UNECE

REN21 Renewable Energy Policy Network for the 21st Century

UNECE RENEWABLE ENERGY STATUS REPORT

2017

PARTNER ORGANISATIONS

The United Nations Economic Commission for Europe (UNECE) was set up in 1947 by ECOSOC.

UNECE's major aim is to promote pan-European economic integration. To do so, it brings together 56 countries located in the European Union, non-EU Western and Eastern Europe, South East Europe and the Commonwealth of Independent States (CIS) and North America. All of these countries dialogue and cooperate under the aegis of UNECE on economic and sectoral issues. However, all interested United Nations member States may participate in the work of UNECE. Over 70 international professional organizations and other non-governmental organizations take part in UNECE activities.

REN21 is the global renewable energy policy multi-stakeholder network that connects a wide range of key actors. REN21's goal is to facilitate knowledge exchange, policy development and joint actions towards a rapid global transition to renewable energy.

REN21 brings together governments, non-governmental organisations, research and academic institutions, international organisations and industry to learn from one another and build on successes that advance renewable energy. To assist policy decision making, REN21 provides high-quality information, catalyses discussion and debate and supports the development of thematic networks.

SUPPORTED BY

The International Energy Agency (IEA) provided invaluable co-operation in verifying data and conducting analysis on countries' energy situations in this report.

The IEA is an autonomous organisation which works to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA has four main areas of focus: energy security, economic development, environmental awareness and engagement worldwide.

Bloomberg New Energy Finance (BNEF) drew from its global dataset to provide crucial data on renewable energy investment in the covered countries.

BNEF has 200 staff based in London, New York, Beijing, Cape Town, Hong Kong, Munich, New Delhi, San Francisco, São Paulo, Singapore, Sydney, Tokyo, Washington, D.C. and Zurich and provides unique analysis, tools and data for decision makers driving change in the energy system.

Revelle Group is a consulting company working in developing countries and emerging economies in three key sectors: energy and climate change, environment, and sustainable economic and social development. As a cross-cutting service, we also provide tailored outreach and communication activities across all sectors of our work. Revelle's core business is devoted to public sector consulting for large institutional clients and donors such as the European Commission, EBRD, World Bank, UNECE, ADB, etc. Revelle is expanding its service offering to private sector clients that are interested in taking advantage of the emerging opportunities in sustainable energy in developing and emerging economies.

Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

We would like to thank UNECE, the Federal Ministry for Economic Affairs and Energy of Germany (BMWi), the International Energy Agency and all partners involved for the excellent collaboration throughout the production of this report

FOREWORD

Offering reliable, affordable and sustainable energy in the future energy system of the eastern reaches of the UNECE region remains a challenge, but even more so it represents an opportunity. Investments in renewable energy in the eastern reaches of the UNECE region in 2015 amounted to USD 400 million, less than 0.2% of the global total. In 2014, investments were USD 700 million, 0.5% of the global total. These are the critical findings of the second report produced by UNECE and REN21 on the status of renewable energy in 17 countries in South East and Eastern Europe, the Caucasus, Central Asia and the Russian Federation.

Once again, the joint report demonstrates that the 17 countries, home to more than 300 million people, lag in global developments both technically and financially despite significant untapped renewable energy resources. This high renewable energy potential, as well as the intention of all countries to substantially increase the deployment of renewable energy, suggests that fundamental changes are about to occur. Knowing the renewable energy status of these countries – as outlined in detail in this report – allows all stakeholders to have a better understanding of the situation and to undertake actions to speed change. The report enshrines the vision for renewable energy playing a key role in the UNECE region.

This report informs policies and programmes that support renewable energy investment with a view towards enabling cost-effective deployment of renewables within future energy systems. It is intended to support the countries of the region as they work to attain the objectives of the 2030 Agenda for Sustainable Development. In addition to monitoring progress, the report identifies major barriers to the expansion of renewable energy capacity in the region and proposes solutions built on a constructive dialogue among all stakeholders.

