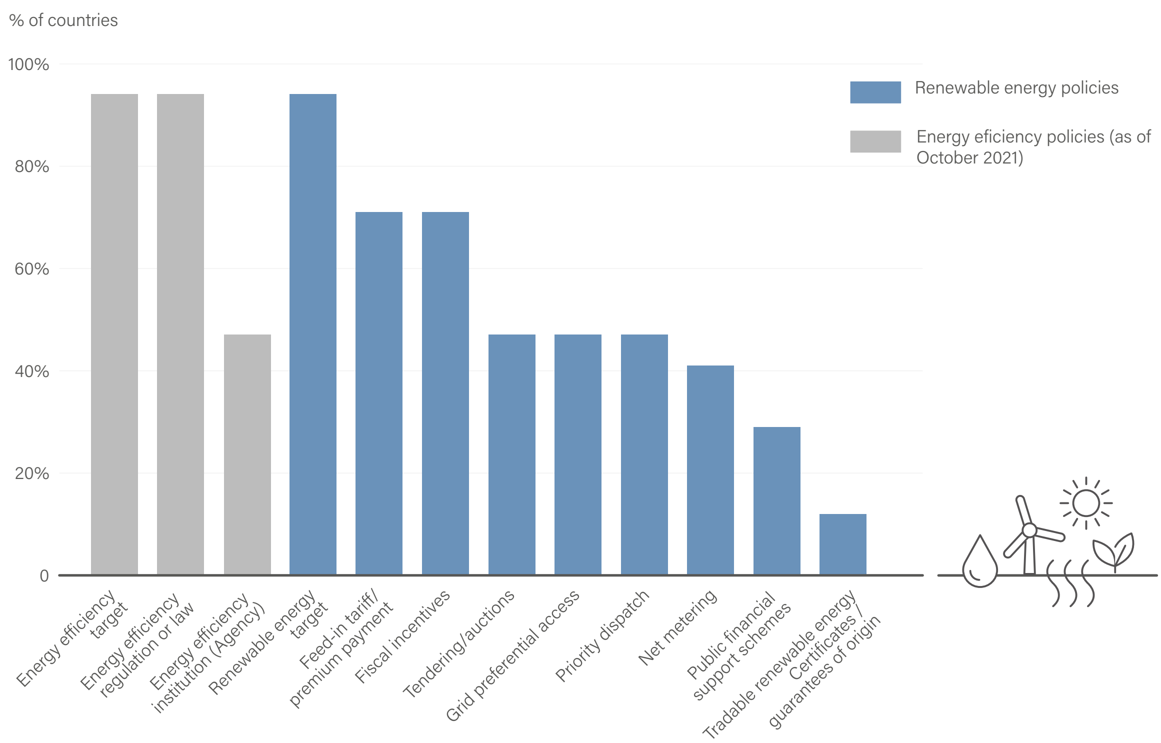
Focus countries without a renewable energy target

Only **40% of the focus countries** having a renewable energy target in total final energy consumption achieved it.

Only **23% of the focus countries** having a renewable energy target in electricity achieved it.

No focus country having a renewable energy target in transport achieved it.

Only **67% of the focus countries** having a renewable energy target in heating and cooling achieved it.



Building codes are a key policy to address thermal energy performance in the buildings sector.[73] Energy conservation requirements were first included in building codes in the Soviet Union in 1955 and then replicated across all of the former Soviet republics.[74] In 1994, the Moscow region adopted the region's first comprehensive building code, which was improved several times before being adopted throughout the Russian Federation starting in the late 1990s.[75] After the break-up of the Soviet Union, other former Soviet republics also improved their building codes, although it took them longer.

So far, the most advanced building codes in the focus countries have been adopted by the members of the EU's Energy Community Treaty following their transposition of the European Performance for Buildings Directive. The directive requires introducing minimum energy performance standards in buildings, including both new buildings and existing buildings undergoing significant renovation.[76] A recent update of the directive requires all new buildings to use "nearly zero" energy from 2020 on, whereas all new public buildings were to achieve this "nZEB" standard from 2018 on.[77]

To meet the high standard, construction assumes the improvement of thermal envelopes, the installation of very efficient building systems (such as heat pumps) and the use of renewable heat technologies, such as advanced biomass stoves and solar thermal (the latter two in cases where buildings are not connected to district heat). Sidebar 2 presents a plan to transition to the nZEB standard for new buildings and renovated existing buildings in Ukraine.[78]

SIDEBAR 2.
Transition to the nZEB Standard for New and Existing Buildings in Ukraine

The government of Ukraine has approved the Concept for the Implementation of the State Policy for Energy Efficiency in Buildings as well as a National Plan, which aims to increase the number of nearly zero energy buildings (nZEBs). The plan outlines that, between 2020 and 2030, developers and building owners will receive additional incentives to use high energy efficiency standards for construction and renovation. The solutions are to be implemented in two stages:

- Between 2020 and 2025, the government will develop a legal framework, establish technical regulations and requirements for nZEBs, set goals for increasing the number of nZEBs and establish a procedure for their monitoring.
- Between 2025 and 2030, the government will ensure the transition to mandatory compliance with nZEB standards for constructed and renovated buildings.

Source: See endnote 78 for this chapter.

Several voluntary labelling and certification programmes for buildings have been adopted and used across the region. Their purpose is to provide information to buyers and tenants about the environmental performance of buildings and often the related additional costs and/or other benefits or shortcomings. As of 2021, the focus region was home to 575 buildings certified by the Leadership in Energy and Environmental Design Certification Scheme (LEED). The largest share was in the Russian Federation (374), followed by Kazakhstan (75), Serbia (71) and Ukraine (28).[79]

Key policies for reducing energy consumption from appliances and equipment are minimum energy performance standards and energy efficiency labelling of these devices. Although nearly all countries in the region have introduced these policies, they do not always cover all types of appliances and equipment, thus leaving a large share of stock uncovered.

Member countries of the Energy Community Treaty have worked to transpose the EU's Labelling Regulation and the Ecodesign Directive.[80] Members of the Eurasian Economic Union (EAEU) – including Armenia, Belarus, Kazakhstan, the Kyrgyz Republic and the Russian Federation – have planned common minimum energy performance standards and energy efficiency labels for appliances and equipment, aligned to those of the European Labelling Directive.[81] During 2017-2019, the UNDP with financial support from the Russian Federation implemented a USD 1.5 million project to support Armenia, Belarus, Kazakhstan and the Kyrgyz Republic with developing minimum energy performance standards and high energy performance standards, to be adopted by the EAEU in the form of technical regulations "for energy efficiency of power consuming devices" (EAEU TR 048/2019).[82] However, in 2021 the EAEU Council postponed enactment of this technical regulation to 1 September 2022.[83]

Across the region, the main tool to regulate natural resource use, including energy use, in industrial and commercial processes is policies promoting the use of best available technologies (BATs). The Russian Federation has mandated the application of BATs since 2014, and Kazakhstan has done so since January 2021, when the country's new Eco-Code was officially adopted.[84] These countries have been elaborating the required regulatory documents to provide industries with sector-specific lists and descriptions of BATs.

The countries also often have used energy audits to promote efficiency in the industrial sector. In Kazakhstan, which has some of the region's most energy-intensive industries, the 2012 Law on Energy Saving mandates that all energy users with annual consumption above 1.5 million tonnes of coal equivalent must undergo regular (every five years) energy audits and formulate and implement energy-saving plans based on the results.[85] Kazakhstan established a State Energy Registry where industries covered by the scheme must regularly report on their energy use and on the measures they have taken to improve efficiency.[86]

As of early 2022, Kazakhstan was the only country in the focus region where emissions from energy-intensive industries were covered by the domestic emission trading scheme.[87] In line with its commitments under the Paris Agreement, the country has considered introducing additional regulatory policies, such as carbon taxation, for sectors not covered by the scheme.[88]

Stakeholders in the region have indicated the need to work with industry and commerce to create industrial demand for energy-efficient products.[89] This includes developing programmes to raise awareness and provide advice and guidance to small and medium-sized enterprises and industry, as well as creating integrated information tools (i.e., e-portals) to consolidate advice, information and methodologies on greening practices by sub-sector. Guidance also could be disseminated through workshops and training, as well as via successful case studies. Overall, many interviewees have pointed out that whereas most countries have developed advanced strategies and policies for residential and public buildings, many lack dedicated energy efficiency strategies for industry and commerce, especially small and medium-sized enterprises.

Key regulatory policies for the transport sector in the region are standards for new vehicles, bans on the import of inefficient vehicles, as well as better infrastructure planning, especially urban planning. Several countries have recently introduced policies supporting the transition to electric mobility, with the assumption of linking the charging of electric vehicles with the use of renewable electricity.[90] Some national programmes, often initiated with donor support, also provide financial incentives for trading out inefficient vehicles for ones with higher fuel efficiency.[91]

Studies have long called for developing the market for energy service companies (ESCOs) in the focus countries. Progress so far has been modest, despite many supporting projects. ESCO schemes – which provide a full range of services, including design, implementation and financing for energy efficiency projects – were present in only a few of the countries as of September 2021, despite policies introduced by many governments to support them.

One successful case study is the UNDP/GEF initiative on Low Carbon Urban Development in Kazakhstan, which tested the mechanism of financial support to urban projects implemented by private ESCOs.[92] The initiative set minimum energy-saving targets to achieve, in the range of 15% to 45% depending on the area of energy use, such as heat supply, water supply, lighting, buildings and sewage treatment systems.[93] The implementing ESCOs could obtain a subsidy covering 10% of the commercial loan rate and a guarantee covering 50% of the loan amount.[94] Altogether, USD 1.5 million in support was disbursed to around 40 projects.[95] Following this successful pilot, the Kazakhstan Entrepreneurship Development Fund (DAMU) introduced a similar supporting mechanism for such project types as part of its operational programmes.[96]

Because of the many barriers to the development of the private ESCO market, a USAID project suggested replicating a public ESCO model, which was found to be successful in a case study of Šabac district in Serbia *(→ see Sidebar 3)*.[97]

SIDEBAR 3.
Testing the Concept of a Public ESCO in Serbia

The concept of a public ESCO has been developed and tested in Serbia. In 2019, the EBRD signed a loan agreement of EUR 2.5 million (USD 2.8 million) with the district heating operator of Šabac municipality, Toplana-Šabac, to implement the Šabac buildings energy efficiency project. The operator acts as a public ESCO to retrofit 40 multi-residence buildings. The city of Šabac entered the contract as a guarantee that made it possible to cut the interest rate, and hence reduce the payback time from 12 to 8 years. The interviewees shared that it took around eight years to build data, knowledge, capacity and structure for the project.

Source: See endnote 97 for this chapter.

Policies in the Contracting Parties of the Energy Community Treaty

Nine of the focus countries are contracting parties of the Energy Community Treaty and have committed to adopting EU energy legislation, including the three energy efficiency directives. Contracting parties also are requested to submit National Energy and Climate Plans (NECPs) in 2024 in response to the Governance Regulation on Energy Union and Climate Action.[98]

Table 7 provides a more detailed overview of the energy efficiency policies adopted in the nine contracting parties as of October 2021.[99] Montenegro has been a leader in this adoption process, and implementation is also well advanced in Kosovo, Moldova, Serbia, Georgia and Ukraine. For example, Ukraine has adopted national legislation on energy labelling of appliances and energy performance contracting; however, the adoption and official notification of energy efficiency obligation schemes is pending. Kosovo has adopted an energy efficiency law, including bylaws for the implementation of legislation on energy efficiency in buildings, and has established an independent energy efficiency fund, but the country lags in adopting energy efficiency labelling provisions. Moldova still has to catch up on implementing energy labelling and buildings policies.[100] In Georgia, the energy efficiency law and the law on energy efficiency in buildings were adopted in 2020. However, the adoption of the 15 regulations for appliances required by the Law was delayed, and some of the drafted product regulations need to be updated.[101]

In Albania, Bosnia and Herzegovina, and North Macedonia, implementation of the EU energy efficiency legislation is moderately advanced. Although these countries had adopted many of the provisions as of the end of 2021, some remained a work in progress or were missing. For example, North Macedonia aligned with the EU energy efficiency legislation by adopting an Energy Efficiency Law in early 2020, but bylaws are still to be adopted. In Albania and in Bosnia and Herzegovina, the existing laws have not yet been fully implemented.[102]

In 2021, the contracting parties to the Energy Community Treaty drafted their NECPs and carried out the related modelling activities. The Energy Community Secretariat assisted them by providing informal input on the first drafts of their plans. Albania and North Macedonia were the most advanced among the countries, having already formally submitted their drafts to the Secretariat and received reviews and recommendations. Work on the NECPs also was relatively advanced in Bosnia and Herzegovina, with the need to clarify energy efficiency financing. NECP preparation remained in the relatively early stages in Kosovo, Moldova and Montenegro. This work was postponed in Ukraine and had yet to commence in Serbia.[103]

TABLE 7.
Overview of Energy Efficiency Policies in the Focus Countries That Are Contracting Parties of the Energy Community Treaty, as of October 2021

Policies / Countries	Energy efficiency targets and policy measures	Energy efficiency in buildings	Energy efficiency financing	Energy-efficient appliances and equipment labelling
Albania	In 2021, Albania amended the Energy Efficiency Law, transposing the EED. The 2030 energy efficiency targets and renovation targets for public buildings were to be set in the NECP. Targets and policy measures for the EEO had not been developed.	Albania adopted bylaws implementing the 2016 Law on Energy Performance of Buildings, i.e., the methodology for calculation and setting of minimum energy performance requirements and certification of buildings. A long-term renovation strategy is still to be adopted.	No state fund for energy efficiency exists. Amendments to the Energy Efficiency Law promoted the ESCO market, with a facilitating role by the Energy Efficiency Agency. Several international technical assistance and investment programmes support energy efficiency, especially in buildings.	The transposition of the Labelling Directive and Labelling Regulation were pending. .
Bosnia and Herzegovina (consists of two entities: the Federation of Bosnia and Herzegovina, and Republika Srpska)	The NECP and respective targets and policies have been drafted but not adopted. The country still has to adopt the NEEAP 2019-2021 and the respective energy efficiency targets and measures. The EEO scheme was suggested in the third NEEAP but not adopted. In 2021, the Federation of Bosnia and Herzegovina adopted its EEAP 2019-2021.	Long-term building renovation strategies have been drafted at the state and entity levels. Republika Srpska has adopted the necessary amendments to primary legislation. Both entities are working on updating existing legislation, including procedures for information systems and certification of buildings.	Each entity has established an energy efficiency and environmental fund. The energy efficiency laws of both entities and the draft law of Brčko District recognise ESCOs and energy performance contracting. However, the ESCO market is not functioning, and implementation gaps remain in public procurement, multi-year budgeting and the adoption of model ESCO contracts.	The regulations were transposed partially in Republika Srpska in 2016. The regional REEP Plus project began supporting Bosnia and Herzegovina in the transposition and implementation of the Labelling Regulation 2017 and the Ecodesign Directive.
Georgia	The general 2020 energy efficiency target was set in the latest NEEAP. The 2020 Energy Efficiency Law established the specific targets required by the EED, including Article 5. Georgia was assessing the feasibility of an EEO implementing Article 7 of the EED.	The Law on Energy Performance of Buildings, minimum energy performance requirements for buildings and their elements, and the national calculation methodology for building performance have been adopted. Regulations on heating and air conditioning inspection and certification rules have been prepared.	The Energy Efficiency Law promotes the use of ESCOs but does not include a framework to support public financing, i.e., an energy efficiency fund. A large number of international technical assistance projects and financing programmes support energy efficiency measures, especially in the buildings sector.	The Law on Energy Labelling, which transposed Labelling Regulation 2017, was adopted in 2019. The adoption of 15 product regulations required by the Law was delayed, and some of the drafted product regulations need to be updated.

Policies / Countries	Energy efficiency targets and policy measures	Energy efficiency in buildings	Energy efficiency financing	Energy-efficient appliances and equipment labelling
Kosovo	The 2018 Law on Energy Efficiency set a final energy consumption target for 2020, an EEO with a 0.7% target and a 1% annual central government buildings renovation target. In 2020, the NEEAP 2019-2021 was submitted.	Kosovo adopted the necessary bylaws to implement the Law on the Energy Performance of Buildings. Activities to strengthen expertise and tools for certification of buildings are ongoing. A plan to boost nZEBs and a building renovation strategy has been drafted.	The Energy Efficiency Fund of EUR 20 million (USD 22.5 million) secured financing until 2022 and issued energy efficiency calls for municipalities. The fund planned to also cover households in 2022. Rules on energy efficiency public procurement, ESCOs, energy performance contracts and energy supply contracts have been aligned with the EU legislation.	Kosovo has not implemented the delegated regulations adopted by the Ministerial Council in 2014 and 2018. Only the labelling regulations adopted by the 2010 Ministerial Council have been implemented.
Moldova	Moldova adopted the Energy Efficiency Law transposing the EED and its targets and policies. The EEO scheme is planned. The country adopted new regulations on energy audits and energy auditors. The Energy Efficiency Agency drafted the template for energy audit reports in buildings, industry and transport, and the guides for quality checking of energy audits.	Moldova has transposed the EPBD. It has prepared bylaws on an updated national methodology for minimum energy performance requirements of buildings and a long-term investment strategy. The national action plan to increase the number of nZEBs has been developed. The government approved a EUR 1.2 million (USD 1.3 million) programme for the renovation of central government buildings by 2022.	The EUR 75 million (USD 84 million) national Energy Efficiency Project for renovation of public buildings has been prepared with international donors. Implementation was expected to start in 2022.	Moldova has prepared a law to transpose the Labelling Regulation 2017 and the Ecodesign Directive.
Montenegro	The 2019-2021 NEEAP includes the overall 2020 target, a 1% annual target for central government buildings and alternative measures for Article 7 of the EED. In 2021, the framework for the NECP was drafted as amendments to the Law on Efficient Use of Energy.	The EPBD and implementing rulebooks were transposed in 2015. The updates on the cost-optimality calculations and a new software for energy performance calculations and certification of buildings have been finalised. Several building renovation programmes are ongoing. A long-term strategy is still to be adopted.	The Eco Fund has financed environmental and energy efficiency projects. Several projects related to the public and residential sector are ongoing, supported by either state subsidies or international loans. The Law on Efficient Use of Energy contains an ESCO framework. The NEEAP envisages measures and financial mechanisms for ESCO projects.	A package of 12 energy labelling rulebooks has been adopted. To be fully compliant, Montenegro still has to adopt three regulations adopted by the Ministerial Council in November 2018.

Policies / Countries	Energy efficiency targets and policy measures	Energy efficiency in buildings	Energy efficiency financing	Energy-efficient appliances and equipment labelling
North Macedonia	The 2020 Law on Energy Efficiency transposed the EED and set the specific targets required for Articles 5 and 7. Bylaws on the EEO scheme, buildings renovation strategy and energy audits have not yet been adopted but are under development. The NECP is a work in progress.	The Law on Energy Efficiency partially transposed the EPBD, but implementation is not complete. North Macedonia is preparing rulebooks on energy performance of buildings, energy audits of buildings and a verification system for energy performance certificates.	The Energy Efficiency Fund is being set up and will be funded through a EUR 24 million (USD 27 million) loan from the World Bank. The government programme for renewables and energy efficiency for 2021 was adopted. A buildings renovation programme of around EUR 24.5 million (USD 27.5 million) is being implemented.	Rulebooks implementing the EU Labelling Directive were adopted. Rulebooks implementing the new Labelling Regulation 2017 are in the drafting process.
Serbia	In 2021, the Law on Energy and the Law on Energy Efficiency and Rational Use of Energy transposed the EED. The EEO was planned to implement Article 7 of the EED. Article 5 was adopted in 2018 with a programme for building renovations. The fourth NEEAP was adopted in 2021. National energy efficiency targets will be established in the NECP (a work in progress).	Preparation of the long-term building renovation strategy is in its final stages. Little progress has been achieved on the update of the regulation implementing the EPBD.	The Directorate for Financing and Promotion of Energy Efficiency, focused on energy efficiency in public buildings, was established within the Ministry of Mining and Energy. In 2021, two public calls were launched to support the renovation and installation of solar PV in the residential sector. A legal framework for energy performance contracting is in place, and ESCO projects in buildings, public lighting and districts are being implemented.	The revised Law on Energy Efficiency and Rational Use of Energy transposed the Framework Labelling Regulation 2017. In 2021, the Ministry updated existing rulebooks to introduce rescaled labels for several appliances; the remainder are still to be adopted.
Ukraine	The NEEAP until 2030 has been drafted. The Energy Efficiency Law, which was to include specific targets, has not yet been adopted. The targets under Article 5 of the EED have not been defined. Ukraine plans to meet the targets of Article 7 with alternative measures.	Ukraine updated five bylaws to implement the EPBD and aligned them with the EED, including those on building certification and energy audits. In 2020, it approved two bylaws establishing minimum energy performance requirements for buildings. With these, the full package of bylaws was adopted.	The Energy Efficiency Fund had a budget of UAH 2.7 billion (USD 112 million) from international donors. As of 2021, it had received 692 applications for grants for apartment building renovations. ESCO projects have progressed well.	Ukraine adopted all energy labelling regulations related to the Labelling Directive and five new regulations implementing Labelling Regulation 2017. It transposed the Ecodesign Directive 2009 and 23 product regulations on a voluntary basis.

Notes: EED = Energy Efficiency Directive 2012/27/EU; EEO = Energy Efficiency Obligation; EPBD = Energy Prformance for Buildings Directive; NEEAP = National Energy Efficiency Action Plan; NECP = National Energy and Climate Plan; nZEB = nearly zero energy building.

Source: See endnote 99 for this chapter.

Overview of Policies in the Eurasian Economic Union and Other Countries

The Eurasian Economic Commission (EEC) works together with the countries of the Eurasian Economic Union – Armenia, Belarus, Kazakhstan, the Kyrgyz Republic and the Russian Federation – to ensure the co-ordination of specific energy efficiency policies to support the energy market integration.

In August 2019, the EEC Council adopted the EAEU technical regulations on the efficiency of energy-consuming devices. The document applies to refrigerators, televisions, computers, washing machines, dishwashers, air conditioners, room fans, water pumps and other electrical appliances. In accordance with the decision of the EEC Council, a phased introduction of certain requirements of the technical regulations of the EAEU was planned, which will ensure a smooth transition of device manufacturers to uniform mandatory requirements. Regulations were to enter into force in 2022.[104]

The EU4Energy initiative targets co-operation on energy sector development – including energy efficiency – among several of the focus countries. During the initiative's first phase (to 2016), the closest support was provided for Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine; in the second phase (ongoing), support went to Georgia, Moldova and Ukraine.

Some countries have related their energy efficiency legislation to both the EU legislation and EAEU initiatives. For example, Armenia is improving the energy efficiency of its economy as part of international integration procedures, particularly within the EAEU and the Comprehensive and Extended Partnership Agreement with the EU to further harmonise with EU energy directives. Thus, the government of Armenia adopted a technical regulation on energy efficiency requirements for energy-consuming equipment by joining the Treaty on the EAEU (enforced since 2021). Several regulatory and legislative proposals regarding the buildings sector (regulations, labelling, standards, etc.) were proposed as part of the EU4Energy project on the Nearly Zero-Energy Buildings Roadmap.[105]

As part of the Energy Charter Treaty and its Energy Community observer status, Armenia also is updating its National Energy Efficiency Action Plan. As of early 2022, the country was transposing the EU's Energy Performance in Buildings Directive. In 2016, the government also adopted minimum energy requirements for new and renovated buildings. An IEA study highlighted that although improvements have been made in Armenia's policy framework for energy efficiency in buildings, gaps remain in actual implementation and enforcement, some of which are being addressed via the EU-Armenia Comprehensive and Enhanced Partnership Agreement (CEPA).[106] In transport, Armenia has incentivised the import of electric vehicles through exemptions on VAT and import tax as part of the EAEU and is increasing awareness through a demonstration project initiated by the three biggest municipalities.

Table 8 provides a more detailed overview of the energy efficiency policies adopted by EAEU members and other countries as of October 2021.[107]

TABLE 8.
Overview of Energy Efficiency Policies in the Eurasian Economic Union and Other Countries, as of October 2021

Policies / Countries	Energy efficiency targets and policy measures	Energy efficiency in buildings	Energy efficiency financing	Energy-efficient appliances and equipment labelling
Armenia	The Law on Energy Saving and Renewable Energy was adopted in 2004; it was followed by a National Programme on Energy Savings and Renewable Energy in 2007, and the first NEEAP in 2010 (updated in 2017). The programme update for 2021-2030, which includes energy efficiency targets, policies and the third NEEAP, is a work in progress. Armenia is aligning with EU policies and norms as part of the EU-Armenia CEPA, and with technical norms with the EAEU.	The mandatory building code was approved in 2016, based on Russian norms. National standards for building energy passports and energy audits were developed in 2013-2016. The EU4Energy project suggested amendments to enforcement and compliance procedures, energy auditing guidelines, nZEBs, eco-labelling requirements, buildings calculation methodology and related standards, in line with the EPBD.	The public R2E2 Fund launched in 2005 provides funding and co-financing for energy efficiency and renewable energy projects, often working with international donors and local commercial banks. Several international donors supported energy efficiency projects, including the loan project by Central Bank of Armenia with KfW financing energy efficiency for more than 450 small and medium-sized enterprises and the UNDP, Global Climate Fund and European Investment Bank project of energy audits and retrofits of around 50 kindergartens.	The government adopted a technical regulation on energy efficiency requirements for energy-consuming equipment, including industry, by joining the EAEU Treaty in 2021. The EU4Energy project suggested further amendments related to the transposition of the EU eco-design and labelling directives and implementing regulations that had been already partially adopted.

Policies / Countries	Energy efficiency targets and policy measures	Energy efficiency in buildings	Energy efficiency financing	Energy-efficient appliances and equipment labelling
Azerbaijan	In 2012, the government set a target to improve energy efficiency 20% by 2020, but it was not supported by bylaws. It adopted the law "On the Efficient Use of Energy Resources and Energy Efficiency" in 2021, and the first NEEAP in 2020. The latter set up energy efficiency measures in all sectors. For industry, these are energy audits, energy management systems, an ESCO market and an EEO scheme. For transport, excise taxes on cars and buses favour small engines.	Requirements for a mandatory building code date to 2001 and 2012, but the bylaws have not been adopted. The new energy efficiency law provided a comprehensive update of energy efficiency measures in buildings, including minimum energy performance requirements for new and renovated buildings, an energy performance contracting system, compulsory energy audits, and energy managers for large non-residential buildings. Bylaws have yet to be adopted.	Financing programmes to construct energy-efficient buildings or to renovate existing buildings have not been identified. Several projects supported by international donors have taken place.	The new energy efficiency law envisioned the introduction of energy labelling and eco-design (energy performance) requirements for energy-related products. Bylaws are still to be adopted.
Belarus	The National Programme on Energy Saving for 2016 to 2020 defines targets and measures aimed at improving energy efficiency, including the target of reducing energy consumption in the manufacturing sector by 2% in 2021 versus 2015. The Law on Energy Saving requires mandatory energy audits for industry; the standard for energy management systems has been valid since 2013. In 2013, Belarus adopted an energy management systems standard that is voluntary for organisations.	Belarus established technical regulations and standards for construction in the residential sector. Thermal energy passports have been introduced. ESCOs do not exist. In 2015, the government adopted the Law on Public-Private Partnership. The Presidential Decree on Increasing the Energy Efficiency of Multi-family Housing is being discussed to create rules and financing sources for renovation.	The Department for Energy Efficiency annually approves the state budget for energy efficiency measures. For the National Energy Saving Programme 2016-2020, it planned for one-fifth of its costs, as well as private financing, soft loans from international financial institutions, and loans from the national Development Bank. Energy efficiency credit lines are available from the EBRD (through the Belarus Sustainable Energy Efficiency Facility), NEFCO, the IFC and the Eurasian Development Bank.	Under the Programme for Developing the System for Technical Regulation, Standardisation and Conformity Attestation in the Field of Energy Saving, in 2016-2020 more than 130 technical regulations were developed on top of the 250 developed in 2007-2015. Almost all are harmonised with international and European requirements.
Kazakhstan	In 2012, the laws "On Saving Energy and Improving Energy Efficiency " and "On introducing amendments into some legislative acts on saving energy and energy efficiency" went into force, with more than 22 normative acts adopted. The Green Energy Concept set the target of reducing the energy intensity of GDP by at least 30% by 2030 and 50% by 2050, as compared to the 2008 level.	Among the adopted acts of the Law were: introducing compulsory requirements on energy efficiency for all types of transport, electrical engines as well as buildings, structures and construction and their design documentation; introducing energy efficiency classes for buildings, structures and facilities and rules for their definition and revisions;	Financing is mainly self-financed. The government is testing the mechanism of subsidising and/or guaranteeing energy service contracts financed through bank borrowing (UNDP-GEF project). In 2020, the EBRD introduced a microfinance energy efficiency facility to support small and medium-sized enterprises and households.	The adopted laws include minimum energy performance standards and labelling requirements for electricity-using appliances and equipment. Such requirements are based on the set of common standards developed in the frame of the EAEU. The sale and use of incandescent lamps of 25 watts has been not allowed since 2014, including in public procurement.

Policies / Countries	Energy efficiency targets and policy measures	Energy efficiency in buildings	Energy efficiency financing	Energy-efficient appliances and equipment labelling
Kazakhstan (continued)	The government is discussing the introduction of energy management systems at large enterprises, targets for Top-100 energy-intensive enterprises, energy efficiency public procurement, consumption standards, etc.	adopting rules for conducting energy auditing at industrial enterprises and buildings; providing an ESCO contract template, etc.	With support of the UNDP, in 2020 the Entrepreneurship Development Fund "Damu" issued the first green bonds to finance energy efficiency and renewable energy; the whole amount of USD 477,760 was subscribed, illustrating the success of the pilot.	
Kyrgyz Republic	The Law on Energy Savings adopted in 1998 and changed a few times since then is the main legislation related to energy efficiency. The law establishes the institutional and legal framework for energy efficiency, but secondary legislation has not been adopted. The Programme on Energy Conservation and Energy Efficiency Policy for 2015-2017 established a target to ensure GDP growth without an increase in energy consumption by 2017.	A Law on Energy Conservation and Energy Efficiency in Buildings and a State Programme on Energy Saving were adopted in 2013, and Energy Efficiency Policy Planning for 2015-2017 was approved in 2015. The National Strategy for Sustainable Development for 2018-2040 envisions energy efficiency technologies for new buildings, large-scale programmes on energy efficiency reconstruction of buildings, as well as energy efficiency passportisation for all buildings.	The country relies on international donors. In 2013, the EBRD launched the USD 20 million energy efficiency credit line KyrSEFF for households and businesses. As part of it, the EU Central Asia Investment Facility provided technical assistance to borrowers upon project delivery. In 2016, the EBRD extended the credit line until 2020 with USD 35 million. Legislative provisions for ESCOs do not exist.	Minimum energy performance standards for industrial energy-consuming appliances, such as motors and pumps, were adopted in line with the EEU Standards on Energy Efficiency.
Russian Federation	The Law on Energy Conservation and Energy Efficiency Improvement, adopted in 2009 and amended in 2021, requires, for example, regulations for building energy efficiency standards, energy audits, and energy services contracts, energy efficiency procurement. The Complex Plan for Energy Efficiency Enhancement, approved in 2018, aims to reduce the energy intensity of GDP by 13% in 2025 and 23% in 2030, as compared to 2016. The plan outlines timelines for the development of numerous measures across all sectors.	Building codes date back to 1955. The Law on Energy Efficiency requires the update of building codes every five years, introduced mandatory energy performance contracting, and established an energy efficiency target in public buildings (by 3% per year). There are also specific requirements for the construction sector, technologies and materials. New buildings must achieve a reduction in energy use of 20% from 2018, 40% from 2023, and 50% from 2028, as compared to the baseline. In 2020, the Russian Federation abolished a part of minimum energy performance requirements, which some say is a drawback.	The Fund for Assistance to the Housing and Public Utilities Reform provides subsidies for energy efficiency in apartment buildings. Tax incentives and benefits are provided to industry for replacement of inefficient equipment. The resolution on Subsidies for Regional Programmes for Energy Saving and Energy Efficiency was adopted in 2011. The energy efficiency plan targets a minimum C-rating for all renovations from 2022 and subsidies to incentivise their uptake. In 2020, 826 ESCO contracts were concluded (up 24% from 2019).	Energy performance standardisation started in the 1980s. Hundreds of minimum energy performance standards regulate the performance of appliances, equipment, and lights, based on energy efficiency indices or maximum consumed power requirements. Most standards are harmonised with international and European requirements. The Law on Energy Conservation and Increase of Energy Efficiency (2011) established the mandatory energy labelling scheme synchronised with that of the EU.

Policies / Countries	Energy efficiency targets and policy measures	Energy efficiency in buildings	Energy efficiency financing	Energy-efficient appliances and equipment labelling
Tajikistan	The first Law on Energy Savings, adopted in 2002 and most recently changed in 2013, set out the legal and institutional framework for energy efficiency. The Sustainable Energy for All Tajikistan 2013-2030 strategy contains an objective to improve energy efficiency across all sectors and end uses 20% by 2030, compared with 2013 levels. Bylaws and secondary legislation needed to implement the law are not fully in place.	The Law on Energy Savings requires new buildings and existing buildings that have undergone a major retrofit to comply with energy efficiency requirements and possess metering equipment and energy passports. The law also requires the update of energy efficiency requirements for buildings every five years. Public authorities must conduct energy audits of their facilities. Secondary legislation implementing these provisions is largely missing.	The Law on Energy Savings envisioned a dedicated fund, but it was not set up. The country mostly relies on support from international lenders, such as the EBRD and the ADB. The Access to Green Finance Project, run by the ADB during 2013-2020, supported energy efficiency microfinance loans for households for energy-efficient cooking stoves and heating appliances. The EBRD also opened an energy efficiency credit line for households. The ESCO market is not developed.	The law requires all purchased and imported energy-using appliances and equipment to be labelled. This also applies to building materials and industrial technologies. The adoption of many specific technical standards is still pending. The ban on the use of incandescent lamps has been in place since 2009 and was backed by a support scheme of providing energy-efficient lamps to 250,000 households.
Turkmenistan	The 2014 Law on Electricity and 2013 Law on Hydrocarbon Gas and Gas Supply are the main pieces of energy efficiency legislation. The State Programme on Energy Saving for 2018-2024 aims to stimulate energy efficiency. The Draft Energy Strategy for 2030 as well as the draft law on energy saving and energy efficiency includes provisions on efficiency in industry, buildings and heat supply.	The building codes for the design and construction of residential buildings were updated in 2012. The country worked on the adoption of building energy passports, certifying the results of energy audits and testing energy management systems in residential buildings.	A dedicated public fund supporting energy efficiency investment is not identified. Provisions for ESCO support are also missing. Climate finance from international donors is the lowest among the countries of Central Asia. Donor support includes that of the EU, the United States and the GEF.	Provisions for minimum energy performance and labelling of appliances and equipment are not found.
Uzbekistan	Energy efficiency legislation was first introduced in 1997. In 2021, the strategy for the transition to a green economy 2030 set targets to double energy efficiency and reduce the carbon intensity of GDP by 2030 as well as to increase the energy efficiency of industrial enterprises by at least 20% by then. In 2020, Ruling 4779 adopted a roadmap to improve energy efficiency in energy-intensive industries, with a list of nearly 300 industrial enterprises that must undergo energy audits by 2022. Certain classes of inefficient vehicles are not permitted for import.	Building codes and energy performance requirements for new buildings and retrofits have been in place since 2000 and were further updated in 2013 and 2016. Since 2016, all new buildings must obtain an energy performance certificate, and since 2020 all new public or commercial buildings must receive an energy audit passport. Building projects that use public funding must undergo an energy efficiency compliance check.	In 2020, the country established a cross-sectoral fund for energy efficiency (Ruling 4779) financed from a 5% annual allocation of proceeds from fossil fuel and electricity industries. The World Bank, the EBRD, the EIB, the UNDP and others play a big role. Ruling 4422 includes provisions for ESCOs; bylaws are still to be adopted. Households may obtain grants for energy efficiency gas heaters and solar water heaters; households and enterprises may obtain compensation of interest on loans for energy efficiency.	The minimum energy performance standards and labelling (A-to-G) framework for appliances is in place since 2016 for 18 product groups. The import and sale of G-rated appliances was banned from 2017, F-rated from 2018, and E-rated and D-rated from 2019. The sale of incandescent lamps above 40 watts was banned in 2017.

Policies / Countries	Energy efficiency targets and policy measures	Energy efficiency in buildings	Energy efficiency financing	Energy-efficient appliances and equipment labelling
Turkmenistan	The 2014 Law on Electricity and 2013 Law on Hydrocarbon Gas and Gas Supply are the main pieces of energy efficiency legislation. The State Programme on Energy Saving for 2018-2024 aims to stimulate energy efficiency. The Draft Energy Strategy for 2030 as well as the draft law on energy saving and energy efficiency includes provisions on efficiency in industry, buildings and heat supply.	The building codes for the design and construction of residential buildings were updated in 2012. The country worked on the adoption of building energy passports, certifying the results of energy audits and testing energy management systems in residential buildings.	A dedicated public fund supporting energy efficiency investment is not identified. Provisions for ESCO support are also missing. Climate finance from international donors is the lowest among the countries of Central Asia. Donor support includes that of the EU, the United States and the GEF.	Provisions for minimum energy performance and labelling of appliances and equipment are not found.
Uzbekistan	Energy efficiency legislation was first introduced in 1997. In 2021, the strategy for the transition to a green economy 2030 set targets to double energy efficiency and reduce the carbon intensity of GDP by 2030 as well as to increase the energy efficiency of industrial enterprises by at least 20% by then. In 2020, Ruling 4779 adopted a roadmap to improve energy efficiency in energy-intensive industries, with a list of nearly 300 industrial enterprises that must undergo energy audits by 2022. Certain classes of inefficient vehicles are not permitted for import.	Building codes and energy performance requirements for new buildings and retrofits have been in place since 2000 and were further updated in 2013 and 2016. Since 2016, all new buildings must obtain an energy performance certificate, and since 2020 all new public or commercial buildings must receive an energy audit passport. Building projects that use public funding must undergo an energy efficiency compliance check.	In 2020, the country established a cross-sectoral fund for energy efficiency (Ruling 4779) financed from a 5% annual allocation of proceeds from fossil fuel and electricity industries. The World Bank, the EBRD, the EIB, the UNDP and others play a big role. Ruling 4422 includes provisions for ESCOs; bylaws are still to be adopted. Households may obtain grants for energy efficiency gas heaters and solar water heaters; households and enterprises may obtain compensation of interest on loans for energy efficiency.	The minimum energy performance standards and labelling (A-to-G) framework for appliances is in place since 2016 for 18 product groups. The import and sale of G-rated appliances was banned from 2017, F-rated from 2018, and E-rated and D-rated from 2019. The sale of incandescent lamps above 40 watts was banned in 2017.

Notes: EEO = energy efficiency obligation; EPBD = Energy Performance for Buildings Directive; ESCO = energy service company; NEEAP = National Energy Efficiency Action Plan;, nZEB = nearly zero energy building, R2E2 Fund = Renewable Resources and Energy Efficiency Fund.

Source: See endnote 107 for this chapter.

INTERNATIONAL, NATIONAL AND LOCAL CLIMATE POLICIES AND COMMITMENTS

International and National Climate Commitments

Since the adoption of the Paris Agreement in 2015, the climate policy landscape has developed rapidly across the focus region, with countries, cities and corporations joining the race for climate neutrality and net zero carbon emissions. In early 2020, some of the largest and most carbon-intensive countries in the region – Armenia, Kazakhstan, the Russian Federation and Ukraine – announced net zero carbon goals in various forms, as summarised in Table 9.[108]

In-depth assessment of some of the climate commitments and policies of the focus countries reveals that their level of ambition remains critically or highly insufficient and will lead to rising rather than falling emissions.[109] Table 10 provides an overview of the status of renewable energy in the latest NDCs submitted by the focus countries to the United Nations Framework Convention on Climate Change, as of October 2021.[110] Although most of the NDCs refer to renewables, they provide little detail on the specifics.

Across the Western Balkans, the level of ambitions varies, with North Macedonia showing among the most comprehensive and ambitious commitments to reducing greenhouse gas emissions in the region (51%).[111] It is followed by Bosnia and Herzegovina, which set an unconditional target to reduce emissions 33.2% by 2030 (from 1990 levels) and a conditional target to reduce emissions up to 80% by 2050 (also from 1990 levels).[112] Montenegro updated its NDC by modestly improving its commitment to reducing emissions from 30% to 35% by 2030 (from 1990 levels).[113] Serbia and Albania were still working on their updated commitments as of early 2022.[114]

The rest of the region has shared similar levels of climate ambition. Georgia set a target for 35% unconditional and 50%-57% conditional emission reductions in its updated NDC and outlined the Climate Strategy 2030 and the Action Plan 2021-2023 as its NDC implementation tool.[115] In May 2021, Armenia submitted its updated NDC and emphasised its intention to decarbonise the energy sector by doubling the share of renewables in energy generation by 2030.[116] However, the stated target was a 40% reduction from 1990 levels, which in absolute terms is 50% more than the current emission volume.[117] Azerbaijan's NDC revision is ongoing, although the current commitment, submitted in 2017, sets a 35% emission reduction target by 2030 (from 1990 levels).[118]

The Russian Federation's NDC, submitted in November 2020, targets a 30% reduction in emissions by 2030 relative to 1990, which is consistent with current emission levels.[119] Belarus published its updated NDC in October 2021, increasing its previous commitment of a 28% reduction by 2030 (from 1990 levels) to 35% and 40% (conditional).[120] In July 2021, Ukraine submitted its second NDC, which raises the previous target of a 40% reduction compared to 1990 to 65% by 2030, with the goal of achieving climate neutrality no later than 2060; this goal is translated in the 2030 Economic Strategy.[121] Moldova's updated NDC includes a more ambitious unconditional target to reduce emissions 70% below 1990 levels by 2030, as well as an 88% conditional target.[122]

Most Central Asian countries were still working on their NDCs as of October 2021. The Kyrgyz Republic intended to unconditionally reduce its emissions 11-14% below the business-as-usual scenario by 2030 and 13-16% by 2050, and to conditionally reduce emissions 29-31% by 2030 and 35-37% by 2050.[123] The lower ranges of these targets are around the same as current emission levels.[124] Uzbekistan submitted its latest NDC in 2018, targeting 10% emission reductions per unit of GDP by 2030 from the 2010 level.[125] Tajikistan pledged not to exceed 80-90% (unconditional) and 65-75% (conditional) of its 1990 emissions by 2030.[126] Turkmenistan did not provide a quantitative target, indicating that if developed countries provide financial and technological support, the country "could achieve zero growth in emissions and even reduce them up to 2030".[127]

TABLE 9.
Overview of Focus Countries with a Net Zero Target, as of October 2021

Country	Target	Year	Form of declaration
Armenia	Climate neutrality	2050	In its NDC, Armenia expressed its readiness to consider climate neutrality, specifically its desire to increase its ambition and ultimately go climate neutral with the help of international donors. The government would undertake long-term planning to 2050 as part of preparing its Long-Term Low Emissions Development Strategy, with a view to adopting this document in 2021.
Kazakhstan	Net zero	2060	Kazakhstan declared a net zero target at the 2020 Climate Ambition Summit.
Russian Federation	Carbon neutrality	2060	The Russian Federation declared that it would strive for carbon neutrality of its economy and set a specific benchmark for this, no later than 2060.
Ukraine	Carbon neutrality	2060	Ukraine committed to carbon neutrality in its National Economic Strategy to 2030.

Source: See endnote 108 for this chapter.

TABLE 10.
Overview of Submitted Nationally Determined Contributions and Renewable Energy in the Focus Countries, as of October 2021

Country	Year of NDC	Renewable energy targets or measures	Comments
Albania	2016	Acknowledged without specific measures or targets.	The country has a unique emission profile as its electricity generation is based on renewables, dominated by hydropower.
Armenia	2021	Acknowledged without specific measures or targets.	The document refers to a range of strategic documents focused on renewables, energy conservation and energy efficiency. These are key priorities for the country's energy security and key drivers of low-carbon development.