UNECE would like to thank the German Federal Ministry for Economic Affairs and Energy (BMWi) for its support, which allowed fruitful collaboration with the Renewable Energy Policy Network for the 21st Century (REN21) and the International Energy Agency. The preparation of this report benefited from the support of the UNECE Group of Experts on Renewable Energy, particularly in gathering country data and information and interpreting key messages with a national relevance.

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

After a very successful collaboration on the first edition of the REN21 UNECE *Renewable Energy Status Report* in 2015, REN21 and the United Nations Economic Commission for Europe (UNECE) have joined forces once more to produce the latest *UNECE Renewable Energy Status Report 2017*. It covers 17 selected UNECE member countries and forms part of a series of regional reports that REN21 has developed.

The report provides updated data for the Russian Federation as well as for countries in South East and Eastern Europe, the Caucasus and Central Asia, which face some common challenges as they advance in deploying renewable energy and improving energy efficiency. The *UNECE Renewable Energy Status Report 2017* puts a renewed spotlight on this highly promising region to foster further regional activity in renewable energy as well as in the energy efficiency sector.

Renewable energy continued to expand globally in 2016 with record renewable capacity being commissioned against the backdrop of rising worldwide energy consumption – particularly in developing countries and emerging economies. Global new investment in renewable power and fuels amounted to USD 242 billion.

While more than 2 GW of renewable power was added in 2016 (581 MW for non-hydro renewable energy), the full renewable energy potential in the region is still far from being reached. Despite a total population of 300 million, the selected 17 UNECE countries still represent only a fraction of global investment in renewable energy in 2016. Modern renewables are uniquely positioned to provide needed energy services in a sustainable manner, more rapidly and generally at lower cost than fossil fuels. Their potential in South East and Eastern Europe, the Caucasus, the Russian Federation and Central Asia remains very significant.

REN21 is committed to tracking the development of renewables worldwide. In addition to its annual flagship publication, the *Renewables Global Status Report*, REN21 works with regional partners to shed further light on renewables development in different world regions. The *UNECE Renewable Energy Status Report 2017* complements earlier regional status reports on China, India, and the EAC, ECOWAS, MENA and SADC regions.

Launched at the Eighth International Forum on Energy for Sustainable Development in Astana, Kazakhstan, this report will help raise awareness about the extraordinary potential of renewable energy and energy efficiency in the UNECE region. It also will be useful for subsequent activities of UNECE and its partners, serving as an updated baseline for renewable energy and energy efficiency in the region.

We would like to thank UNECE, the Federal Ministry for Economic Affairs and Energy of Germany (BMWi), the International Energy Agency and all partners involved for the excellent collaboration throughout the production of this report. We hope that you find the information contained in this report informative.

Christine Lins
Executive Secretary
Renewable Energy Policy Network for the 21st Century (REN21)

> LAUNCHED AT THE EIGHTH INTERNATIONAL FORUM ON ENERGY FOR SUSTAINABLE DEVELOPMENT IN ASTANA, KAZAKHSTAN, THIS REPORT WILL HELP RAISE AWARENESS ABOUT THE EXTRAORDINARY POTENTIAL OF RENEWABLE ENERGY AND ENERGY EFFICIENCY IN THE UNECE REGION. IT ALSO WILL BE USEFUL FOR SUBSEQUENT ACTIVITIES OF UNECE AND ITS PARTNERS, SERVING AS AN UPDATED BASELINE FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY IN THE REGION.

ACKNOWLEDGEMENTS

This report was commissioned by the United Nations Economic Commission for Europe. Its production was co-ordinated by REN21 in collaboration with a wide network of partner institutions and individuals. Financial support was provided by GIZ. Over 50 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.