Country	Year of NDC	Renewable energy targets or measures	Comments
Azerbaijan	2017	Acknowledged without specific measures or targets	Among climate change mitigation measures, the document mentions wind, small hydropower, biomass and solar PV as well as energy efficiency in buildings and electrification of transport.
Belarus	2021	Acknowledged without specific measures or targets.	The NDC calls for investments in renewable energy equivalent to 5% of GDP in 2011-2015.
Bosnia and Herzegovina	2021	Several measures for renewables and energy efficiency are acknowledged and provided.	Measures are being implemented in diverse sectors, especially buildings: for example, reducing the use of coal and heating oil through greater energy efficiency, increasing the efficiency of heating and cooling systems, energy efficiency labelling and banning imports of used heating and cooling equipment. Reform of the incentive system for renewables would aim to encourage decentralisation of the energy system and the implementation of community energy projects.
Georgia	2021	Only energy efficiency in buildings is acknowledged.	The updated NDC supports the development of low-carbon approaches in buildings, including public and tourist buildings, by encouraging energy-efficient technologies and services oriented towards the climate goals. Georgia further considers to enhance the role of women as agents of change through their participation in decision-making processes related to energy efficiency measures in households.
Kazakhstan	2016	Acknowledged without specific measures or targets.	Following a path of low-carbon economy growth, the country adopted the laws "On energy saving and energy efficiency" and "On supporting the use of renewable energy sources," which aim for greater use of renewables.
Kyrgyz Republic	2020	Not acknowledged.	
Moldova	2021	Several measures for renewables and energy efficiency are acknowledged and provided.	The NDC highlights that the key priority for 2019 was adopting 2030 goals in the areas of renewables and energy efficiency and reducing greenhouse gas emissions in the Energy Community Treaty by transposing the recent EU clean energy package for its members.
Montenegro	2021	Several measures and targets for renewables and energy efficiency (in terms of emission savings) are acknowledged and provided.	The NDC sets a target measured as cumulative energy savings in 2019-2030 in gigagrams of CO_2-equivalent. It also targets commissioning 557 new renewable power plants (planned projects are provided). In addition, the NDC sets targets for electric cars, energy efficiency in the power sector (transmission and distribution), energy efficiency in public municipal companies, energy labelling, etc.
North Macedonia	2021	Several measures and targets for renewables and energy efficiency are acknowledged and provided.	The NDC refers to several strategic documents and provides renewable energy targets, as specified in the draft National Energy and Climate Plan.
Russian Federation	2020	Several measures for renewables and energy efficiency are acknowledged and provided.	The NDC focuses on the following measures: increasing energy efficiency in all sectors, developing the use of non-fuel and renewable energy sources, protecting and improving the quality of natural sinks and storage of greenhouse gas emissions, and finance and taxation to stimulate emission reductions.
Serbia	2017	Not acknowledged.	
Tajikistan	2017	Acknowledged without specific measures or targets.	The country has among the lowest greenhouse gas emissions but a high share of renewables, and its growing economy and population face an acute energy shortage.

Country	Year of NDC	Renewable energy targets or measures	Comments
Tajikistan (continued)	2017	Acknowledged without specific measures or targets.	The NDC refers to a range of strategic documents focused on renewables and energy efficiency.
Turkmenistan	2016	Acknowledged without specific measures or targets.	Stabilising emissions by 2030 is not an obstacle for the country's economic and social development and is consistent with the overall objectives of economic development, increasing energy efficiency, reducing energy intensity and increasing the share of renewables in the energy balance.
Ukraine	2021	Several measures for renewables and energy efficiency are acknowledged and provided.	The NDC states that the share of renewables in electricity generation increased from 7.9% in 2015 to 11.3% in 2020.
Uzbekistan	2018	Acknowledged without specific measures or targets.	The NDC views investments in renewables and energy efficiency to be of high priority.

Source: See endnote 110 for this chapter.

The EU Carbon Border Adjustment Mechanism

The EU announced the adoption of the European Green Deal as a plan to widely decarbonise the regional economy by 2050. The Carbon Border Adjustment Mechanism (CBAM), introduced as a key part of the Green Deal, aims to provide equal competitive chances to local EU producers investing in decarbonisation, as opposed to producers from overseas with less intention to do so. Although the mechanism had not been finalised as of early 2022, the CBAM was anticipated to take the form of an import levy that would equalise the emission content of imported goods with that of EU goods. In doing so, the levy would correlate with the price of EU emission allowances paid by European producers and consider carbon prices already paid domestically by importing companies. To stimulate companies that export to the EU to reduce the carbon intensity of their goods and avoid paying for non-compliance, many countries are expected to introduce domestic emission trading schemes.

The CBAM is slated to begin full operation in 2025, with a transitional period starting in 2023. The mechanism has been widely discussed in countries that export to the EU and has generated significant decarbonisation research and investment analysis in the focus countries of this report. Key sectors and goods subject to the mechanism are electricity, cement, steel and aluminium, and fertilisers – the most energy-intensive sectors of an economy. Therefore, the CBAM is expected to have both direct and indirect impacts on the further deployment of renewables and energy efficiency in the focus region and worldwide.

Although the impact of the CBAM will vary across sectors and countries, ultimately it will increase the deployment of renewable and energy efficiency technologies in order to increase the competitiveness of goods in the EU market. In addition to the greenhouse gas emission and trade profiles of non-EU countries, the effects of the mechanism will be reflected in real income, employment and other socio-economic indicators.[128]

Emission Trading Scheme of Kazakhstan

Kazakhstan is the only country in the focus region that has an Emission Trading System (ETS). This system regulated 43% of carbon emissions in the country as of 2021 and has included the power and heating sectors since 2013, with major amendments in 2016-2017.[129] The scheme is regulated by the Environmental Code of the Republic of Kazakhstan and includes entities with annual emissions of more than 20,000 tonnes of CO_2[vi, 130] Entities releasing 10,000-20,000 tonnes of CO_2 per year are required to report their emissions but do not have to participate in the ETS.

National Allocation Plans in Kazakhstan set caps on emissions, and the next Plan is to be published for the four-year period 2022-2025. The average allocation price for a tonne of CO_2 is USD 1.1, with high penalties for non-compliance.[131] Since 2021, the allocation of allowances has been fully based on benchmarking.[132] Although the ETS instrument has not yet had a significant impact on the decarbonisation of Kazakhstan's energy sector (due mainly to low emission costs), it is expected to become more relevant with the introduction of the CBAM in 2025 and the final period to meet Paris Agreement commitments, as well as other national policy and strategic documents introduced in the country.

Local Climate Actions

Significant progress had been achieved in expanding the list of signatories to the Global Covenant of Mayors for Climate and Energy, among other renewable energy actions in cities *(→ see Sidebar 4)*.[133] During 2017-2021, several cities and towns joined the Covenant of Mayors and submitted their Action Plans.[134] The most active cities were in Armenia, Belarus, Bosnia and Herzegovina, Georgia, Moldova, Serbia, and Ukraine, while a few cities also joined in Albania, Azerbaijan, Kazakhstan, Kosovo, the Kyrgyz Republic, Montenegro, North Macedonia, the Russian Federation and Tajikistan.[135] As of October 2021, the initiative lacked signatories from Turkmenistan and Uzbekistan.[136]

vi Reporting is also done for nitrogen dioxide, methane and perfluorocarbons.

SIDEBAR 4.
Renewable Energy in Cities

The COVID-19 pandemic has thrown into stark relief the global battle of cities for cleaner air, healthier living environments and a better future. Driven by these concerns, city governments have taken action to accelerate the uptake of renewables, relying on different types of targets, policies and actions to show local commitment. Overall, more than 1 billion people – around 25% of the world's urban population – lived in a city with a renewable energy target and/or policy in 2020. Over 1,300 cities have demonstrated leadership in advancing renewables beyond the power sector. Cities also have taken actions that indirectly support the shift to renewables – such as efforts to reduce CO_2 emissions through net zero commitments and the electrification of public transport.

Cities' ambition to support the deployment of renewables is relevant because urban energy use has increased sharply; by 2018, this share had risen to around three-quarters, and cities release a similar share of global energy-related CO_2 emissions. Cities are now home to more than 55% of the world's population, and urban inhabitants worldwide are negatively affected by the burning of fossil fuels. Cities also are essential for accelerating the development of renewables in sectors that continue to lag, namely buildings and transport, which combined represent more than 50% of final energy demand.

Renewable energy developments in cities vary by city and depend on the local context, resources, and community values and priorities. As such, drivers for renewables are broad, with efforts motivated by a city's economic, social and environmental priorities. Because cities have close ties to their citizens, they are motivated to find solutions that meet growing energy demand while building healthy, resilient and liveable urban communities. Generally, efforts to ensure public health and well-being, while supporting local economic recovery and resilience, have been at the forefront of urban priorities.

City governments have directly supported renewables by setting specific renewable energy targets and by installing, purchasing and contracting for renewables to meet the demand of their own buildings and vehicle fleets. Because municipal energy demand accounts for only a small share of a city's energy demand, city governments also have adopted policies to incentivise the local generation and use of renewables city-wide and have supported urban community energy projects.

In South-East and Eastern Europe, the Caucasus, and Central Asia, national governments have tended to dominate city-level actions to promote renewables. However, with growing concerns about air pollution and smog, city-level action in the focus region has been growing.

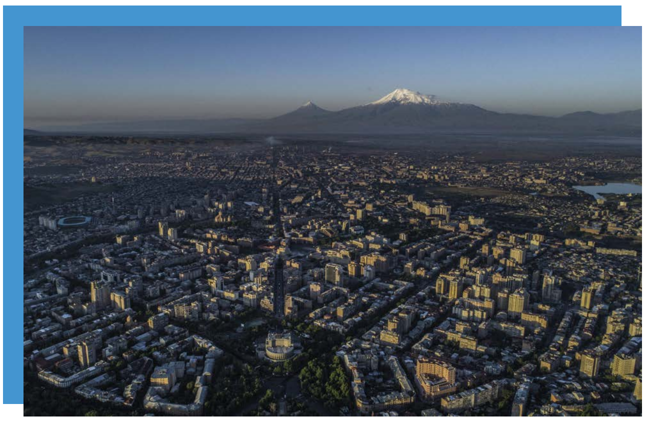
For example, the region is home to countries with among the largest use of district heating worldwide (dominated by the Russian Federation but also including Ukraine and Belarus). Although these systems rely heavily on natural gas and coal, some efforts are under way to shift to renewables. For example, the EBRD provided Banja Luka in Bosnia and Herzegovina with a loan of EUR 8.3 million (USD 10.2 million) to build a 49 MW district heating boiler plant fired by wood biomass. Pancevo (Serbia) received a loan from the EBRD and Germany's KfW to construct a solar thermal field in 2017 as part of a solar district heating project.

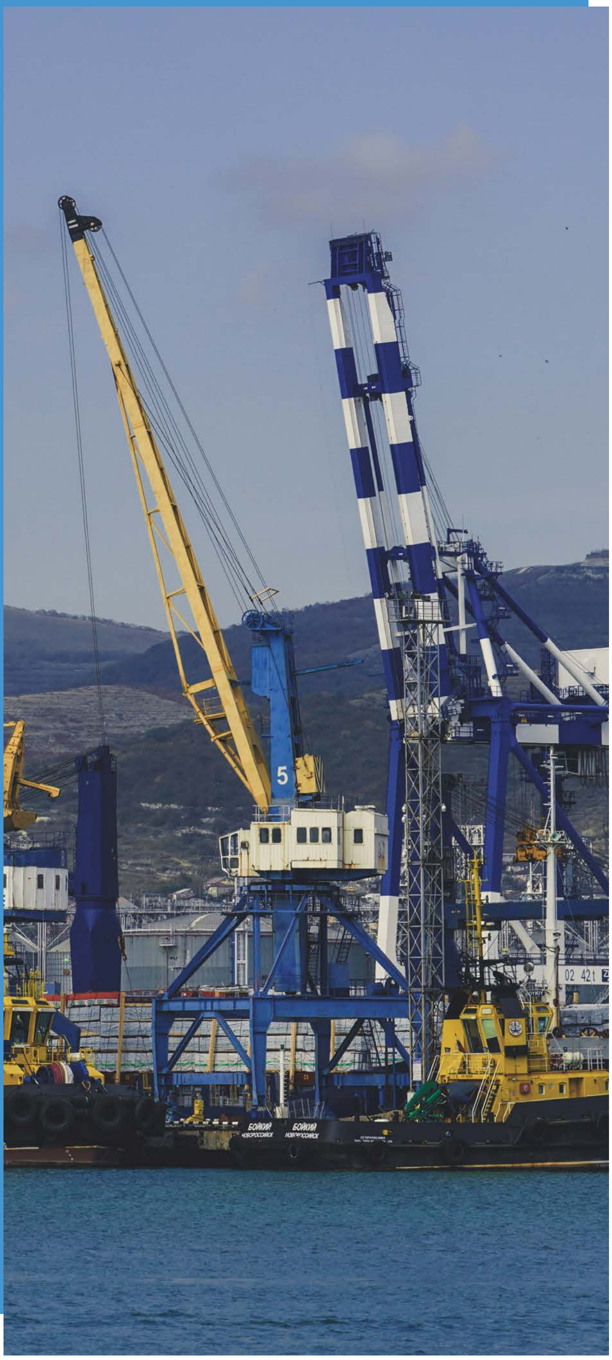
In the transport sector, although some cities have continued to support the use of biofuels in fleets, urban policies and procurement increasingly have focused on the electrification of transport. Procurement of electric buses for public transport is slowly gaining ground in the focus region. In 2021, Belgrade (Serbia) announced its plan to have 40% of the bus fleet electrified, as well as 80% of taxis and 100% of municipal vehicles, 80% of commercial vehicles and 20% of private vehicles. At least 10 electric buses are in operation so far. In addition, Moscow (Russian Federation) has joined the C40 pledge to procure only zero-emission buses from 2025 onwards.

Source: See endnote 133 for this chapter.

Corporate Climate Commitments

Recognising the climate emergency, many businesses around the world have adopted their own commitments to reduce greenhouse gas emissions, beyond the requirements imposed by governments. As of 2020, more than 4,500 companies worldwide were disclosing their emissions, and around 40% of these companies had committed to specific emission targets as part of their strategic and financial plans.[137] For example, more than 100 of the world's largest companies have declared commitments towards net zero emissions or carbon neutrality for the year 2050 or sooner.[138] Although companies from the focus countries are not leaders in this area, corporate climate commitments in the region have been growing. The most common implementation strategies include improving energy efficiency at their facilities, procuring renewable energy, investing in carbon removal measures and advocating for climate-related policies (→ *see Sidebar 5*).[139]





The region is home to countries with among the **largest use of district heating** worldwide.

SIDEBAR 5.
Carbon Neutrality Targets of Russian Businesses

Several public companies in the Russian Federation have announced plans to achieve zero greenhouse gas emissions by 2050. These include En+ Group, Tatneft, X5 Retail Group and S7 Airlines. Norilsk Nickel introduced its own approach to reducing its carbon footprint, planning to produce carbon-neutral products.

En+ Group has committed to 35% emission reductions by 2030 and to net carbon neutrality by 2050. To achieve this, it intends to switch to natural gas and green hydrogen. A key asset of En+ Group is RUSAL, the world's largest supplier of "clean" aluminium, produced mostly with hydropower.

Tatneft committed to reduce its emissions 10% by 2025 and 20% by 2030 and to become carbon neutral by 2050. The company is implementing a carbon neutrality programme along the entire value chain in order to offer products with a smaller carbon footprint. Measures include renewable energy and carbon capture and storage.

X5 Retail Group has set targets to reduce greenhouse gas emissions 30%, to decrease the intensity of waste production 30%, and to increase the share of renewables in its operating processes 30% – all by 2030. X5 also has incorporated sustainability principles into its procurement policy. The company aims to achieve carbon neutrality by 2050.

S7 Airlines has committed to net carbon neutrality by 2050 through measures such as renewal of the company fleet, improvements in fuel efficiency and fuel switching. In December 2021, the company operated the first flight in the Russian Federation using biofuel.

Norilsk Nickel, the Russian mining and metallurgical giant, was the first of the world's top five nickel producers to start producing carbon-neutral metal. This was achieved through carbon offsetting at all stages of the value chain, from ore mining to enrichment and refining. The company also has greatly reduced its greenhouse gas emissions through measures including increased renewable energy use (up to 55%), modernisation of energy infrastructure, introduction of automated controls and metering systems, and minimisation of heat losses in pipelines. In June 2021, the company produced the first 5,000 tonnes of nickel with a zero-carbon footprint.

Source: See endnote 139 for this chapter.

03 RENEWABLE ENERGY MARKET AND INDUSTRY OVERVIEW

CURRENT TRENDS

Between 2017 and 2021, the focus countries greatly accelerated their adoption of renewable energy technologies. This expansion occurred mainly in the power sector, whereas achievements in transport and in the heating and cooling sector were slower. The highest growth rates in installed renewable power capacity were in solar PV (58%) and wind power (25%), unlike during the 2015-2016 period when most of the additions were in hydropower *(see the 2017 REN21/UNECE report)*.[1]

Despite this progress, gaps remain across countries, technologies, and end-use sectors, pointing to a range of barriers to decarbonisation of the region. Although renewable energy uptake grew from hundreds of megawatts to multiple gigawatts, significant untapped potential remains.

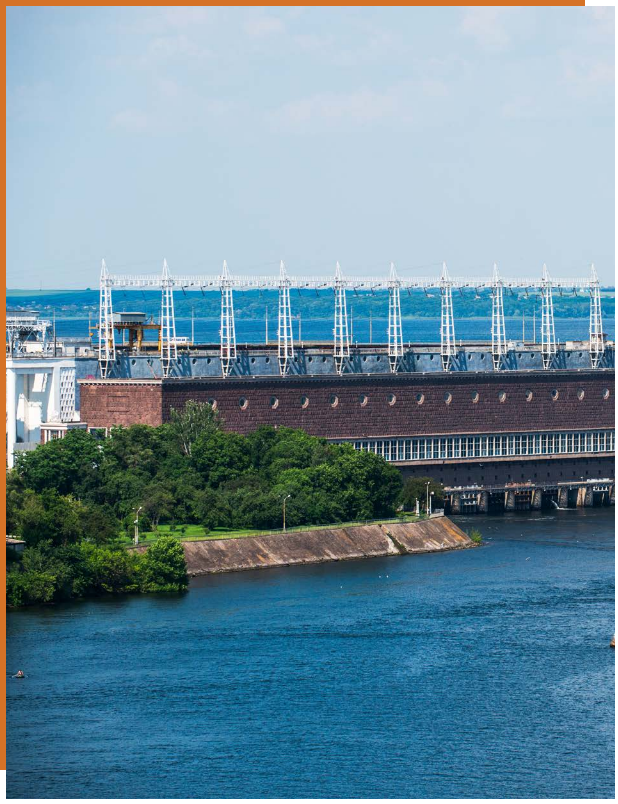
Several countries that had been at the periphery of renewable energy development before 2017 achieved strong growth in utility-scale projects and in their total installed capacities. Uzbekistan arranged a tendering process for 500 MW of renewable power, and the government is targeting 8 GW of installed solar PV and wind power by the end of 2030.[2] By comparison, the country had only 2 MW of solar PV installed capacity in 2016.[3]

The data on renewable power capacity used in this chapter are derived from the database of the International Renewable Energy Agency (IRENA); however, peer review of the report by national experts revealed significant differences among the data reported by IRENA, other international organisations (such as the International Energy Agency), and national official and unofficial sources. Given these differences, the data analysis and interpretation in this chapter should be taken with caution. Future assessments of the renewable energy market in the region would benefit from better harmonisation of data across international and national sources.

Overall, more than 20 GW of renewable power capacity was added in the focus countries during the 2017-2021 period, bringing the total installed capacity to more than 100 GW.[4] The top three countries for non-hydropower capacity additions remained the same as in the 2017 REN21/UNECE report, although their positioning changed: Ukraine became the leader, installing 8.3 GW of solar PV and wind power capacity during the period, followed by the Russian Federation with 3.5 GW and Kazakhstan with 3.7 GW.[5] All three countries surpassed the capacity thresholds of 1 GW of solar PV power and 1 GW of wind power.[6] Meanwhile, 12 countries in the region had a total installed capacity of hydropower exceeding 1 GW.[7]

Comprehensive statistics on renewable heating and cooling were not available for all countries; however, the available data show that developments were much slower in this sector than in the power sector. Most of the renewable heat was derived from combusting renewable biofuels and sometimes biogas. Solar thermal capacities for hot water production increased only in a handful of countries, including Albania, Armenia and Georgia. Geothermal energy used directly as heat remained steady in most cases.

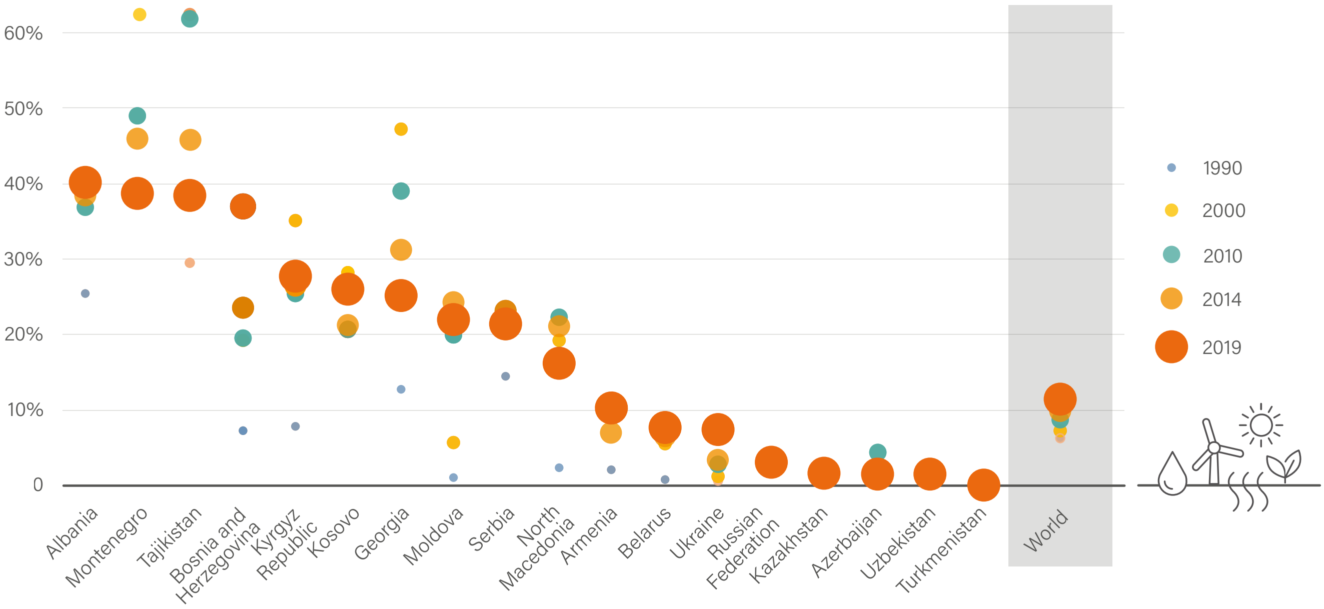
Data on renewable energy use in the transport sector were not broadly available for the focus countries, but overall, the conditions for the transition to sustainable mobility varied. Most countries were still in the initial stages of transport sector decarbonisation. Some encouraged a more centralised shift, targeting public transport systems and policy instruments to reduce demand for individualised transport, whereas others promoted the switch to sustainable transport among private consumers. Existing demonstration and commercial projects targeted private consumers, commercial companies and the public sector.



TOTAL FINAL ENERGY CONSUMPTION

The contribution of renewables to the total final energy consumption of the focus countries varied widely in 2019, ranging from only 0.1% in Turkmenistan to 40.2% in Albania *(→ see Figure 6)*.[8] Overall, the renewable share was the highest in Albania, Montenegro, and Tajikistan, due to their vast hydropower capacities, and the lowest in Turkmenistan, Uzbekistan, Azerbaijan and Kazakhstan – all large oil and natural gas producers and exporters.[9] The average share of renewables in total final energy consumption grew from only 7.0% in 1990 to 17.9% in 2000, 19.2% in 2010 and 18.2% in 2019.[10] While overall growth slowed during 2010-2019, positive developments occurred in Bosnia and Herzegovina, Kosovo, and Ukraine, as well as in Armenia (for 2014-2019).[11] Notably, the renewable share did not change from the 2017 REN21/UNECE report, when it also was 18.2% (in 2014).[12]

FIGURE 6.
Share of Renewables in Total Final Energy Consumption in the Focus Countries and World, 1990, 2000, 2010, 2014 and 2019



Note: 2014 was the reporting year of the previous REN21/UNECE report. Renewable energy was estimated as the consumption of renewable electricity, renewable heat and renewable energy in transport. The consumption of renewable electricity covers the final consumption of renewable electricity in all sectors excluding transport. The consumption of renewable heat covers the final consumption of renewable energy for heating purposes (excluding electricity) in manufacturing, construction and non-fuel mining industries, household, commerce and public services, agriculture, forestry, fishing and not elsewhere specified. The consumption of renewable energy in transport covers the final consumption of renewable energy (including electricity) in the transport sector. For details, see the methodology of Tracking SDG7 and the REN21 *Renewables 2022 Global Status Report*.
Source: See endnote 8 for this chapter.

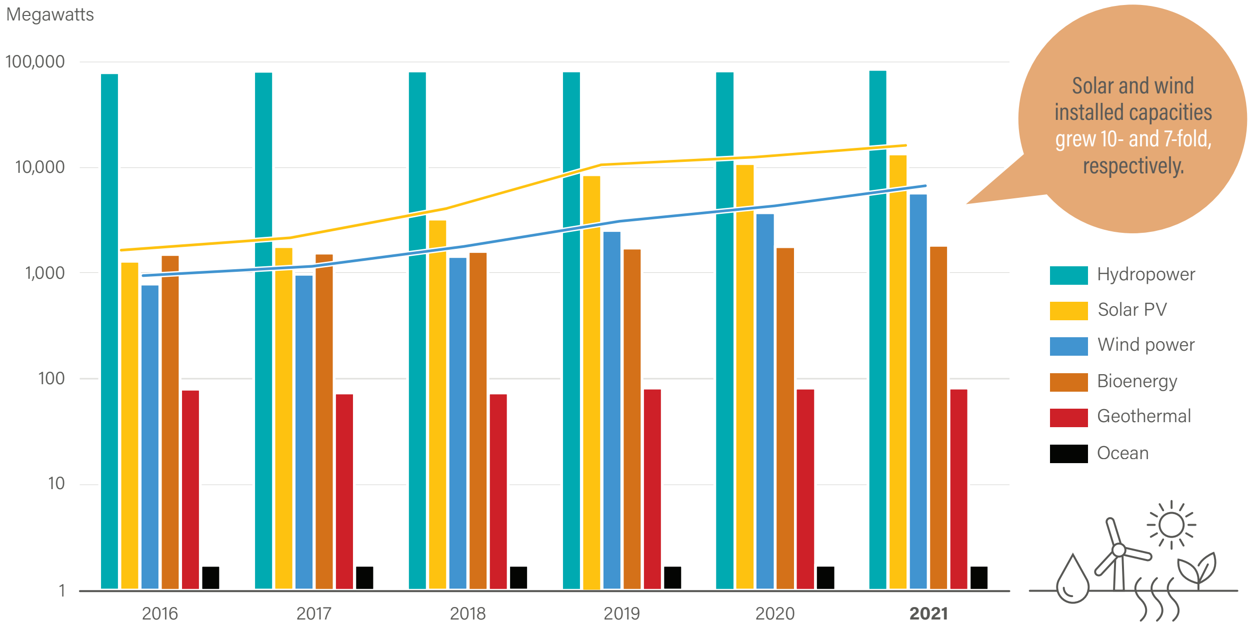
The decline in the average share of renewables in total final energy consumption during the last two decades is explained by three factors: 1) the slowdown in the deployment of hydropower, which previously was the main renewable energy source in the region, 2) an increase in motorisation rates, which was met mostly with higher consumption of diesel and petrol, and 3) the fact that final energy consumption in the region did not change significantly in recent years, leading to a declining share of renewables in it (given the first two factors).[13] However, the growth in solar and wind power nearly offset this decline. Additional factors affecting the dynamics of the renewable energy share include difficulties in monitoring and measuring the use of biomass, seasonal fluctuations in hydropower, long-term lock-in to other energy sources, and cheap fossil fuel prices, among others.

Average **share of renewables** in total final energy consumption was **18.2%.**

POWER SECTOR

Renewables continued to expand across the power sector during 2017-2021, adding 20.7 GW of capacity in the focus countries and bringing the total installed renewable electricity capacity to 106 GW.[14] The biggest contribution was from solar PV power (12.1 GW), followed by wind power (5.2 GW) and renewable hydropower (3.1 GW) *(→ see Figure 7)*.[15] The year 2018 was the first time that solar PV overtook hydropower as the leading source of newly installed renewable power capacity in the region, and this trend continued through the end of 2021.[16]

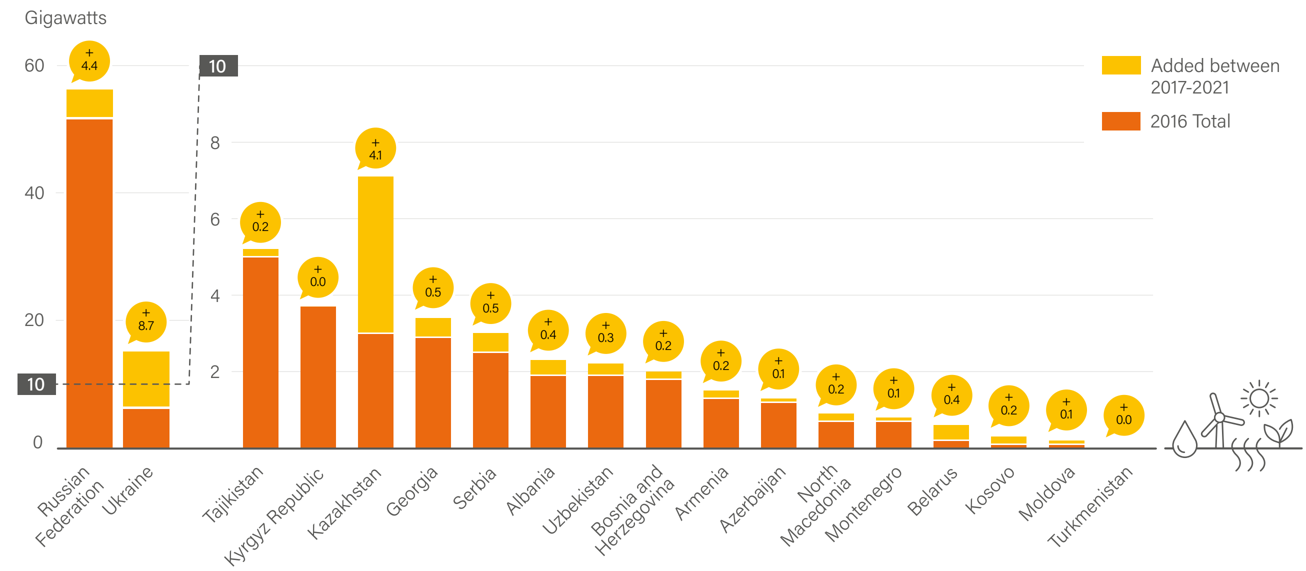
FIGURE 7.
Renewable Power Capacity by Technology in the Focus Region, 2016-2021, MW



Note: For hydropower, only renewable hydropower is included (both large-scale and small-scale), not accounting for pumped storage capacity. Capacities are plotted against a logarithmic scale.
Source: See endnote 15 for this chapter.

During the 2017-2021 period, renewable power capacity additions were not spread equally across the countries. Ukraine contributed 59% of solar PV additions (7.1 GW), followed by Kazakhstan with 22% (2.7 GW) and the Russian Federation with 13% (1.6 GW).[17] For wind power additions, the Russian Federation led with 38% (1.9 GW), followed by Ukraine with 24% (1.2 GW) and Kazakhstan with 21% (1.1 GW).[18] The Russian Federation ranked first in hydropower additions, contributing 29% (0.9 GW), while Georgia ranked second with 17% (0.5 GW) and Albania and Kazakhstan tied for third with 12% or 0.4 GW each *(→ see Figure 8)*.[19]

FIGURE 8.
Renewable Power Capacity in 2016 and Additions During 2017-2021 in the Focus Countries, GW



Note: The values provided in the figures indicate the addition. For hydropower, only renewable hydropower is included (both large-scale and small-scale), not accounting for pumped storage capacity.
Source: See endnote 19 for this chapter.

In Ukraine, a significant burst of renewable power was made possible by a large number of utility-scale projects. DTEK (Ukrainian energy company) commissioned two of Europe's biggest solar PV projects in 2019 – the 240 MW Pokrovska and the 200 MW Nikopol plants – at the surface of former coal mines, helping to contribute to the just transition of former coal regions in the country.[20] Similar success was achieved in Kazakhstan, where in 2020 the Nura and Saran solar PV plants (both 100 MW) in the Karaganda region were commissioned, ranking among the biggest PV plants in Central Asia.[21]

North Macedonia, despite a modest addition of 78 MW of solar PV capacity during 2017-2019, has since pursued several ambitious projects (with capacities of 50-350 MW), with plans to also build one of the five biggest solar PV plants in Europe.[22] In the Russian Federation, the largest solar PV plant (116 MW) was under construction in Kalmykia.[23] In Ukraine, the three-stage Zophia wind project (790 MW) in the Zaporizhzhia region and an 800 MW wind project in the Nikolsky and Mangush districts of Donetsk region were under construction as of 2021, with the potential to become the country's (and continent's) largest wind parks.[24] Maestrale Ring, a 600 MW wind park being developed near Subotica in Serbia, also was among Europe's most ambitious renewable energy projects.[25]

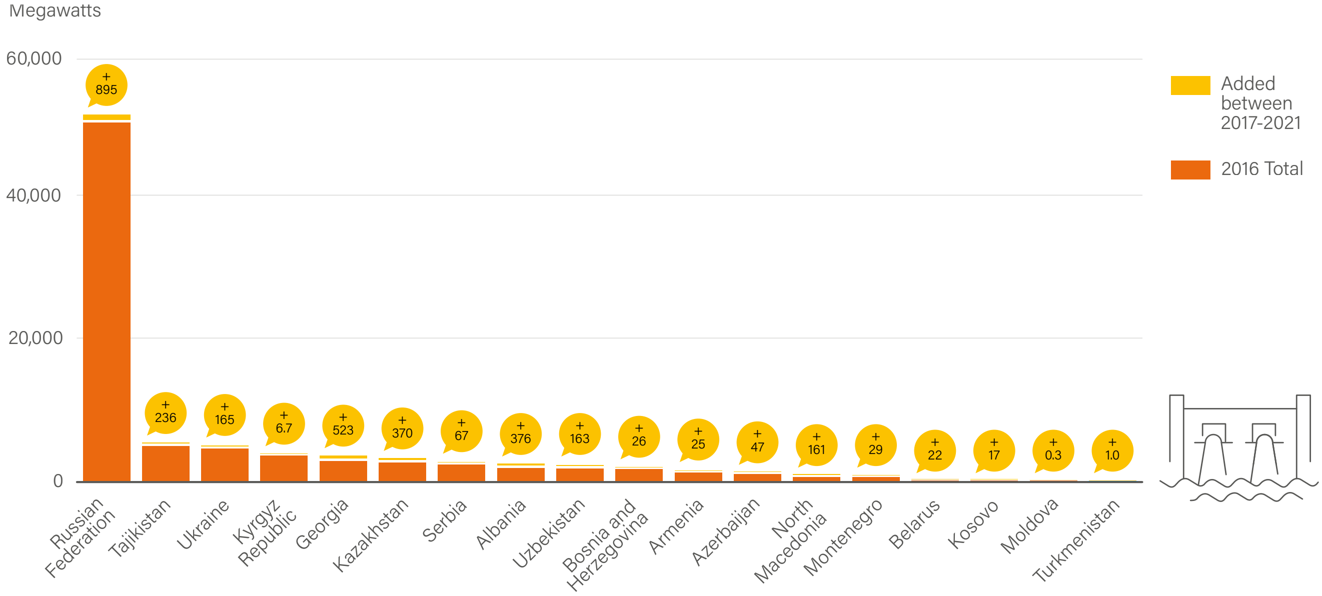
Given that Ukraine contributed nearly 30% of the wind power capacity and 60% of the solar PV capacity of the focus countries in 2021, it remained unclear as of early 2022 whether this capacity would continue to grow.[26] The Russian invasion of Ukraine that began in February 2022[i] affected a land area that is home to around half of Ukraine's installed renewable energy capacity. The impacts of the ongoing conflict on the focal region's total renewable capacity remain to be seen (→ see Chapter 7).

Hydropower

Despite the increased attention to wind and solar PV, hydropower remained the top renewable power source in the region, although its share has been declining.[27] Hydropower contributed 80% of the total renewable power capacity in 2021, down from 96% five years earlier (2016).[28] These data reflect only renewable hydropower capacity (both large-scale and small-scale) and do not account for pumped storage capacity that could be fed by both renewable and non-renewable electricity.

During 2017-2021, the Russian Federation installed 29% of all new hydropower capacity additions, at 895 MW, followed by Georgia (523 MW), Albania (376 MW) and Kazakhstan (370 MW).[29] In total, around 3.1 GW of hydropower capacity was added in the region during this period (→ see Figure 9).[30]

FIGURE 9.
Renewable Hydropower Installed Capacity in 2016 and Additions During 2017-2021 in the Focus Countries, MW



Note: The upper figures above the bars are the total capacities in 2021, which include 2016 capacities and additions made between 2017 and 2021. The figure includes only renewable hydropower capacity (both large-scale and small-scale), not accounting for pumped storage capacity.
Source: See endnote 30 for this chapter.

In 2017, Georgia commissioned the 108 MW Dariali hydropower plant.[31] That same year, the country's 187 MW Shuakhevi hydropower cascade began supplying electricity, although operations were halted after two months due to tunnel blockages and then later reopened in 2020.[32] The plant will provide electricity to local consumers in Georgia for three winter months and sell it to Turkey for the rest of the time.[33] Some planned projects in Georgia were stalled or cancelled due to public opposition, including the Kheledula 3 (51 MW) and Khudoni (702 MW) plants.[34]

i See footnote ii on page 19 in Chapter 1.

In 2019, Albania commissioned the 197 MW Moglice hydropower plant, which ranked the country first in the region in hydropower capacity additions that year.[35] The Russian Federation commissioned the Zaramagskaya 1 hydropower plant in 2020 with a capacity of 346 MW.[36] Smaller-scale plants were commissioned in Uzbekistan, Tajikistan, the Kyrgyz Republic and Ukraine.[37] As of 11 March 2022, 16% of Ukraine's small hydropower capacity was in locations under active fire and another 26% was in neighbouring areas, meaning that more than 40% of the country's capacity was endangered.[38]

For pumped hydropower storage capacity, Ukraine was the regional leader with 1.8 GW of capacity in 2021, followed by the Russian Federation (1.4 GW), Serbia (614 MW) and Bosnia and Herzegovina (420 MW).[39]

As with other renewable energy sources, considerable hydropower potential remains untapped in the region. The International Hydropower Association indicates that Georgia, Tajikistan, the Kyrgyz Republic and Uzbekistan have used only around one-quarter of their hydropower potential.[40] The bulk of the attention recently has been on modernising existing hydropower capacities *(→ see Sidebar 6)*.[41]

SIDEBAR 6.

Rehabilitation of the Golovnaya and Toktogul Hydropower Plants

The installed capacity of the Golovnaya hydropower plant in Tajikistan is 240 MW, and due to its poor condition and decreasing annual generation, the facility requires the replacement of units and refurbishment of electric and mechanical equipment. A new plant rehabilitation project is expected to increase the country's generation of clean power, which can be used both for domestic sales and exports to Afghanistan. The project, financed by the Asian Development Bank (ADB) with a grant of USD 136 million, aims to increase power generation to 252 MW and raise the weighted average generation efficiency of the power plant from a maximum of 83% to 89%.

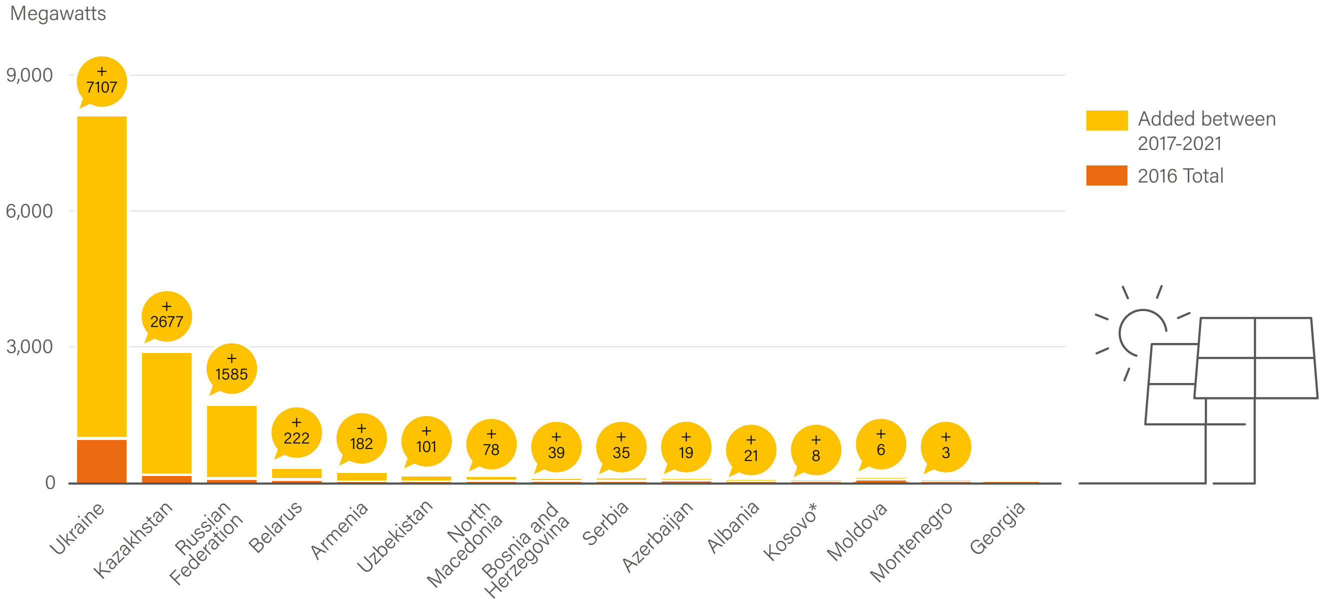
In the Kyrgyz Republic, the Toktogul hydropower plant is the country's largest and a key supplier of electricity, with a production capacity of 1,200 MW. The Toktogul Rehabilitation Phase 2 Project, also financed by the ADB, will retrofit the plant by replacing two of the four existing generator and turbine units and associated equipment. The project will deliver cross-cutting measures in the power sector of the Kyrgyz Republic, including the improvement of finances, governance and management. The results are expected to translate into an increase in domestic energy supply and international electricity trade, as well as improved asset management. The project attracted USD 210 million in investment and is expected to conclude in 2025.

Source: See endnote 41 for this chapter.

Solar PV

Solar PV showed tremendous growth in the focus region during 2017-2021, reaching a total installed capacity of 12.1 GW.[42] This was achieved mainly through capacity additions in Ukraine (7.1 GW), Kazakhstan (2.7 GW), and the Russian Federation (1.6 GW), and to a lesser extent in Belarus (222 MW), Armenia (182 MW) and Uzbekistan (101 MW) *(→ see Figure 10)*.[43] During 2015-2016, in contrast, regional capacity additions totalled less than 0.3 GW, as discussed in the 2017 REN21/UNECE report.[44] In 2020, the solar PV capacity installed in Ukraine helped avoid 3.2 million tonnes of CO_2 emissions from electricity generation and heat production (around 4.8% of the country's total), and in the Russian Federation it helped avoid 1.4 million tonnes of CO_2 (0.2% of the total).[45]

FIGURE 10.
Solar PV Installed Capacity and Annual Additions in the Focus Countries, 2016 and 2021, MW



Source: See endnote 44 for this chapter.

Ukraine was the unequivocal leader in solar PV additions, installing 245 MW in 2017, 803 MW in 2018 and 3,933 MW in 2019.[46] However, economic and political barriers became evident starting in 2019, related less to the COVID-19 pandemic and more to the reform of the country's feed-in tariff scheme. This policy development led to uncertain solar market development in Ukraine that contributed to a decline in capacity additions to 1,395 MW in 2020 and 731 MW in 2021.[47]

As of 11 March 2022, 37% of Ukraine's solar PV capacity was in locations under active fire, and by 15 June, 30% of the PV capacity had been destroyed.[48] This will require extensive repairs. The good news is that solar PV plants are more resilient to military attacks than are fossil fuel-based electricity generation plants, since the damaged section often can be localised in a day, so as not to affect the operation of the surviving equipment.[49]

Kazakhstan has been a regional leader in renewable energy development and a pioneer of solar PV in Central Asia. Several utility-scale projects were commissioned during 2017-2020, including the Saran solar park (100 MW) in the Karaganda region, supported by the Kazakhstan Renewables Framework of the EBRD and the Global Climate Fund (GCF), and the Nura solar project (100 MW) near Nur-Sultan.[50] Projects under development included a 100 MW project in the Akmola region, two 50 MW projects in the Zhambyl region and a 50 MW project in the Kyzylorda region.[51]

The Russian Federation was on track to meet its target of developing 1.5 GW of solar PV by 2021, showing steady (although slower) growth in capacity additions.[52] The country added a record 1.1 GW of solar PV that year, enabled in large part by government-initiated tenders and auctions.[53] A new support programme targeting 7 GW of installed renewable power capacity by 2035 was under consideration as of early 2022.[54] The country's largest solar PV plant (116 MW) was being built in the Kalmykia region, partly financed by the Russian Direct Investment Fund.[55]

Uzbekistan has boosted its solar PV capacity in recent years. The country's first PV plant, with 100 MW of capacity, was commissioned by Masdar (the government-owned renewable energy company of the United Arab Emirates) in the Navoi region.[56] Masdar also won a tender in 2021 to develop two ambitious projects with a cumulative capacity of 400 MW in the Jizzakh and Samarkand regions.[57] All of these projects were facilitated by the World Bank's Scaling Solar programme. In 2020, Masdar won a tender to build the 457 MW Sherabad 1 solar PV plant in the Surkhandarya region.[58] By 2030, the Uzbek government plans to scale up its solar energy deployment to 7 GW *(→ see Sidebar 7)*.[59]

Ukraine was the unequivocal leader in solar PV additions, however

30% of capacity has been destroyed

as of 15 June 2022.

SIDEBAR 7.

Uzbekistan Inaugurates Its First Utility-scale Solar PV Plant

The first solar PV plant in Uzbekistan, with a capacity of 100 MW, started construction in 2019 and was commissioned in 2021 by Masdar (United Arab Emirates) in the Karmaninsky district of the Navoi region. The plant comprises 300,000 solar PV panels installed on a 268-hectare site. The panels were expected to generate 252 million kWh of electricity annually, which would reduce greenhouse gas emissions by 0.16 million tonnes of CO2 per year.

The project was implemented through a public-private partnership with Nur Navoi Solar, a Masdar-owned company established for this purpose. The generated electricity is to be sold to JSC National Electric Networks of Uzbekistan for a period of 25 years (until 2046) at a fixed price of 2.7 US cents per kWh.

The total project cost was USD 110 million, and the IFC and the ADB allocated USD 60 million in financing. The EBRD provided Masdar with a short-term bridge loan of USD 1 million to finance the equity of the project. The World Bank provided the government of Uzbekistan with a USD 5.1 million bank guarantee to secure its payment obligations under the project.

In 2021, Uzbekistan set a target to achieve 7 GW of solar PV capacity by 2030 and announced multiple initiatives towards the target. The newest PV plant, with a capacity of 100 MW, was being built by Total Eren S.A. in the Nurata district of the Samarkand region. Nine solar PV plants with a total capacity of 2,100 MW are expected to be built in the coming years in Bukhara, Djizak, Namangan, Samarkand, Khorezm, Surkhandarya and Kashkadarya regions, and four wind power plants with a total capacity of 1,600 MW are expected to be built in Karakalpakstan, Bukhara and Navoi regions.

Source: See endnote 59 for this chapter.

Other countries in the region also implemented demonstration solar PV projects and their first utility-scale projects. Azerbaijan secured its first foreign investment-based project in 2021, aimed at a cumulative capacity of 230 MW.[60] In addition, the ADB was working on a 100 kW floating solar PV plant on the country's Boyukshor lake.[61] By the end of 2021, Armenia was nearing 100 MW of cumulative installed solar PV capacity, having announced the development of the Masarik-1 55 MW and Masdar 200 MW projects, slated to be the first utility-scale solar PV projects in the Caucasus. The Masarik-1 plant will use bi-facial technology, which is supposed to increase yields. Together, the two plants will contribute around 10% of Armenia's total installed power capacity.[62]

Belarus showed promising results in 2017, installing 102 MW of solar PV that year (similar to levels in the Russian Federation and Ukraine); however, it has since experienced a significant slowdown, not adding any solar PV capacity in 2019.[63] As of early 2022, the country's largest PV plant (55 MW) was based in Rechitsa, and a 109 MW plant was under development in the Cherikovskiy district.[64]

Albania implemented solar PV auctions in Karavasta (140 MW) and Spitalla (100 MW) in 2020.[65] In 2021, with financing from the EBRD, it started building a 13 MW floating solar PV pilot farm on the Vau i Dejës reservoir, then the largest floating PV plant in the region.[66] In Bosnia and Herzegovina, a 72 MW project is to be commissioned near Trebinje.[67] In addition, Montenegro tendered its first utility-scale solar PV project for 100 MW, and the country's state-owned electric utility company was planning to develop its first floating PV project on the surface of an artificial lake.[68]

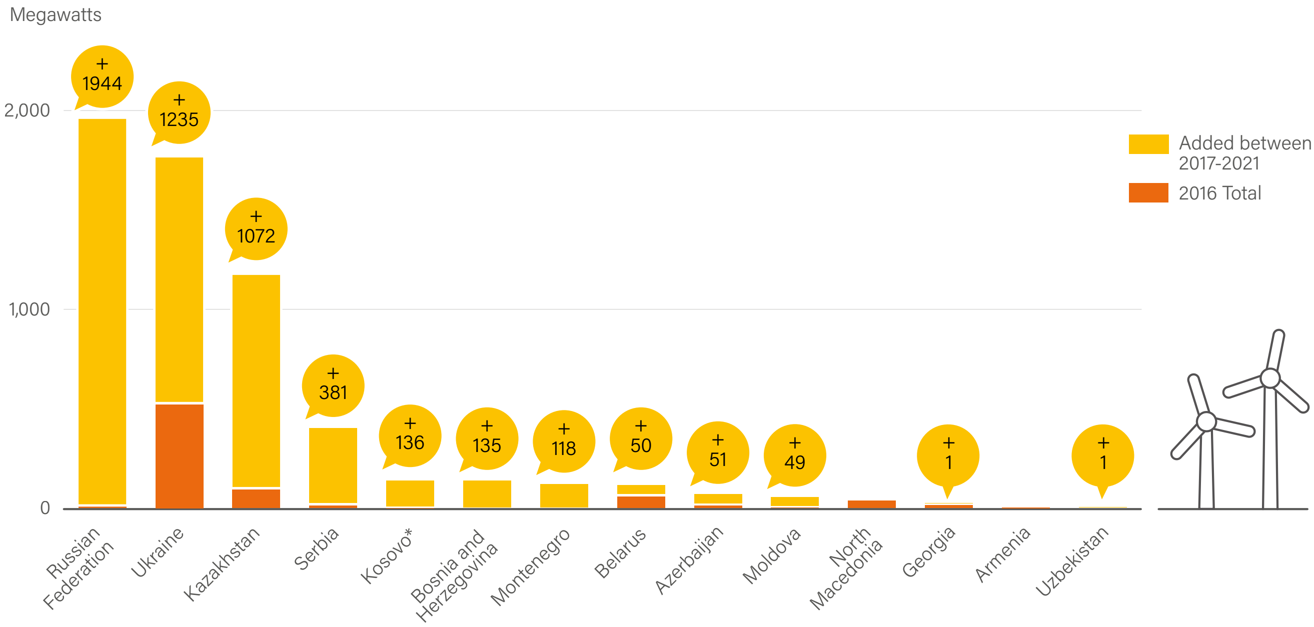
Wind Power

The region's wind power capacity grew by more than a factor of seven between 2016 and 2021.[69] As with solar PV, the same three countries led in wind power deployment during this period. The Russian Federation added 1.9 GW to achieve the region's highest installed wind power capacity, Ukraine added 1.2 GW for a total capacity only 10% behind the Russian Federation, and Kazakhstan added 1.1 GW *(→ see Figure 11)*.[70] Smaller additions occurred in Serbia (381 MW), Kosovo (136 MW), Bosnia and Herzegovina (135 MW), Montenegro (118 MW), Azerbaijan (51 MW), Belarus (50 MW) and Moldova (49 MW).[71] Georgia and Uzbekistan each added less than 1 MW.[72] All of this reported capacity was onshore.[73]

Russian Federation, Ukraine and Kazakhstan led wind power deployment, adding

4.2 GW cumulatively.

FIGURE 11.
Wind Power Installed Capacity in 2016 and Annual Additions During 2017-2021 in the Focus Countries, MW



Note: Albania, the Kyrgyz Republic, Tajikistan and Turkmenistan did not report their installed wind power capacities and are not included in the figure.
Source: See endnote 70 for this chapter.

The Russian Federation showed the fastest growth in total installed wind power capacity in the region, rising from 11 MW in 2016 to nearly 2 GW in 2021.[74] Despite the COVID-19 pandemic, the country saw its largest capacity additions ever (1 GW) in 2021.[75] The biggest wind parks were Ulyanovsk-1 and Ulyanovsk-2, with a cumulative capacity of 85 MW, and ambitious projects were under development in several regions, including Astrakhan (340 MW), Samara (237 MW), Volgograd (105 MW) and Rostov (50 MW).[76] Within the Russian Federation's support framework for renewable energy sources (capacity supply agreements), an additional 3.5 GW of wind power capacity is to be constructed by 2024, and the second phase of this programme is slated to bring a further 4 GW by 2035.[77] Interest in developing offshore wind power in the Black Sea also increased.[78]

In Ukraine, the pace of wind power deployment slowed during 2017-2021 because development of this renewable source started earlier, with the country having achieved 0.5 GW of capacity prior to 2014.[79] Nearly half of this capacity was located in the Crimea, which has since been a territory of dispute between the Russian Federation and Ukraine. Another 0.9 GW was added during 2016-2019 to make Ukraine the regional leader in wind power, with a total of 1 GW in 2019.[80] Following additions of 637 MW in 2019, growth stalled in 2020 with only 144 MW of capacity brought online (in the Kherson and Mykolaiv regions).[81] Sizable utility-scale projects included the Botievska plant (200 MW), the Myrnenska plant (163 MW), and the Syvaska plant (103 MW), among others.[82]

In 2021, wind power capacity growth in Ukraine recovered somewhat with additions of 359 MW – still more than elsewhere in the region but less ambitious than past years. Projects were under development in Odesa (77 MW), Rivne (72 MW) and Zaporizhzhia (56 MW).[83] The three-stage 790 MW Zofia project in the Zaporizhzhia region and an 800 MW project in the Donetsk region were expected to become the country's largest wind parks.[84] However, as of 18 June 2022 around 90% of the country's wind power capacity was in locations under active fire and reportedly destroyed, suggesting that critical damage to the sector may have occurred.[85] Interviews as of June 2022 suggest that only 150 MW out of a total of around 1.5 GW was in operation.[86]

Kazakhstan has the highest wind power potential in Central Asia by far due to a large steppe area with high wind speeds.[87] Between 2019 and 2021, the country began to build rapidly on this potential, adding more than 1 GW to its previous 121 MW of capacity.[88] The largest operating wind park was Badamsha 1 (50 MW) and 2 (48 MW), developed in a partnership between ENI and GE.[89] The 100 MW Zhanatas Wind Farm in the Zhambyl region, jointly developed with China, was expected to be commissioned as the biggest wind farm in Central Asia.[90] Also under development was the expansion of the existing 45 MW Ereymentau-1 wind farm with two turbines of 2.5 MW each.[91] In 2021, the French developer Total Eren signed a memorandum of understanding with the Ministry of Energy to build and operate a 1 GW wind farm in central Kazakhstan.[92]

Serbia is an emerging player in the region, with an ambitious 2.7 GW of wind power projects in different stages of development as of 2021, adding greatly to the existing 398 MW of installed capacity. Operating wind farms include the 158 MW Čibuk 1 (the biggest in the Western Balkans with 57 turbines) and the 104 MW Kovačica, both constructed with support from the EBRD.[93] Smaller farms include Košava 1 (69 MW), Alibunar (42 MW), Malibunar, Kula and La Piccolina.[94] The 638 MW Maestrale Ring facility, under development near Subotica, is expected to become Europe's largest onshore wind park.[95].

Active deployment of wind power has also occurred in Bosnia and Herzegovina, with a proposed capacity of 1.3 GW in the pipeline.[96] Operating parks as of 2021 were Jelovača (36 MW)

Serbia is an emerging player in the region with **2.7 GW of wind power** projects in different stages of development.

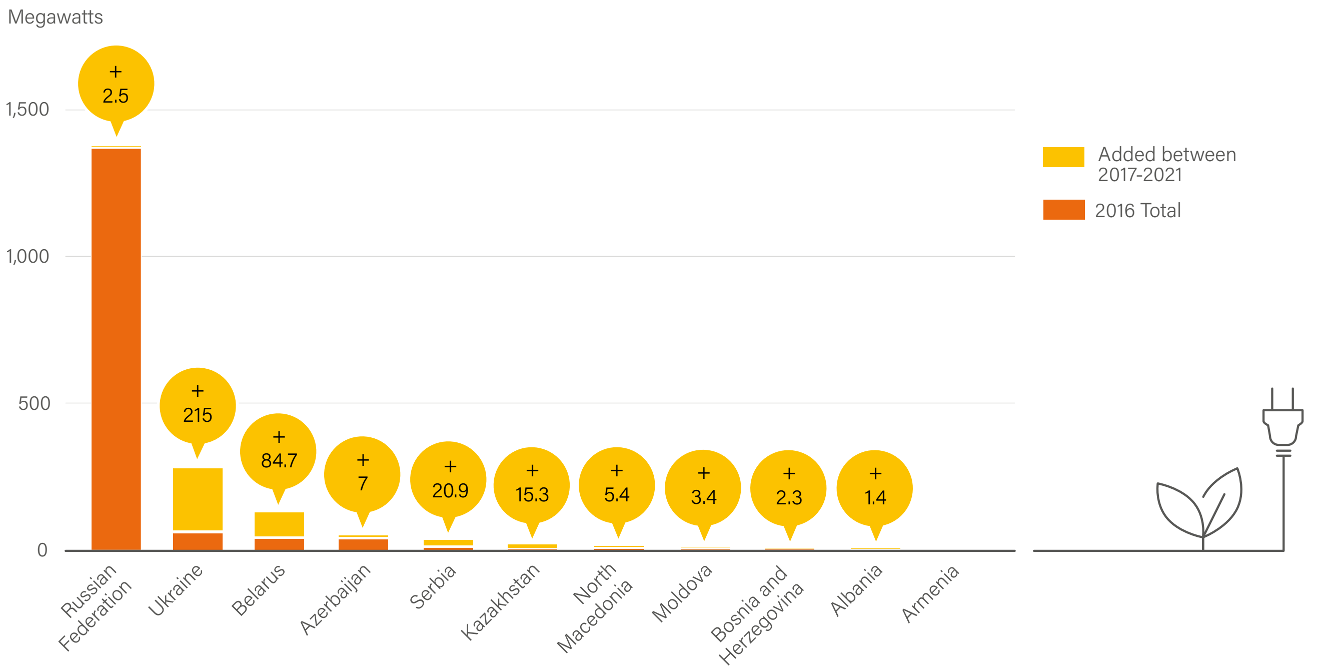
and Mesihovina (50 MW).[97] Montenegro also commissioned its first wind park, the 72 MW Krnovo facility.[98] In 2021, Albania announced its first call for invitations for utility-scale wind power projects with capacities between 10 MW and 75 MW and a total tendering capacity of 100-150 MW.[99] Two projects in North Macedonia – Bogoslovec (36 MW, under construction) and Bogdanci (37 MW in Phase I and 14 MW in Phase II, commissioned in 2015) – proved wind power's feasibility in the country and contributed to further studies, including for the 50 MW Miravci project in Gevgelija.[100]

Belarus added a modest 52 MW of wind power in 2021 to its existing 68 MW of installed capacity.[101] The country's largest wind park (25 MW) was being built in the Vitebsk region with technical assistance from the UNDP/GEF project "Removing Barriers to the Development of Wind Power in the Republic of Belarus."[102] Moldova was expected to commission 180 MW of private wind power capacity without state support.[103] Azerbaijan, despite very modest additions between 2016 and 2021 (51 MW total) and high reliance on domestic fossil fuels, began diversifying its energy portfolio by developing a 240 MW wind power project together with ACWA Power (Saudi Arabia), which will start operating in 2023 in the Absheron and Khizi regions.[104] Georgia's only wind park, the 20.8 MW Qartli, has been in operation since 2016.[105]

Biopower

Overall, the potential for generating electricity from bioenergy in the region remains untapped. Between 2016 and 2021, the Russian Federation, Belarus and Ukraine were the main market players for biopower, including from solid biofuels and biogas *(→ see Figure 12)*.[106] Minor developments occurred in Bosnia and Herzegovina, Moldova, North Macedonia, Serbia and Uzbekistan.[107]

FIGURE 12.
Biopower Installed Capacity in 2016 and Annual Additions During 2017-2021 in the Focus Countries, MW



Source: See endnote 106 for this chapter.

Ukraine had the largest growth in biopower capacity, mainly in the Kherson, Kirovohrad, Rivne, Volyn and Zakarpatie regions.[108] According to the Bioenergy Association of Ukraine, the country's biomass energy potential (963 gigajoules, GJ) was enough to replace all imports of natural gas, coal and petrol.[109] The main contributors to this potential were plant residues (44%) and energy crops (32%).[110] By 2021, Ukraine's cumulative power capacity from solid biofuels was 152 MW and from biogas was 123 MW, with most of this capacity (113 MW and 102 MW, respectively) added during 2016-2021.[111] Biopower capacity was projected to triple by 2035 and to quadruple by 2050, to reach 84-226 GJ.[112] However, as of 11 March 2022, 48% of Ukraine's biopower capacity was in locations under active fire, suggesting that damage to this infrastructure may be large.[113]

Belarus has significant potential for biogas and biomass energy due to well-developed agricultural activities and thus large quantities of manure and food waste, as well as broad forest coverage (around 40%).[114] Bioenergy was the country's only renewable energy source that showed stable growth between 2017 and 2021.[115] Between 2016 and 2021, small-scale (1-5 MW) biogas facilities (organic waste-to-energy) were commissioned in Baranovichi, Brest, Shchuchin, Slonim, and Vitebsk, with financial support from the EBRD, the Swedish International Development Cooperation Agency (SIDA), as well as bilateral partners and foreign companies.[116] By the end of 2021, the country had more than 20 biogas plants, with a cumulative capacity of 86 MW of solid biofuel and 39 MW of biogas facilities, most of them added between 2016 and 2021 (73 MW and 12 MW, respectively).[117]

Also notable was the UNDP Serbia project "Reducing Barriers to Accelerate the Development of Biomass Markets in Serbia" *(→ see Sidebar 8)*.[118]

SIDEBAR 8.
Development of the Biomass Market in Serbia

In 2014, UNDP started a project to accelerate the development of the biomass market in Serbia. Although biomass was not widely used for electricity generation in the country, its development showed high potential and technical feasibility. The project aimed to increase the share of biomass in the energy mix, to finance, build and connect to the grid six combined heat and power (CHP) facilities, and to raise awareness about the benefits of biomass energy among investors, consumers, policy makers and others. The project accelerated a total of USD 22.6 million in investments in six biogas CHP plants and increased the installed capacity of biogas CHP facilities by 130% compared to 2015, for a total of 6.35 MW. The project also helped to create an online biomass e-trading platform, managed by the Chamber of Commerce.

Source: See endnote 118 for this chapter.

Bioenergy was Belarus' only renewable energy source that showed **stable growth** between 2017 and 2021.

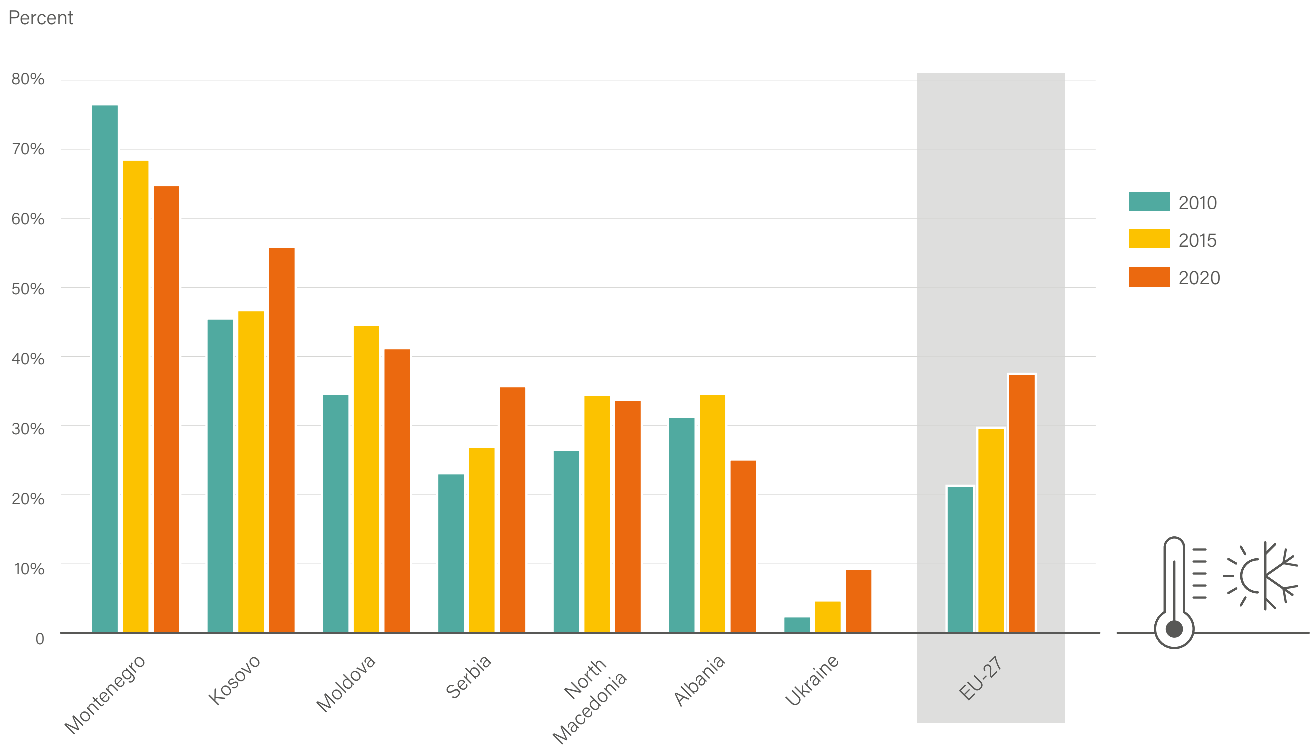
Geothermal Power

Globally, the installed geothermal power capacity increased from 11.8 GW in 2015 to 15.6 GW in 2021; however, overall diffusion of this renewable energy source has been small-scale and limited.[119] The Russian Federation was the only country in the focus region with installed geothermal power capacity, totalling 82 MW in 2021 and located mostly on the Pacific coast, specifically the Kamchatka peninsula and the Kuril Islands.[120] This installed capacity was up only slightly from 2015, pointing to the limited development of geothermal energy in the region despite its enormous potential.[121]

HEATING AND COOLING

Statistics on the share of renewables in heating and cooling were not available for all focus countries; however, the available data indicate that the dynamics varied, with some countries experiencing a relative reduction in renewable heat between 2015 and 2020 *(→ see Figure 13)*.[122]

FIGURE 13.
Share of Renewable Energy in Heating and Cooling in the Focus Countries and in the EU-27, 2010-2020



Note: Renewable energy in heating and cooling includes: 1) final energy consumption of renewable energy sources (mostly biofuels), excluding electricity, derived heat, and bioliquids, in sectors other than transport; 2) total heat production in heating plants and in CHP plants from geothermal, solar thermal, renewable municipal waste, solid biofuels and biogas; and 3) renewable energy from heat pumps (excluding double counting with other elements).
Source: See endnote 122 for this chapter.

The largest contribution to renewable heating and cooling came from the renewable share in final energy consumption – mostly bioenergy and very small shares of solar and geothermal heat. The Republic of Moldova, Serbia, and Ukraine obtained a very small share of their derived heat from renewables (i.e., the heat produced in heat plants and CHP plants), mostly from biomass. Only Ukraine reported heat delivered by heat pumps. Among the countries with available statistics, the largest share of renewables in heating and cooling was recorded in Montenegro *(→ see Figure 13)*. This is because firewood burned in individual dwelling stoves accounts for the largest share of the energy consumed for residential heating, followed by electricity that is much more expensive per unit of energy and thus, less affordable to use for heating, while the shares of other energy carriers for residential heating is negligible. Similar situation is also observed in Kosovo.

Solar Heat

Solar thermal collectors were among the most promising technologies providing renewable heat, especially in the southern countries of the region. Albania has been the leader in solar heat production since 2015.[123] In 2020, the country operated 293,965 square metres of collector area, for a total capacity of 206 megawatts-thermal (MWth) and a per capita capacity of 66.8 kilowatts-thermal.[124] North Macedonia ranked second in the region with a total operating capacity of 87 MWth, and the Russian Federation ranked third with 19 MWth.[125] The remaining countries had insignificant capacities of solar thermal collectors as of 2020.

Geothermal Heat

Cumulative heat production from geothermal sources in the region did not change significantly between 2015 and 2020, remaining stable at around 1.2 petajoules (PJ).[126] These data do not include geothermal (ground-source) heat pumps, the penetration of which increased sharply during the reporting period *(→ see Table 11)*.[127] The Russian Federation, Georgia and Serbia were the clear leaders in the use of geothermal heat for various thermal services and applications.[128]

TABLE 11.
Use of Geothermal Heat in the Focus Region, as of 2020

Albania	Geothermal water is used mainly at wellness centres for balneology (bathing and swimming), for example at Elbasani Llixha Spa in central Albania and at Peshkopia Spa. Geothermal heat pumps are increasingly used for heating and cooling, with 138 units installed at seven locations including schools, the Cultural Palace and the Twin Towers in Tirana. The total installed heat production capacity is 16.2 MW_{th}, including 11.7 MW_{th} for bathing and swimming and 4.5 MW_{th} for geothermal heat pumps. Actual heat consumption is 107.6 TJ terajoules (TJ) annually, including 84.3 TJ for bathing and swimming and 23.3 TJ for geothermal heat pumps.
Armenia	Geothermal water from an operating well is being bottled and sold as mineral water and also used to heat a nearby guesthouse. Two wells produce CO_2, one for a bottling plant and the other for a dry ice factory. These wells also supply hot water to the Ankavan Sanatorium, dedicated to the treatment of stomach ailments. The total installed heat production capacity is 1.5 MW_{th}, including 0.5 MW_{th} for individual space heating and 1.0 MW_{th} for bathing and swimming. Actual heat consumption is 22.5 TJ annually, including 7.5 TJ for individual space heating and 15 TJ for bathing and swimming.
Belarus	The country's largest geothermal installation is at the Berestye greenhouse complex in Brest, in the south-west. A few hundred small heat pump systems are installed in private cottages within and around the main towns and cities. In total, 28 locations across the country are listed as having around 300 geothermal heat pumps (mostly water-source), with a total installed heat production capacity of 10 MW_{th} and actual heat consumption of 137 TJ annually.
Bosnia and Herzegovina	Geothermal energy is used in 24 locations, primarily for balneology and recreation and to a lesser extent for space heating and water heating for swimming pools, industrial processes and sanitary water. Thermal and mineral waters are used at 18 locations for balneological and recreational purposes. Geothermal waters also are used at three locations for industrial processes for washing fruit and vegetables and for milk and dairy processing. The number of installed heat pumps has grown to nearly 500 in 13 locations, including at least 400 small and 30 large units. Thermal and mineral waters are used for water supply in 12 locations – for bottling of mineral water, extraction of free CO_2 from mineral waters at four wells, and extracting salt from brine. The total installed heat production capacity is 36.0 MW_{th}, including 16.5 MW_{th} for individual space heating, 0.54 MW_{th} for industrial process use, 11.8 MW_{th} for bathing and swimming, and 7.2 MW_{th} for geothermal heat pumps. Actual heat consumption totals 306.7 TJ annually, including 16.5 TJ for individual space heating, 3.6 TJ for industrial process use, 61.8 TJ for bathing and swimming, and 71.2 TJ for geothermal heat pumps.
Georgia	A total of 42 locations use geothermal energy for direct-use applications, including 22 for greenhouse heating, 19 for bathing and swimming, and 1 for fish farming. Space heating and domestic hot water heating occur in the Tbilisi area. Five geothermal heat pump units are reported at Kutaisi airport. The total installed heat production capacity is 69.2 MW_{th}, including 8.1 MW_{th} for space heating, 5.5 MW_{th} for district heating, 18.1 MW_{th} for greenhouse heating, 0.03 MW_{th} for fish farming, 37.5 MW_{th} for bathing and swimming, and 0.03 MW_{th} for geothermal heat pumps. Actual heat consumption totals 2,186 TJ annually, including 261.0 TJ for space heating, 172.2 TJ for district heating, 571.0 TJ for greenhouse heating, 1.1 TJ for fish farming, 1,180 TJ for bathing and swimming, and 0.16 TJ for geothermal heat pumps.
North Macedonia	Thermal waters are used in seven geothermal projects and six spas, all completed prior to 1990. The largest project is Kocani (Podlog) Geothermal Project ("Geoterma"), which heats an 18-hectare greenhouse complex and covers the space heating needs of public buildings in the town centre.

North Macedonia (continued)	Other uses are the heating of the Car Samuil hotel, the Spiro Zakov rest house (and rehabilitation facilities for children), other plastic-covered greenhouses, the Jugotutun rest house, the ZIK Strumica rest house, and experimental and private plastic-covered greenhouses. Ground-source heat pumps are increasingly popular, especially in individual houses, with an estimated 1,000 units installed with a typical size of 2.5 kW. The total installed heat production capacity is 47.4 MW_{th}, including 0.84 MW_{th} for individual space heating, 42.6 MW_{th} for district heating (mainly at Bansko and Kocani), 2.8 MW_{th} for greenhouse heating (mainly at Istibanja) and 1.25 MW_{th} for geothermal heat pumps. Actual heat consumption totals 623.6 TJ annually, including 6.6 TJ for individual space heating, 518.4 TJ for district heating (mainly at Bansko and Kocani), 61.1 TJ for greenhouse heating (mainly at Istibanja) and 37.5 TJ for geothermal heat pumps.
Russian Federation	Direct use of geothermal resources is most developed in Kuril-Kamchatka region, Dagestan and Krasnodar Krai, for heat supply and greenhouse heating in eastern Russia (Kamchatka peninsula) and southern Russia (Caucasus Mountains). Of these locations, 10 use geothermal energy for direct-use applications, 7 for district heating, 7 for individual space heating, 6 for greenhouse heating, 5 for bathing and swimming, 2 for agricultural drying, 1 for fish farming, and 1 for industrial uses – with some locations having multiple uses. Around 1,000 geothermal heat pumps units are in operation at six locations in western and central Russia. The total installed heat production capacity is 433 MW_{th}, including 110 MW_{th} for individual space heating, 110 MW_{th} for district heating, 160 MW_{th} for greenhouse heating, 4 MW_{th} for fish farming, 4 MW_{th} for animal farming, 4 MW_{th} for agricultural drying, 25 MW_{th} for industrial process heating, 4 MW_{th} for bathing and swimming, and an estimated 12 MW_{th} for geothermal heat pumps. Actual heat consumption totals 8,475 TJ annually, including 2,185 TJ for individual space heating, 2,185 TJ for district heating, 3,279 TJ for greenhouse heating, 63 TJ for fish farming, 63 TJ for animal farming, 69 TJ for agricultural drying, 473 TJ for industrial process heating, 63 TJ for bathing and swimming, and an estimated 95 TJ for geothermal heat pumps.
Serbia	Thermal water is used at more than 50 locations for balneology, sport and recreation. Geothermal energy use for heating and in agriculture and industrial processes occurs at only a few locations. In total, 66 projects are for direct-use applications, 49 for bathing and swimming, 21 for district heating, 8 for greenhouse heating, 3 for animal farming, 1 for agricultural drying, and 1 for fish farming, with some sites having multiple uses. An estimated 1,005 geothermal heat pump units are in use, varying in size between 10 and 40 kW and operating 2,860 full load hours per year. The total installed heat production capacity is 115.3 MW_{th}, including 12.8 MW_{th} for individual space heating, 41.5 MW_{th} for district heating, 5.1 MW_{th} for greenhouse heating, 1.7 MW_{th} for fish farming, 3.9 MW_{th} for animal farming, 0.967 MW_{th} for agricultural drying, 33.8 MW_{th} for bathing and swimming, and 15.6 MW_{th} for geothermal heat pumps. Actual heat consumption totals 1,726 TJ annually, including 245 TJ for individual space heating, 503.1 TJ for district heating, 89.3 TJ for greenhouse heating, 22.9 TJ for fish farming, 85.9 TJ for animal farming, 26.9 TJ for agricultural drying, 628.6 TJ for bathing and swimming, and 124.4 TJ for geothermal heat pumps.
Tajikistan	The only geothermal use is for bathing and swimming, with an installed heat production capacity of 2.9 MW_{th} and actual heat consumption of 55.4 TJ annually. In 2019, hot spring discharge nationally had an estimated installed heat production capacity of 17.3 MW_{th} and actual heat consumption of 479 TJ annually, a substantial increase since 2010.
Ukraine	Ten areas in the country use geothermal energy for direct-use applications in 30 locations (cities and counties), with all of them using it for both individual space heating and bathing. Three other areas are identified as having “small” facilities. An estimated 110,000 geothermal heat pumps (between 5 kW and 20 kW in size) are listed, with a combined installed heat production capacity of 1,600 MW_{th} and actual heat consumption of 4,990 TJ annually. The total installed heat production capacity is 1,607 MW_{th}, including 6.96 MW_{th} for bathing and swimming. Actual heat consumption totals 5,086 TJ annually, including 95.9 TJ for bathing and swimming.

Source: See endnote 127 for this chapter.

Bioenergy for Heating

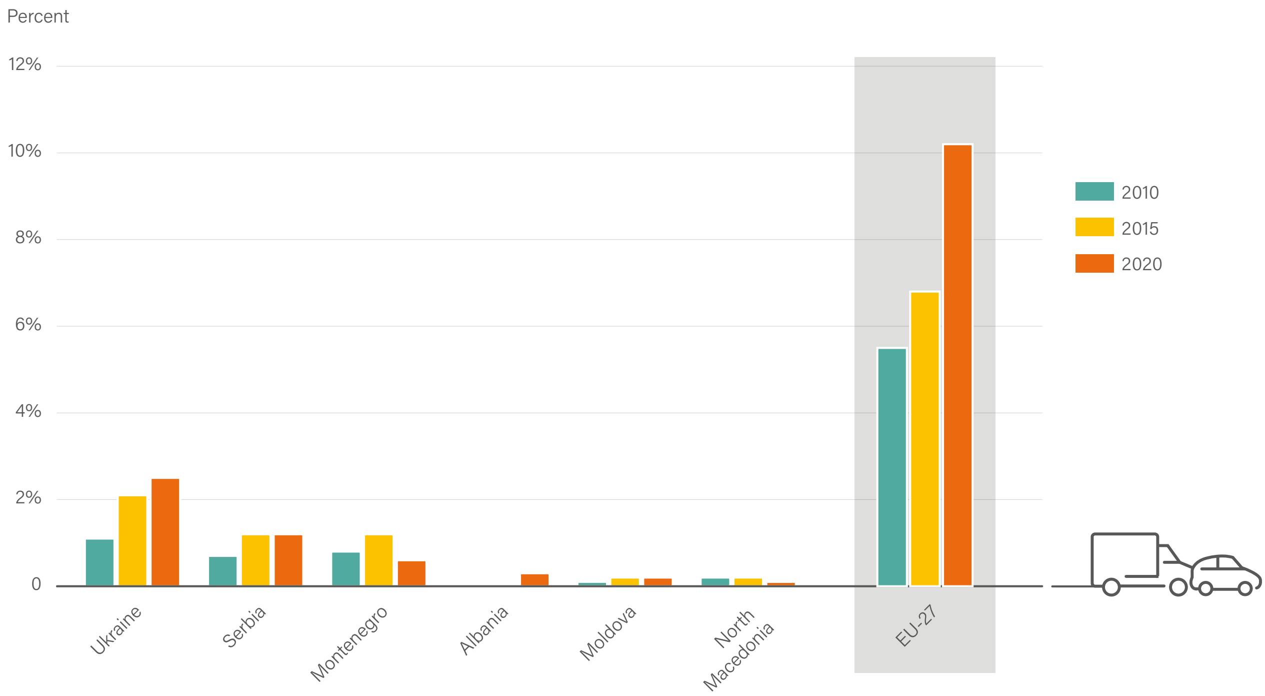
Given the small (but growing) role of solar heat and geothermal heat, most of the renewable energy used for heating and cooling in the region comes from bioenergy (mainly biomass and to a lesser extent biogas). The largest share is used for space and water heating in residential, commercial, and public buildings, followed by industry and agriculture.

Many countries are promoting biofuels for heating via both heating plants and CHP plants. Ukraine, in line with its "Concept of implementation of state policy in the field of heat supply," is investing in projects to replace natural gas in order to achieve a 30% renewable share in the country's heat supply systems by 2025, and 40% by 2035.[129] Belarus, through the IBRD-World Bank Belarus Biomass District Heating Project, was in the final stages of commissioning 103 MWth of renewable sources (mainly wood biomass) in district heating systems in 13 towns.[130] In Moldova, the Energy and Biomass EU-funded project, implemented by UNDP in two phases between 2011 and 2018, provided public institutions with 79 biomass heating systems and 49 solar water heaters and enabled more than 500 households and small and medium-sized enterprises to install sustainable heating technologies.[131] In areas of northern Kazakhstan located far from the main coal regions, biomass boilers have been a cost-effective alternative for use at agricultural sites, with no government support.[132]

TRANSPORT

Statistics on the share of renewables in the transport sector were not available for all focus countries. Based on the available data, the region has showed only limited progress in the sector *(→ see Figure 14)*.[133]

FIGURE 14.
Share of Renewable Energy in the Transport Sector in the Focus Countries and in the EU-27, 2010-2020



Source: See endnote 133 for this chapter.

The main technological means for decarbonising transport in the region has been fuel switching, specifically the promotion of electric vehicles and the use of biofuels in both public and private vehicle fleets. Whereas the production and use of biofuels, such as biodiesel, varies across the region, the transition to electric vehicles is occurring in most countries.

Ukraine is a leader with around 50,000 registered electric vehicles (including battery electric vehicles and plug-in hybrids) and around 9,000 charge points as of 2020.[134] This market growth was among the highest in Europe that year, supported mainly by the growth in charging infrastructure and by the exemption on VAT for imported electric vehicles and their components. This incentive, in place since 2018, was under discussion to be extended to 2030 as part of the incentive package included in the EV Draft Law.[135] Other pending legislation includes the CE Ban Draft Law considering a ban on diesel engines by 2027 and petrol engines by 2030.[136] Low electricity prices and high petrol and diesel prices in Ukraine also have attracted consumers to electric vehicles.[137]

Private and foreign actors have supported Ukraine's ambition. Vehicle dealerships (e.g., Renault) actively promote the use of electric vehicles in the country, ride-sharing services (e.g., Uber) with electric options have been introduced in cities, and private charging infrastructure developers (e.g., Toka) have been established.[138] The IFC initiated four projects under its Cities Initiative, helping to modernise high-speed public transport in Kyiv, introduce environmentally friendly bus fleets in Lviv and Mariupol, and install smart city infrastructure in Zaporizhzhia.[139]

Cross-border co-operation, for example with Hungary, Romania and the Slovak Republic during 2014-2020, aimed to interconnect Ukraine with neighbouring EU countries.[140] City-level electric mobility strategies were being developed for six Ukrainian cities with support from the GEF and the World Bank.[141]

The Russian Federation also has made great progress in accelerating the shift to electric mobility. In August 2021, the government approved a concept for the development of electric vehicles and related infrastructure by 2030, covering aspects of sustainable mobility including integrated urban programmes, stimulation of demand and hard-to-abate vehicle modes (such as trucks).[142] The concept also considers requiring auto manufacturers to produce a mandatory share of electric vehicles.[143]

In 2021, around 11,000 electric vehicles and 1,000 charging stations were registered in the Russian Federation, most of them e-buses being used in Moscow and other cities.[144] In April 2020, the manufacturer Kamaz opened an electric bus-only production facility near Moscow with a production capacity of 500-700 units per year, and as of early 2021 the city was procuring only electric buses for its public fleet, placing it among the leading green public transport cities in Europe.[145] Moscow set a target to have 1,000 e-buses in use by the end of 2021, with full electrification of the bus fleet by 2030.[146] In addition, the city demonstrated its first hydrogen bus, produced by Kamaz; overall, the Russian Federation aims to install 1,000 hydrogen fuelling stations during 2025-2030.[147]

The private vehicle fleet in the Russian Federation has been slower to transition to electric. However, public investments were planned to promote further local production and purchase of electric vehicles (via convenient leasing terms and loans) as well as charging infrastructure development (around USD 8 billion).[148] The country aims to have 25,000 electric vehicles by 2024, and the companies Zetta and Kamaz were aiming to start commercial sales as of 2021.[149]

The framework for electric vehicle promotion in the focus region has been unified in part by members of the Eurasian Economic Union, which includes Armenia, Belarus, Kazakhstan, the Kyrgyz Republic and the Russian Federation. Between 2016 and 2017, the EEU exempted electric vehicle owners from the import tax (which can add around 15%-50% to the price tag), although this change failed to attract many consumers because electric vehicle prices were still much higher than those of conventional vehicles.[150] Between 2020 and 2021, the incentive was reintroduced and began showing an impact through increased sales in EEU countries.[151]

Other countries in the region also began transitioning towards electric mobility. In Belarus, the number of electric vehicles reached 4,000 in mid-2021, with around 700 charging stations.[152] As in the Russian Federation, production capacities focused mainly on the public transport sector. More than 100 domestically produced electric buses were on the roads in Minsk, and more than 1,000 were to be deployed by 2025 in accordance with the Complex Programme for the Development of Electric Transport.[153]

In Georgia, an electric vehicle production facility was being built in co-ordination with a Chinese developer.[154] Serbia suspended its subsidy programme for electric vehicles, which provided a grant of up to EUR 5,000 (USD 5,500) for private vehicle owners and had been in place in 2020-2021.[155] As of 2020, only around 300 battery electric vehicles and 2,000 hybrid electric vehicles were registered in the country.[156] Three countries – Belarus, Ukraine and most recently Armenia – have benefited from the GEF and United Nations Environment Programme's "Global Programme to Support Countries with the Shift to Electric Mobility Child Projects," enabling these countries to make additional steps in electric mobility development *(→ see Sidebar 9)*.[157]

SIDEBAR 9.
Electric Mobility in Armenia

The GEF project "Transition Towards Electric Mobility in Armenia," approved in 2021, is working to create an enabling environment for the long-term development of electric mobility in the country. The project aims to provide strategic direction for this development and to build consensus around near- and long-term targets for electric mobility and an appropriate institutional set-up to govern the sector.

The project supports the establishment, operationalisation and institutionalisation of an inter-sectoral electric mobility co-ordination body consisting of representatives from relevant ministries, municipalities, non-governmental organisations and academia to co-ordinate and guide policy making, facilitate knowledge exchange among stakeholders and build consensus on Armenia's long-term strategy. The project plans to demonstrate the technical, financial and environmental feasibility of electric mobility through a pilot national electric vehicle procurement programme and infrastructure roll-out in the three biggest municipalities.

Source: See endnote 157 for this chapter.

The share of biofuels in the region's transport sector is negligible. In Ukraine – the regional leader in liquid biofuel production – the total installed capacity was 300,000 tonnes annually each for ethanol and biodiesel production in 2021.[158] Belarus stopped producing biodiesel in 2020.[159]

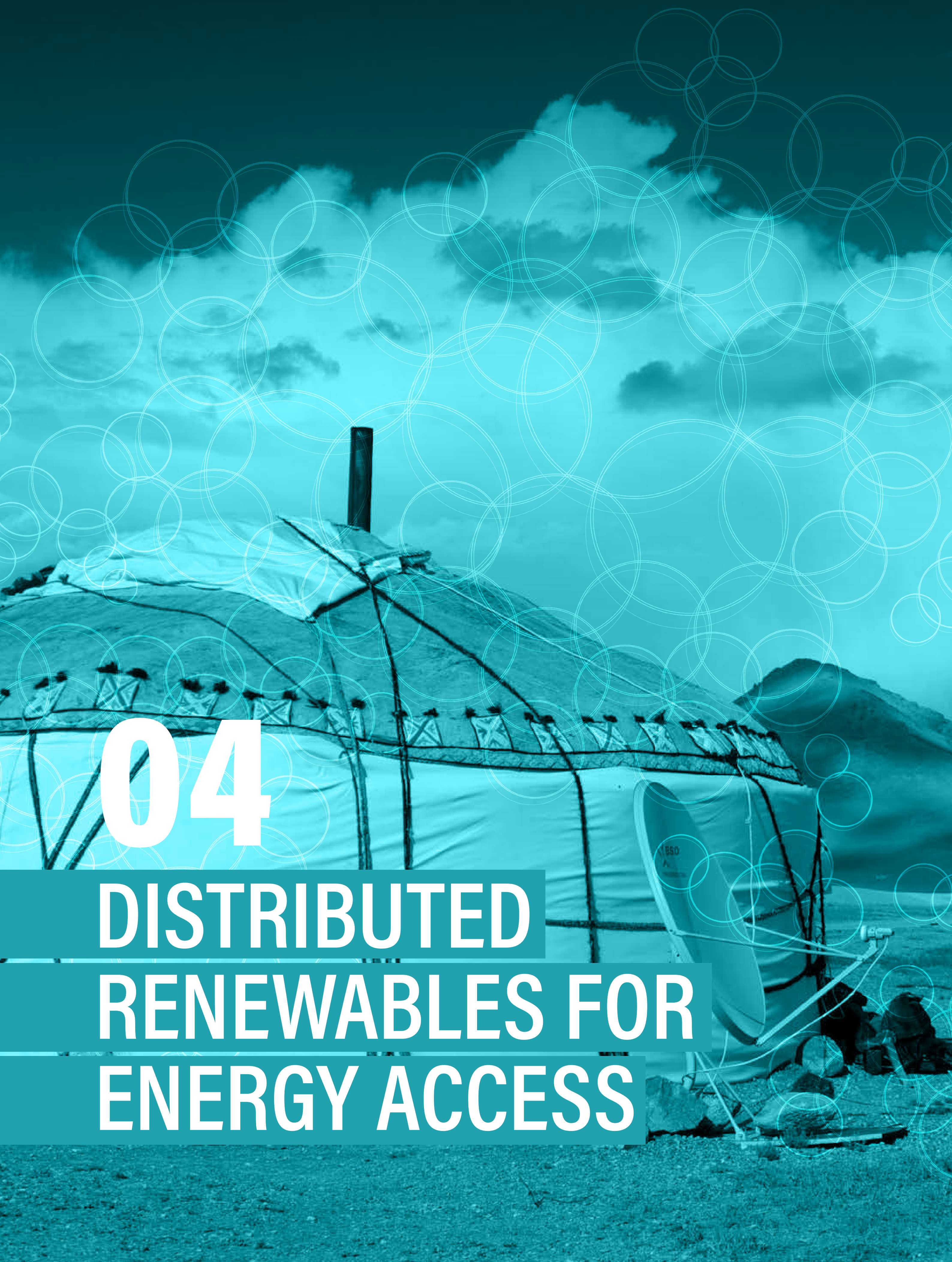
RENEWABLE ENERGY SUPPLY CHAIN

A critical aspect of the energy transition is access to green technologies and to know-how on their operation and maintenance. It is also important for countries to maximise the value of co-benefits harvested locally, as many renewable technologies remain more expensive than their conventional counterparts. Therefore, technological security as well as local know-how and production of these technologies are important enablers for successful decarbonisation in the focus countries.

The Russian Federation was the biggest regional player in both solar and wind power equipment production capacity. Industrial development is one of four key pillars of the country's renewable energy support programme 2.0 for 2024-2035, which aims to create a sustainable technological cluster based on production, generation, education, and research and development focused on renewables. The programme's main aim, which also will ensure its long-term development and sustainability, is to make the renewable energy industry export-oriented. The first phase of the programme (2014-2024) envisions annual production of renewable energy equipment equivalent to 1.4 GW of installed capacity.[160]

In 2020, the Russian company Rosnano, together with Vestas (Denmark), produced geared wind turbines with a cumulative annual capacity of 300 MW; the turbine gondolas are produced in Nizhny Novgorod, the blades in Ulyanovsk and the towers in Taganrog.[161] Also in 2020, a wind turbine production facility (Siemens-Gamesa licence) started operating in St. Petersburg, and gearless wind turbines of total capacity of 300 MW were being produced in Volgodonsk.[162] Solar PV panels with a total cumulative capacity of 530 MW have been produced by Hevel Group in Novocheboksarsk (250 MW production capacity), by Helios Resource in Saransk and Mytishci (100 MW) and by Solar Systems in Podolsk (180 MW).[163]

The Kyrgyz Republic has engaged in equipment production despite very modest local generation of renewables. New-Tek produces solar PV modules in the Bishkek free trade zone (almost entirely for export), and the country also hosts the production of medium-sized (1 MW) biogas equipment.[164] In Azerbaijan, Azguntex LLC has produced solar panels and LED lights at a production cluster in Sumgayit; the plant was under modernisation as of 2019 and was expected to eventually produce 60-65 MW of solar PV panels annually.[165] Belarus and Ukraine have been among the region's leading countries in producing bioproducts such as briquettes and pellets.[166] For other countries, building the technology supply chain remains a future task, thus representing a challenge for renewable energy expansion.



04

DISTRIBUTED RENEWABLES FOR ENERGY ACCESS

Distributed renewables for energy access (DREA) systems are renewable-based systems (stand-alone systems as well as mini-grids) that can generate and distribute energy independently of a centralised heat or electricity supply system. DREA systems can provide a wide range of services – including for lighting, consumer and productive appliances, cooking, space heating and cooling – in both urban and rural areas. In developing countries, where millions of people lack access to centralised energy supply, DREA systems represent a key solution for meeting modern energy needs and improving livelihoods. In the UNECE region, where there is already near-universal access to central power grids, DREA systems are critical to improve the reliability of the grid and to provide access to modern and sustainable sources of heat supply, particularly in rural settings.

ENERGY ACCESS

In 2020, nearly all of the focus countries reported a 100% electrification rate, up from an average of 99.5% in 2015.[1] The only country that did not achieve full electrification was Tajikistan, with a rate of 99.8% in 2020.[2] However, the electrification rate does not tell the full story of the sustainability of energy access in the region. Access to reliable and sustainable energy has remained a challenge in some countries, areas, and populations, with implications for food security, economic development, human health and poverty reduction. Even in many areas that are connected to the grid, insufficient generation capacity and deteriorating transmission infrastructure have effectively broken the link between grid access and reliable energy supply.

The quality of service provided on energy networks is far from homogeneous across the region. Several countries have failed to transmit, produce or import enough electricity to meet peak demand, especially during the winter months. Centralised energy supply systems also face multiple threats related to climate change, particularly from extreme weather events and increasing water shortages, which could further affect the reliability and sustainability of energy access *(→ see Sidebar 10)*.[3]

SIDEBAR 10.

Climate Change and the Reliability of Energy Access in Moldova

Moldova's energy sector is highly vulnerable to the impacts of climate change. The country's Fourth National Communication to the UNFCCC (2018) predicts that continued declines in precipitation during the summer and autumn months will have negative consequences for the hydrological regime and for hydropower generation capacity. By the end of this century, the reduction in annual water run-off compared to the base period could be as high as 45.0% in northern regions and up to 64.5% in southern regions. Ongoing changes in precipitation would reduce river flows and affect Moldova's ability to meet its energy demand, which is already chronically stressed (only 25% of energy is produced locally).

In addition, increased incidences of flooding have put more of the country's energy network at risk, as many power plants are already highly susceptible to floods. The rising frequency of heat and cold periods is also impacting the transmission network, which is very sensitive to variations in air temperature. Such disruptions occurred in 2008, 2009 and 2017. According to the Climate Change Adaptation Strategy of Moldova, 72% of the country's total freshwater use in 2017 went to heating and hot water supply. Water scarcity is expected to adversely affect the country's energy sector development goals already by 2030. A key effect of climate change on the water supply will be growing instability in annual water flows, with spring and flash floods leading to short-term oversupply, and longer and more severe droughts leading to scarcity.

Distributed renewable energy systems can play a prominent role in enhancing resilience to climate-induced disruption of the energy supply, both for Moldova's population and for its small and medium-sized businesses. For example, solar PV can help flatten the potential sharp increases in electricity demand during peak hours that can be damaging to the grid. There is a strong need to diversify and promote the use of domestic renewable energy resources to reduce the vulnerability of the energy sector and the population to the impacts of climate change.

Source: See endnote 3 for this chapter.

For example, in Tajikistan the demand for electricity is highly seasonal, with a winter peak driven by electricity-based heating. The national utility, Barqi Tajik, has struggled to fully meet winter power demand despite near-universal grid access, due in part to the company's reliance on hydropower and to unfavourable hydrological conditions in winter.[4] The frequency of equipment failures on the country's transmission and distribution network has continued to increase due to insufficient investment in operations and maintenance; as a result, the average daily duration of electricity supply to customers on the Barqi Tajik grid in 2017 was 22 hours.[5]

In addition, several very remote settlements in Tajikistan, totalling around 12,000 people, were not connected to electricity service as of 2019.[6] When the country was part of the Soviet Union, these areas – scattered over a vast territory in eastern Gorno Badakhshan Autonomous Okrug – were supplied mainly with diesel-based portable generator sets.[7] However, once the generous Soviet fuel subsidies disappeared and the unit cost of diesel-based electricity generation increased, use of the generators became prohibitively expensive.

Similarly, in neighbouring Uzbekistan, more than 250,000 kilometres of electricity transmission and distribution lines built during the Soviet era had exceeded their useful economic life as of 2019.[8] This resulted in high electricity losses, estimated at 20% of net generation, that would be unable to sustain high penetrations of renewables on the grid.[9] The level of losses in Uzbekistan was more than twice that of the commercial and technical losses experienced in high-income and some middle-income countries.[10] Both the frequency and duration of outages have been high, with large and small manufacturing firms experiencing 24-29 days of blackouts in 2017/2018.[11] Ageing transmission infrastructure has impeded the implementation of a large-scale national renewable energy development programme in the country.[12]

In several situations, the reliability of power supply is compromised by the availability of water resources used simultaneously for household water consumption, agricultural irrigation, industrial needs and power production - either by one country or by several counties positioned upstream or downstream of a river. This is an example of the so-called water, food and energy nexus, when these three sectors are interlinked so strongly that actions in one policy area commonly have impacts on the others. Co-ordination among these sectors is challenging at the national level, and even more so across borders. The deployment of vast renewable energy potential could form part of a discourse among relevant focus countries on this nexus, addressing the needs of various sectors and linking them *(→ see Sidebar 11)*.[13]

Uzbekistan has over
250,000 kilometres
of economically redundant electricity transmission and distribution lines.

SIDEBAR 11.
Water, Food and Energy Nexus

Many occurrences of the water, food and energy nexus across borders exist in the focus region. Transboundary river basins include the Alazani/Ganykh in the Caucuses, the Sava and Drina in the Western Balkans, and the Syr Darya and Amu Darya in Central Asia.

The Alazani/Ganykh river basin, shared by Georgia and Azerbaijan, provides water resources for agriculture and tourism, as well as hydropower to support these activities. Due to the lack of modern energy access in the upper basin, the local population typically gathers fuelwood, a practice that has led to forest degradation, loss of water retention capacity by forests, and greater exposure to landslides and flash floods downstream. Insufficient management of riverbanks and irrigation systems has led to degradation of fertile soils. Soil erosion, sedimentation and flash floods compromise water quality and infrastructure operations, including for the hydropower plant.

The Sava river basin, shared by Bosnia and Herzegovina, Croatia, Montenegro, Serbia and Slovenia, provides these countries with a large share of hydropower, water, agricultural land and other resources. Economic development and climate change put these countries into competition for these resources. In dry times, hydropower generation decreases, while flooding events result in the shutdown of thermal plants and affect the operation of coal mines.

The Drina river basin, shared by Bosnia and Herzegovina, Montenegro and Serbia, provides a basis for power generation, small-scale agriculture and nature-based tourism. Development and water management activities in any of the three riparian countries that affect the river flow, water quality and the presence of solid waste can be felt across borders.

The Syr Darya and Amu Darya rivers form the main water resource system of Central Asia - the Aral Sea Basin - which is shared by Kazakhstan, the Kyrgyz Republic, Tajikistan and Uzbekistan. These countries depend heavily on the river for hydropower production and agricultural irrigation, and seasonal demands are sometimes incompatible. During the Soviet period, the Kyrgyz Republic and Tajikistan made water available to downstream countries for irrigation during the summer months. In exchange, Kazakhstan, Turkmenistan and Uzbekistan supplied coal, natural gas and electricity during the winter. Since the collapse of the Soviet Union, however, these water-energy exchanges have failed, weakening co-operation and resulting in negative economic impacts.

With climate change, population growth, and other challenges, it has become ever more critical to manage scarce water and energy resources with a view to the impacts on other sectors and neighbouring countries. The deployment of vast renewable energy potential in the region could form part of a discourse on the broader water, food and energy nexus, addressing the needs of various sectors and linking them. This also represents an opportunity for enhanced regional co-operation, building on experiences from the Soviet era.

Source: See endnote 13 for this chapter.

AVAILABILITY OF CLEAN FUELS

Access to a modern, sustainable and affordable heat supply has been a major environmental and energy challenge in the focus region, particularly in rural and mountainous areas. Countries in the Western Balkans especially were lagging in adopting clean and sustainable fuels and technology as of 2019 *(→ see Table 12)*.[14] In Bosnia and Herzegovina, only 17.6% of the population used clean fuels that year.[15]

In three Western Balkans countries, the share of clean energy and technologies declined between 2015 and 2019, falling from 19.2% to 17.6% in Bosnia and Herzegovina, from 93% to 90.1% in North Macedonia, and from 44.8% to 43.8% in Serbia.[16] In rural and mountainous areas in particular, much of the population has continued to rely on fuelwood for heat, cooking and water heating. Surveys in Bosnia and Herzegovina indicate that around 75% of households rely either partly or fully on traditional biomass for heating or cooking.[17] Altogether, around 32.3 million people, or 10.5% of the total population of the focus region, lacked access to clean energy fuels and technologies in 2019.[18]

TABLE 12.
Overview of the Quality of Energy Access in the Focus Countries, 2019

	Share of the population using clean fuels and technologies, 2019 (percent)	Average annual growth in clean fuels and technologies, 2015-2019 (percent)	Population without clean fuels and technologies, 2019 (millions)	Share of sales lost due to electrical outages, 2018-2019 (percent)
Albania	63.4	2.08	0.6	1.9
Armenia	95.8	0.13	0.1	0.7
Azerbaijan	94.2	0.43	0.3	1.5
Belarus	98.0	0.12	0.1	0.3
Bosnia and Herzegovina	**17.6**	**-1.73**	1.9	0.8
Georgia	77.2	5.28	0.5	0.5
Kazakhstan	95.9	0.62	0.4	1.7
Kyrgyz Republic	66.1	0.09	1.4	1.1
Moldova	94.4	0.49	0.2	1.1
Montenegro	**43.6**	1.09	0.2	**2.4**
North Macedonia	56.4	2.98	0.5	1.9
Russian Federation	90.1	**-0.63**	14.2	0.3
Serbia	**43.8**	**-0.45**	3.0	0.9
Tajikistan	75.8	1.52	1.7	0.6
Turkmenistan	99.9	N/A	N/A	N/A
Ukraine	87.9	**-0.02**	2.1	0.8
Uzbekistan	74.2	**-0.19**	5.1	**3.0**

Note: Calculated as the number of people using clean fuels and technologies for cooking, heating and lighting divided by the total population having access to such services as cooking, heating or lighting. A different source was used than in the previous REN21 UNECE report. N/A = not available.

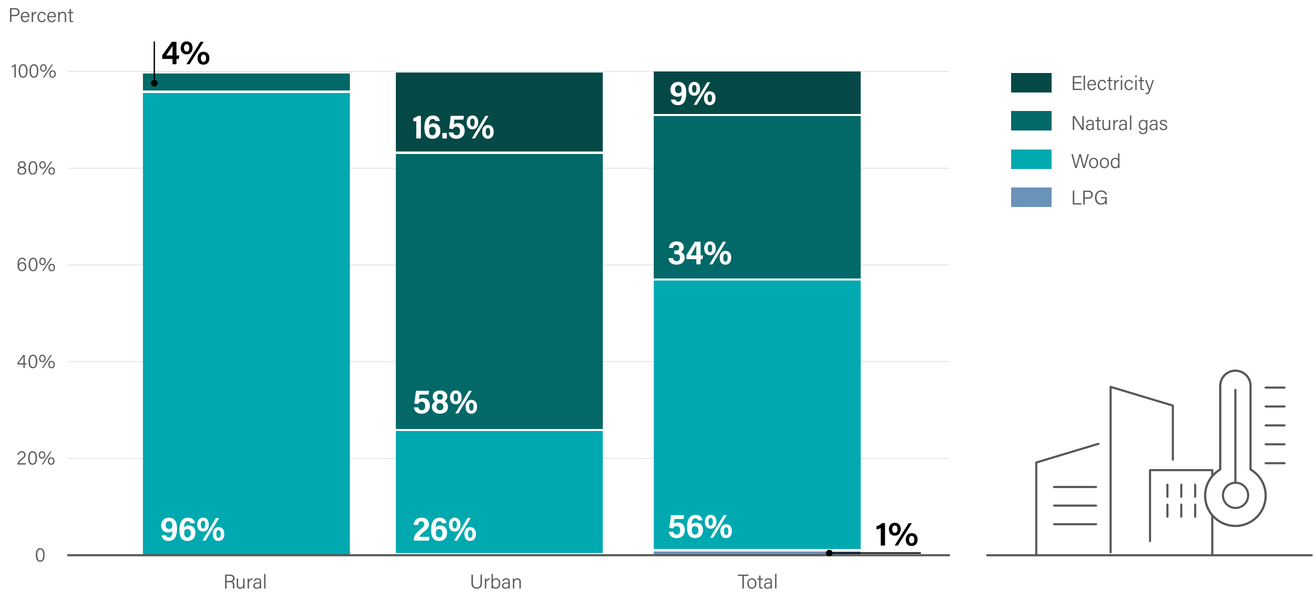
Source: See endnote 14 for this chapter.

Even though Serbia had the largest share of households with central heating in the Western Balkans (38.4%) in 2019, the use of traditional stoves for heating was still predominant in the country.[19] The efficiency of these stoves is generally low, below 40%, leading households to economise on fuel by reducing the size of their living space and heating for only a few hours.[20] Burning fuelwood in traditional stoves can release high levels of particulate matter (PM2.5) and carbon monoxide, resulting in environmental and health problems. Small-scale combustion of solid fuel also is a key source of black carbon emissions, which contribute to global warming.

Consequently, wood stoves have been a major source of outdoor air pollution in the region, as well as indoor air pollution through either direct exposure or infiltration from outside. The World Health Organization (WHO) has linked emissions from wood heating to serious health effects, including respiratory and cardiovascular mortality and morbidity, particularly among children.[21] According to WHO estimates for Central and Eastern Europe, wood burning accounted for 20-30% of outdoor PM2.5 levels during the local heating season, especially in rural areas.[22] This, among other factors, has contributed to a rise in mortality in Serbia in recent years.[23]

Rural areas in the Southern Caucasus and Central Asia face similar challenges. In Georgia, an estimated 95.9% of rural households relied on fuelwood for heat supply in 2019, compared with only 25.7% of urban households *(→ see Figure 15)*.[24] Across the focus region, an overreliance on fuelwood coupled with household use of inefficient appliances and technologies has led to increasing forest degradation and deforestation and the associated loss of precious carbon stocks.[25]

FIGURE 15.
Energy Sources Used for Space Heating in Georgia, 2019



Source: See endnote 24 for this chapter.

Local markets offer a variety of energy-efficient heating solutions that can greatly reduce fuelwood use. These range from relatively simple, affordable and efficient locally produced wood stoves (or analogous imported stoves of higher price and quality) to more sophisticated and much pricier boiler-powered central heating systems. The most affordable options are locally manufactured (although non-certified) efficient stoves, produced by hand in small workshops in local towns and villages. Common features of improved woodstoves are combustion chambers, air inlet control and smoke chambers.

In Georgia, the locally available efficient wood stoves known as "Svanuri pechi" consume 25-50% less wood and have a thermal efficiency of up to 75%, according to the producer.[26] A range of even more efficient and durable imported wood stoves can be found on the market in urban centres. These products have much higher combustion efficiency and low emission levels, and most are EU-certified and compliant with the requirements of the EU Ecodesign Directive. However, due to their high price, demand for such products is concentrated mainly in more affluent urban areas.

Around
32 million people
in the focus region lacked access to clean fuels and technologies.

Solar water heating is another renewable-based alternative that can reduce fuelwood consumption and partly address the need for reliable energy access. Consumers with relatively high hot water demand (more than 5,000 litres annually) – such as hotels, restaurants, and small and medium-sized enterprises – have increasingly adopted this solar technology, which can be more cost-effective.[27] In contrast, demand for solar water heating among households has remained limited, as the cost savings are small relative to the relatively high upfront cost of purchasing the system (especially since water heating accounts for only a small share of the total household energy demand).[28]

Several countries in the region – Moldova, Ukraine, and countries in the Western Balkans and the Southern Caucasus – possess large volumes of solid woody biomass residues, which could be used to produce upgraded solid biofuels (briquettes, pellets and chips) to satisfy considerable heating needs. Modern processes and technologies could be used to convert woody or vegetable material into these alternative fuels.

In Georgia, the large hazelnut-growing sector has been a source of solid biofuels, with the nutshells either burned directly in stoves or used in briquette manufacturing. Some Georgian cities and suburban areas have used hazelnut shells as a viable heating alternative to fuelwood. The calorific value of the nutshell (18.0-19.0 megajoules per kilogram (MJ/kg)) is roughly equivalent to that of oven-dry wood (18.5 MJ/kg). Considering that the fuelwood currently used by the population has a high moisture content and a low calorific value (10-12 MJ/kg), the hazelnut shells could be an efficient fuelwood substitute both for households and for autonomous heating systems in public buildings.

In Bosnia and Herzegovina, the annual biomass potential in 2015 was an estimated 10.3-10.4 million tonnes of dry matter; in theory, this could cover up to an additional 12-15% of the country's total primary energy supply.[29] In 2018, the Czech Development Agency awarded a series of grants to UNDP and to private sector recipients in Bosnia and Herzegovina to implement a range of sustainable heat supply projects, including:

- a project in the city of Doboj to modernise the heating system of St. Luke Hospital, which involved a comprehensive replacement of heat sources (including both the fuels used and the heat distribution systems) as well as the reconstruction of transfer stations;
- a project aimed at renovating the heating systems of two kindergartens, including installing container pellet boilers, heat storage and a water treatment plant for refilling the heating system; and
- a project to build solar systems for electricity generation and hot water production in minority communities in Western Bosnia[i]. The solar systems promoted energy self-sufficiency and improved the quality of life of 40 households that previously used fossil (naphtha) or solid (wood) fuels to produce energy and heat. The households used the renewable electricity not only for their own consumption, but also to grow and store agricultural products for sale, thereby generating income. Local business personnel were trained in the solar system installation and maintenance.[30]

ENERGY POVERTY

Despite near-universal access to energy in the region, the incidence of energy poverty is high. This is due to a combination of low average household incomes, limited access to affordable energy, and the low thermal performance of homes and heating appliances. The inefficiency of buildings, household appliances and heating systems has meant that the energy required to provide the same level of comfort is much higher on average in the region than in member countries of the OECD.[31]

There is no established definition of energy poverty either in the UNECE region or globally. One approach is to consider as "energy poor" those households that are unable to provide adequate and proper heating conditions. The WHO recommends minimum indoor temperatures of 21 degrees Celsius (°C) in the living room and 18°C in other rooms.[32] In the United Kingdom, a household is considered "fuel poor" if it needs to spend more than 10% of its income on fuel use and heating to achieve an adequate standard of warmth.[33]

Within the EU legal framework, the concept of energy poverty was introduced for the first time through the so-called Third Energy Package, which included a definition of consumer protection with a view to reducing energy poverty. Under the EU Internal Market Directives on Electric Energy (2009/72/EC) and Natural Gas (2009/73/EC), Member States were required to define energy poverty and to protect energy consumers.

Even without a clear definition of energy poverty, or related national statistics, in the UNECE region, it is clear that many households have been living in sub-standard and inadequate conditions as a result of their inability to pay their energy bills or

to invest in energy efficiency improvements. This is despite the

i These minority residents are primarily ethnic Serbs who have returned to their homes after being forced to leave during the 1992-1995 war.

fact that energy tariffs for households have remained much lower than in the EU, even as tariffs for non-residential consumers have gradually approached the EU level.[34]

In Albania, a study of energy poverty found that 62% of surveyed households had difficulties paying energy bills.[35] Across Ukraine, with the exception of Kyiv, 40-50% of people could not afford to pay their electricity bills during most months or at least a few times a year as of 2020.[36] The main source of energy poverty in Ukraine, as elsewhere in the region, is the poor quality of the ageing building stock, as the multi-family apartment buildings built during the Soviet era are highly energy inefficient, making heat bills unaffordable without subsidies. Improving the energy efficiency of buildings is therefore key to addressing energy poverty.[37]

In the Western Balkans countries, the share of households unable to keep their homes adequately warm is among the highest in Europe, reaching as high as 50% in Kosovo.[38] As a result, households commonly heat only certain rooms and for limited periods. Because of inadequate heating systems, the average Serbian household is fuel poor, spending more than 10% of its monthly income on energy bills.[39] According to Serbia's 2013 Household Budget Survey, nearly 20% of respondents reported living in houses that were not adequately warm in the winter months, due mainly to a lack of financial resources.[40] In Ukraine, most survey respondents reported that their heating payment was high or very high.[41]

DISTRIBUTED RENEWABLE SOLUTIONS FOR ENERGY ACCESS

Distributed renewable energy generation holds large potential across the focus countries. However, the sector has remained at a nascent stage. Because of the near-universal access to centralised grid supplies and low electricity tariffs, distributed renewables are not feasible to install and have evolved mainly based on a self-consumption model. In this model, electricity consumers ("prosumers") produce part of their electricity needs themselves and use the distribution network both to inject excess production and to withdraw electricity when self-production is insufficient to meet their needs.

To promote and enable such self-consumption based on distributed renewables, several countries in the focus region have introduced dedicated net metering policies and regulations *(→ see Chapter 2)*. However, uptake of this solution has been limited, with a focus mainly on solar PV.

In Georgia, where net metering for systems with an installed capacity of less than 100 kW has been in place since 2016, only around 243 systems totalling some 3.8 MW in capacity were connected to the net accounting scheme as of the end of 2020.[42] Even though the scheme was technology neutral, most of these microgenerators were solar PV. In summer 2020, the installation limit was increased from 100 kW to 500 kW, which drove the number of systems to 349 units (again mostly solar PV) with a total installed capacity of 14.3 MW by December 2021.[43] Given that the estimated potential for integrating variable renewables into the Georgian power system was 333 MW for wind power and 130 MW for solar PV in 2020-21, net metering has contributed minimally to capturing this potential.[44]

In Moldova, where net metering was introduced in 2018, prosumers had installed only 269 solar PV systems, totalling 4.85 MW, as of the end of 2020.[45] Ukraine, in contrast, has seen notable success in distributed renewable energy: as of mid-2021, more than 32,000 prosumer households had installed renewable power capacity systems of less than 30 kW each, for a total capacity of 835 MW.[46] A key driver in Ukraine has been a special green tariff that pays prosumers to feed their surplus energy to the grid, thus making such investments more attractive than in countries that do not offer additional compensation in their net metering schemes.[47]

Early lessons from the development of the region's distributed renewable energy sector suggest that net metering on its own does not yet represent a viable business case for smaller consumers due to the relatively high capital expenditure, the low level of self-consumption and low tariffs. Additional financial and technical support is required to scale the sector. In recent years, several countries have considered and/or introduced public financing schemes to stimulate the uptake of distributed renewables.

For example, the Georgian government budgeted nearly EUR 22 million (USD 24.7 million) for its "Light to every village" programme, launched in 2019, which supplied 178 households in 87 villages with solar PV systems (1.5 kW peak each).[48] In 2021, Montenegro's power utility company introduced a net metering programme covering 3,000 solar rooftops, and the Investment and Development Fund of Montenegro launched a financing support programme to award low-interest loans for commercial PV projects at an interest rate of 3% per year, with a repayment period of up to 10 years.[49] Meanwhile, the government's Eco Fund awards non-refundable grants of up to EUR 25,000 (around USD 28,000) per project.[50]

Incidence of **energy poverty is high** in the focus region, despite near-universal access to energy.

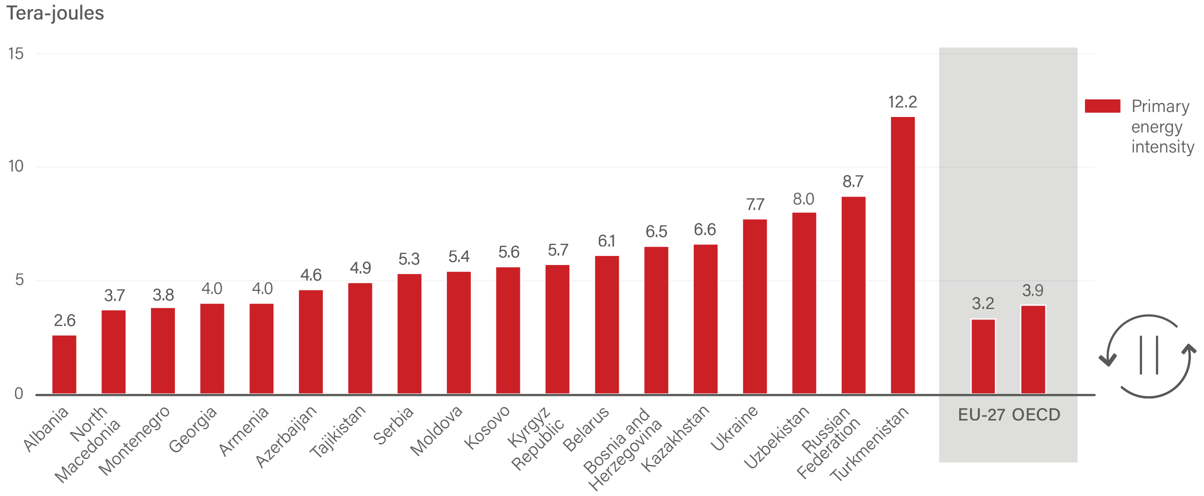
05 ENERGY EFFICIENCY

Despite the broad range of energy supply options, including renewables, meeting energy demand in the UNECE region at affordable costs will be challenging.[1] Hence, enhancing energy conservation and the efficiency of energy use is a key first step. Conserving energy implies reducing the amount of energy services consumed without compromising the level of comfort and/or recommended health standards. Increasing energy efficiency means delivering more services with the same amount of energy consumed, or the same services with less energy. Since 2017, nearly all of the focus countries improved their energy efficiency, with support from national governments and international donors. However, significant potential remains in all sectors. Additional efforts are needed to capture this potential and to reduce energy demand to levels that can be met using renewable energy options.

REGIONAL OVERVIEW

Progress in energy efficiency at the national level is often measured in terms of the energy intensity of GDP, or the amount of energy needed to produce one unit of economic production. In 2019, energy intensity in the focus countries exceeded the EU-27 average in all countries except Albania, and it exceeded the OECD average in all countries except Albania, Montenegro and North Macedonia – with the highest rates in Turkmenistan and the Russian Federation. *(→ see Figure 16)*.[2]

FIGURE 16.
Primary Energy Intensity in the Focus Countries, 2019



Source: See endnote 2 for this chapter.

Even so, the energy intensity of all focus countries has declined sharply on an average annual basis over the last 30 years *(→ see Table 13)*.[3] During the period 1990-1999, this decline was related to economic restructuring that occurred after the collapse of the Soviet Union and Yugoslavia; the trend continued during 2000-2010 and also through 2019, with the only exceptions being Azerbaijan and Georgia.[4]

TABLE 13.
Compound Annual Growth in Primary Energy Intensity in the Focus Countries, by Decade, 1990-2019

Country/Region	1990-2000	2000-2010	2010-2019
Albania	-5.3%	-3.6%	-1.4%
Armenia	-9.1%	-5.4%	-1.1%
Azerbaijan	-1.7%	-12.4%	**2.1%**
Belarus	-4.8%	-5.9%	-1.8%
Bosnia and Herzegovina	-15.5%	-0.2%	-0.8%
Georgia	-4.7%	-5.1%	**0.9%**
Kazakhstan	-3.5%	-1.3%	-3.3%
Kosovo	n/a	-1.4%	-2.8%
Kyrgyz Republic	-7.4%	-2.3%	-0.3%
Moldova	-5.7%	-2.4%	-3.1%

Country/Region	1990-2000	2000-2010	2010-2019
Montenegro*	n/a	-1.7%*	-3.1%
North Macedonia	**1.6%**	-2.1%	-2.7%
Russian Federation	**0.5%**	-3.5%	-0.4%
Serbia	-4.6%	-3.1%	-2.2%
Tajikistan	**0.6%**	-7.4%	-0.5%
Turkmenistan	**0.8%**	-3.2%	-5.6%
Ukraine	**2.0%**	-4.2%	-4.3%
Uzbekistan	0.0%	-6.6%	-5.7%
EU-27	-1.8%	-1.1%	-2.4%

* For Montenegro, the period of coverage is 2005-2010.
Note: Primary energy intensity is measured in 2015 USD PPP.
Source: See endnote 3 for this chapter.

A variety of factors impact the measurement of energy intensity, including a country's total economic activity (measured as GDP), its economic structure and the energy efficiency itself. Between 1990 and 2000, GDP grew quicker than the primary energy supply in all of the focus countries except North Macedonia, the Russian Federation, Tajikistan, Turkmenistan and Ukraine (→ *see Table 14*).[5] Subsequently, between 2000 and 2010, all of the focus countries experienced this decoupling of GDP growth from energy supply growth.[6] The decoupling continued through 2019 in all countries except Azerbaijan and Georgia.[7]

TABLE 14.
Compound Annual Growth in GDP versus Primary Energy Supply in the Focus Countries, by Decade, 1990-2019

Country/Region	1990-2000			2000-2010			2010-2019		
	PES	GDP	GDP - PES	PES	GDP	GDP - PES	PES	GDP	GDP - PES
Albania	**-3.9%**	1.4%	5.3%	1.7%	5.6%	3.9%	1.0%	2.5%	1.5%
Armenia	**-12.6%**	**-3.8%**	8.7%	2.1%	8.0%	5.8%	3.6%	4.7%	1.1%
Azerbaijan	**-6.7%**	**-5.2%**	1.6%	0.5%	14.8%	14.3%	3.4%	1.2%	**-2.2%**
Belarus	**-5.9%**	**-1.2%**	4.7%	1.1%	7.4%	6.3%	**-0.6%**	1.1%	1.8%
Bosnia and Herzegovina	**-4.7%**	12.8%	17.5%	4.1%	4.3%	0.2%	1.2%	2.0%	0.8%
Georgia	**-13.6%**	**-9.3%**	4.3%	0.8%	6.3%	5.4%	5.6%	4.7%	**-0.9%**
Kazakhstan	**-7.0%**	**-3.6%**	3.4%	6.8%	8.3%	1.4%	0.6%	4.1%	3.5%
Kosovo			**N/A**			4.9%	6.4%	1.4%	0.7%
Kyrgyz Republic	**-11.1%**	**-4.0%**	7.1%	1.7%	4.1%	2.4%	4.3%	4.6%	0.3%
Moldova	**-11.6%**	**-6.2%**	5.4%	2.6%	5.1%	2.5%	0.8%	3.9%	3.2%
North Macedonia	0.7%	**-0.9%**	**-1.7%**	0.7%	3.0%	2.2%	**-0.3%**	2.5%	2.8%
Russian Federation	**-3.4%**	**-3.9%**	**-0.5%**	1.1%	4.8%	3.7%	1.2%	1.6%	0.4%
Serbia	**-3.6%**	1.0%	4.6%	1.5%	4.7%	3.2%	**-0.3%**	2.0%	2.3%
Tajikistan	**-8.6%**	**-9.2%**	**-0.6%**	0.1%	8.1%	8.0%	6.6%	7.1%	0.5%
Turkmenistan	**-1.6%**	**-2.4%**	**-0.8%**	4.3%	7.7%	3.4%	2.5%	8.6%	6.1%
Ukraine	**-6.1%**	**-8.0%**	**-1.9%**	**-0.1%**	4.3%	4.4%	**-4.3%**	**-0.04%**	4.2%
Uzbekistan	**-0.2%**	**-0.2%**	0.0%	**-0.2%**	6.8%	7.1%	0.5%	6.5%	6.1%
EU-27	0.2%	2.1%	1.9%	0.4%	1.5%	1.1%	**-0.9%**	1.6%	2.5%

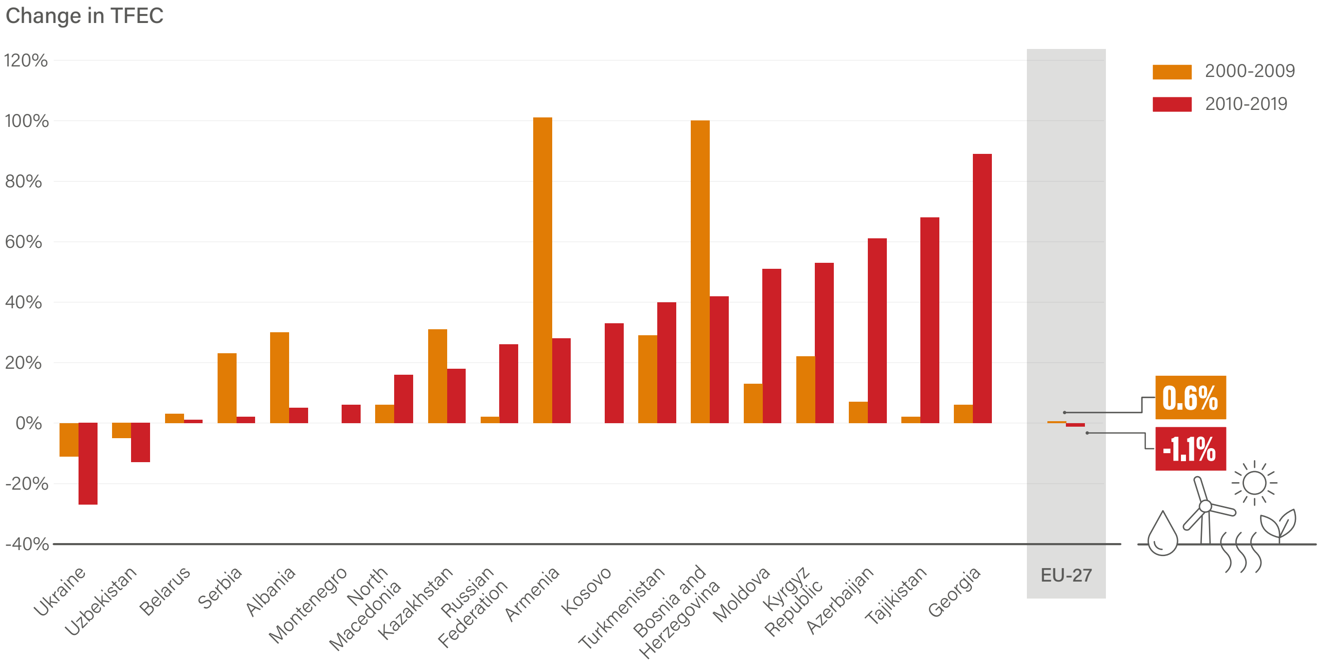
Note: PES = primary energy supply. GDP - PES is the difference between the compound annual growth rates of GDP and PES over the indicated time period. N/A = data not available.

Source: See endnote 5 for this chapter.

Final energy consumption reflects an economy's demand for energy. It is measured as the difference between the primary energy supply and the energy consumed in the process of energy transformation – that is, for the production of secondary energy carriers such as electricity, heat and petroleum refinery products. The secondary energy carriers are ultimately consumed in energy-using sectors, along with fuels that are directly combusted there, such as coal, natural gas and biomass. The main energy-consuming sectors are buildings (residential, commercial and public), industry, transport, agriculture and fishing.

Overall, final energy consumption in the focus region increased between 2010 and 2019 *(→ see Figure 17)*, although it declined in Ukraine and Uzbekistan and stayed around the same in Belarus.[8] Growth in energy consumption was highest in Georgia, followed by Tajikistan, Azerbaijan, the Kyrgyz Republic, Moldova, Bosnia and Herzegovina, Turkmenistan, Kosovo and Armenia.[9]

FIGURE 17.
Changes in Final Energy Consumption in the Focus Countries and in the EU-27, 2000-2019



Source: See endnote 9 for this chapter.

In 2019, residential, commercial and public buildings combined contributed the largest share to final energy consumption in all focus countries except Albania and North Macedonia, where transport contributed the largest share *(→ see Figure 18)*.[10] The transport sector typically ranked second in final energy consumption, except in Kazakhstan, the Kyrgyz Republic, the Russian Federation, Tajikistan, Ukraine and Uzbekistan, where the industry sector ranked second, and Albania and North Macedonia, where buildings ranked second.[11] The industry sector typically ranked third, although the transport sector was third in Kazakhstan, the Kyrgyz Republic, Moldova, Montenegro, North Macedonia, the Russian Federation, Serbia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.[12] Agriculture consumed the lowest share of energy.[13] Because of ongoing data gaps, three countries reported shares of energy consumption that were "non-specified" by sector: Armenia (13%), Turkmenistan (25%) and Tajikistan (16%).[14]

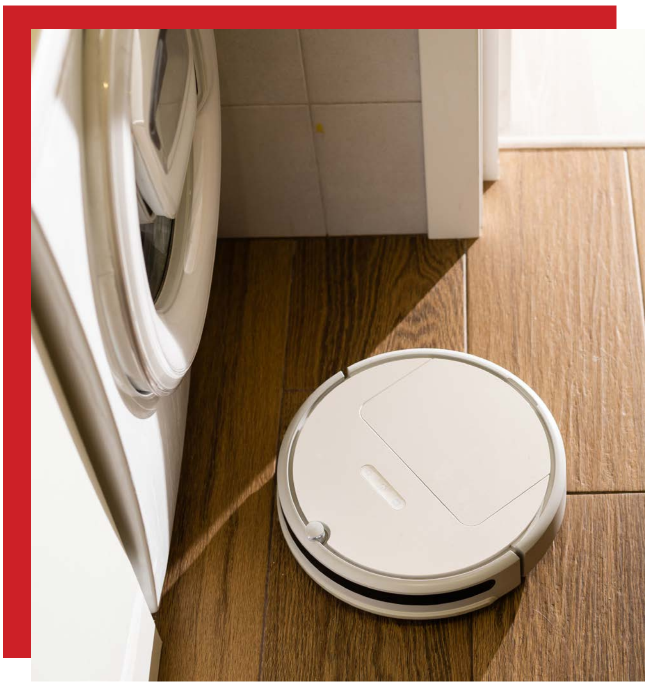
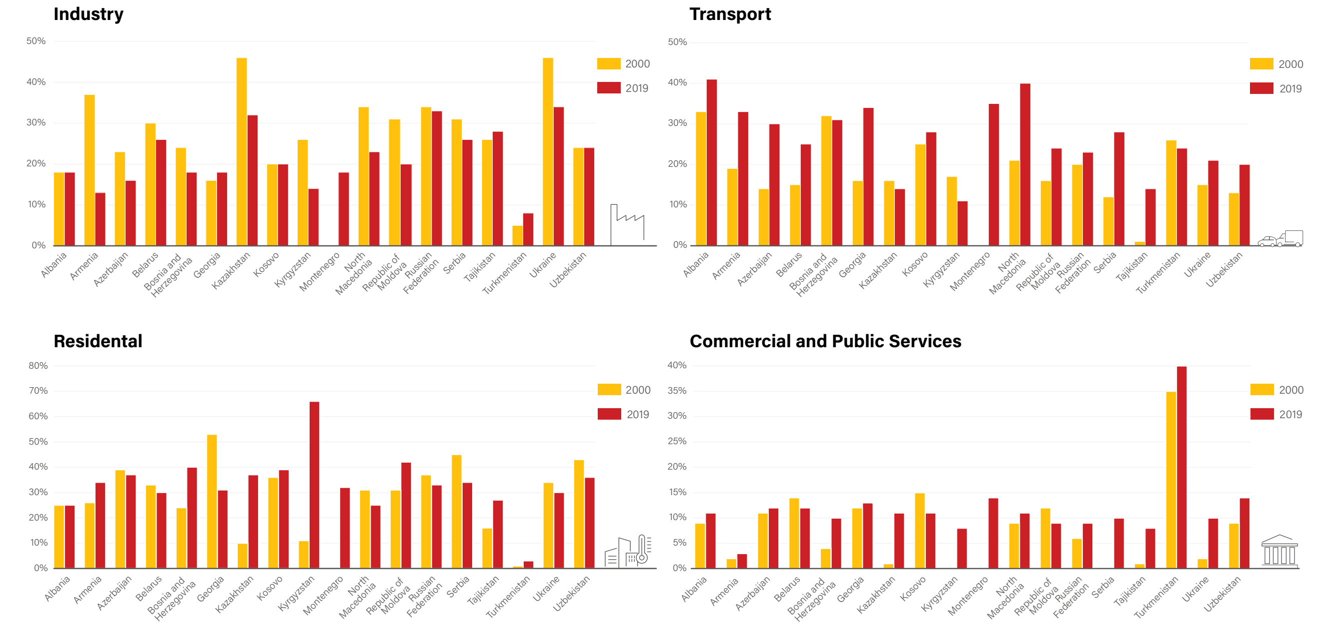


FIGURE 18.
Sectoral Shares in Final Energy Consumption in the Focus Countries, 2000 and 2019



Source: See endnote 10 for this chapter.

The shares of some sectors in final energy consumption changed between 2000 and 2019. For example, the share of transport grew across most countries, including Georgia (from 16% to 34%), Tajikistan (from 1% to 14%), and North Macedonia (from 21% to 40%), although it fell significantly in the Kyrgyz Republic and minimally in Turkmenistan.[15] The share of industry in final energy consumption also typically declined, with the largest change in Armenia (from 37% to 13%).[16] The share of the commercial and public sector typically increased, with the highest growth in Kazakhstan (from 1% to 11%) and Serbia (from 0.4% to 10%).[17] The share of the residential sector varied among countries, with the largest increases in the Kyrgyz Republic (from 11% to 66%) and Kazakhstan (from 10% to 37%), and the largest decrease in Georgia (from 53% to 31%).[18]

Key barriers to energy efficiency that were identified in the previous REN21/UNECE report have persisted. In an extensive UNECE survey conducted in 2017, respondents (grouped by sub-region) selected up to three barriers to investing in energy efficiency that they deemed most important.[19]

In Eastern Europe, the Caucasus, Central Asia, and the Russian Federation, the leading barriers were low awareness of the multiple benefits of energy efficiency and high interest rates for efficiency projects (both indicated by 39% of respondents).[20] This was followed by a lack of technical expertise and capacity to identify, evaluate, and implement projects (38%), and by the difficulties with obtaining financing, especially commercial loans.[21] Low energy prices were also a high barrier (both 36%).[22]

In South-East Europe, a lack of understanding of energy efficiency financing by banks and other financial institutions was viewed as the main barrier (61%), followed by administrative barriers and bureaucracy (57%).[23] Meanwhile, 43% of respondents expressed each of the next four barriers: lack of specific policies, programmes, legislation, by-laws, norms and standards; inadequate implementation and enforcement of policies and legislation; lack of technical expertise and capacity to identify, evaluate and implement projects; and problems with using savings on energy efficiency measures. [24]

A key challenge to energy efficiency in the region is frequently assumed to be the so-called rebound effect. Rebound occurs when efficiency gains result in higher energy demand, as people use the cost savings to subsequently increase their comfort levels or spending. However, research conducted in South-East Europe found that households did not receive thermal energy services adequate to their needs, and that partial and intermittent heating represented a big problem.[25] For example, households typically heated only one room, often the kitchen, for just a few hours a day. Therefore, by installing energy efficiency technologies, people did not consume more due to the rebound effect but rather to help meet their basic thermal comfort and health needs.[26]

Countries have adopted a range of policies to address the barriers to energy efficiency penetration. As contracting parties to the EU's Energy Community Treaty, Georgia, Moldova, Ukraine and the countries of South-East Europe committed to align their domestic policies with EU legislation.[27] This implies the transposition of selected EU directives, including on energy efficiency. Policies elsewhere in the region are more heterogeneous, with some shared elements among the member countries of the Eurasian Economic Union, including Armenia, Belarus, Kazakhstan, the Kyrgyz Republic and the Russian Federation. Among these are technical regulations for energy efficiency, such as minimum energy performance standards and efficiency labels for appliances and equipment *(→ see Chapter 2)*.[28]

Addressing the financial barrier is not straightforward. For example, project implementers often have cited difficulties in accessing finance. However, many donors point to a challenge in actually disbursing the available funds because of a lack of bankable projects and demand for funds.[29] Therefore, it is essential not only to ensure the supply of funding, but also to provide sufficient technical assistance to create the demand for financial products supporting energy efficiency projects, and to design a sound exit strategy ensuring sustainability after the termination of the project. Since 2017, donors have backed several projects addressing cross-cutting energy efficiency in various sectors, with many of the projects including a comprehensive technical assistance component.

In 2018, the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) under the International Climate Initiative platform approved a grant of USD 4.5 million to the Kazakh Ministry of Environment and Water Resources, the Kazakh Ministry of National Economy, and the UNDP to implement the project "Support of Green Economy in Kazakhstan and Central Asia for a Low-Carbon Economic Development over 2018-2021."[30] To increase the capacity of partners to implement the green economy concept, several concerted policies were developed in co-ordination, including a long-term low-carbon development strategy to 2050, the EcoCodex, integrated environmental permits for industry and a best available technology (BAT) standard for energy efficiency in industry.[31] In addition, the project analysed the impact of the planned EU Carbon Border Adjustment Mechanism on the Kazakh economy.[32] In 2022, the governments of Georgia and Denmark signed an agreement to support the programme "Creating a favorable environment for development of sustainable energy in Georgia." Under this programme, Denmark will assist Georgia in the development of energy efficiency and renewable energy by 2023 with a grant of EUR 2 million (USD 2.24 million).[33]

Also in 2018, Sweden's SIDA approved a USD 4.6 million grant to UNDP in Bosnia and Herzegovina to implement the project "Green economic development, II phase over 2018-2021."[34] The project aimed to improve and scale up energy efficiency through six implementation activities: 1) the development and capacity building of municipal authorities, environmental funds and energy professionals on energy efficiency, renewable energy and human development benefits; 2) systematic energy, costs and greenhouse gas emission management and monitoring in municipalities; 3) the development and adoption of sustainable financial mechanisms within environmental protection funds on energy efficiency and renewable energy sources; 4) infrastructure measures in municipalities and public buildings, such as energy-efficient public lighting systems, solar systems and other renewable energy measures; 5) public awareness on the role of clean energy and energy efficiency in human development; and 6) finding a renewable energy solution for rural households not connected to the power grid.[35]

Low awareness of the benefits of energy efficiency & **high interest rates** for efficiency projects were key barriers in Central Asia and Russia, among others.

In 2019, the German development bank KfW and the French Development Agency (AFD) committed to providing concessional policy-based loans of EUR 74 million (USD 83 million) and EUR 25 million (USD 28 million), respectively, to the government of Georgia for the project "Support and incentive setting for the reform process in the Georgian energy sector." The project focused on the reforms necessary to align the country's energy sector with EU requirements, proposing a roadmap for structured reforms over a four-year period (2018-2021). The suggested reform package tackled energy efficiency on the supply and demand side, market institutions in compliance (such as an independent regulator), internal market development and regional market integration.[36]

In 2018, the Ministry of Foreign Affairs of Denmark approved a grant of USD 4.75 million to public corporations of Georgia and Ukraine to finance the Neighborhood Energy Efficiency Fund (NEIF) implemented by the Investment Fund for Developing Countries (IFU).[37] The purpose of the fund was to promote private investments for projects related to energy efficiency and renewable energy (and its suppliers), as well as other projects that could provide substantial mitigation effects compared to common industry standards in the country. Eligible projects included energy efficiency improvement, production of materials or equipment dedicated to generating higher energy efficiency levels, renewable energy generation (including from waste), and production of products or equipment for renewable energy generation.[38] To obtain equity or loan financing from the NEIF, projects must be commercially viable and offer a return to investors.[39]

In 2011, the Eastern Europe Energy Efficiency and Environment Partnership (E5P) committed to providing technical assistance and investment grants of EUR 220 million (USD 247 million) during the period 2011-2022 *(→ see Chapter 1)*.[40] As of early 2022, the E5P had delivered 43 projects, which include financing to the municipal energy management company Dniprovska Municipalna Energoservisna Kompanya in 2019 to improve the energy efficiency of public buildings in the city of Dnipro in Ukraine.[41] Dnipro undertook thermal efficiency retrofits of 100 buildings – including kindergartens, schools and outpatient clinics – relying on private contractors and using contracts structured similarly to energy performance contracts[i].

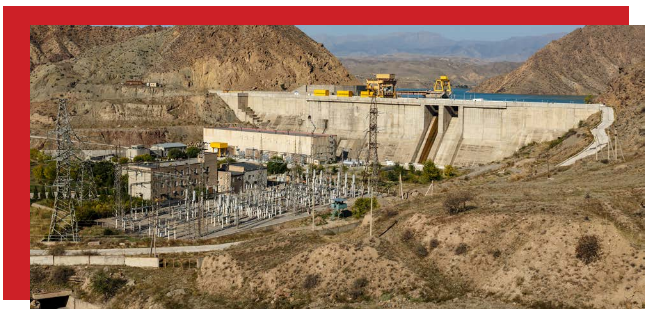
In 2018 and 2019, the German Federal Ministry of Finance approved grants of USD 248,000 and USD 535,000 respectively to the government of Kazakhstan to implement the project "Transnational dialogue eco-cities 2019-2020."[42] The dialogue was facilitated by the German Energy Agency (dena) and focused on climate protection, sustainable energy production, energy efficiency, and renewables, with the aim of better connecting Germany, Eastern Europe and Central Asia.

In 2018, the Austrian Development Agency approved a USD 67,000 grant for the United Nations Industrial Development Organization (UNIDO) to undertake a comprehensive consultative preparatory process for a potential ECO Centre for Renewable Energy and Energy Efficiency (ECEC) in Central Asia.[43] The process involved assessing the added value, feasibility, and possible technical and institutional design of the ECEC. It included stakeholder consultations, consultative workshops, a needs assessment, a feasibility study and the development of a project document that defines the institutional and technical design of the ECEC during its first operational phase.

ELECTRICITY SUPPLY

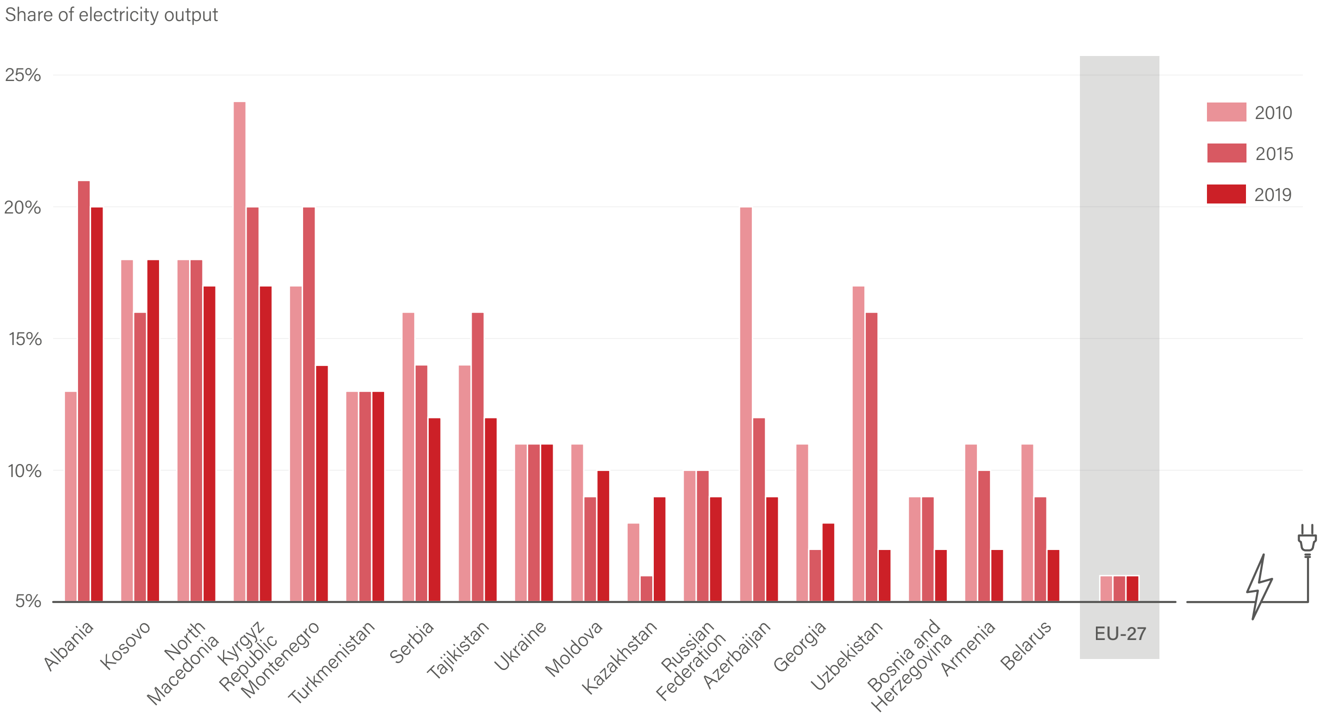
Although many of the focus countries have improved the energy efficiency of their electricity supply since 2010, some continue to face challenges *(→ see Figure 19)*.[44] For example, Albania's electricity transmission and distribution losses grew from 13% in 2010 to 20% in 2019, and losses in Kosovo, the Kyrgyz Republic and North Macedonia reached 17% in 2019.[45] Azerbaijan and Uzbekistan achieved the largest progress in reducing their transmission and distribution losses during this period, cutting them from 20% to 8% and from 17% to 7% respectively.[46] However, losses in all focus countries still exceeded the 6% average losses in the EU-27 and in OECD countries.[47]

The focus countries undertook significant efforts to modernise or add transmission networks. Several interconnection projects were launched prior to 2016, and projects continued during 2017-2021. The CASA-1000 Power Line Project, launched in 2016, aimed to transmit high-voltage electricity between the Kyrgyz Republic and Tajikistan, and from Tajikistan to Afghanistan and Pakistan.[48] Donor financing of USD 1.2 billion came from the World Bank through the International Development Association (IDA), as well as from the Islamic Development Bank, the EIB, USAID, the US State Department, the UK Department for International Development, the Australian Agency for International Development (AusAID) and others.[49] The implementing agencies were the State Enterprise Project Management Unit for the Energy Sector (ESPMU), OJSHC Barqi Tojik and the National Social Investment Fund of Tajikistan. The project's 2019 phase included village electricity supply improvements and construction of the Isfara-1 sub-station.[50] The project obtained energy-related project management, monitoring and evaluation, communications, investments in socio-economic infrastructure and other expenditures.[51]



i A contract where a contractor commits to implement energy efficiency measures and provides a performance guarantee for them; the contractor fee is paid from saved energy costs delivered over the agreed time.

FIGURE 19.
Transmission and Distribution Losses as a Share of Electricity Output in the Focus Countries and in the EU-27 and OECD, 2010, 2015 and 2019



Source: See endnote 44 for this chapter.

In 2019, the World Bank through the International Bank for Reconstruction and Development (IBRD) signed non-concessional debt of USD 70.7 million to the government of Georgia to implement the project "Energy supply reliability and financial recovery over 2019-2024."[52] The project involved strengthening the power transmission network and building both the Jvari-Tskaltubo 500 kilovolt (kV) power transmission line and the 500/220 kV Tskaltubo sub-station in western Georgia.[53] It also supported the financial recovery of Georgian State Electrosystem (GSE) and its preparatory work to access the capital market.[54] Finally, it helped GSE access domestic and international markets for long-term commercial financing.[55]

In 2018, the Asian Development Bank provided concessional debt of USD 35 million to the government of Tajikistan for the project "Regional power interconnection."[56] In April 2018, Tajikistan started exporting power to Uzbekistan on an islanded mode. However, in order to synchronise the systems and achieve the power trade target, the relay protection system in Tajikistan had to be modernised and new interconnection points established.[57] The project installed modern relays, circuit breakers, instrumental transformers and ancillary equipment and systems at eight 220 kV and two 500 kV interconnection points; established two new 500 kV interconnections; and provided capacity building to Barki Tojik staff.[58]

The EBRD and Germany's KfW provided investment grants of EUR 210 million (USD 236 million) for the project "Power grid enhancement," implemented in Georgia during 2019-2023.[59] The project aimed to support GSE in reinforcing and enhancing the electricity transmission grid and improving the integration of renewable energy sources, especially hydropower and wind power.[60] It included building the 500 kV overhead line Tskaltubo-Akhaltisikhe-Tortum, building the North Ring and reinforcing the transmission infrastructure in the regions of Guria and Kakheti.[61]

In 2018, USAID provided a USD 1.6 million grant for the "USAID Power the Future" activity in Central Asia.[62] A project study for the government of Uzbekistan evaluated the impacts of renewable energy generation and integration on the national grid and on the overall regional power system.[63] In 2019, the study assessed potential energy efficiency measures for Almaty's CHP plants and identified 26 measures to reduce fuel and energy costs.[64] To ensure the bankability of the measures, pre-feasibility studies and business plans were developed to implement the energy efficiency investment projects.[65]

In 2020, the project replicated this work at several CHP plants in the Pavlodar region of Kazakhstan and identified applicable energy efficiency measures and cost-efficient ways to implement them.[66] Similar efforts were pursued in Sogrinskaya and Stepnogorskaya in 2021.[67] In 2021, USAID launched the five-year "Securing Georgia's energy future" programme with a budget of USD 15.7 million.[68] Its goal was to improve Georgia's energy security through the implementation of reforms and sustainable development of the energy sector, by increasing investment in domestic renewable energy and infrastructure, supporting improved energy planning, reducing the vulnerability to cyberattacks, and building capacity of Georgian institutions responsible for energy market governance.[69]

Several activities were aimed at building new transmission and distribution lines, with the EBRD committing to providing non-concessional debt financing for these projects. In 2017, it provided

Electric Networks of Armenia (ENA) with a senior corporate loan of USD 80 million in 2017 to finance a five-year (2016-2020), USD 200 million investment programme to modernise Armenia's distribution network, including through smart metering.[70] In 2020, the EBRD provided a senior loan facility of USD 25 million to ENA in parallel with a USD 20 million senior loan from the ADB.[71] The loans supported ENA in addressing its working capital needs during the liquidity squeeze caused by the COVID-19 pandemic.[72] In 2021, the EBRD provided a further USD 60 million for the USD 148.4 million facility for Phase 2 of the project, targeting Yerevan and Gyumri in 2021-2022.[73] All three phases were co-financed by the ADB.[74]

The EBRD also provided senior corporate loans of USD 9.4 million in 2016, USD 8.5 million in 2017 and USD 8.6 million in 2018 to the electricity distribution company ZP Elektrokrajina a.d. Banja Luka in Bosnia and Herzegovina for the reconstruction of sub-stations and medium- and low-voltage networks, and to introduce smart metering in the company's coverage territory.[75] In 2017, the EBRD signed a sovereign loan of up to EUR 4 million (USD 4.5 million) to finance the Vostokelectro investment programme in the Kyrgyz Republic, aimed at rehabilitating and modernising low- and medium-voltage networks, including by installing 32,000 smart meters in the regions of Tup and Jeti-Oghuz.[76]

In 2019, the EBRD committed to providing a sovereign guaranteed loan of EUR 20 million (USD 22.5 million) for the modernisation of power distribution networks in southern Tajikistan.[77] It targeted modernising a low-voltage distribution network in the cities of Kulob and Bokhtar, building a new sub-station (and upgrading the existing 110/35/10 kV substation) in Kulob, and installing automatic billing and metering systems in both cities.[78] In 2020, the EBRD signed a loan of up to USD 25 million to OJSC "Shabakahoi taksimoti bark" of Tajikistan to finance advanced metering infrastructure and the enhancement of low- and medium-voltage grids in the cities of Buston, Dangara, Dushanbe, Isfara, Istaravshan, Konibodom and Panjakent.[79]

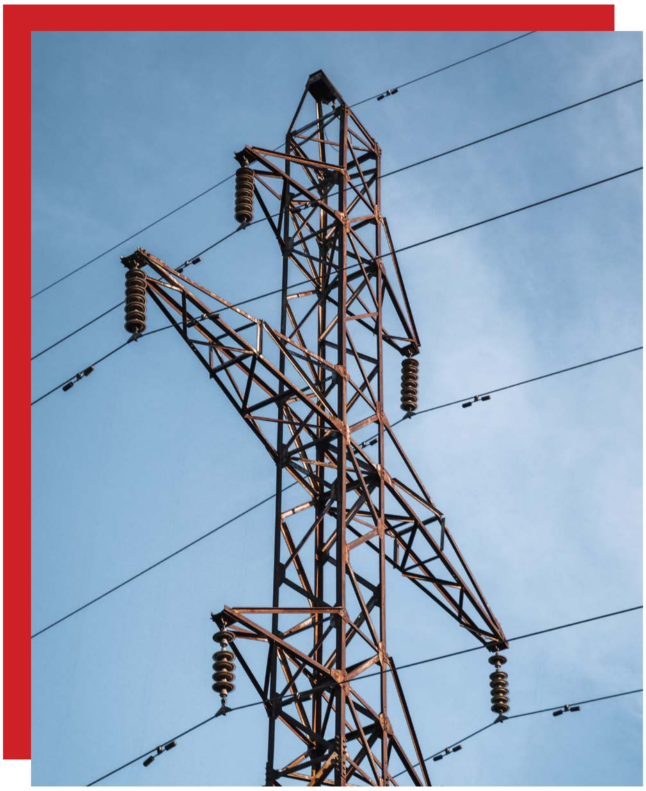
In 2019, USAID signed grants of USD 5 million to finance the Central Asia Partnership within the Energy Regulatory Partnership Program (ERRP) during 2020-2023, which was established by the National Association of Regulatory Utility Commissioners (NARUC).[80] NARUC assisted Uzbekistan's efforts to create a more favourable investment environment through increased transparency in the energy sector by reviewing and providing technical comments on a draft regulation.[81] NARUC also trained Central Asian regional partners on best practices in regulatory organisational structure, and helped to bolster transparency and public participation in energy regulation by reviewing and improving the communications methods and strategy of the Kyrgyz Republic's regulator.[82] Finally, NARUC supported Kazakhstan's Committee for Regulation of Natural Monopolies (CRNM) with recommendations for reforming its tariff-setting methodology.[83]

In 2019, the State Secretariat for Economic Affairs of Switzerland signed a USD 9.4 million grant to the government of Tajikistan for the "Pamir private power project – phase III" (PPPP III), as a continuation of the first two phases.[84] The third and final phase of the project built on the positive results of the previous two phases and continued the well-established co-operation with Pamir Energy Company.[85] The company has made considerable achievements since its founding in 2002, providing access to clean and affordable electricity for 96% of households in the poorest region of Tajikistan.[86]

The World Bank through the IDA signed grants in 2019 of USD 31.7 million and USD 500,000 for a rural electrification project in Tajikistan.[87] The project provided electricity access to settlements in Gorno-Badakhshan Autonomous Oblast, including building micro-grids and connecting consumers both to the micro-grids and to Pamir Energy's centralised distribution network.[88] It also connected settlements in Khatlon region to the centralised distribution network of Barqi Tojik.[89]

Starting in 2018, France's AFD worked alongside Germany's KfW to support electricity market reforms and promote energy efficiency via a four-year programme of public policy loans that was later extended to six years.[90] In 2019, AFD approved concessional debt of USD 67.2 million to the government of Georgia for these actions.[91] It also provided support to the Georgian government via an FEXTE grant of EUR 0.25 million (USD 0.28 million) to implement technical assistance from French entities including EDF.[92] These efforts aim to help public electricity stakeholders model the country's energy mix over the medium to long term.

Several of the focus countries undertook significant efforts to **modernise or add transmission networks**, with the support of donors.



DISTRICT HEATING AND COOLING

District heating has been important in several of the focus countries, including Belarus, Kazakhstan, the Kyrgyz Republic, Moldova, the Russian Federation, Serbia, Ukraine, Uzbekistan, Tajikistan and Turkmenistan. The Russian Federation is the world's largest user of district heating systems.[93] Across the region, reforming and upgrading existing district systems has become a priority during the last two decades, although many barriers remain.

Often, cities or municipalities own the district heat companies, while the private sector has played a negligible role. The legal framework has allowed mainly for public participation in the district heat sector, but the absence of successful public-private partnerships has discouraged private sector involvement.

Many countries also traditionally have lacked metering devices and have not billed for heating services based on the level of consumption, creating a disincentive for households to engage in energy-saving behaviour. In several member countries of the EU Energy Community Treaty, such as Serbia, public and other companies in charge of heat distribution have since been obliged to apply a new tariff system using consumption-based billing. However, the legal requirements to install heat meters in apartments and to bill according to actual heat consumption apply only to new construction. For all other buildings, the EU Energy Efficiency Directive states that heat consumption should be measured by heat meters at distribution stations and only be billed to apartments connected to the meter. Heat consumption for existing buildings is also often measured by living area. As a consequence, in Bosnia and Herzegovina only around 20% of the housing that is connected to district heat pays based on actual consumption, while more than 80% pays either a flat rate or per square metre of heated area.[94]

Under a fixed-tariff system, poorer residents living in non-insulated houses are able to consume a lot of energy at a low price. With a transition to consumption-based billing, households may be driven to disconnect from more costly district heat systems and to switch to electric heaters or less efficient heating appliances. Meanwhile, in countries such as Albania, Montenegro, and Serbia, heavy subsidisation of electricity has created an incentive for consumers to make this switch from district heat to small electric heaters. Such moves put additional stress on the weak electricity grid and also make the district heat system less efficient, as it typically supplies whole buildings and not individual apartments. This points to a need to co-ordinate the restructuring of the district heat sector with energy-efficient retrofits (i.e., insulation) of residences *(→ see Sidebar 12)*.[95]

SIDEBAR 12.

Co-ordinating District Heat Systems with Energy Efficiency Retrofits

If older, inefficient buildings are to be retrofitted to meet energy efficiency goals, this must be planned in a way that compensates for the losses in revenue of district heat enterprises. At the same time, the district heat enterprises face a challenge in meeting the growing demand for district heat due to the rising number of businesses and households.

In Serbia, two pioneering municipalities, Šabac and Niš, introduced consumption-based billing for all customers and began testing the use of public energy services companies (ESCOs) to retrofit the concrete panel buildings common to the region. As a consequence of higher bills for energy consumption, customers started disconnecting from the district heat system, and the efficiency of the district heat supply to individual buildings declined due to fewer consumers per building. The ESCOs sought to address the affordability issue by providing a local subsidy to households that consume at least 20% more heat than their neighbours. Their analysis revealed that it was cheaper to save heat with efficiency retrofits and to extend existing district heat networks to new customers rather than to build new plants and networks.

Source: See endnote 95 for this chapter.

Investments in renewable energy sources to provide district heat have been tentative in the region. Cities generally have spearheaded these efforts in partnership with international institutions, with the use of renewables being dependent upon the provision of favourable loans or grants. For example, a biomass-fuelled district heating plant was scheduled to begin operations in Negotin, Serbia in the early 2000s, but a feasibility study concluded that the investment was not justifiable.[96] Meanwhile, the integration of renewables is crucial for energy security reasons. The district heat sector in this town uses 24% of total natural gas consumption and peaks in the winter season, where it reaches the limits of supply infrastructure and has forced industrial consumers to temporarily disconnect from the grid.[97]

In 2018, the EBRD began awarding grant funding for the preparation of feasibility studies for renewable energy systems at either new or existing district heating plants under a programme Renewable District Energy in the Western Balkans (ReDEWeB).[98] These could include district heat systems producing heat or chilled water from solar thermal, biomass, biogas, geothermal, waste heat, heat pumps or the sea, lakes or rivers. By July 2022, the ReDEWeB project had provided funding for (pre)-feasibility studies in eight cities, and in some of them the municipalities secured financing and started development *(→ see Table 15)*.[99] Two of the projects – in the Serbian towns of Bor and Zrenjanin – were stopped or delayed due to lack of available land.[100]

TABLE 15.
Status Quo of Solar District Heating Plants Planned or Developed in South-East Europe, as of June 2022

City, country	Status	Political decision making	Plant design parameters	Area availability for the collector field
Pančevo, Serbia	Feasibility study completed	The municipality and district heating company accepted the feasibility study results. The EBRD was discussing financing options including private investment in the project.	35,000 m^2 of collector field (24.5 MW); seasonal storage of 150,000 m^3	Land surrounded by railroad tracks from all sides
Priština, Kosovo	Feasibility study under development	The national and city governments decided to proceed with the project, with financing from KfW bank, the EBRD, and the German government.	69,000 m^2 of collector field (48.3 MW); seasonal storage of 410,000 m^3	Obiliq municipality
Niš, Serbia	Feasibility study under development	Project will be financed under the Renewable District Energy Programme formed by the Serbian Ministry of Energy and the EBRD with support from Swiss SECO.	12,000 m^2 of collectors	Land near the city water supply protected area
Novi Sad, Serbia	Pre-feasibility study completed	The municipality and the district heating company accepted the pre-feasibility study results and are discussing with the EBRD how to proceed with project development.	Collector field between 45.5 MW and 163.5 MW; seasonal storage between 324,000 m^3 and 972,000 m^3	City water supply protected area
Korca, Albania	Pre-feasibility study completed	Albanian ministry of Infrastructure and Energy, the city of Korca and the EBRD agreed to apply to the Western Balkan Investment Fund (WBIF) for the continued project development.	95,000 m^2 of collectors (66.5 MW); seasonal storage 475,000 m^3	Information not available

Source: See endnote 99 for this chapter.

Member countries of the Energy Community Treaty are required to transpose the EU's Renewable Energy Directive, as of 2014.[101] To do so, countries have adopted National Renewable Energy Action Plans, many of which include plans to use biomass-based district heating plants.[102]

Many donor-funded projects to reform district heating have been under way or are planned. In 2018, Germany's KfW approved a loan of EUR 32.6 million (USD 36.6 million) for the "Rehabilitation of district heat systems V programme" in eight municipalities.[103] In 2018, the German Federal Ministry for Economic Cooperation and Development (BMZ) approved the project "Promotion of renewable energies: developing the biomass market in the Republic of Serbia," for which KfW awarded a EUR 20 million (USD 22.5 million) loan, co-financed by a KfW grant of EUR 2 million (USD 2.2 million) and by a SECO grant of EUR 5 million (USD 5.6 million).[104] The EBRD, Sweden's SIDA and KfW further awarded loans and technical assistance of EUR 22 million (USD 24.7 million) for the "Technical assistance project on Belgrade district heating rehabilitation" project.[105] In the pipeline as of early 2022 was EBRD approval of the EUR 2.5 million (USD 2.8 million) "Šabac buildings energy efficiency" project on measures related to consumption-based billing.[106]

In 2017, the World Bank through the IBRD signed a USD 99.3 million loan for the "Sustainable energy scale-up" project in Belarus.[107] The project aimed to improve the energy efficiency of space heating in multi-apartment buildings and of renewable wood biomass use for heating in selected localities. It supported building and rehabilitating boiler plants, installing new wood-biomass heat networks, installing individual heat sub-stations and operational monitoring and control systems, and developing local sites for wood fuel preparation. The project also supported a programme for thermal renovation of multi-apartment buildings by piloting a partially payable grant scheme in two oblasts.[108] For the pilot, the IBRD and EIB loan proceeds were used to pre-finance the full cost of the renovations. Homeowners of participating buildings were obliged to repay a pre-determined portion of the full cost of thermal renovation through instalments for up to 15 years.[109]

In 2017, the World Bank through the IDA signed concessional debt of USD 23 million for the "Heat supply improvement" project in the Kyrgyz Republic, implemented during 2018-2023.[110] The project improved the supply efficiency and quality of the district heating system in Bishkek, piloted efficient and clean heating stoves, and demonstrated the benefits of energy efficiency improvements in public buildings.[111]

In 2020, the World Bank signed a USD 100 million loan through the IBRD-financed "Second district heating efficiency improvement" project in Moldova, implemented during 2020-2025.[112] The project financed the modernisation of the CHP plant Source-1 and the installation of new gas-based co-generation units in Chisinau (including electrical connections), and also increased and optimised the efficiency of heat and electricity co-generated by Termoelectrica. In addition, the project financed energy efficiency investments by Termoelectrica in selected public and residential buildings, including pilot investments in switching to a horizontal internal layout, as well as the installation of 140 individual heat sub-stations and associated piping in residential and public buildings.[113]

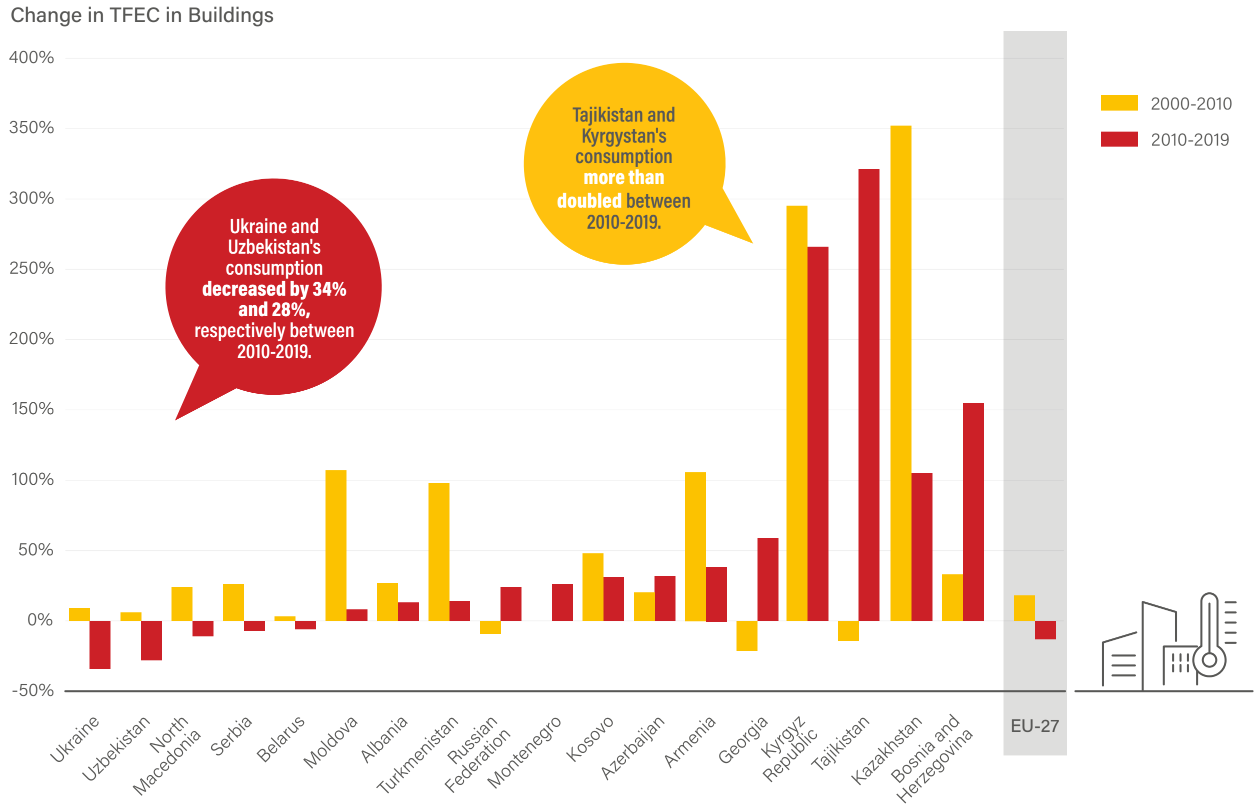
Starting in 2019, the Nordic Environment Finance Corporation (NEFCO) implemented the "Sweden-Ukraine district heating" programme based on experiences gained in the DemoUkrainaDH programme for demonstrating best practices in the design, procurement and implementation of modern and energy-efficient district heating.[114] The programme demonstrated the development of such systems using high shares of renewable and waste heat sources, ultimately meeting the EU requirements for efficient district heating.[115] The projects were typically designed to provide a starting point for developing long-term sustainable and customer-oriented district heating in Ukraine. The programme provided loans and grants (EUR 6.0 million or USD 6.7 million) as well as technical assistance (EUR 4.0 million or USD 4.5 million) to selected project partners in Ukraine.[116] A grant could not exceed 30% of the total investment cost of each project, and the beneficiaries were expected to provide at least 10% of the project cost from their own funds.[117]

In 2018, the World Bank through the IBRD and IDA signed a USD 140 million loan to implement the "District heating energy efficiency" project in Uzbekistan in the cities of Andijan, Bukhara, Chirchik, and Samarkand, and in Sergeli district during 2018-2024.[118] The project finances energy efficiency investments in the modernisation of heat production and of transport and distribution systems, including installing building-level heat sub-stations and heat meters for billing purposes, as well as renovating obsolete boilers and pipes.[119] The project also entails a shift to metering and consumption-based billing, as well as the upgrading of gas, electricity and water supply systems as needed for district heating purposes. In addition, the project finances the procurement of specialised maintenance equipment for participating district heat companies.[120]

BUILDINGS

In absolute numbers, the final energy consumption of buildings in most of the focus countries has grown over the past 20 years, except in Belarus, Ukraine and Uzbekistan *(→ see Figure 20)*.[121] On average, building energy consumption increased 63% between 2000 and 2010 and 52% between 2010 and 2019.[122] In the former period, the fastest growth occurred in the Kyrgyz Republic (up by a factor of 4), Kazakhstan (factor of 3), Moldova (factor of 2), Armenia (factor of 2) and Turkmenistan (factor of 2).[123] More recently (2010-2019), high growth occurred in Tajikistan (up by more than a factor of 4), the Kyrgyz Republic (factor of 3), Bosnia and Herzegovina (factor of 2), and Kazakhstan (factor of 2).[124] By comparison, the final energy consumption of the EU's buildings sector grew 18% between 2000 and 2010 but then declined 13% between 2010 and 2019.[125]

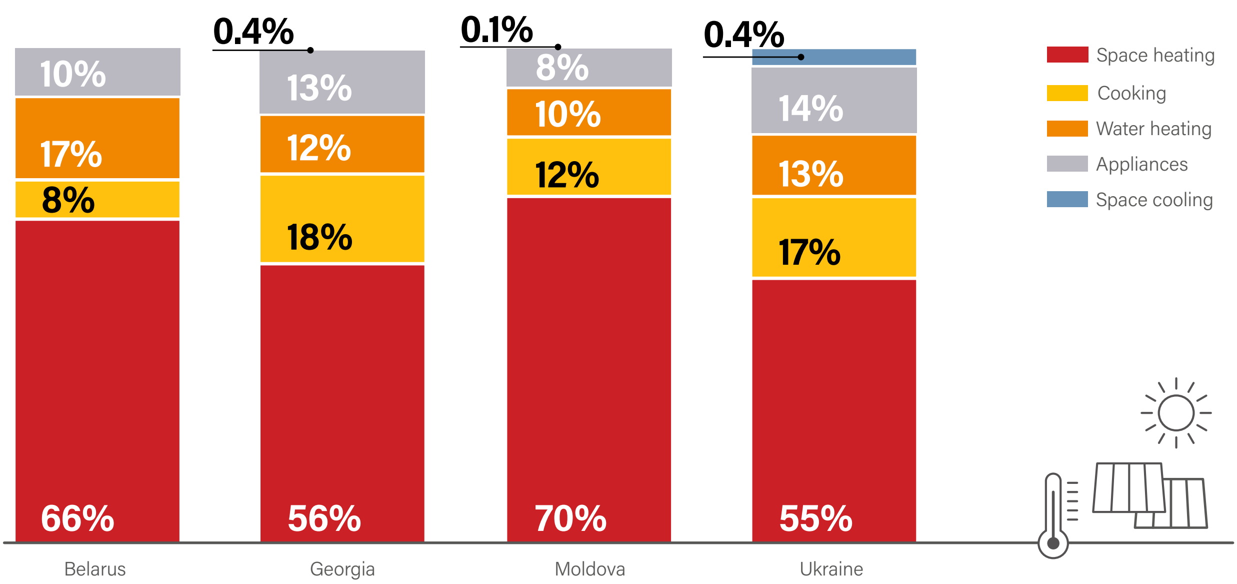
FIGURE 20.
Change in Final Energy Consumption of Buildings in the Focus Countries and the EU-27, by Decade, 2000-2019



Source: See endnote 121 for this chapter.

Among energy end-uses, space heating contributed the largest share to the sector's final energy consumption.[126] In Belarus, Georgia, Moldova and Ukraine (the countries for which data were available), space heating was responsible for 55-70% of residential final energy consumption in 2018 (→ see Figure 21).[127]

FIGURE 21.
Residential Final Energy Consumption by End-Use in Selected Focus Countries, 2018



Source: See endnote 127 for this chapter.

However, the available data did not indicate a change in the intensity of space heating energy over time, in contrast to EU countries, where household heating consumption per square metre fell 1.7% annually between 2000 and 2018.[128] This decline in the EU is attributed to the tightening of building codes following the adoption of the European Performance for Buildings Directive (which mainly impacted the performance of new buildings) and to generous financial incentives to promote thermal retrofitting of existing buildings. Given that data on this indicator are available only for Belarus, Moldova, and Ukraine, it is difficult to make conclusions regarding either positive or negative trends.

The good news is that this energy intensity trend appears to be different for the commercial and public buildings sector, as compared to the residential sector. For example, the energy intensity per employee declined in both Belarus and Germany between 2000 and 2018, falling nearly 20% in both countries during this period.[129]

The final energy consumption of buildings for space heating is determined by factors such as the floor area, climate, thermal performance of building envelopes, and efficiency of building systems and appliances delivering thermal comfort. Buildings across the region (with the exception of Albania) share many common features. Much of the stock was built between 1960 and 1990 using industrialised technology (panel buildings), most are individual single-family houses, and the share of urban dwellings continues to grow. Buildings in city centres are often of high architectural value and are protected as heritage buildings, thereby excluding them from mandatory energy efficiency improvement requirements, which has greatly reduced the options for energy retrofits.

A key barrier to improving the energy efficiency of buildings is inadequate pricing of energy, which impedes efforts to make efficiency attractive. Furthermore, the non-commercial nature of a large share of fuelwood *(→ see Chapter 3)* has made investments in building retrofits and shifts in building systems unattractive, because saved energy costs are paid back slowly. A frequent argument against raising energy prices is the high share of vulnerable households facing fuel poverty, who would face higher heating costs in the absence of compensation or retrofit of the building stock.

Households in multi-residential buildings often face organisational and legal barriers to planning and conducting thermal efficiency retrofits. They must make collective decisions about renovations, and housing associations commonly encounter legal barriers regarding how to borrow finance jointly. Housing associations and their members also may have difficulty proving their creditworthiness to obtain loans.

Due to a lack of information, decision makers in the public sector often struggle to make decisions about which public buildings to retrofit. In many of the focus countries, energy management systems that provide data on the energy performance of buildings do not exist. Thus, thermal efficiency investments in public buildings are rarely assessed based on the most cost-effective criteria.

Overall, the potential for improving the thermal efficiency of buildings and for installing building-integrated renewable energy systems is very large. In the Russian Federation, the greenhouse gas emissions of the buildings sector could be reduced by as much as 62% in 2050, as compared to the efficiency baseline.[130] In Serbia, Montenegro, and Albania, emission reductions could reach 23-73% by 2030 as compared to baseline emissions, while simultaneously offering higher thermal comfort.[131] The highest potentials could be achieved through installing biomass heating systems and heat pumps, building advanced new buildings with highly efficient envelopes, and thermal efficiency retrofits of existing buildings.

Many donors have financed actions to help realise the potential for costly emission reductions in buildings. Multilateral development banks that have provided financing for buildings sector transformation include the EBRD, the ADB and the World Bank. Bilateral donors include Germany's KfW, BMZ and BMU; the State Secretariat for Economic Affairs of Switzerland; the Ministry of Foreign Affairs of Lithuania; France's AFD; USAID; and the Austrian Federal Ministry of Sustainability and Tourism. The Global Environment Facility has actively provided technical assistance, and the Green Climate Fund also has provided financing in the buildings sector, although prior to the 2016-2021 period.

In 2019, Germany's BMZ approved two grants of USD 21.8 million for the government of Bosnia and Herzegovina to implement the project "Energy efficiency in public buildings."[132] The project aimed to improve the energy efficiency of public buildings, with a focus on the educational sector and poverty reduction.[133] In 2018, BMZ approved financing to the government of Bosnia and Herzegovina for the "Credit programme for energy efficient housing – investment incentives," disbursed as investment grants of USD 3.5 million and technical assistance of USD 0.6 million.[134] The action was co-financed with concessional debt from KfW of USD 17.7 million.[135] In 2019, BMZ committed a USD 2.05 million grant to the government of Georgia for the project "Energy efficiency measures and approach to EU energy efficiency standard," which aimed to increase efficiency in select public buildings by decreasing their annual energy use by 20%.[136]

In 2019, the German Federal Ministry of Finance approved a grant of USD 0.4 million to the government of Kazakhstan for energy efficiency councils in 2018-2019.[137] The project built on the Kazakh government's ambition to greatly increase communication on energy efficiency to key target groups and to develop implementation mechanisms and instruments.[138]

Also in 2019, the European Commission approved a USD 7.6 million grant to public entities of Armenia to conduct the EU4ENERGY project "Efficiency and Environment Programme."[139] The programme supported initiatives aimed at energy efficiency and environmental protection, with a focus on existing multi-apartment residential buildings.[140]

In 2018, the World Bank approved a loan of USD 32 million for the government of Bosnia and Herzegovina for the project "Energy efficiency in public buildings."[141] This funding was additional to the previous package of USD 32 million approved by the World Bank in 2014 and to the GCF grant of USD 17 million approved in 2017 via UNDP.[142]

Multilateral development banks and bilateral donors also have supported several actions targeting the growing energy demand of urban buildings. The capital cities of all of the focus countries have experienced high growth in their populations and associated demand for dwellings and energy services. In contrast, rural areas have seen population outflows, as have some other cities that became less attractive following the economic reconstruction efforts of previous decades. Such population declines highlight issues such as unbalanced economic growth, limited employment opportunities and poor liveability in many areas and regions.

In 2017, the State Secretariat for Economic Affairs of Switzerland signed a 100,000 grant to Bosnia and Herzegovina for an "Urban transformation project" to build stakeholder capacity to improve urban planning in the capital city Sarajevo in an inclusive and sustainable way.[143] Also in Bosnia and Herzegovina, a USD 2.5 million GEF-funded project promoted low-carbon urban development by piloting innovative financing and regulatory approaches.[144]

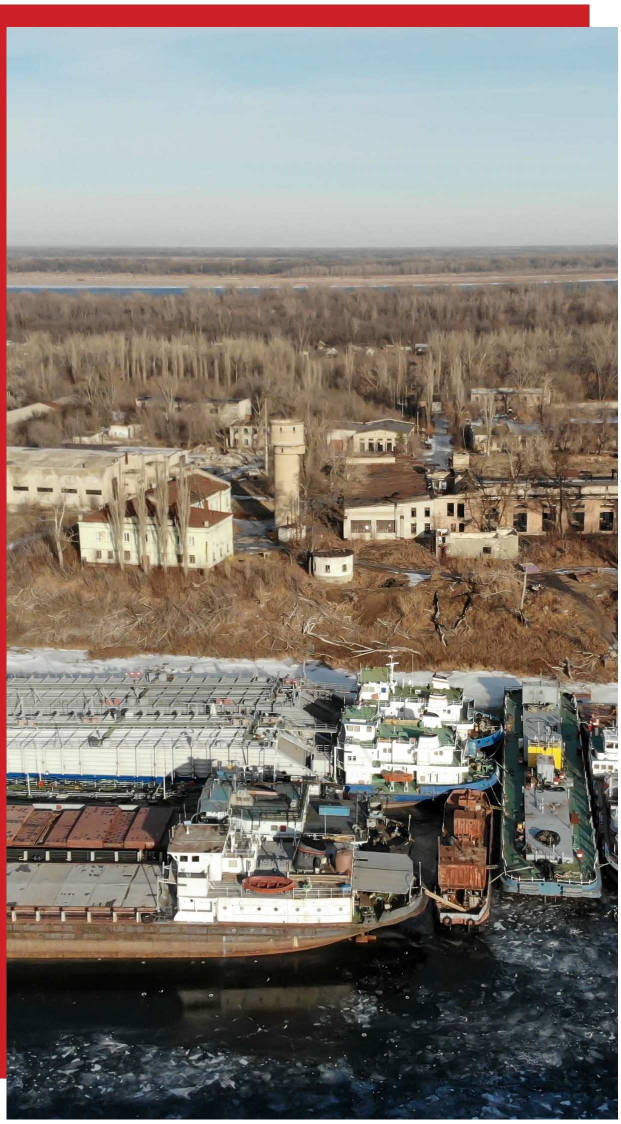
The ADB approved non-concessional debt of USD 1.1 million for the government of Georgia to implement the "Liveable Cities" investment programme, focused on the capital city Tbilisi.[145] The German Federal Ministry of Finance approved a USD 15,000 grant to the government of Kazakhstan for the project "Advice on the construction of an energy-efficient district," which aimed to create and test an energy concept for a new district in the capital city Astana and to design a modern, energy-efficient building standard based on the results of this pilot.[146] The German Federal Ministry of Education and Research provided a grant of USD 45,000 for scientific co-operation of Central Asian countries with other countries.[147] It focused on sustainable cities and urban development in Uzbekistan and Kazakhstan, with the project financing committed in 2019.[148]

LIGHTING, APPLIANCES AND EQUIPMENT

Lighting, appliances and equipment – including devices for cooking, water heating and space cooling – contribute a large share of the final energy consumption in the buildings sector. In Belarus, Georgia, Moldova and Ukraine (the countries for which this indicator was available), the share of these end-uses in residential energy consumption ranged between 30% and 45% in 2018.[149] In general, analysis in both the focus countries and other European countries shows that the share of energy used for space heating and cooking has declined over time, whereas energy use for appliances (including water heating) has grown.[150]

The growing energy consumption of electrical appliances and equipment is a challenge in the focal region as well as worldwide. Despite constant improvements in the energy efficiency of individual devices, their growing numbers offset the gains in energy saving.[151]

Many appliances are not electric but instead consume natural gas, liquefied petroleum gas (LPG) or biomass. Sometimes, cooking and water heating services are delivered by the same stoves as space heating, using solid fuels such as traditional biomass and coal *(→ see Chapter 4)*. More efforts are needed to address the low efficiency of these appliances.

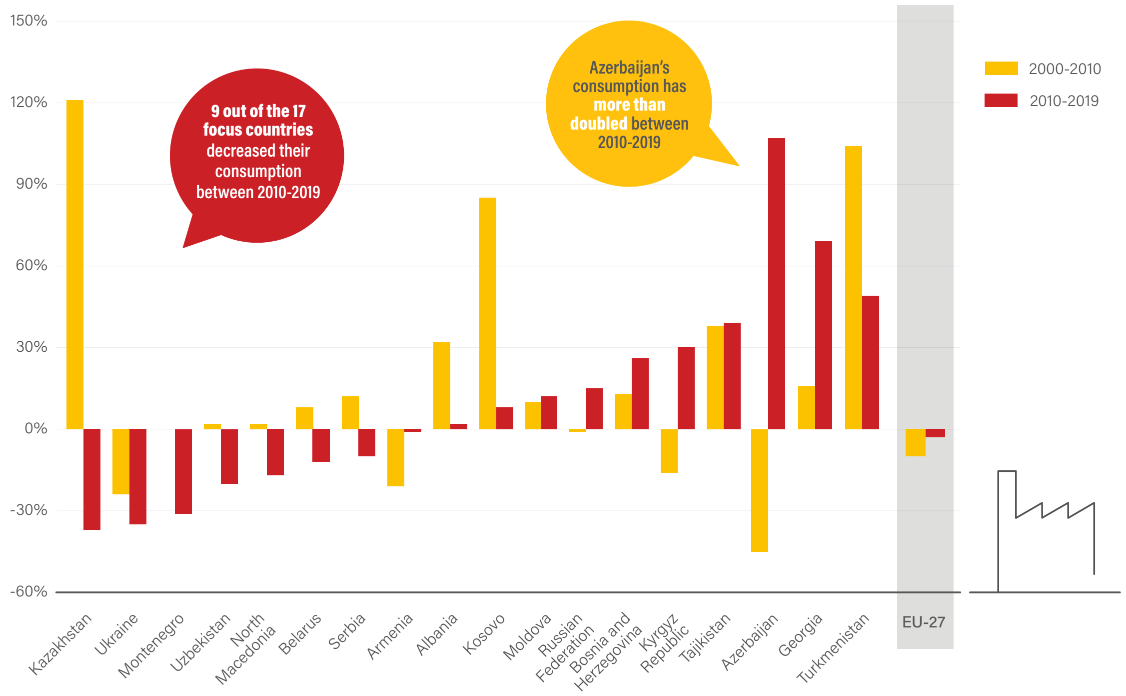


INDUSTRY

During the last 20 years, the final energy consumption of the industry sector has increased in all of the focus countries except for Armenia, Belarus, North Macedonia, Ukraine and Uzbekistan *(→ see Figure 22)*.[152] The most remarkable increase was in Turkmenistan, where industrial energy consumption doubled between 2000 and 2010 and then grew 49% between 2010 and 2019.[153] Ukraine has seen the most dramatic decline (more than 50%) in its industrial energy consumption since 2000.[154] Although energy efficiency is improving more slowly in the region than in the EU-27, this hides the fact that the EU's most consuming and polluting industrial facilities have moved abroad, where they face fewer challenges in complying with the EU emissions trading system and other stringent environmental policies and measures.[155]

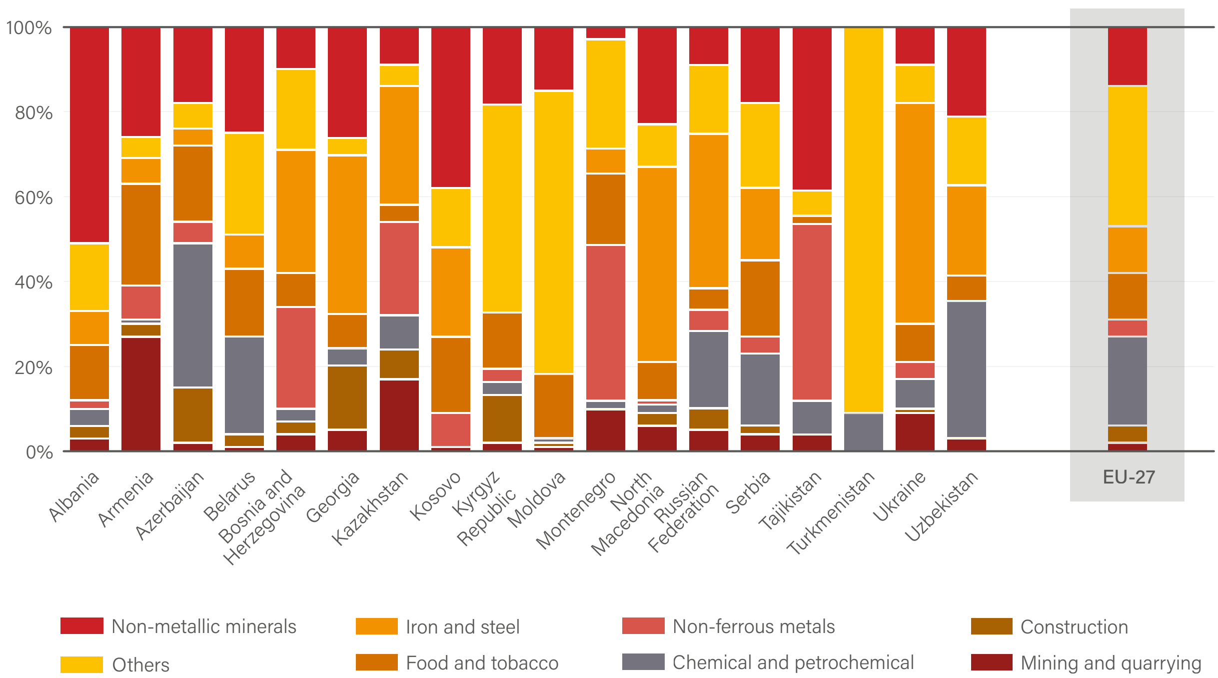
The main energy-consuming industrial sub-sectors in the focus region are non-metallic minerals, iron and steel, chemicals and petrochemicals, construction, non-ferrous materials, mining and quarrying, and food and tobacco. The shares of these sub-sectors vary by country *(→ see Figure 23)*.[156] Assessing their energy intensity and considering opportunities to reduce this intensity is critical.

FIGURE 22.
Change in Final Energy Consumption of Industry in the Focus Countries and in the EU-27, by Decade, 2000-2019



Source: See endnote 152 for this chapter.

FIGURE 23.
Final Energy Consumption of the Industrial Sector by Sub-sector in the Focus Countries and in the EU-27, 2019



Source: See endnote 156 for this chapter.

Of these sub-sectors, the two most energy-consuming are ferrous metals and cement (non-metallic minerals). In 2018, among the focal countries for which data were available, the energy intensity of ferrous metals was the world's lowest in Belarus but the world's highest in Ukraine and Kazakhstan.[157] For cement, the energy intensity was among the world's highest in Armenia and Belarus.[158] Such analyses point to the high potentials for energy efficiency in the industry sectors of the focus countries.

Many opportunities exist to improve energy efficiency in the industry sectors of these countries. However, this requires addressing key barriers such as the high capital cost of investment, as many factories in the region have not been modernised since they were built in the 1950s and 1960s and require significant overhaul. Other barriers include a lack of access to and knowledge about modern efficient technologies and practices, as well as insufficient policy and regulatory frameworks to promote investment and technology transfer.

Across the region, the main tool to regulate natural resource use, including energy use, in industrial processes is policies promoting the use of best available technologies (BATs). The Russian Federation has mandated the application of BATs since 2014, and Kazakhstan has done so since January 2021, when the new Eco-Code was officially adopted.[159] These countries have been elaborating the required regulatory documents to provide industries with sector-specific lists and descriptions of BATs.

Countries also have used energy audits as a policy to promote efficiency in the industrial sector. In Kazakhstan, which has some of the region's most energy-intensive industries, the 2012 "Law on energy saving" mandates that all energy users with annual consumption above 1.5 million tonnes of coal equivalent must undergo regular (every five years) energy audits and formulate and implement energy-saving plans based on the results.[160] Kazakhstan established a State Energy Registry where industries covered by the scheme must regularly report on their energy use and the measures they have taken to improve efficiency.[161] As of early 2022, Kazakhstan was the only country in the region where emissions from energy-intensive industries were covered by the EU's Emission Trading Scheme.[162]

Stakeholders in the region have indicated the need to work with industry and commerce to create industrial demand for energy-efficient products.[163] This includes developing programmes to raise awareness and provide advice and guidance to small and medium-sized enterprises and industry, as well as creating integrated information tools (i.e., e-portals) to consolidate advice, information and methodologies on greening practices by sub-sector. Guidance also could be disseminated through workshops and training, as well as via successful case studies.

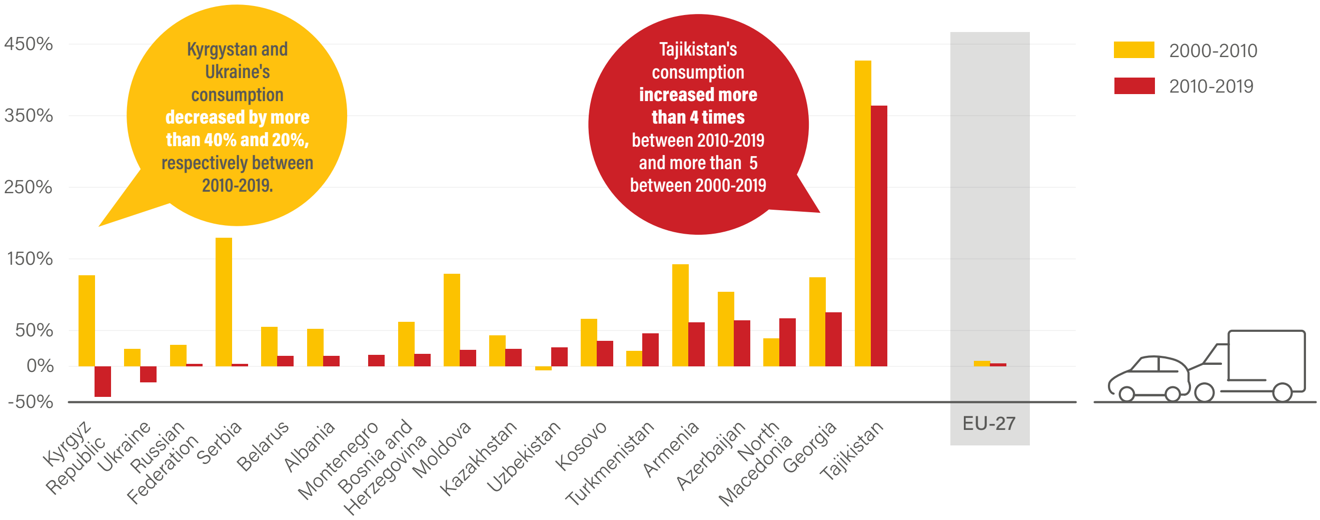
Multilateral development banks and bilateral donors have financed several projects to address energy efficiency in industry. For example, the World Bank has been among the largest financiers of industrial energy efficiency in the region. Between 2011 and 2017, it successfully disbursed a USD 200 million credit line to finance energy efficiency improvements in the industrial sector of Ukraine.[164] In 2018, it established a similar USD 200 million facility for industrial enterprises in Uzbekistan.[165]

Most bilateral action has focused on Kazakhstan. In 2019, the German Federal Ministry of Finance approved two grants of USD 0.2 million to the Kazakh government to implement the project "Energy efficiency of heat supply in industry" with the assistance of the German Energy Agency (dena). The project helped to develop governmental instruments and measures to increase energy efficiency in industry as part of a major modernisation and industrialisation programme. In 2018, the German Federal Ministry of Education and Research approved a USD 50,000 grant to academic and teaching institutions of Central Asia for the project "Industry 4.0 for renewable energy and energy-saving technologies," which encouraged scientific co-operation between Central Asia and other countries.[166] In 2016, the Norwegian Ministry of Foreign Affairs approved a USD 60,000 grant to support the development and implementation of the Kazakh Emission Trading Scheme, aimed at creating a workable, effective and transparent scheme that meets international standards.

TRANSPORT

During the last 20 years, the final energy consumption of the transport sector in the focus region has increased at unprecedented rates *(→ see Figure 24)*.[167] Between 2000 and 2019, it more than tripled in Moldova, North Macedonia and Serbia; more than doubled in Kosovo; and grew by more than a factor of 20 in Tajikistan.[168] For the region as a whole, the final energy consumption of transport increased 39% during the 2000-2019 period, compared with 11% in the EU-27.[169] Road transport accounted for the largest share of final energy consumption, while in a few countries rail and/or domestic aviation had high shares.[170]

FIGURE 24.
Change in Final Energy Consumption of Transport in the Focus Countries and in the EU-27, by Decade, 2000-2019



Source: See endnote 167 for this chapter.

The key drivers of rising energy use in transport have been the demands for mobility and for the movement of freight. In Azerbaijan, Kazakhstan and the Kyrgyz Republic (the countries for which data were available), passenger-kilometres grew 63-105% between 2000 and 2010 and 45-87% between 2010 and 2018.[171] For freight traffic, tonne-kilometres in Azerbaijan, Belarus, Kazakhstan and the Kyrgyz Republic grew 30-111% between 2000 and 2010 and 9-60% between 2010 and 2018.[172] Despite this high growth, per capita mobility in Azerbaijan and the Kyrgyz Republic was among the lowest in the world in 2018.[173] This suggests that the demand for mobility and freight movement will continue to grow, in line with global trends.

The good news is that Azerbaijan, Kazakhstan and the Kyrgyz Republic (as well as many other countries in the region) rely largely on the most environmentally friendly transport modes for their passenger and freight transport. This includes a dominant share of public transport (mainly buses) for inland passenger traffic, as compared to all other countries in the world.[174] The reliance on more environmentally friendly modes is similar for freight transport, with Belarus and Kazakhstan having very high shares of rail and water freight.[175]

Key regulatory policies for the transport sector in the region are standards for new vehicles as well as better infrastructure planning, especially urban planning. Several countries recently introduced policies supporting the transition to electric mobility, with the assumption of linking charging electric vehicles with renewable electricity.[176] Some national programmes, often initiated with donor support, also provide financial incentives for trading out inefficient vehicles for ones with higher fuel efficiency.[177]

Multilateral development banks and bilateral doners have financed several projects to address energy efficiency in transport, many of them focused on promoting public transport. The EBRD has financed the largest number of transport projects. For example, in 2019 it approved a sovereign loan of USD 72.8 million to the Georgian government to implement the project "GRCF2 W2 – Tbilisi bus extension," which provides on-lending to the city of Tbilisi to help the municipal transport company purchase a new fleet of modern 12-metre low-floor compressed natural gas (CNG) buses, and to rehabilitate/modernise city bus depots.[178]

The EBRD also approved non-concessional debt of USD 19.0 million to the Georgian government in 2019 to implement the "Georgia urban transport enhancement programme," which will finance around 175 units of modern diesel (Euro 5) buses in the cities of Gori, Kutaisi, Rustavi, Poti, Telavi and Zugdidi.[179] In addition, the EBRD approved financing that year for the "Dushanbe public transport" project in Tajikistan, providing a sovereign guaranteed loan of up to USD 5.2 million (with the possibility of up to USD 2.8 million in co-financing with a capital grant) to the city-owned trolleybus company to rehabilitate trolleybus infrastructure.[180]

Also in 2019, Germany's BMZ approved a grant of USD 5.4 million to public corporations in Central Asia for the project "Sustainable urban mobility in the South Caucasus," which promoted integrated, climate-friendly urban development among respective city administrations.[181] In addition, the Foreign Office of Germany approved a USD 336,000 grant to the Organisation for Security and Co-operation in Europe (OSCE) to promote green ports and connectivity in the Caspian Sea region and apply green port principles.[182] Large Caspian Sea ports, such as Baku (Azerbaijan) and Turkmenbashi (Turkmenistan), as well as neighbouring seaports such as Aktau (Kazakhstan), expect to greatly increase their trading activities. Baku was the region's first port to commit to the Green Port Principles, which entail reducing the ecological and energy footprint of goods distribution, including materials management, waste management and physical distribution.[183] The project also considered integrating energy efficiency and renewable energy in port operations.

06 INVESTMENT FLOWS

GLOBAL OVERVIEW

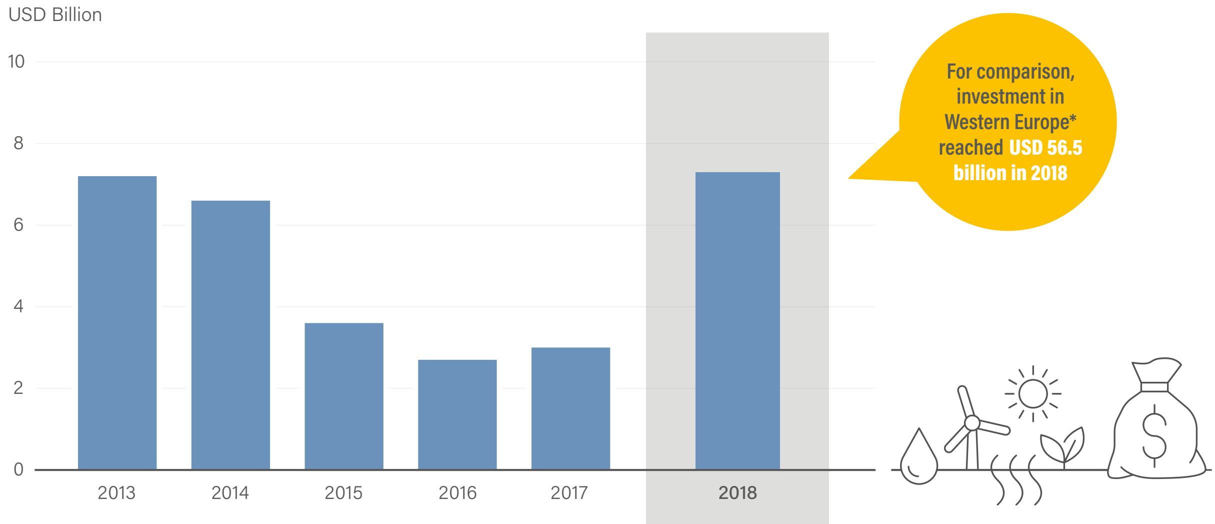
Worldwide investment in renewable power, heat and fuels[i] (excluding hydropower projects larger than 50 MW) totalled USD 303.5 billion in 2020.[1] This represents both public and private investment flows as well as international and domestic flows. The trend in global renewable energy investment has not been linear, growing steadily between 2000 and 2011 and then declining until 2013 before recovering in 2015. Since then, global investment in renewables has remained fairly constant, fluctuating between USD 277 billion and USD 313 billion annually.[2]

Beneath the headline figures, much has changed on the unit costs of new renewable energy additions and on the geographical split of investment.[3] In most global regions, solar PV or wind power is now the cheapest available source of new electricity generation.[4] Falling capital costs have meant that more capacity in these two renewable sources has been added every year, for the same investment volume.[5] In 2020, developing and emerging economies (including China) surpassed developed countries in investment in renewable energy capacity for the sixth year running, with a total USD 153.4 billion (although a smaller margin than in previous years).[6]

The combined renewable energy investment of the focus countries did not follow the global trend. Investment declined from 2013 levels, reaching USD 2.7 billion in 2016, and then returned to the 2013 level of USD 7.2 billion in 2018, contributing around 2.2% of the world total[ii] that year *(→ see Figure 25)*.[7]

None of the focus countries ranked among the world's top 10 countries in renewable energy investment; however, a few ranked among the top 30. In 2018, Ukraine ranked 18th and the Russian Federation ranked 22nd *(→ see Table 16.)*.[8] The following year, both countries moved up in the ranking (to 17th and 20th respectively), and Kazakhstan entered the top 30 list.[9]

FIGURE 25.
Renewable Energy Investment in the Focus Countries and in Four Countries of Central and Eastern Europe, 2013-2018



Note: These data refer to public and private, international and domestic investments. They aggregate the investments of the focus countries (excluding Kosovo) with four other countries of Central and Eastern Europe: Bulgaria, Latvia, Lithuania and Romania. Western Europe includes Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.
Source: See endnote 7 for this chapter.

TABLE 16.
Investment in Renewable Energy Capacity, Top 30 Countries, 2018 and 2019

2018			2019		
Ranking	Country	Investment (billion USD)	Ranking	Country	Investment (billion USD)
1	China	88.5	1	China	83.4
2	United States	42.8	2	United States	55.5
3	Japan	17.6	3	Japan	16.5
4	India	11	4	India	9.3

i Including wind (both onshore and offshore), solar (large and small scale), biofuels, biomass and waste, ocean, geothermal and small hydropower.

ii These data refer to public and private, international and domestic investments. They aggregate the investments of the focus countries (excluding Kosovo) with four other countries of Central and Eastern Europe: Bulgaria, Latvia, Lithuania and Romania. Available background data was comprehensive for public international flows while limited for other flows. The estimate of regional investment and its share of global investment was calculated using IRENA's Global Landscape of Renewable Energy Finance 2020. Estimates in the IRENA report and in the REN21 Renewables 2021 Global Status Report do not match due to differences in methodologies.

2018			2019		
Ranking	Country	Investment (billion USD)	Ranking	Country	Investment (billion USD)
5	Australia	9.2	5	Taiwan	8.8
6	United Kingdom	8.8	6	Spain	8.4
7	Spain	7.5	7	Brazil	6.5
8	Germany	6.3	8	Australia	5.6
9	Vietnam	5.2	9	Netherlands	5.5
10	Netherlands	4.9	10	United Kingdom	5.3
11	Sweden	4.5	11	Chile	4.9
12	France	4.1	12	United Arab Emirates	4.5
13	South Africa	4.1	13	Germany	4.4
14	Mexico	3.8	14	France	4.4
15	Brazil	3.4	15	Mexico	4.3
16	Belgium	3.1	16	Sweden	3.7
17	Morocco	3.1	**17**	**Ukraine**	**3.4**
18	**Ukraine**	**2.1**	18	Vietnam	2.6
19	Turkey	2	19	Republic of Korea	2.4
20	Italy	2	**20**	**Russian Federation**	**2.3**
21	Argentina	1.9	21	Argentina	2
22	**Russian Federation**	**1.9**	22	Turkey	1.9
23	Taiwan	1.8	23	Poland	1.8
24	Denmark	1.7	24	Finland	1.5
25	Kenya	1.4	25	Italy	1.3
26	Republic of Korea	1.4	26	Norway	1
27	Chile	1.3	27	South Africa	1
28	Norway	1.1	**28**	**Kazakhstan**	**0.8**
29	Finland	1	29	Greece	0.7
30	Egypt	1.0	30	Israel	0.7

Source: See endnote 8 for this chapter.

Despite the positive impact of the COVID-19 pandemic on renewable energy investment in some parts of the world, this was not the case in the focus countries.[10] According to stakeholders, the pandemic delayed the implementation of some projects in the region, and nether interviews nor available data report a positive effect of COVID recovery packages on renewable energy trends in the region.[11]

This chapter provides a detailed assessment of renewable energy investment flows since 2017, using the best available open-access information on international development finance flows.[iii,12] Information on other international investments in renewables, as well as on domestic investment (both public and private), is fragmented and/or not publicly accessible. This limited data availability impedes analysis of renewable energy trends in the UNECE region. Future assessments will benefit from better availability of information.

DEPLOYING RENEWABLES THROUGH CLIMATE AND DEVELOPMENT FINANCE

Two important drivers of renewable energy investment flows in the region are international development finance – which supports investments in sustainable energy and climate-related activities – and dedicated international climate finance. This investment includes bilateral and multilateral aid, aid from private providers, and other resource flows to developing countries; together, the OECD[iv] records these flows as "official development assistance," also known as foreign aid. Multilateral support is provided by development agencies, multilateral development banks, and international climate funds, whereas bilateral support

iii The OECD provides open-access information on international development finance flows.

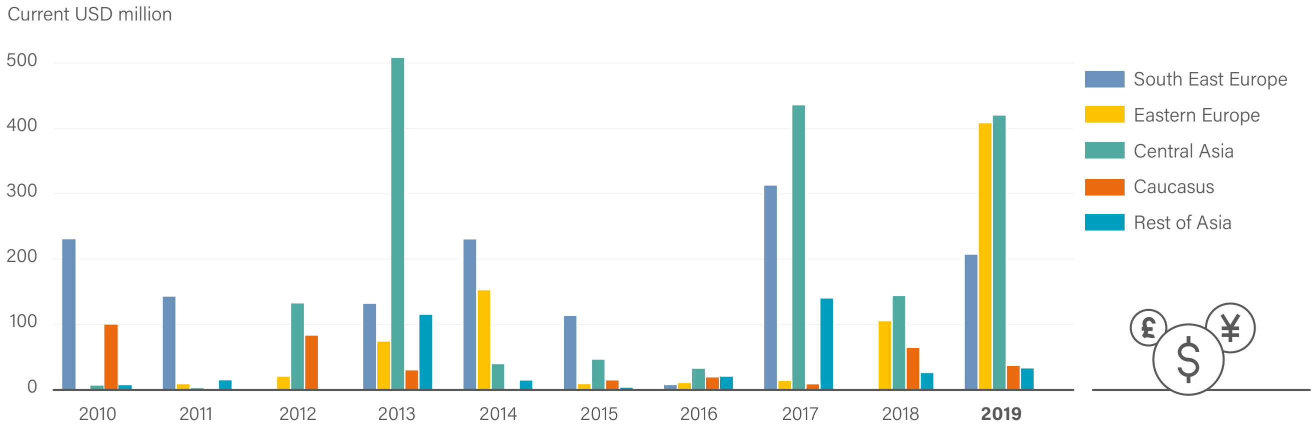
iv Countries registered with the OECD as providing official development assistance are: Australia, Austria, Belgium, Canada, Denmark, the EU, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

typically is provided by ministries and development agencies of donor countries to the governments of recipient countries.
All of the focus countries except for the Russian Federation were eligible to receive foreign aid. They also had access to funding resources under the financial mechanisms of the UNFCCC, such as the Global Environment Facility (GEF) and the Green Climate Fund (GCF).

The information on foreign aid for the eligible focus countries was available from the OECD's development assistance database[v]; however, because this database does not cover all donors and private investors, the volumes reported in this chapter are likely low.[13] The OECD data also reflect the commitment of funds but not their actual disbursement, so the results may differ from the recipient countries' own statistics. The data covered in the analysis include projects with a specific focus on the following renewable energy technologies: biofuels (including biomass, waste and biogas), hydropower (including projects smaller than 50 MW), geothermal energy, solar energy (including solar PV and solar thermal), wind power and renewable energy technologies in aggregate. The analysis excludes projects that may be related to renewables but were not reported as such.

Between 2000 and 2019, a total of USD 5.0 billion in foreign aid – 8.3% of the global total[vi] – was committed to support renewable energy development in the focus countries *(→ see Figure 26).*[14] The volume and timing of the aid varied considerably by country. Nearly half of the total amount was registered between 2016 and 2019 (i.e., since the previous REN21/UNECE report in 2017) to support more than 200 projects and initiatives, with the largest share for the countries of Central Asia.[15]

FIGURE 26.
Foreign Aid Committed for Renewable Energy Projects in the Focus Countries, 2000-2019



Note: Figure does not include foreign aid disbursed to projects listed as "regional," including in Central Asia, Europe, Asia, South & Central Asia, and "Other."
Source: See endnote 14 for this chapter.

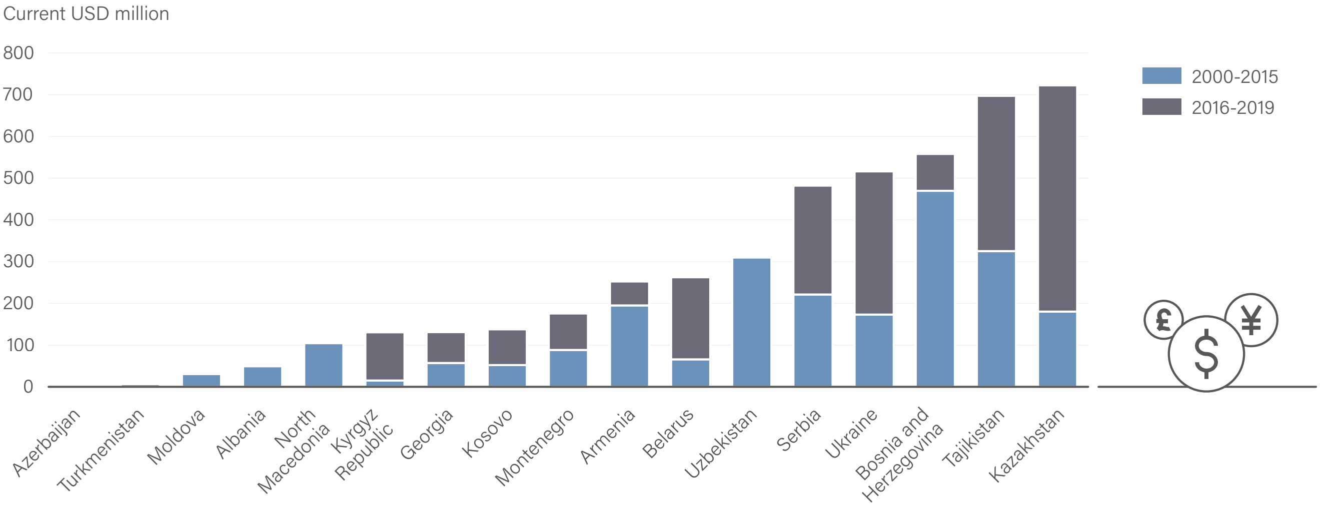
At the country level, the largest volumes of foreign aid in absolute terms between 2016 and 2019 were committed (in descending order) to Kazakhstan, Tajikistan, Ukraine, Serbia, and Belarus, with each country attracting more than USD 100 million. *(→ see Figure 27)*[16] Kazakhstan, Ukraine, Belarus and the Kyrgyz Republic received significantly higher support during this period than in the previous 15 years.[17] By contrast, the commitment for renewable energy financing in Azerbaijan, Moldova, Albania, North Macedonia and Uzbekistan was relatively small, with less than USD 5 million each, while Turkmenistan realised no commitments during this period.[18]

v The data in this chapter are from the OECD's Development Assistance Committee (DAC) database. Other data sources, such as the United Nations Sustainable Development Goal Indicators database and the IRENA database, were less comprehensive and thus not included in the analysis. A few countries that are not DAC members, such as Lithuania, also report to the OECD database.

vi Estimated comparing this volume with that reported in the REN21 Renewables 2021 Global Status Report.

FIGURE 27.

Foreign Aid Committed for Renewable Energy Projects in the Focus Countries, 2016-2019 versus 2000-2015



Note: Figure does not include foreign aid disbursed to regional projects.
Source: See endnote 16 for this chapter.

By technology, the largest aid amount committed during 2016-2019 went to projects addressing multiple renewable energy technologies (USD 1.3 billion), followed by financing for hydropower plants (USD 507 million).[19] Financing for biofuels attracted USD 229 million, for wind power USD 234 million, and for solar PV capacity USD 149 million *(→ see Figure 28)*.[20]

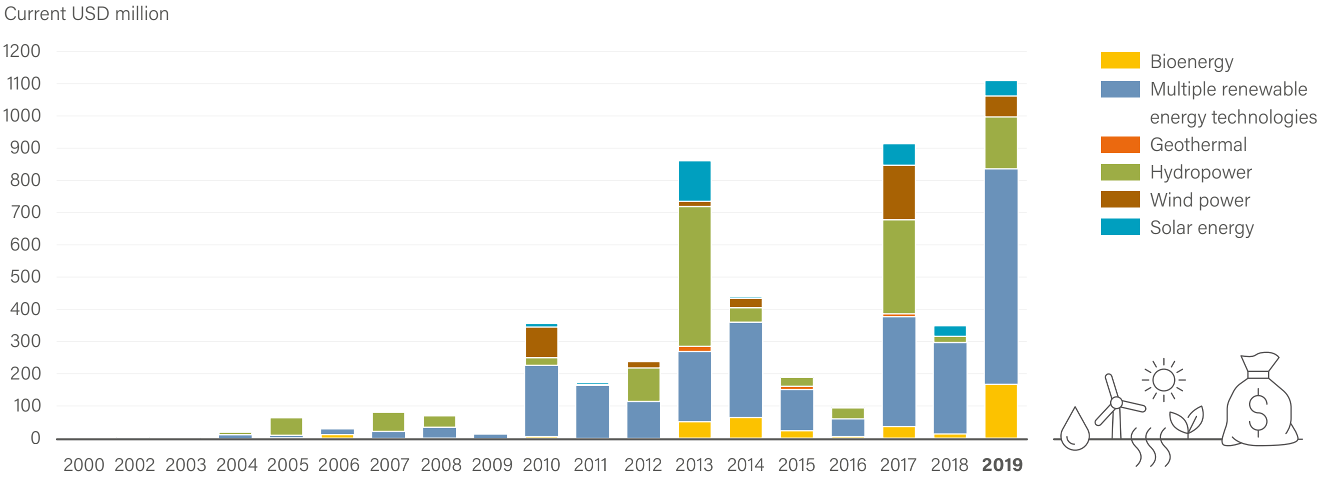
Every country of the region (except the Russian Federation) received foreign aid commitments for renewables, which was channelled either bilaterally or through multilateral development banks, climate funds and other multilateral institutions *(→ see Table 17)*.[21] Between 2016 and 2019, multilateral donors committed 70% of the finance, whereas bilateral donors committed 30%.[22]

Bilateral donors also provide some development finance through international development agencies, multilateral development banks, and climate funds, but this is calculated here under the multilateral channels to avoid double counting.

Altogether, 20 geographical jurisdictions provided bilateral aid for renewable energy projects in the focus region during 2016-2019, whether directly from governments or via their development agencies and banks *(→ see Table 17)*.[23] This support totalled USD 546 million and was committed to all of the focus countries except Albania and North Macedonia (as well as the Russian Federation).[24] The most active provider of bilateral support for renewables was Germany, followed by Japan and Austria.[25]

FIGURE 28.

Foreign Aid Committed to Renewable Energy Projects by Technology in the Focus Region, 2009-2019



Source: See endnote 20 for this chapter.

TABLE 17.
Bilateral and Multilateral Foreign Aid Commitments by Provider for Renewable Energy Projects in the Focus Countries, 2016-2019

Provider	Albania	Armenia	Azerbaijan	Belarus	Bosnia and Herzegovina	Georgia	Kazakhstan	Kosovo	Kyrgyz Republic	Moldova	Montenegro	North Macedonia	Serbia	Tajikistan	Ukraine	Uzbekistan	Europe, regional	Central Asia, regional	Asia, regional
Bilateral donors																			
Austria				X	X	X		X		X	X						X		X
Canada																	X		X
Czech Republic					X	X							X						
Denmark						X									X				
EU institutions (excl. EIB)														X					
Finland								X	X				X						X
France		X														X			
Germany		X		X	X		X	X			X		X	X	X	X	X	X	X
Iceland							X								X				
Ireland																	X		
Italy					X					X			X						X
Lithuania		X				X				X					X				
Japan		X	X				X		X					X		X		X	
Republic of Korea									X							X			
Norway						X									X				X
Poland										X					X				
Slovenia					X										X				
Switzerland								X					X	X	X		X		
United Kingdom																			X
United States																			X
Multilateral Development Banks																			
AIIB							X							X					
ADB*						X	X		X							X			
EBRD	X			X		X	X	X				X	X		X				
EIB	X			X		X							X	X					X
World Bank**				X										X					
Climate Funds																			
CIF***		X												X					
GCF							X												
GEF****															X				

Notes: EIB = European Investment Bank, AIIB = Asian Infrastructure Investment Bank, ADB = Asian Development Bank, EBRD = European Bank for Reconstruction and Development, CIF = Clean Investment Funds, GCF = Green Climate Fund, GEF = Global Environment Facility.
* The ADB committed to provide foreign aid either directly or through its Climate Change Fund, the Regional Cooperation and Integration Fund (RCIF) and the Technical Assistance Special Fund (TASF).
** The World Bank committed to provide foreign aid through the IBRD and the IDA.
*** The CIF committed to provide foreign aid through the Clean Technology Fund (CTF) and the Strategic Climate Fund (SREP).
**** The GEF channelled the commitment of donors through implementing agencies, such as UNDP.
Source: See endnote 23 for this chapter.

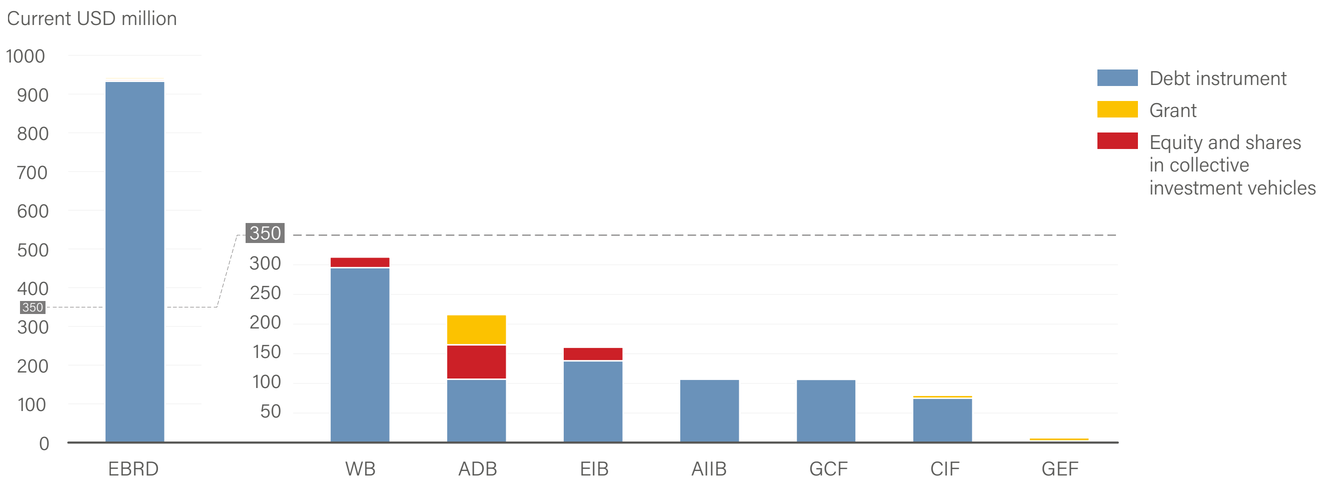
All bilateral support was committed as concessional and developmental aid, typically provided by the ministries and development agencies of donor countries in the form of grants or technical assistance to governments.[26] The exception was the foreign aid from Canada, Finland, Germany and the United Kingdom. Canada allocated the entirety of its foreign aid as debt from Global Affairs Canada (the Department of Foreign Affairs, Trade and Development of the Government of Canada) through the ADB and the IFC.[27] Finland committed to provide 88% of its foreign aid through equity investment via Finnfund.[28] Germany committed to disburse 89% of its assistance as debt provided by KfW, in addition to a small share of equity from the Federal Ministry for Economic Cooperation and Development (BMZ) and the rest as grants from several federal and regional ministries.[29] The United Kingdom committed to provide 17% of its foreign aid through the ADB as equity investment.[30]

Between 2016 and 2019, five multilateral development banks committed a total of USD 1,732 million in support for renewable energy projects in all of the focus countries except Armenia, Azerbaijan, Moldova, Montenegro and the Russian Federation. The EBRD committed the majority share (54%), followed by the World Bank (18%), the EIB (12%), the ADB (9%) and the AIIB (6%) *(→ see Figure 29)*.[31]

Typically, multilateral development banks have provided foreign aid in the form of debt (both concessional and non-concessional) and sometimes equity, often accompanied by grants for technical assistance.[32] The EBRD, which operates in the largest number of countries, committed finance for renewables mostly through non-concessional debt and a small amount of non-concessional equity. The World Bank provided non-concessional debt through the IBRD, as well as concessional debt and grants through the IDA. The ADB committed to provide concessional and non-concessional debt, as well as grants either itself or through its Climate Change Fund, Regional Cooperation and Integration Fund (RCIF) and Technical Assistance Special Fund (TASF). Notably, the ADB was the largest provider among the multilateral development banks of both equity (86% of the total) and grants (74%) to the focus countries.[33] The EIB committed to provide concessional and non-concessional debt and equity, with its largest share in debt. The AIIB committed to provide only non-concessional debt.

Climate funds and other multilateral institutions providing financing to the focus countries included the GCF, the CIF and the GEF *(→ see Figure 29)*. Between 2016 and 2019, these institutions disbursed USD 191 million to support renewable energy projects in Armenia, Kazakhstan, Tajikistan and Ukraine.[34] The GCF contributed 56% of the total, followed by the CIF (42%) and the GEF (3%).[35] The GCF was the largest debt provider (concessional and non-concessional), followed by the CIF, which disbursed concessional debt through the Clean Technology Fund (CTF) and the Strategic Climate Fund (SREP).[36] The CIF also provided grant finance, primarily in the form of technical assistance to complement its non-grant instruments. The GEF committed to provide only grants.

FIGURE 29.
Foreign Aid for Renewable Energy Committed by Multilateral Development Banks, Climate Funds and Other Multilateral Institutions to the Focus Countries, by Financial Instrument, 2016-2019



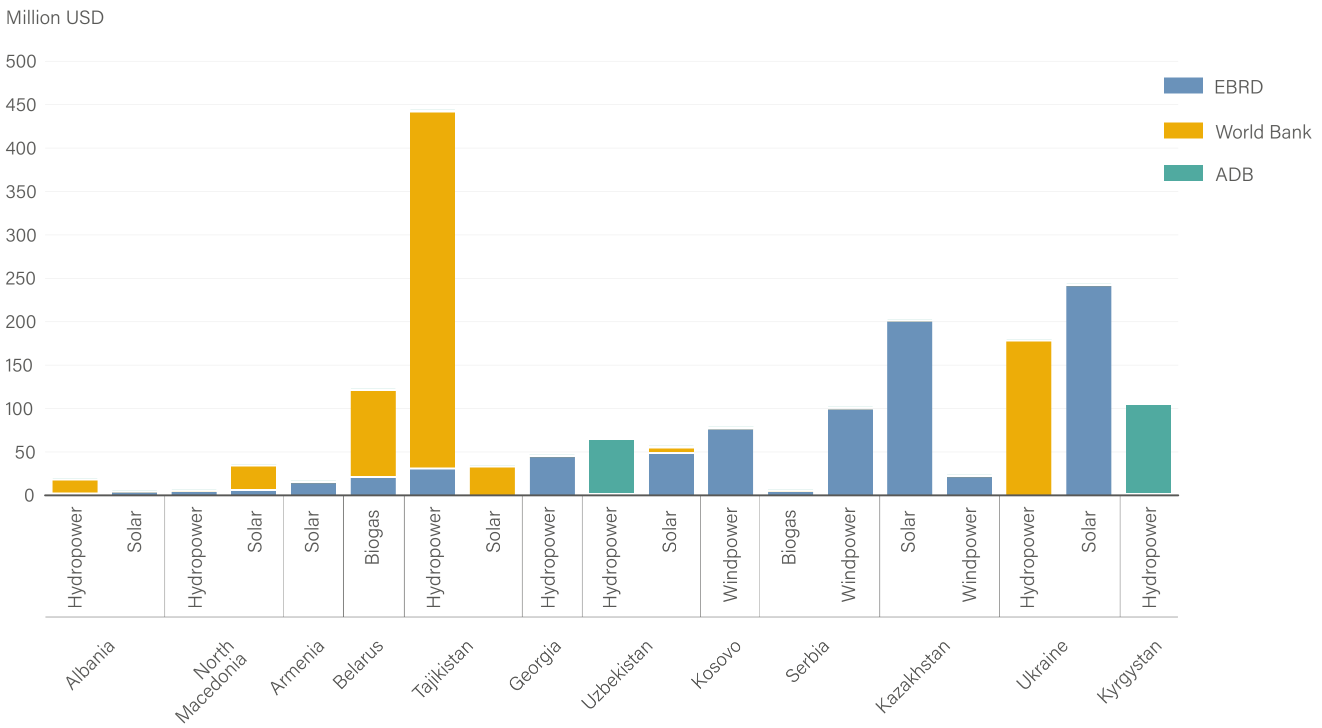
Note: The ADB committed to provide foreign aid itself or through its Climate Change Fund, Regional Cooperation and Integration Fund (RCIF) and Technical Assistance Special Fund (TASF). The World Bank committed to provide foreign aid through the IBRD and the IDA. The CIF committed to provide foreign aid through the CTF and the SREP.
Source: See endnote 31 for this chapter.

Multilateral Development Banks

In 2018, multilateral development banks contributed around 3.7% of the total investment flows in renewable energy to the focus countries (excluding the Russian Federation), in line with the share that these banks contributed to renewables globally (3.8%).[37] This section tracks the key activities of donor institutions from 2017 up to the most recent year for which data were available[vii].

Among the banks, the EBRD committed the largest volume of renewable energy finance in the focus countries, in the form of non-concessional debt, mostly to the private sector. Between 2017 and 2020, the EBRD's activity was spread across several focus countries, providing a total of USD 815 million in investments, excluding co-financing with other project financiers.[38] The largest shares (a combined 57% of the total) were disbursed to Ukraine and Kazakhstan.[39] By technology, the largest share (63%) of EBRD financing supported solar energy projects *(→ see Figure 30)*.[40]

FIGURE 30.
EBRD, World Bank and ADB Finance for Renewable Energy Projects in the Focus Countries, 2017-2021



Note: EBRD and ADB finance for renewable energy projects refer to the 2017-2020 period, while World Bank finance refers to the 2017-2021 period.
Source: See endnote 40 for this chapter.

In Kazakhstan, the EBRD provided debt financing of USD 200 million for solar energy projects and USD 21 million for wind energy projects.[41] Most notable was the GCF-EBRD Kazakhstan Renewables Framework (KAZREF), which aimed to support the construction of 8 to 11 renewable energy projects, with a total capacity of 330 MW, representing nearly half of the country's renewable capacity.[42] Under KAZREF, the EBRD committed USD 78 million to build solar PV power plants in Baikonur, Burnoye, Nomad, Zadarya and Zhangiz between 2017 and 2020. Additional finance was achieved by blending the EBRD and the GCF financing and leveraging additional debt from international and development financial institutions. In the future, the EBRD plans to scale up finance through blended capital involving commercial banks and private sector investment.

During the 2017-2020 period, the EBRD provided debt financing for additional solar PV projects in Kazakhstan including Chulakkurgan Solar (USD 24.3 million), Karaganda Solar Phase II (USD 3.6 million), M-KAT Green Solar PV Power Plant (USD 41.5 million), Risen Solar PV (USD 16.0 million) and SES Saran Solar PV Power (USD 36.8 million).[43] The EBRD's Kazakhstan Renewables Framework Programme Phase II (KazRef II) also supported a wind farm in Zhanatas (USD 21.0 million) in 2020.[44]

In Ukraine, the EBRD provided debt financing through the bank's Ukrainian Sustainable Energy Lending Facility (USELF). Between 2017 and 2020, the facility disbursed USD 241 million of debt for 14 solar energy projects.[45] Elsewhere in the region, the EBRD supported solar projects with debt for the Masrik-1 solar PV power plant in Armenia (USD 14.4 million), a solar PV power project in Nur Navoi in Uzbekistan (USD 48.9 million) and the ELEM solar PV power project in North Macedonia (USD 5.9 million).[46] The EBRD provided debt financing for two biogas projects in Belarus for a total of USD 21.4 million and a biogas project in Serbia for USD 3.8 million.[47] It further disbursed debt for two wind farms in Kosovo (USD 75.5 million) and two wind farms

vii The previous section relied on the commitments of bilateral and multilateral donors to finance renewable energy projects. This section refers to active and closed projects reported by the donors from 2017 onwards; therefore, the data could differ slightly from those reported in the previous section.

in Serbia (USD 99.2 million).[48] Finally, it provided debt financing for five hydropower projects: one in North Macedonia (USD 4.1 million), one in Tajikistan (USD 31.0 million), one in Albania (USD 2.0 million) and two in Georgia (USD 43.6 million).[49]

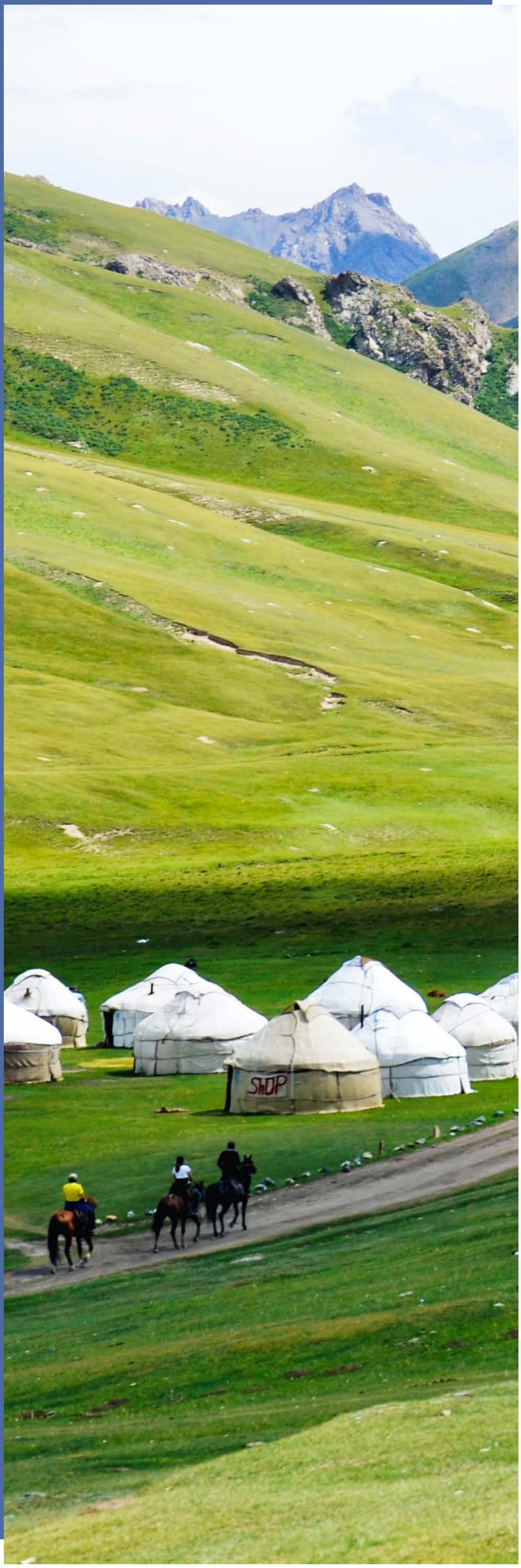
The World Bank provided USD 765 million of debt financing for renewable energy projects in the region between 2017 and 2021 *(→ see Figure 30)*.[50] More than half of this was for financing large hydropower projects in Tajikistan, including the Nurek hydropower rehabilitation project (USD 276 million) and the financial recovery of the national utility, also related to hydropower (USD 134 million).[51] In addition, the World Bank provided debt financing for the hydropower-related projects "Improving Power System Resilience for European Power Grid Integration" in Ukraine (USD 177 million) and "APL 5 for Albania Dam Safety" in Albania (USD 15 million).[52]

The World Bank provided debt financing for three solar energy projects, including the scaling up of solar PV power in Navoi in Uzbekistan (USD 5.1 million), a rural electrification project involving small hydropower and solar PV energy in Tajikistan (USD 31.7 million) and a project pursuing energy efficiency retrofits of public buildings using building-integrated renewables in North Macedonia (USD 27.4 million).[53] The World Bank also provided debt financing for a project to scale up biomass heating in Belarus (USD 99.3 million).[54]

The portfolio of the ADB covers Central Asia and the Southern Caucasus. Between 2017 and 2020, the ADB financed exclusively hydropower projects in the region, including both large and small plants *(→ see Figure 30)*.[55] The biggest project involved the modernisation of a large hydropower plant in Uch-Kurgan in the Kyrgyz Republic, for which the ADB signed debt financing of USD 100 million and a technical assistance grant of USD 1.3 million.[56] The ADB also provided debt financing plus a technical assistance grant for a small hydropower project in Uzbekistan (USD 61 million), as well as a technical assistance grant of USD 175,000 for the preparation of small hydropower projects in Kazakhstan.[57]

Between 2017 and 2020, the EIB disbursed concessional debt to support renewable energy projects in Belarus, Georgia and Ukraine. It disbursed EUR 62.6 million (USD 70.3 million) for biofuel-fired power plants in Belarus in 2020 and provided EUR 3.5 million (USD 3.9) for rehabilitation work at the Enguri and Vardnili hydropower plants in Georgia in 2017.[58] In 2018-2019, the EIB approved EUR 221 million (USD 248 million) for the "Agri-infrastructure and biomass power generation" project, which among other activities built five biomass-fired CHP plants in Ukraine.[59]

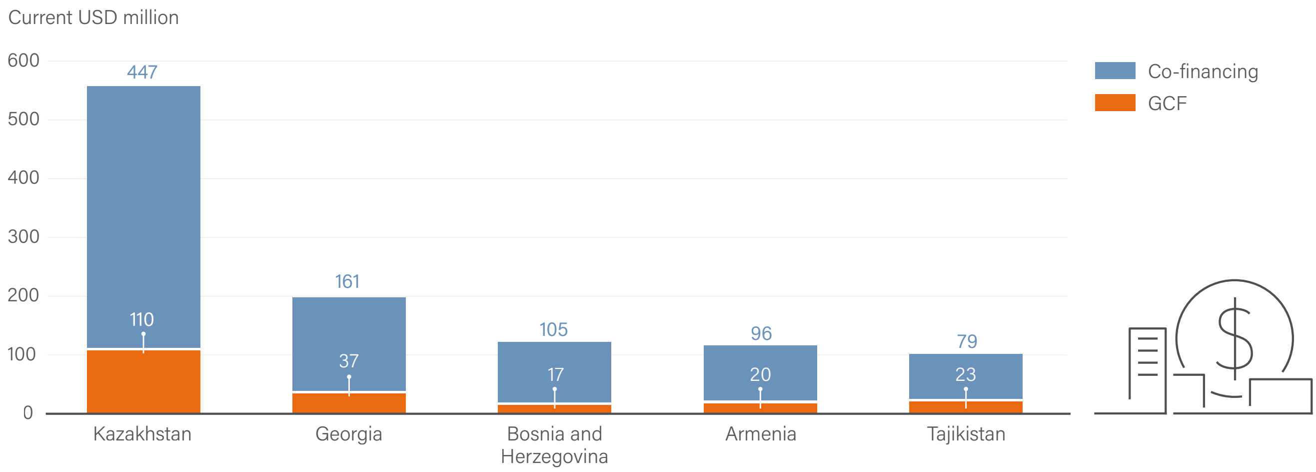
The AIIB supported two projects in the form of non-concessional debt in Central Asia between 2017 and 2020. It approved USD 46.7 million in 2019 for the construction of a 100 MW wind power plant in Zhanatas in Kazakhstan and provided USD 60 million in 2017 for Phase I of the Nurek hydropower plant rehabilitation in Tajikistan.[60]



Climate and Environmental Funds

Climate funds provide finance for non-Annex I Parties under the UNFCCC[viii]. This covers all of the focus countries except for Belarus, the Russian Federation and Ukraine. This section tracks the key activities of climate and environmental funds from 2017 up to the most recent year for which data were available[ix]. The GCF was the largest climate funder, followed by the CIF and GEF *(→ see Figure 31)*.[61]

FIGURE 31.
GCF Finance for Renewable Energy Projects in the Focus Countries, 2016-2020



Note: The figure covers only national projects and includes projects on renewable energy and energy efficiency.
Source: See endnote 61 for this chapter.

Between 2016 and 2020, the GCF disbursed USD 208 million for renewable energy projects in the region, which also attracted co-financing of USD 888 million from other sources.[62] The GCF's largest renewable energy investment in the region was the previously mentioned KAZREF, approved by the GCF and the EBRD in 2017. KAZREF's total value was USD 557 million, including a USD 106 million loan and a USD 4 million grant from the GCF; the rest came from other donors, with the largest share from the EBRD.[63] Earlier in 2016, the GCF and the EBRD co-financed the set-up of the USD 1.4 billion Sustainable Energy Financing Facilities (SEFF) programme for 10 countries globally, including 5 in the focus region (Armenia, Georgia, Moldova, Serbia and Tajikistan).[64] The SEFF runs until 2033 and provides credit lines for local financial institutions to then on-lend funds to borrowers (such as households and enterprises) for energy efficiency and renewable energy projects.

In 2016, the GCF approved a project on de-risking and scaling-up investment in energy-efficient building retrofits in Armenia and supported it with a USD 20 million grant.[65] The project attracted a further USD 86.3 million as debt financing and USD 9.8 million as grants.[66] In 2017, the GCF approved a loan of USD 27 million and a grant of USD 23 million for a project in Tajikistan, also with the EBRD, to strengthen the climate resilience of hydropower facilities.[67] That same year, the GCF provided a USD 17.4 million grant via UNDP for a project in Bosnia and Herzegovina aimed at energy efficiency retrofits in buildings, including transitioning more than 300 public buildings from coal and fuel oil use to renewables.[68]

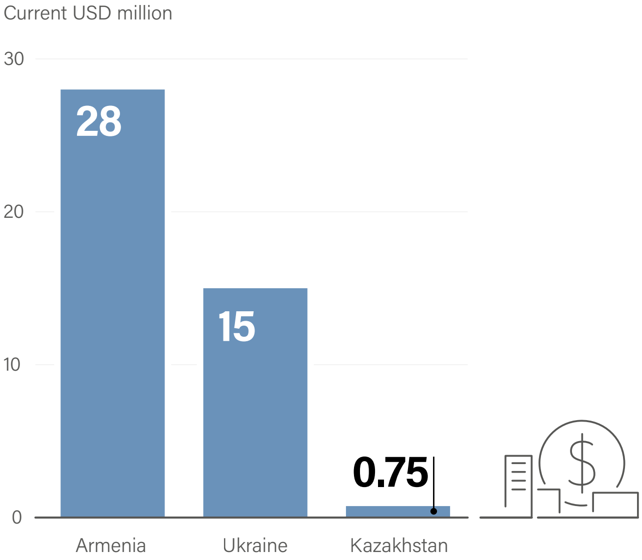
In 2020, the GCF approved a USD 38 million grant for the seven-year long project "Enabling Implementation of Forest Sector Reform in Georgia" to support energy-efficient and renewable energy technologies in rural areas, both to reduce dependence on fuelwood and to make the production of forest biomass more sustainable.[69]

Between 2017 and 2020, the CIF provided financing for renewable energy projects in three of the focus countries: Armenia, Ukraine and Kazakhstan *(→ see Figure 32)*.[70] In Armenia, the CIF approved grant funding of USD 2.3 million in 2020 to finance solar thermal technologies and geothermal heat pumps under the Caucasus Green Economy Financing Facility (GEFF).[71] The GEFF was co-financed by the EBRD with USD 19.3 million in debt.[72] In 2018, the CIF also provided a guarantee of USD 26.0 million for a project in Armenia on private sector utility-scale solar PV, which received co-financing of USD 124 million from the IBRD (including a USD 4 million guarantee, USD 30 million in equity financing and USD 90 million in debt financing).[73]

viii Annex I Parties include the industrialised countries that were members of the OECD in 1992, and countries with economies in transition, such as the Russian Federation and Ukraine. Even though Ukraine became an Annex I Party in 1997, it is still sometimes eligible for finance from climate funds.

ix Unlike the previous sections covering multilateral and bilateral donors, which relied on data on commitments to financing renewable energy projects, this section refers to active and closed projects reported by donors. As a result, the data may differ slightly among the sections.

FIGURE 32.
CIF Finance for Renewable Energy Projects in the Focus Countries, 2017-2020



Source: See endnote 70 for this chapter.

In Kazakhstan, the CIF provided a USD 750,000 grant for capacity building on renewable energy integration.[74] In Ukraine, the CIF provided a loan of USD 14.6 million to support accelerated investment in biomass and biogas technologies using residues and agricultural waste in the agribusiness sector; the project was co-financed by the EBRD with debt of USD 161 million.[75]

Between 2017 and 2020, the GEF supported three projects that focused explicitly on renewable energy. In 2019, this included the approvals of a USD 3.7 million grant for the project on sustainable energy scale-up in Belarus implemented by the World Bank, and a USD 4.8 million grant for the project on sustainable bioenergy value chain innovations in Ukraine.[76] In 2017, the GEF also approved a USD 4.5 million grant for the project on de-risking renewable energy investment implemented by UNDP in Kazakhstan.[77] Other GEF-funded projects to support renewables indirectly in the region included a USD 2.5 million grant for the "Green Energy SMEs Development" project in Tajikistan and a USD 0.7 million grant for the "Growing Green Business in Montenegro" project, both via UNDP.[78]

Other Green Development Funds

Several other environmental funds provided support for renewable energy projects during 2017-2021. These included the Green for Growth Fund (GGF), a specialised fund for financing renewables, which covers South-East Europe and the Caucasus, as well as the Western Balkans Investment Framework (WBIF), an EU regional blending facility supporting EU enlargement and socio-economic development in South-East Europe. (The EU's other regional blending facility, the Investment Facility for Central Asia – which targets sustainable development, economic growth and poverty reduction in Central Asia – did not provide financing for renewables during the analysis period).

The GGF financed three projects in the region during 2017 to 2021. It provided an equity investment of EUR 3.5 million (USD 3.98 million) in 2021 to partially fund the construction and operations of a 36 MW wind farm near the village of Bogoslovec in North Macedonia.[79] The project was co-funded by private financiers including several domestic banks and the Austrian Development Bank (OeEB). In 2019, the GGF provided two senior loans for renewable energy in Ukraine. The first loan of EUR 9.0 million (USD 10.2 million) was for the construction of a 45 MW solar PV power plant in Boguslav that was co-financed by the Dutch Development Bank (FMO) and the Norwegian Export Credit Agency (GIEK).[80] The second loan of EUR 25 million (USD 22 million) was for the construction of a 250 MW wind power plant in Syvasch.[81]

The Western Balkans Investment Framework continued operating in the countries of South-East Europe between 2017 and 2020. It primarily provided grants and technical assistance from the European Commission's Instrument for Pre-Accession Assistance (IPA) and 20 bilateral donors. By 2020, the WBIF had disbursed a cumulative EUR 10.4 million (USD 11.8 million) in grants for renewable energy projects in the focus countries of the Western Balkans, helping to install 90 MW of renewable power generation capacity.[82]

EMERGING OPPORTUNITIES FOR RENEWABLE ENERGY INVESTMENT

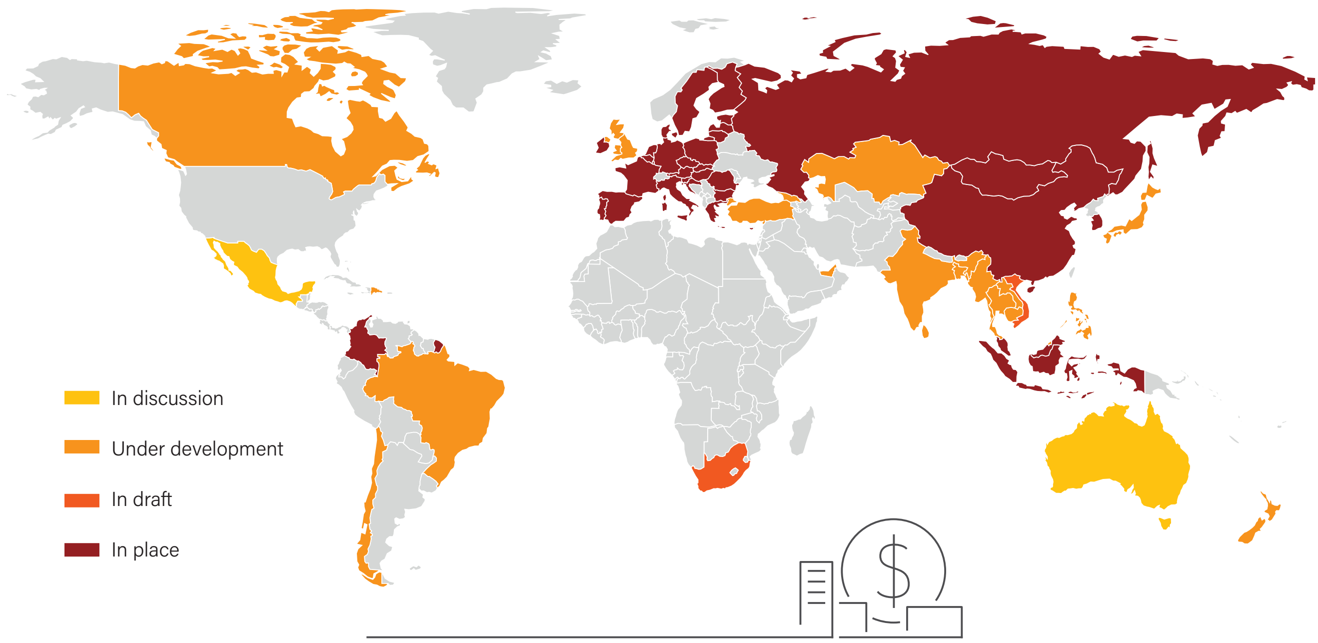
Sustainable Finance Taxonomies

The period 2017-2020 was dynamic for sustainable finance across the world. To leverage this investment and avoid greenwashing[x], some geographical jurisdictions and financial intermediaries have recognised the need to develop clearer classifications for sustainable finance. Following the EU's introduction of the Taxonomy on Sustainable Activities, several jurisdictions and financial organisations have adopted similar classifications, and many more countries were working to develop them *(→ see Figure 33)*.[83] The introduction of such taxonomies is expected to boost sustainable investment, including in renewables.

A sustainable finance taxonomy is a catalogue establishing a list of sustainable activities. It aims to help investors and companies make informed investment decisions, which governments would then ideally support and finance providers would finance. Classifications of sustainable finance range from more prescriptive approaches such as taxonomies, to less prescriptive ones such as guidance and principles. Such classifications could be applied or adopted by, for example, governments (e.g., China), industry associations, investors/financiers (e.g., the International Capital Market Association), think tanks (e.g., the Green Bond Initiative) and international financial institutions (e.g., the EBRD).

x Greenwashing refers to unsubstantiated claims about the environmental benefits of a product, service, technology or company practice.

FIGURE 33.
Sustainable Finance Taxonomies Worldwide, in Place, Under Development and in Discussion, Early 2022



Note: This figure is replicated from the REN21 *Renewables 2022 Global Status Report*.
Source: See endnote 83 for this chapter.

As of early 2022, two of the focus countries had introduced their own taxonomies, and two more had announced plans to do so. In September 2021, the Russian Federation adopted the taxonomy for green projects developed by the country's Ministry of Economic Development.[84] The taxonomy was accompanied by standards for green financial instruments and a methodology to verify the conformity of such instruments.[85] The taxonomy explicitly includes the construction and modernisation of generation facilities and auxiliary infrastructure using renewable energy sources and low-carbon fuels. The state-owned bank, Sberbank, began providing green loans compliant with the taxonomy in 2020, and by mid-2021 their volume had reached RUR 75 billion (USD 1.03 billion).[86] Sberbank and other public banks were expected to expand green lending and to buy bonds meeting the taxonomy criteria, while providing debt financing for green projects.[87]

In 2019, Georgia adopted the Roadmap for Sustainable Finance developed by the National Bank of Georgia.[88] In 2021, the National Bank of Ukraine announced that Ukraine also would develop and adopt a green taxonomy, although no progress was reported.[89] Also in 2021, Kazakhstan adopted the Classification of Green Projects that are eligible for financing through green bonds and green loans.[90]

Green Bonds

In general, loans, grants, and equity financing have been the main public financial instruments used to support renewable energy projects in the region, whereas loans and equity have tended to be the main private financial instruments. However, the issuance of green bonds has been used increasingly to support sustainable finance. Although green bonds are not yet the key instrument in these countries, stakeholder interviews suggest that they may become so soon.[91]

Globally, green bonds hit record levels for a second consecutive year in 2020, up 1.1% to reach USD 269.5 billion.[92] Rebounding in the second half of the year amid the COVID-19 pandemic, the green bonds market hit a milestone, exceeding a cumulative USD 1 trillion in issuance since the mechanism was created.[93] Of the seven countries worldwide that started issuing green bonds in 2020, three were in the focus region.[94] In Armenia and Kazakhstan, the issuers were financial sector institutions, whereas in Georgia they were non-financial corporates.[95] Several issuers in the Russian Federation also have issued green bonds since 2018, including a financial sector institution, a state-owned enterprise and a municipality of Moscow.[96] Cumulatively, green bonds helped raise USD 658 million for environmental projects in these four countries in 2020.[97]

Although the green bonds issued by the focus countries so far have not financed renewable energy projects, there are no obstacles to doing so. An IFC assessment noted good prospects for green bond markets in the region, based on the positive experience in 2020 with issuance in three new markets, along with efforts to create supportive policy environments.[98]

07 CURRENT THINKING ABOUT THE FUTURE OF RENEWABLES

Countries across the UNECE focus region hold significant potential for deploying renewables and improving energy efficiency *(→ see Chapters 2 and 5)*. Between 2017 and 2021, the region added substantially to its renewable energy capacity, which grew more than 25% during the period *(→ see Chapter 3)*. This was enabled by new renewable energy policies, the availability of financing from both international donors and domestic institutions, and the conducive global environment for renewables, particularly falling costs for solar PV and other technologies *(→ see Chapter 2)*.

This chapter presents an outlook for the future deployment of renewables in the focus countries, considering not only the positive global momentum and the consensus regarding the urgency and ambition of climate action and sustainable development more broadly, but also region-specific drivers, benefits, barriers and needs for the renewable energy sector. The chapter is based mainly on interviews with national and regional experts and reflects current perspectives on renewables in the countries, rather than evidence-based data and information.

DRIVERS

Climate Change

Decarbonisation of the energy sector is central to achieving net zero emissions by 2050, and renewable energy will play a key role in this process. In Eastern Europe and Central Asia, electricity generation and heat production were the largest sources of greenhouse gas emissions in 2019, accounting for nearly half of all energy-related CO_2 emissions.[1] Emissions from electricity and heat supply contributed 67%, of the total CO_2 emissions from fuels in Serbia, 64% in Bosnia and Herzegovina and 51% in Kazakhstan in 2019.[2] Thus, decarbonising energy production through the transition to renewables is critical for achieving emission reduction targets in line with the Paris Agreement.

According to the IEA's Net Zero Emission Pathway, annual installations of renewable electricity globally must triple by 2030 for the world to achieve net zero carbon emissions by 2050.[3] The focus region must align with this acceleration in renewable power to meet the global targets. In 2021, several countries in the region, notably the Russian Federation and Kazakhstan, announced ambitious renewable energy targets and carbon neutrality commitments. To meet their net zero carbon goals, countries have identified renewables as playing a key role *(→ see Chapter 2)*.

Renewable energy deployment in the focus countries is affected not only by their domestic and global climate targets and policies, but also by climate policies of other regions and countries. Especially affected are the countries - exporters of energy-intensive goods and services because they carry embodied energy and emissions of these goods on their balance *(→ see Chapter 1)*. The Carbon Border Adjustment Mechanism (CBAM) adopted by the European Union in 2021 aims to ensure fair competition between EU producers covered by the EU emission cap-and-trade regime and foreign producers, which are rarely covered by emission trading or equivalent policies. The CBAM will require from EU importers to buy carbon certificates corresponding to the carbon price that would have been paid, had the goods been produced in the EU. Should an EU importer be able to prove that it has already a price for greenhouse gases generated during the production of the imported goods in a home country, the corresponding cost can be deducted for the EU importer *(→ see Chapter 2)*. To avoid their companies' purchasing EU carbon certificates, the focus countries will introduce domestic emission trading schemes for affected companies or stimulate them to introduce measures for reducing carbon intensity of their products with other policies, with switch to renewable energy being one of key measures.

Energy Security

The climate change agenda is not the only factor influencing the deployment of renewables in the focus region. Despite having very different energy profiles, all of the countries prioritise energy security, especially given their large dependence on oil and natural gas. Whereas in some countries this dependence is deterring the shift to renewables, in others it is providing an important stimulus.

As discussed in Chapter 1, five of the focus countries were unable to meet their energy needs with domestic production as of 2019. Four countries were unable to produce even a third of their total energy supply domestically (in some cases far less): Armenia (27%), Georgia (21%), Belarus (17%) and Moldova (17%) *(→ see Chapter 1)*.[4] In 2019, all of the natural gas used in Moldova was imported, with 99% of it coming from the Russian Federation.[5] Around 66% of this gas went to the energy sector, to be converted into electricity and heat.[6] Renewable energy could help countries diversify their energy supply and protect against widely fluctuating natural gas and oil prices.

Energy security also is critical for countries that do not depend as heavily on imported hydrocarbons. Some countries in the focus region rely on only a single or very few energy carriers; in Albania, nearly all of the electricity generated domestically in 2019 was from hydropower.[7] Rising electricity demand has created competition between the country's energy-consuming sectors, such as industry and buildings, forcing the country to import electricity with higher carbon content. Even the Russian Federation, which may not be perceived as having energy security issues, faces challenges at the regional level, where delivering energy to remote, barely populated northern areas is often difficult and expensive. Thus, the exploration of local renewable energy sources offers an attractive solution.

Health and Air Quality

Air pollution (especially from particulate matter, nitrogen oxides and sulphur oxides) contributes to increased mortality, premature deaths, higher rates of chronic diseases and shorter life expectancy.[8] The focus region includes some of the most polluted spots in Europe, such as the Central Balkans, Eastern Ukraine and southern Central Asia.[9] Indoor and outdoor air pollution both play a role in the region's sub-optimal air quality, with the former caused by the use of inefficient heating and cooking fuels and equipment in households. Outdoor air pollution reflects, among others, the use of coal in the energy sector, the energy intensity of the economy, and the use of old and inefficient vehicles in transport. In some cases, topography prevents the dispersal of emissions, thus leaving them to concentrate near the source.

A study found that in 2019, levels of $PM_{2.5}$ in Eastern Europe exceeded the norm of "unhealthiness" for more than 100 days, compared to the EU average of 20 days.[10] This analysis does not include Central Asia, where the situation is often far worse. Increased public awareness about the links between fossil fuels and local air pollution, as well as between energy poverty (i.e., the use of inefficient, traditional bioenergy) and air pollution, may put greater pressure on governments to prioritise renewable energy deployment.

In Kazakhstan, air quality is a key driver of renewables. Because the country has among the world's largest reserves of coal, oil and natural gas, domestic energy shortage is not a major issue. But with around 70% of the electricity generated by coal plants, combined with the combustion of coal for winter heating, cities and towns suffer from air pollution and smog.[11] High levels of ambient air pollution contribute to more than 10,000 premature deaths annually across Kazakhstan, with costs of USD 10.5 billion.[12] The country is developing an integrated approach to both reducing air pollution and mitigating greenhouse gas emissions, building on a synergy of complementary measures.

Energy Poverty

As discussed in Chapter 4, many households across the focus region live in conditions that are below WHO standards for indoor comfort, as they are only able to afford space heating for one room and for very few hours per day.[13] Despite universal access to electricity across all focus countries, the power supply is not always reliable and/or sufficient to meet the demand.

Distributed renewable energy, especially electricity, remains a relatively unexplored niche in the region, due in part to the nearly 100% grid access and relatively low electricity tariffs. However, distributed renewables have gained momentum as policy makers and consumers realise the benefits for addressing not only energy security, but also the limitations of centralised power supply. In countries where the investment environment for utility-scale renewable energy projects is not favourable, individual producers can become pioneers in deployment.

Net metering, combined with concessional financing packages, are the main policy tools for promoting distributed renewables among households and small and medium-sized enterprises. So far, these instruments are found only in a few countries in the region, but as attention shifts from utility-scale generation, the focus on distributed renewables is expected to increase in the next decade.

MULTIPLE ASSOCIATED BENEFITS

Countries worldwide are increasingly recognising the multiple benefits of universal access to affordable, reliable and modern energy services; higher shares of renewables in the global energy mix; and improvements in energy efficiency. These are key components of the UN's Sustainable Development Goal 7 (SDG 7), which aims to ensure access to affordable, reliable, sustainable and modern energy for all[i]. Growing evidence points to the linkages between SDG 7 and other key UN goals, including sustainable economic development and job creation (SDG 8), poverty alleviation (SDG 1), greater gender equality (SDG 5) and reductions in inequality (SDG 10). Progress on SDG 7 can be seen as a means towards achieving the key co-benefits included in these goals, among others.

Job Creation

Globally, renewable energy employment has grown from 7 million in 2012 to 12 million in 2020.[14] This figure is expected to triple by 2050, in terms of both direct jobs related to the energy sector and indirect jobs, such as in energy technology production.[15]

Data on jobs in renewables in the focus region remain scarce. In Ukraine, around 25,000 people were employed in the solar PV sector in 2019.[16] Around one-third of these jobs were in rooftop solar PV, even though this sector accounts for only around 10-12% of the country's cumulative installed solar PV capacity.[17] This suggests a high labour intensity for rooftop solar, which policy makers could take into account when drafting support policies for microgeneration. In the Russian Federation, around 12,000 people were employed in the wind industry in 2019, while the hydropower sector provided 57,600 direct jobs.[18]

Job losses from the fossil fuel sector could be offset by gains in the renewable energy sector, including in fossil fuel exporting countries such as the Russian Federation.[19] With decarbonisation and the transition to clean energy, the biggest declines in employment are expected to occur in the extractive sector (i.e., coal mining and oil and gas extraction), while the biggest gains are foreseen in solar and wind technology manufacturing.[20] Efforts to achieve the Paris Agreement goal of keeping global temperature rise well below 2°C by 2050 could support replacing 80% of direct energy-related jobs with jobs in renewables.[21] This also highlights the importance of energy self-sufficiency and of domestic production and promotion of renewable energy equipment in fossil fuel-based economies.

Gender Equality

Transitioning to renewables can help narrow the gender gap in participation in the energy sector. According to IRENA, the share of women employed in the renewable energy sector is higher

i The 17 UN Sustainable Development Goals represent a universal call to action to end poverty, protect the planet, and improve the lives and prospects of all people. The goals were adopted in 2015 by the UN General Assembly, together with a 2030 Agenda for Sustainable Development that set up a 15-year plan to achieve the goals.

than in the oil and gas sector (32% versus 22%).[22] Still, women face numerous barriers to entering the energy sector, include lack of awareness, role models, information, advocacy, capacity building and training. For the focus countries to reach their full potential in the shift to renewables, they will need to boost the promotion of women in science, technology, engineering, and mathematics (STEM) fields as well as entrepreneurship and politics.

Gender issues in the energy sector should be mainstreamed across all dimensions of labour, including: engineering (utility companies), the public sector (ministries), construction, entrepreneurship and education. Ultimately, the absence of female representation in energy policy and decision making can be explained by the lack of women in energy engineering. This challenge is global and is usually tackled through the promotion of female student participation in STEM.

USAID has suggested that establishing better data collection on women's participation in the energy sector could bring forward the gender agenda.[23] In countries with large rural population shares, there is great potential to promote renewables at a smaller, decentralised scale. The renewable energy sector and off-grid energy development will have a great impact in improving energy access and job creation for the rural poor, as well as in climate change mitigation globally.

BARRIERS

Low Tariffs for Fossil-Based Energy

Energy tariffs for fossil fuel-based energy are an important determinant of the long-term success of renewables because they define the level of competitiveness of renewable energy installations. In most countries in the focus region, renewables still struggle to compete with conventional energy sources in the power and transport sectors without policy support, due to the difference in tariffs. Low tariffs for conventional energy also undermine efforts to reduce the energy intensity of different economic sectors because they lead to excess consumption.

This barrier applies to the entire focus region but is more pronounced in the post-Soviet countries, where electricity costs for households are less than USD 0.09 per kWh.[24] In the Balkan countries, electricity costs are generally higher. Governments can address the low-tariffs barrier by introducing market instruments that create enabling conditions for further deployment of renewables, making these sources more affordable and competitive. Conventional energy tariffs must be at a similar cost level with renewables. An overall increase in electricity tariffs leads to greater investments in energy equipment, such as grid modernisation and new power plants for balancing, both of which are highly relevant to the region.

Competition with Other Energy Sources

Realising the need for additional capacity to meet the growing demand for clean energy, several countries in the region – such as Belarus, Kazakhstan, the Russian Federation and Uzbekistan – have considered nuclear power as an alternative pathway for decarbonising the power sector.

In Belarus, the growth in renewables was stalled following the decision to build a nuclear power plant, which began operating in October 2020. The plant will contribute around 25% of the country's installed capacity and 50% of electricity generation and will produce excess power either for export or for domestic use.[25] Several support policies and other efforts have been implemented to electrify transport (electric vehicles) and buildings (electric appliances and heating), although the economic feasibility (the price of electric vehicles) and the technical feasibility (electrification of old buildings) are often sub-optimal for local consumers. This leaves renewables in the shadow of the nuclear plant, and further deployment of wind and solar energy can be expected only in the case of sustainable economic growth.

Uzbekistan, on the other hand, has gained momentum in renewable energy deployment and in creating a legal framework. It has stated its interest in achieving carbon neutrality and seems to consider nuclear power alongside renewable energy as a way to phase out fossil-based generation capacity. The constraint of investments in non-renewable sources may apply to many of the focus countries that have recently built or are planning additional power capacities (especially coal plants), including Bosnia and Herzegovina, Kazakhstan, Kosovo, the Russian Federation and Serbia.

Better data collection on **women's participation** in the energy sector could bring forward the gender agenda

Public Opposition

Raising awareness and understanding of renewable energy among the population may offer more space for such technologies to emerge in the public and political discourse. Without adequate understanding of the benefits and risks of renewable energy projects, they may face opposition from the public or local communities. Public opposition is particularly common around new hydropower plants being built in the focus countries.

During 2021, people rallied in Georgia against construction of the Namakhvani hydropower plant cascade in the western Rioni Valley.[26] Local residents and environmental activists have long expressed concerns about the plants' potential seismic and environmental risks. If built, the facility is expected to supply 12% of Georgia's domestic electricity demand.[27] In April 2021, the government announced a 9-12 month moratorium on construction to allow for more safety and feasibility research, although construction appeared to continue, prompting renewed, expanded protests.[28]

Such opposition could be overcome with recognised, science-based assessments of the environmental, social and economic sustainability of renewable energy projects. When results of assessments are embedded in national governance mechanisms, this can further build trust regarding appropriate policy decisions.

Investment Risks and Uncertainties

Renewable energy projects require long-term financial planning, which must be facilitated by policy to ensure the viability of projects. A common uncertainty is what will happen after the expiration of a project's power purchase agreement, which usually spans 12-25 years. One key to the long-term sustainability of the renewables market has been accurate planning and the setting-up of feed-in tariffs, as well as the transition to feed-in premiums once the market takes off. Kazakhstan underwent a smooth transition in this regard, leaving FITs only for small producers and rooftop generation, which later also was eliminated. In contrast, Ukraine was hit hard by the restructuring of FITs in 2019-2020 and was expected to see significant declines in renewable energy growth in coming years, even without the Russian invasion.

Uncertainties about local currencies also add risk for investors in renewable energy because of the sector's dependence on imported technologies. In addition, many countries access loans from international donors in US dollars, which can be subject to currency fluctuations. This commonly does not work in favour of an investor, thus creating a risk of higher-than-expected costs. Investors also bear additional risks, including construction delays, natural hazards, and political instability, with the latter having recently impacted renewable energy projects in Ukraine (see the next section).

OPPORTUNITIES AND NEEDS

Need for Balancing Capacity

Scaling up the deployment of renewables in the focus region may be constrained by the capacity of national power grids to integrate the increasing volumes of variable renewable electricity. Effective grid integration requires that countries modify their grid planning and operations to support more flexibility, enhanced market design, changes in reserves, faster dispatch, improved forecasting, and the addition of voltage control and inertial response capabilities, among other solutions. The ability of national grid operators to integrate variable renewables often is limited due to ageing infrastructure.

Another potential constraint to integrating variable renewable energy in national grids is the need to provide sufficient capacity to balance variable supply with demand, especially during peak hours. Balancing generation and consumption to ensure the energy security of a country is vital, and these processes must be performed over various time frames: hours, days and even years. When variable renewable energy is unavailable, it has to be balanced by other energy sources – hydropower or bioenergy – or stored for later use via energy storage technologies to support stable daily and seasonal energy consumption patterns.

Since it is impossible to precisely forecast the output from solar or wind energy, it is necessary to reserve some power for when less energy is produced from renewables than expected. Since energy storage technologies have yet to become cost effective in the focus region, and some countries do not have flexible hydropower capacities, they may face significant challenges with balancing electricity. This is particularly relevant in the long

term, since the region has yet to realise its renewable energy potential at scale.

In 2019, the electricity grid of Kazakhstan comprised 70% coal capacity, which was used mainly as a base load and thus was sub-optimal for balancing.[29] The system was balanced by the Russian energy system. As more renewable projects are commissioned in the focus region, the need for greater balancing capacity may increase dependency on the Russian Federation for energy supply. If not addressed, this constraint will become increasingly evident with greater deployment of renewables.

In the long run, renewables may limit the stability of national energy systems unless more investment is directed to so-called hybrid projects that incorporate new hydropower capacities and/or energy storage technologies. The costs associated with hybrid projects are usually borne by renewable energy investors and greatly increase a project's capital costs and payback periods; thus, hybrid projects are not commercially attractive without state support. The other option for reducing the demand for balancing capacities is decentralisation, or the promotion of distributed generation.

Another important aspect of energy planning and renewable energy integration is the life span of the existing power supply infrastructure. Renewables can be used to replace ageing infrastructure, such as fossil fuel power plants, and to diversify a country's energy portfolio. They also can provide additional capacity when the demand for electricity is rising due to economic growth, electrification of the economy, or other factors. The focus region mostly uses renewables to provide additional capacity to the grid. The average age of fossil fuel plants is generally longer than that of renewable energy installations, and lock-in can occur as new fossil plants are commissioned to add capacity.

Need for Domestic Technology Supply Chains

Only a few countries in the focus region have the industrial capacities to (at least partially) manufacture or assemble renewable energy technologies, including solar panels, wind turbines, efficient stoves and others. Most countries import these technologies, creating a situation where the deployment of renewables creates less economic value in the country. VAT exemptions play a significant role in reducing the capital expenditure of renewable energy projects; however, policy action also should be taken to promote local production of renewable energy equipment and to encourage project developers to use this local equipment.

The best practices for replication already exist in some countries. For example, Kazakhstan has experimented with promoting local producers through incentivised FITs for projects that use locally produced equipment.[30] The Russian Federation has been the region's biggest industry player in producing both solar and wind power equipment; its recently adopted renewable energy support programme 2.0 for the period 2024-2035 plans to create a sustainable technological cluster to provide for production, generation, education, and research and development focused on renewables.[31] The goal is to orient the industry not only to the domestic market, but also towards exports of renewable equipment equivalent to 1.4 GW of capacity per year.[32]

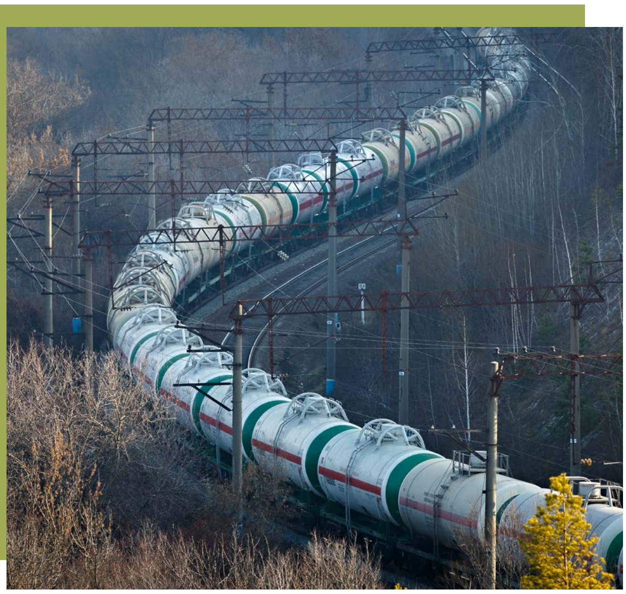
Need for Smart Policy Design and Implementation Capacities

Policy support is critical to unlock the focus region's renewable energy potential and to address barriers to deployment. However, policy support for renewables has not always been even and sufficient to spur market development, in particular in the heating and transport sectors *(→ see Chapter 2)*. Two key policy gaps are: 1) the absence or vagueness of national strategies and targets for renewable energy, which should address all relevant sub-sectors and which are critical for investor confidence, and 2) insufficient implementation capacities to make policies and regulations work.

The mere existence of laws does not lead to their implementation, as it can take a long time for countries to prepare bylaws and make policies operational. Several donors have sought to address this discrepancy by providing technical assistance support for renewable energy market development. For example, the USAID-funded Power for Future project in Central Asia helped countries with power sector planning, preparation of auctions, and grid-integration of renewables. The EBRD has provided technical assistance to many of the focus countries in setting up robust legal and regulatory frameworks for investments in renewables, and in preparing and implementing renewable energy auctions.

Countries participating in the EU's Energy Community Treaty have been obligated to submit action plans for renewables and energy efficiency, among other required steps. However, other countries in the region have not necessarily developed fundamental documents that envision the long-term development of renewables. In some countries, laws and strategies are adopted but with limited detail and ambition, no quantifiable targets, no bylaws or action plans, and time frames that are either too short or too long. This leaves potential investors with a range of uncertainties. Long-term planning should be considered an important milestone for the deployment of renewables and can help smooth their integration into conventional power grids.

Auctions can be an effective policy instrument to promote large-scale renewable energy projects, whereas FITs are more



appropriate for small-scale applications. FITs are not appropriate for new large projects, since by setting prices administratively governments bear significant risk of overpaying, and investors end up facing regulatory risk in the form of potential future restructuring. The success of auctions depends mostly on the underlying risk allocation of the support scheme (the split of risks between the state and investors) and on the auction design, in particular the selection criteria. Bearing this in mind would help countries avoid painful restructuring and destabilisation of the system, as occurred in Ukraine in 2019.

Across the focus region, gaps have been identified in the implementation of different policy support instruments for renewables, and in the overall efficiency of legislative frameworks. This challenge arises when incentives and support mechanisms exist in law but are not widely implemented or used. Identified gaps include the implementation of net metering and energy passports for buildings in Kazakhstan, as well as renewable energy auctions and certificates in Ukraine. Technical assistance from international development partners has been instrumental in helping to address these issues.

Countries that adopted renewable energy laws prior to 2010 appear to have made less overall progress with renewables than countries that created their legislation frameworks later. In the case of the Kyrgyz Republic, such laws were adopted before 2010, when renewables were attracting little interest in the region, and thus little effort was made to adopt secondary legislation and start implementation. In contrast, some countries (such as Azerbaijan), which for various reasons (e.g., institutional changes) only recently have realised the potential of renewable energy, have adopted laws and then drafted bylaws soon after, ensuring fast and effective implementation.

Post-COVID Agenda and Regional Co-operation

The economic crisis associated with the COVID-19 pandemic offers an opportunity to include renewable energy development in national recovery plans. This could bring numerous co-benefits, such as better health, new economic opportunities, additional jobs and improved energy security. Although the COVID-19 pandemic has had a positive impact on renewable energy investment in some countries of the world, this has not been the case in the focus region.[33] Interviews suggest that this is largely because these countries have not specifically supported such recovery measures.

Nonetheless, renewable energy capacity additions in the region in 2020 and 2021 were among the highest ever *(→ see Chapter 3)*. This could be due to a combination of factors, such as the overall positive policy environment *(→ see Chapter 2)* and the impact of international donors. Donor involvement has aimed to help countries not only recover and strengthen their economies after the pandemic but also focus on green energy development and sectoral growth.

In Central Asia, the World Bank has pursued plans for a resilient recovery, which prioritises investments that facilitate a green, climate-smart economic transition; strengthen, preserve, and leverage agriculture and natural capital for climate resilience; accelerate sustainable, integrated spatial development aligned to a green economy; and address fragility and exclusion so that the transition works for everyone.[34] UNDP initiated projects in Armenia, Georgia, Moldova, Ukraine, Uzbekistan and the Western Balkans that aim to mobilise investments in low-carbon energy solutions and help governments build green economies.[35]

At the time of writing this report, the focus region was dealing not only with COVID-19 recovery issues, but also with the escalation of conflict following the Russian Federation's invasion of Ukraine in February 2022[ii]. As of 16 June 2022, based on interviews with local experts, around 5% of the total power generation capacity of Ukraine had been destroyed.[36] Nearly all of the country's wind power capacity (90%) was out of operation[iii], as was more than 30% of its solar PV capacity and more than 50% of its thermal capacity.[37]

Much of the renewable energy capacity in Ukraine was added in the last five years and has not had a chance to amortise *(→ see Chapter 3)*. The Ukrainian Renewable Energy Association estimates that the total investment associated with this capacity is EUR 5 billion (USD 5.5 billion), or around 4% of the country's annual GDP.[38] In the near term, Ukraine may face challenges in sustaining its high share of the focus region's renewable energy production. As of 2021, Ukraine accounted for 30% of the wind power capacity in the focus countries and 60% of the solar PV capacity; this suggests that around a quarter of the region's total wind power capacity and a fifth of its total solar PV capacity have been affected.[39]

The good news is that some renewable energy technologies are more resilient to military attack than are conventional centralised energy supply systems.[40] The analysis of Ukraine's affected capacities revealed that when a solar PV plant is affected by an attack, the damaged section often can be localised in a day, so as not to affect the operation of the surviving equipment. This points to an additional advantage of renewable energy solutions that are built in sections, such as solar PV panels, solar thermal collectors and wind parks.

The security and political situations in Ukraine and the Russian Federation, which also have affected neighbouring countries and regions, could greatly undermine short-term investment prospects and thus the deployment of renewables. Moldova has reported a significant negative impact on its solar PV sector: whereas the country enjoyed a boom in new solar PV contracts during the first two months of 2022, starting in March this contracting either stopped completely or took much more time, driven by investor uncertainty at the international and local levels.[41]

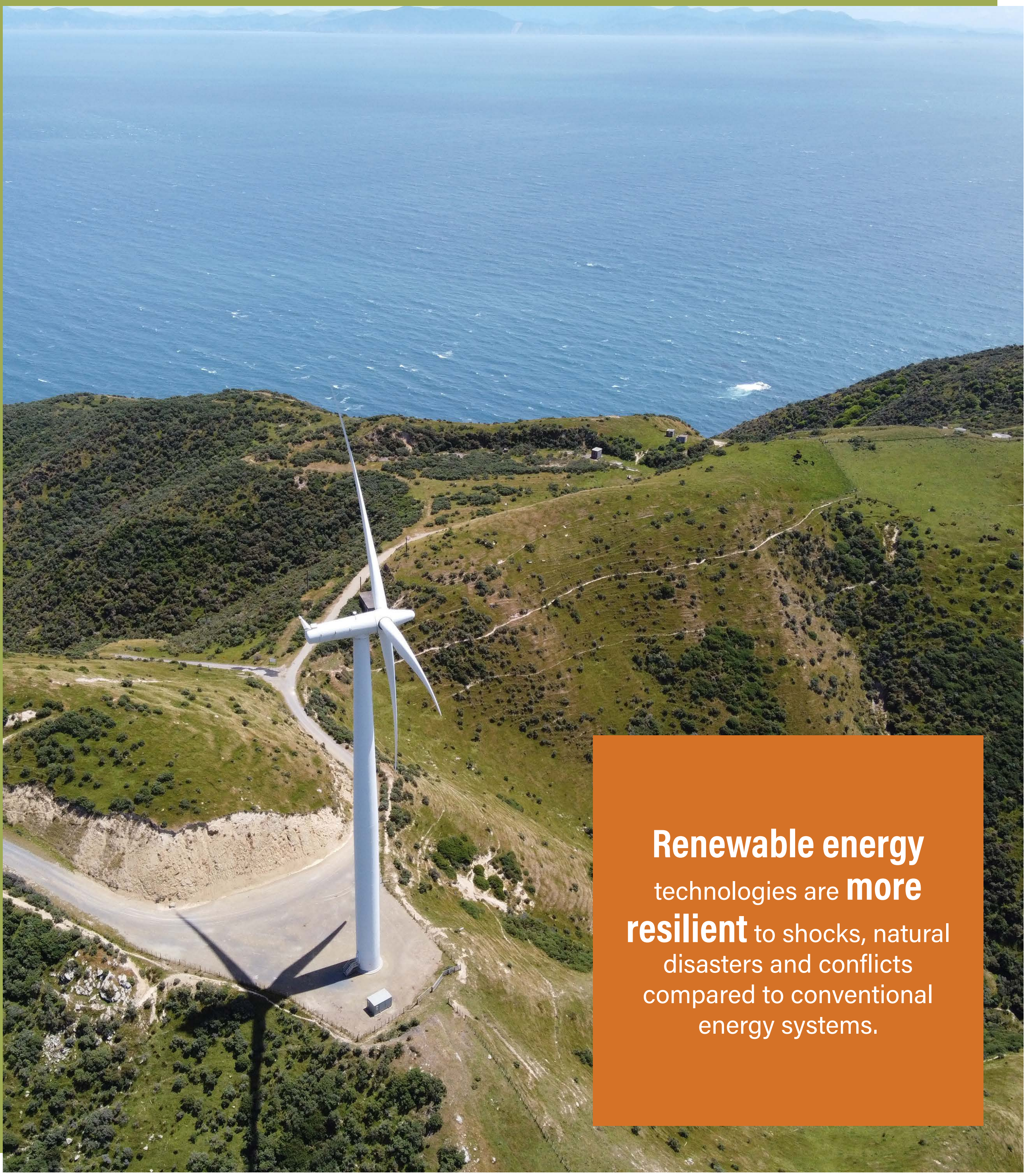
Over the long term, the actual and potential interruptions to the energy supply related to the conflict – including in natural gas, oil and electricity – make energy security an even more critical driver of renewables in the region. The conflict is likely to boost long-term renewable energy developments in both individual countries and regionally. Politicians, researchers and other experts interviewed across the focus region have indicated that

ii See footnote ii on page 19.

iii Thirty-eight of Ukraine's wind farms are located between Odesa and Luhansk, with the remaining four near the border with Poland.

these geopolitical events will facilitate the development of both renewables and energy efficiency, with a boom in prosumers and energy communities.[42]

In summary, when certain conditions are met – mainly grid capacity and a strong policy framework – renewables have proved effective in advancing countries' energy (and thus economic) security. They provide technological and fuel diversification of the energy portfolio, helping to reduce energy imports and reliance on imbalanced fossil fuel prices, ultimately reducing the risk profile of generation portfolios. Compared to other energy sources, renewables offer greater spatial diversity, making them more resilient to shocks such as natural disasters and conflict. Renewables also are more resilient to cyberattacks, a growing concern in the region.[43] Due to their modularity, renewable technologies can be deployed or replaced more rapidly than fossil fuel installations in response to threats or damage.[44]



DATA COLLECTION AND VALIDATION

REN21 has developed a unique renewable energy reporting culture, allowing it to become recognised as a neutral data and knowledge broker that provides credible and widely accepted information. Transparency is at the heart of the REN21 data and reporting culture, and the following text explains some of the report's key processes for data collection and validation.

DATA COLLECTION

The data collection process involves the following elements:

1. Open data collection. In the open data collection questionnaire, contributors from the focus countries and around the world submit data on renewable energy in their respective countries or countries of interest. This covers information on annual developments in renewable energy technologies, market trends, policies and local perspectives. The questionnaire also collects data related to energy access from respondents – with a focus on developing and emerging countries – on the status of electrification and clean cooking as well as policies and programmes for energy access and markets for distributed renewables. Each data point is provided with a source and verified independently by the REN21 team.

2. Sub-regional or country contributors. For such a regional report, REN21 appoints a principal data contributor to provide specific renewable energy data across different sectors and to share an overview of general trends and developments of renewables in the specific sub-region/country.

3. Peer review. To further collect data and project examples and to ensure that significant developments have not been overlooked, report contributors and reviewers participate in an open peer-review process. This occurred in June 2022 and included a review of the full draft report. Peer review is open to all interested experts.

4. Expert interviews. REN21's community consists of a wide range of professionals who provide their expert input on renewable energy trends in the target year through interviews and personal communication with the REN21 team and authors. The vast majority of the information is backed up by primary sources.

5. Desk research. To fill in remaining gaps in the report and to pursue new topics, the REN21 team and authors conduct extensive desk research. Topics of research depend on emerging topics, important trends and annual availability of formal or informal data in the target sector.

6. Data-sharing agreements. REN21 holds several data-sharing agreements with some of the largest and most reliable data providers/aggregators in the energy sector. These formal data are used exclusively in some cases or, in others, form the foundation of calculations and estimations presented in the report.

DATA VALIDATION

REN21 ensures the accuracy and reliability of its reports by conducting data validation and fact-checking as a continuous process. Beginning following the first submission of the country questionnaires, data are continually verified up through the design period and until the final report is published. All data provided by contributors, whether written or verbal, are validated by primary sources, which are published alongside the full report.

METHODOLOGICAL NOTES

The REN21 2022 UNECE Renewable Energy Status Report is the third edition for the UNECE region. In keeping with the objectives of previous REN21 regional reports, it provides an overview of the renewable energy status of 17 focus countries (plus Kosovo). These countries cover a vast territory that is rich in natural resources, including those suitable for most types of renewable energy technology. The report highlights the fronts on which progress is being made and attempts, through newly gathered data and information, to provide the knowledge that is needed to identify obstacles and to highlight opportunities to greatly increase renewable energy uptake in the region.

Most of the data for 2021 and 2022 on national and regional capacity, output, growth and investment provided in this report are preliminary. Where necessary, information and data that are conflicting, partial or older are reconciled using reasoned expert judgment. Endnotes provide additional details, including references, supporting information and assumptions where relevant.

The report draws from thousands of published and unpublished references, including: official government sources; reports from international organisations and industry associations; input from the REN21 community via hundreds of questionnaires submitted by country, regional and technology contributors as well as feedback from several rounds of formal and informal reviews; additional personal communications with scores of international experts; and a variety of electronic newsletters, news media and other sources.

Much of the data found in the report is built from the ground up by the authors with the aid of these resources. This often involves extrapolation of older data, based on recent changes in key countries within a sector or based on recent growth rates and regional trends. Other data, often very specific and narrow in scope, come more-or-less prepared from third parties. The report attempts to synthesise these data points into a collective whole for the focus year. The report endeavours to provide the best data available in each successive edition; as such, data should not be compared with previous versions of this report to ascertain year-by-year changes.

NOTES

» Editorial content of this report closed by 30 June 2022 for all data.

» Growth rates in the report are calculated as compound annual growth rates (CAGR) rather than as an average of annual growth rates.

» All exchange rates in this report are as of 31 December 2021 and are calculated using the OANDA currency converter (*http://www.oanda.com/currency/converter*).

» Corporate domicile, where noted, is determined by the location of headquarters

For extensive notes on establishing renewable energy shares of total final energy consumption (TFEC), and renewable energy capacities and energy output, see the Methodological Notes in REN21's Renewables 2022 Global Status Report (available at *www.ren21.net/gsr*).

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
CAREC	Central Asia Regional Economic Cooperation
CBAM	Carbon Border Adjustment Mechanism
CEB	Council of Europe Development Bank
CESEC	Central and South-Eastern Europe Gas Connectivity
CfD	Contract for difference
CHP	Combined heat and power
CIF	Climate Investment Funds
CTF	Clean Technology Fund
DAC	OECD Development Assistance Committee
dena	German Energy Agency (Deutsche Energie-Agentur)
DREA	Distributed renewables for energy access
E5P	Eastern Europe Energy Efficiency and Environment Partnership
EAC	East African Community
EAEU	Eurasian Economic Union
EBRD	European Bank for Reconstruction and Development
EEC	Eurasian Economic Commission
EED	Energy Efficiency Directive
EEO	Energy Efficiency Obligations
EIB	European Investment Bank
EPBD	Energy Performance of Buildings Directive
ESCO	Energy service company
ETS	Emission Trading System
EU	European Union
FIT	Feed-in tariff
HDI	Human Development Index
IBRD	International Bank for Reconstruction and Development
ICLEI	ICLEI – Local Governments for Sustainability
IDA	International Development Association
IEA	International Energy Agency
IFC	International Finance Corporation
IRENA	International Renewable Energy Agency
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GERE	Group of Experts on Renewable Energy
OECD	Organisation for Economic Co-operation and Development
NDC	Nationally Determined Contribution
NECP	National Energy and Climate Plan
NEEAP	National Energy Efficiency Action Plan
NEFCO	Nordic Environment Finance Corporation
NREAP	National Renewable Energy Action Plan
nZEB	Nearly zero energy building
PPA	Power purchase agreement
PPP	Purchasing power parity
PV	Photovoltaic
RCIF	Regional Cooperation and Integration Fund
RISE	Regulatory Indicators for Sustainable Energy
RUR	Russian ruble
SDG	Sustainable Development Goal
SEE CAO	Coordinated Action Office in Southeast Europe
SEforALL	Sustainable Energy for All
SREP	Strategic Climate Fund
TASF	Technical Assistance Special Fund
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	United States dollar
VAT	Value-added tax
WHO	World Health Organization

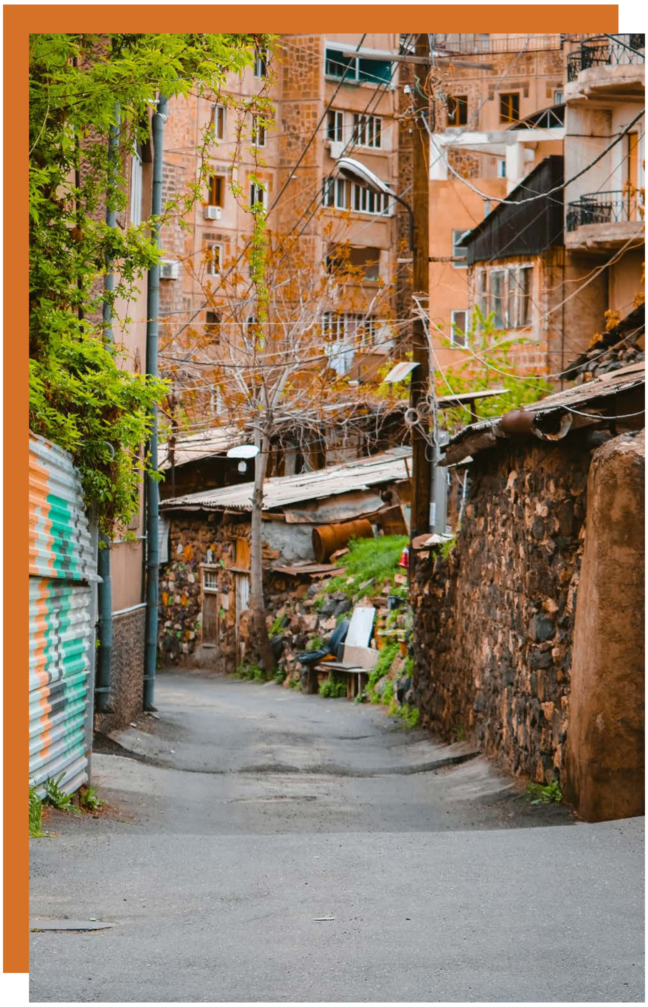
GLOSSARY

Auction. See Tendering.

Biodiesel. A fuel produced from oilseed crops such as soy, rapeseed (canola) and palm oil, and from other oil sources such as waste cooking oil and animal fats. Biodiesel is used in diesel engines installed in cars, trucks, buses and other vehicles, as well as in stationary heat and power applications. Most biodiesel is made by chemically treating vegetable oils and fats (such as palm, soy and canola oils, and some animal fats) to produce fatty acid methyl esters (FAME). (Also see Hydrotreated vegetable oil (HVO) and hydrotreated esters and fatty acids (HEFA).)

Bioenergy. Energy derived from any form of biomass (solid, liquid or gaseous) for heat, power and transport. (Also see Biofuel.)

Biofuel. A liquid or gaseous fuel derived from biomass, primarily ethanol, biodiesel and biogas. Biofuels can be combusted in vehicle engines as transport fuels and in stationary engines for heat and electricity generation. They also can be used for domestic heating and cooking (for example, as ethanol gels). Conventional biofuels are principally ethanol produced by fermentation of sugar or starch crops (such as wheat and corn), and FAME biodiesel produced from oil crops such as palm oil and canola and from waste oils and fats. Advanced biofuels are made from feedstocks derived from the lignocellulosic fractions of biomass sources or from algae. They are made using biochemical and thermochemical conversion processes, some of which are still under development.



Biogas/Biomethane. Biogas is a gaseous mixture consisting mainly of methane and carbon dioxide produced by the anaerobic digestion of organic matter (broken down by microorganisms in the absence of oxygen). Organic material and/or waste is converted into biogas in a digester. Suitable feedstocks include agricultural residues, animal wastes, food industry wastes, sewage sludge, purpose-grown green crops and the organic components of municipal solid wastes. Raw biogas can be combusted to produce heat and/or power. It also can be refined to produce biomethane.

Biomass. Any material of biological origin, excluding fossil fuels or peat, that contains a chemical store of energy (originally received from the sun) and that is available for conversion to a wide range of convenient energy carriers.

Biomass, traditional (use of). Solid biomass (including fuel wood, charcoal, agricultural and forest residues, and animal dung), that is used in rural areas of developing countries with traditional technologies such as open fires and ovens for cooking and residential heating. Often the traditional use of biomass leads to high pollution levels, forest degradation and deforestation.

Biomass energy, modern. Energy derived from combustion of solid, liquid and gaseous biomass fuels in high-efficiency conversion systems, which range from small domestic appliances to large-scale industrial conversion plants. Modern applications include heat and electricity generation, combined heat and power (CHP) and transport.

Biomass pellets. Solid biomass fuel produced by compressing pulverised dry biomass, such as waste wood and agricultural residues. Pellets typically are cylindrical in shape with a diameter of around 10 millimetres and a length of 30-50 millimetres. Pellets are easy to handle, store and transport and are used as fuel for heating and cooking applications, as well as for electricity generation and CHP. (Also see Torrefied wood.)

Building energy codes and standards. Rules specifying the minimum energy standards for buildings. These can include standards for renewable energy and energy efficiency that are applicable to new and/or renovated and refurbished buildings.

Capacity. The rated power of a heat or electricity generating plant, which refers to the potential instantaneous heat or electricity output, or the aggregate potential output of a collection of such units (such as a wind farm or set of solar panels). Installed capacity describes equipment that has been constructed, although it may or may not be operational (e.g., delivering electricity to the grid, providing useful heat or producing biofuels).

Capacity factor. The ratio of the actual output of a unit of electricity or heat generation over a period of time (typically one year) to the theoretical output that would be produced if the unit were operating without interruption at its rated capacity during the same period of time.

Capital subsidy. A subsidy that covers a share of the upfront capital cost of an asset (such as a solar water heater). These include, for example, consumer grants, rebates or one-time payments by a utility, government agency or government-owned bank.

Carbon intensity. Measure of carbon emitted by weight per megajoule of energy produced, or rate of produced greenhouse gas emissions to gross domestic product.

Carbon neutrality. The achievement of a state in which every tonne of carbon dioxide emitted to the atmosphere is compensated by an equivalent tonne removed (e.g., sequestered). Emissions can be compensated for by carbon offsets.

City. No international criteria or standards exist to determine what a city is. Most definitions of "cities" rely on settlement density and/or population numbers, although the criteria vary widely across countries. Generally, the term "urban area" refers to settlement areas that are more densely populated than suburban or peri-urban communities within the same metropolitan area. The term "city", meanwhile, has broader meanings: according to the United Nations, it can connote a political or civic entity, a geographic unit, a formalised economy or an infrastructure bundle. In some instances, local communities, neighbourhood associations, urban businesses and industries may be subsumed under the term "city". Throughout the GSR, municipal and city government refers to the local decision-making bodies and government authorities (the mayor's office, city council, etc.), unless noted otherwise. In addition to municipal governments, key city-level stakeholders include individual citizens, groups of citizens and private enterprises, as well as various civil society groups that are active within the city.

City-wide. Extending or happening in all parts of a city.

Combined heat and power (CHP) (also called co-generation). CHP facilities produce both heat and power from the combustion of fossil and/or biomass fuels, as well as from geothermal and solar thermal resources. The term also is applied to plants that recover "waste heat" from thermal power generation processes.

Community energy. An approach to renewable energy development that involves a community initiating, developing, operating, owning, investing and/or benefiting from a project. Communities vary in size and shape (e.g., schools, neighbourhoods, partnering city governments, etc.); similarly, projects vary in technology, size, structure, governance, funding and motivation.

Competitive bidding. See Tendering.

Conversion efficiency. The ratio between the useful energy output from an energy conversion device and the energy input into it. For example, the conversion efficiency of a PV module is the ratio between the electricity generated and the total solar energy received by the PV module. If 100 kilowatt-hours (kWh) of solar radiation is received and 10 kWh of electricity is generated, the conversion efficiency is 10%.

Curtailment. A reduction in the output of a generator, typically on an involuntary basis, from what it could produce otherwise given the resources available. Curtailment of electricity generation has long been a normal occurrence in the electric power industry and can occur for a variety of reasons, including a lack of transmission access or transmission congestion.

Demand-side management. The application of economic incentives and technology in the pursuit of cost-effective energy efficiency measures and load-shifting on the customer side, to achieve least-cost overall energy system optimisation.

Demand response. Use of market signals such as time-of-use pricing, incentive payments or penalties to influence end-user electricity consumption behaviours. Usually used to balance electrical supply and demand within a power system.

Digitalisation. The application of digital technologies across the economy, including energy.

Digitisation. The conversion of something (e.g., data or an image) from analogue to digital.

Distributed generation. Generation of electricity from dispersed, generally small-scale systems that are close to the point of consumption.

Distributed renewable energy. Energy systems are considered to be distributed if 1) the systems are connected to the distribution network rather than the transmission network, which implies that they are relatively small and dispersed (such as small-scale solar PV on rooftops) rather than relatively large and centralised; or 2) generation and distribution occur independently from a centralised network. Specifically for the purpose of the chapter on Distributed Renewables for Energy Access, "distributed renewable energy" meets both conditions. It includes energy services for electrification, cooking, heating and cooling that are generated and distributed independent of any centralised system, in urban and rural areas of the developing world.

Distribution grid. The portion of the electrical network that takes power off the high-voltage transmission network via sub-stations (at varying stepped-down voltages) and distributes electricity to customers.

Electric vehicle. Includes any road-, rail-, sea- and air- based transport vehicle that uses electric drive and can take an electric charge from an external source, or from hydrogen in the case of a fuel cell electric vehicle (FCEV). Electric road vehicles encompass battery electric vehicles (BEVs), plug-in hybrids (PHEVs) and FCEVs, all of which can include passenger vehicles (i.e., electric cars), commercial vehicles including buses and trucks, and two- and three-wheeled vehicles.

Energy. The ability to do work, which comes in a number of forms including thermal, radiant, kinetic, chemical, potential and electrical. Primary energy is the energy embodied in (energy potential of) natural resources, such as coal, natural gas and renewable sources. Final energy is the energy delivered for end-use (such as electricity at an electrical outlet). Conversion losses occur whenever primary energy needs to be transformed for final energy use, such as combustion of fossil fuels for electricity generation.

Energy audit. Analysis of energy flows in a building, process or system, conducted with the goal of reducing energy inputs into the system without negatively affecting outputs.

Energy conservation. Any change in behaviour of an energy-consuming entity for the specific purpose of affecting an energy demand reduction. Energy conservation is distinct from energy efficiency in that it is predicated on the assumption that an otherwise preferred behaviour of greater energy intensity is abandoned. (See Energy efficiency and Energy intensity.)

Energy efficiency. The measure that accounts for delivering more services for the same energy input, or the same amount of services for less energy input. Conceptually, this is the reduction of losses from the conversion of primary source fuels through final energy use, as well as other active or passive measures to reduce energy demand without diminishing the quality of energy services delivered. Energy efficiency is technology-specific and distinct from energy conservation, which pertains to behavioural change. Both energy efficiency and energy conservation can contribute to energy demand reduction.

Energy intensity. Primary energy consumption per unit of economic output. Energy intensity is a broader concept than energy efficiency in that it is also determined by non-efficiency variables, such as the composition of economic activity. Energy intensity typically is used as a proxy for energy efficiency in macro-level analyses due to the lack of an internationally agreed-upon high-level indicator for measuring energy efficiency.

Energy service company (ESCO). A company that provides a range of energy solutions including selling the energy services from a (renewable) energy system on a long-term basis while retaining ownership of the system, collecting regular payments from customers and providing necessary maintenance service. An ESCO can be an electric utility, co-operative, non-governmental organisation or private company, and typically installs energy systems on or near customer sites. An ESCO also can advise on improving the energy efficiency of systems (such as a building or an industry) as well as on methods for energy conservation and energy management.

Energy subsidy. A government measure that artificially reduces the price that consumers pay for energy or that reduces energy production cost.

Energy sufficiency. Entails a change or shift in actions and behaviours (at the individual and collective levels) in the way energy is used. Results in access to energy for everyone while limiting the impacts of energy use on the environment. For example, avoiding the use of cars and spending less time on electrical devices.

Ethanol (fuel). A liquid fuel made from biomass (typically corn, sugar cane or small cereals/grains) that can replace petrol in modest percentages for use in ordinary spark-ignition engines (stationary or in vehicles), or that can be used at higher blend levels (usually up to 85% ethanol, or 100% in Brazil) in slightly modified engines, such as those provided in "flex-fuel" vehicles. Ethanol also is used in the chemical and beverage industries.

Feed-in policy (feed-in tariff or feed-in premium). A policy that typically guarantees renewable generators specified payments per unit (e.g., USD per kWh) over a fixed period. Feed-in tariff (FIT) policies also may establish regulations by which generators can interconnect and sell power to the grid. Numerous options exist for defining the level of incentive, such as whether the payment is structured as a guaranteed minimum price (e.g., a FIT), or whether the payment floats on top of the wholesale electricity price (e.g., a feed-in premium).

Final energy. The part of primary energy, after deduction of losses from conversion, transmission and distribution, that reaches the consumer and is available to provide heating, hot water, lighting and other services. Final energy forms include, among others, electricity, district heating, mechanical energy, liquid hydrocarbons such as kerosene or fuel oil, and various gaseous fuels such as natural gas, biogas and hydrogen.

(Total) Final energy consumption (TFEC). Energy that is supplied to the consumer for all final energy services such as transport, cooling and lighting, building or industrial heating or mechanical work. Differs from total final consumption (TFC), which includes all energy use in end-use sectors (TFEC) as well as for non-energy applications, mainly various industrial uses, such as feedstocks for petrochemical manufacturing.

Fiscal incentive. An incentive that provides individuals, households or companies with a reduction in their contribution to the public treasury via income or other taxes.

Generation. The process of converting energy into electricity and/or useful heat from a primary energy source such as wind, solar radiation, natural gas, biomass, etc.

Geothermal energy. Heat energy emitted from within the earth's crust, usually in the form of hot water and steam. It can be used to generate electricity in a thermal power plant or to provide heat directly at various temperatures.

Green bond. A bond issued by a bank or company, the proceeds of which will go entirely into renewable energy and other environmentally friendly projects. The issuer will normally label it as a green bond. There is no internationally recognised standard for what constitutes a green bond.

Green building. A building that (in its construction or operation) reduces or eliminates negative impacts and can create positive impacts on the climate and natural environment. Countries and regions have a variety of characteristics that may change their strategies for green buildings, such as building stock, climate, cultural traditions, or wide-ranging environmental, economic and social priorities – all of which shape their approach to green building.

Green energy purchasing. Voluntary purchase of renewable energy – usually electricity, but also heat and transport fuels – by residential, commercial, government or industrial consumers, either directly from an energy trader or utility company, from a third-party renewable energy generator or indirectly via trading of renewable energy certificates (such as renewable energy credits, green tags and guarantees of origin). It can create additional demand for renewable capacity and/or generation, often going beyond that resulting from government support policies or obligations.

Heat pump. A device that transfers heat from a heat source to a heat sink using a refrigeration cycle that is driven by external electric or thermal energy. It can use the ground (geothermal/ground-source), the surrounding air (aerothermal/air-source) or a body of water (hydrothermal/water-source) as a heat source in heating mode, and as a heat sink in cooling mode. A heat pump's final energy output can be several multiples of the energy input, depending on its inherent efficiency and operating condition. The output of a heat pump is at least partially renewable on a final energy basis. However, the renewable component can be much lower on a primary energy basis, depending on the composition and derivation of the input energy; in the case of electricity, this includes the efficiency of the power generation process. The output of a heat pump can be fully renewable energy if the input energy is also fully renewable.

Hydropower. Electricity derived from the potential energy of water captured when moving from higher to lower elevations. Categories of hydropower projects include run-of-river, reservoir-based capacity and low-head in-stream technology (the least developed). Hydropower covers a continuum in project scale from large (usually defined as more than 10 megawatts (MW) of installed capacity, but the definition varies by country) to small, mini, micro and pico.

Investment. Purchase of an item of value with an expectation of favourable future returns. In the GSR, new investment in renewable energy refers to investment in: technology research and development, commercialisation, construction of manufacturing facilities and project development (including the construction of wind farms and the purchase and installation of solar PV systems). Total investment refers to new investment plus merger and acquisition (M&A) activity (the refinancing and sale of companies and projects).

Joule. A joule (J) is a unit of work or energy equal to the work done by a force equal to one newton acting over a distance of one metre. One joule is equal to one watt-second (the power of one watt exerted over the period of one second). The potential chemical energy stored in one barrel of oil and released when combusted is approximately 6 gigajoules (GJ); a tonne of oven-dry wood contains around 20 GJ of energy.

Levelised cost of energy/electricity (LCOE). The cost per unit of energy from an energy generating asset that is based on the present value of its total construction and lifetime operating costs, divided by total energy output expected from that asset over its lifetime.

Long-term strategic plan. A strategy to achieve energy savings over a specified period of time (i.e., several years), including specific goals and actions to improve energy efficiency, typically spanning all major sectors.

Mandate/Obligation. A measure that requires designated parties (consumers, suppliers, generators) to meet a minimum – and often gradually increasing – standard for renewable energy (or energy efficiency), such as a percentage of total supply, a stated amount of capacity, or the required use of a specified renewable technology. Costs generally are borne by consumers. Mandates can include renewable portfolio standards (RPS); building codes or obligations that require the installation of renewable heat or power technologies (often in combination with energy efficiency investments); renewable heat purchase requirements; and requirements for blending specified shares of biofuels (biodiesel or ethanol) into transport fuel.

Market concession model. A model in which a private company or non-governmental organisation is selected through a competitive process and given the exclusive obligation to provide energy services to customers in its service territory, upon customer request. The concession approach allows concessionaires to select the most appropriate and cost-effective technology for a given situation.

Mini-grid / Micro-grid. For distributed renewable energy systems for energy access, a mini-grid/micro-grid typically refers to an independent grid network operating on a scale of less than 10 MW (with most at very small scale) that distributes electricity to a limited number of customers. Mini-/micro-grids also can refer to much larger networks (e.g., for corporate or university campuses) that can operate independently of, or in conjunction with, the main power grid. However, there is no universal definition differentiating mini- and micro-grids.

Monitoring. Energy use is monitored to establish a basis for energy management and to provide information on deviations from established patterns.

Municipal operations. Services or infrastructure that are owned and/or operated by municipal governments. This may include municipal buildings and transport fleets (such as buses, policy vehicles and refuse collection trucks).

Municipal solid waste. Waste materials generated by households and similar waste produced by commercial, industrial or institutional entities. The wastes are a mixture of renewable plant and fossil-based materials, with the proportions varying depending on local circumstances. A default value that assumes that at least 50% of the material is "renewable" is often applied.

Net metering / Net billing. A regulated arrangement in which utility customers with on-site electricity generators can receive credits for excess generation, which can be applied to offset consumption in other billing periods. Under net metering, customers typically receive credit at the level of the retail electricity price. Under net billing, customers typically receive credit for excess power at a rate that is lower than the retail electricity price. Different jurisdictions may apply these terms in different ways, however.

Net zero. Net zero emissions refers to achieving an overall balance between greenhouse gas emissions produced and greenhouse gas emissions emitted from the atmosphere. The concept involves equating the quantity of gases such as carbon dioxide, methane, nitrous oxide that are released into the atmosphere due to human-induced activities and cause the greenhouse effect, with the quantity of greenhouse gases that are naturally absorbed by the earth.

Net zero carbon building / Net zero energy building / Nearly zero energy building. Various definitions have emerged of buildings that achieve high levels of energy efficiency and meet remaining energy demand with either on-site or off-site renewable energy. For example, the World Green Building Council's Net Zero Carbon Buildings Commitment considers use of renewable energy as one of five key components that characterise a net zero building. Definitions of net zero carbon, net zero energy and nearly zero energy buildings can vary in scope and geographic relevance.

Off-take agreement. An agreement between a producer of energy and a buyer of energy to purchase/sell portions of the producer's future production. An off-take agreement normally is negotiated prior to the construction of a renewable energy project or installation of renewable energy equipment in order to secure a market for the future output (e.g., electricity, heat). Examples of this type of agreement include power purchase agreements and feed-in tariffs.

Off-taker. The purchaser of the energy from a renewable energy project or installation (e.g., a utility company) following an off-take agreement. (See Off-take agreement.)

Pico solar devices / pico solar systems. Small solar systems such as solar lanterns that are designed to provide only a limited amount of electricity service, usually lighting and in some cases mobile phone charging. Such systems are deployed mainly in areas that have no or poor access to electricity. The systems usually have a power output of 1-10 watts and a voltage of up to 12 volts.

Power. The rate at which energy is converted into work, expressed in watts (joules/second).

Power purchase agreement (PPA). A contract between two parties, one that generates electricity (the seller) and one that is looking to purchase electricity (the buyer).

Primary energy. The theoretically available energy content of a naturally occurring energy source (such as coal, oil, natural gas, uranium ore, geothermal and biomass energy, etc.) before it undergoes conversion to useful final energy delivered to the end-user. Conversion of primary energy into other forms of useful final energy (such as electricity and fuels) entails losses. Some primary energy is consumed at the end-user level as final energy without any prior conversion.

Primary energy consumption. The direct use of energy at the source, or supplying users with unprocessed fuel.

Product and sectoral standards. Rules specifying the minimum standards for certain products (e.g., appliances) or sectors (industry, transport, etc.) for increasing energy efficiency.

Prosumer. An individual, household or small business that not only consumes energy but also produces it. Prosumers may play an active role in energy storage and demand-side management.

Public financing. A type of financial support mechanism whereby governments provide assistance, often in the form of grants or loans, to support the development or deployment of renewable energy technologies.

Regulatory policy. A rule to guide or control the conduct of those to whom it applies. In the renewable energy context, examples include mandates or quotas such as renewable portfolio standards, feed-in tariffs and technology/fuel-specific obligations.

Sector integration (also called sector coupling). The integration of energy supply and demand across electricity, thermal and transport applications, which may occur via co-production, combined use, conversion and substitution.

Smart energy system. An energy system that aims to optimise the overall efficiency and balance of a range of interconnected energy technologies and processes, both electrical and non-electrical (including heat, gas and fuels). This is achieved through dynamic demand- and supply-side management; enhanced monitoring of electrical, thermal and fuel-based system assets; control and optimisation of consumer equipment, appliances and services; better integration of distributed energy (on both the macro and micro scales); and cost minimisation for both suppliers and consumers.

Smart grid. Electrical grid that uses information and communications technology to co-ordinate the needs and capabilities of the generators, grid operators, end-users and electricity market stakeholders in a system, with the aim of operating all parts as efficiently as possible, minimising costs and environmental impacts and maximising system reliability, resilience and stability.

Smart grid technology. Advanced information and control technology that is required for improved systems integration and resource optimisation on the grid.

Smart inverter. An inverter with robust software that is capable of rapid, bidirectional communications, which utilities can control remotely to help with issues such as voltage and frequency fluctuations in order to stabilise the grid during disruptive events.

Solar collector. A device used for converting solar energy to thermal energy (heat), typically used for domestic water heating but also used for space heating, for industrial process heat or to drive thermal cooling machines. Evacuated tube and flat plate collectors that operate with water or a water/glycol mixture as the heat-transfer medium are the most common solar thermal collectors used worldwide. These are referred to as glazed water collectors because irradiation from the sun first hits a glazing (for thermal insulation) before the energy is converted to heat and transported away by the heat transfer medium. Unglazed water collectors, often referred to as swimming pool absorbers, are simple collectors made of plastics and used for lower-temperature applications. Unglazed and glazed air collectors use air rather than water as the heat-transfer medium to heat indoor spaces or to pre-heat drying air or combustion air for agriculture and industry purposes.

Solar cooker. A cooking device for household and institutional applications that converts sunlight to heat energy that is retained for cooking. There are several types of solar cookers, including box cookers, panel cookers, parabolic cookers, evacuated tube cookers and trough cookers.

Solar photovoltaics (PV). A technology used for converting light directly into electricity. Solar PV cells are constructed from semiconducting materials that use sunlight to separate electrons from atoms to create an electric current. Modules are formed by interconnecting individual cells. Building-integrated PV (BIPV) generates electricity and replaces conventional materials in parts of a building envelope, such as the roof or facade.

Solar water heater (SWH). An entire system consisting of a solar collector, storage tank, water pipes and other components. There are two types of solar water heaters: pumped solar water heaters use mechanical pumps to circulate a heat transfer fluid through the collector loop (active systems), whereas thermosyphon solar water heaters make use of buoyancy forces caused by natural convection (passive systems).

Storage battery. A type of battery that can be given a new charge by passing an electric current through it. A lithium-ion battery uses a liquid lithium-based material for one of its electrodes. A lead-acid battery uses plates made of pure lead or lead oxide for the electrodes and sulphuric acid for the electrolyte, and remains common for off-grid installations. A flow battery uses two chemical components dissolved in liquids contained within the system and most commonly separated by a membrane. Flow batteries can be recharged almost instantly by replacing the electrolyte liquid, while simultaneously recovering the spent material for re-energisation.

Target. An official commitment, plan or goal set by a government (at the local, state, national or regional level) to achieve a certain amount of renewable energy or energy efficiency by a future date. Targets may be backed by specific compliance mechanisms or policy support measures. Some targets are legislated, while others are set by regulatory agencies, ministries or public officials.

Tender (also called auction / reverse auction or tender). A procurement mechanism by which renewable energy supply or capacity is competitively solicited from sellers, who offer bids at the lowest price that they would be willing to accept. Bids may be evaluated on both price and non-price factors.

Transmission grid. The portion of the electrical supply distribution network that carries bulk electricity from power plants to sub-stations, where voltage is stepped down for further distribution. High-voltage transmission lines can carry electricity between regional grids in order to balance supply and demand.

Variable renewable energy. A renewable energy source that fluctuates within a relatively short time frame, such as wind and solar energy, which vary within daily, hourly and even sub-hourly time frames. By contrast, resources and technologies that are variable on an annual or seasonal basis due to environmental changes, such as hydropower (due to changes in rainfall) and thermal power plants (due to changes in temperature of ambient air and cooling water), do not fall into this category.

Voltage and frequency control. The process of maintaining grid voltage and frequency stable within a narrow band through management of system resources.

Watt. A unit of power that measures the rate of energy conversion or transfer. A kilowatt is equal to 1 thousand watts; a megawatt to 1 million watts; and so on. A megawatt-electrical (MWe) is used to refer to electric power, whereas a megawatt-thermal (MWth) refers to thermal/heat energy produced. Power is the rate at which energy is consumed or generated. A kilowatt-hour is the amount of energy equivalent to steady power of 1 kW operating for one hour.

ENDNOTES

01 REGIONAL INTRODUCTION

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REN21 Secretariat
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