REN21 PROJECT MANAGEMENT:

Martin Hullin (REN21 Secretariat)

UNECE PROJECT MANAGEMENT:

Gianluca Sambucini (UNECE)
Lisa Tinschert (UNECE)

LEAD AUTHOR:

Katarina Uherova Hasbani (Revelle Group)

SUPPLEMENTARY AUTHORSHIP AND PROJECT TEAM:

Martina Repikova (Consultant)
Sandra Chavez (Consultant)
Vassilis Triantafillos (Revelle Group)
Elena Nikitina (Revelle Group)
Elisa Asmelash (Revelle Group)

CONTRIBUTORS AND REVIEWERS:

Albania: Lira Hakani (SEE SEP project), Artan Leskoviku (National Agency of Natural Resources)

Armenia: Levon Vardanyan (local co-ordinating contributor)

Azerbaijan: Rauf Gurbanov, Parvin Mammadzada, Turkay Gasimzade (State Agency on Alternative and Renewable Energy Sources of Azerbaijan), Jahangir Afandiyev (local co-ordinating contributor), Nazir Ramazanov (State Agency on Alternative and Renewable Energy Sources)

Belarus: Hanna Berazanskaya (Scientific Research and Project Republican Unitary Enterprise, Belarusian Heat and Power Institute (RUE BELTEI), Vladimir Zui (professor), Minenkov Andrey Vladimirovich (State Committee for Standardization of the Republic of Belarus)

Bosnia and Herzegovina: Eldar Hukić (Regulatory Commission for Energy in the Federation of Bosnia and Herzegovina (BiH)), Slađana Božić (Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina), Kafedžić Jasmina (Environmental Fund of the Federation of BIH), Ratković Željko (MH ERS Trebinje)

Georgia: Natalia Jamburia (Ministry of Energy of Georgia), Maia Tskhvaradze (Ministry of Environment and Natural Resources Protection of Georgia), Murman Margvelashvili (World Experience for Georgia), Archil Kokhtashvili (Chief of Electrical Regimes and Development Service), Tornike Kazarashvili (Georgian Energy Development Fund), Marina Gogoladze (National Statistics Office of Georgia), Nugzar Beridze (Georgian National Energy and Water Supply Regulatory Commission), Archil Kokhtashvili (JSC Georgian State Electrosystem), Giorgi Lekveishvili (Tbilisi City Hall), Murman Margvelashvili (World Experience for Georgia), Nana Pirtskhelani (Ministry of Energy of Georgia)

Kazakhstan: Zharas Takenov (freelance consultant), Raygul Bazarbayevna-Bulekbayeva (Ministry of Industry and New Technologies of the Republic of Kazakhstan)

Kyrgyzstan: Gulsara Kasymova (local co-ordinating contributor), Melisande F. Liu (CIM/ Unison Group)

Former Yugoslav Republic of Macedonia: Darko Janevski (US Agency for International Development), Aleksandar Dedinec (Macedonian Academy of Sciences and Arts), Sonja Risteska (Analytica Think Tank)

Moldova: Ruslan Surugiu (Center for Energy Efficiency and Renewables/ Pro-Energy)

Montenegro: Jasna Sekulović (GIZ), Sanja Orlandic (SEE SEP project)

Russian Federation: Talyat Aliev (Ministry of Energy of the Russian Federation), Georgy Ermolenko (National Research University), Nonprofit Partnership Council for Organizing Efficient System of Trading at Wholesale and Retail Electricity and Capacity Market

Serbia: Predrag Milanović (Ministry of Mining and Energy)

Tajikistan: Valamat-Zade Timur Gafarovich (expert on water and energy resources)

Turkmenistan: Rustam Bekmuradov (independent research consultant)

Ukraine: Iuliia Usenko (All-Ukrainian Sustainable Development and Investment Agency), Andriy Konechenkov (Ukrainian Wind Energy Association), Galyna Trypolska (Institute for Economics and Forecasting, UAS)

Uzbekistan: Bakhtiyar Sadriddinov (IKS Company), Nizomiddin Rakhmanov (Tashkent State Technical University)

Regional:

Adedoyin Adeleke (researcher), Bilyana Chobanova (Energy Charter), Emmanuel Bergasse (independent consultant), Eros Artuso (independent consultant, ProQuest), Eugene Simonov (Rivers Without Boundaries), Eva Krēmere (International Hydropower Association), Gaetano Rizzo (Universita' degli Studi di Palermo), Jo Rowbotham (Clean Energy Business Council), Lorcan Lyons (University of France), Luis Camacho (Asia Pacific Energy Research Centre), Matija Vajdić (Energy Institute Hrvoje Požar), Pachauri Shonali (International Institute for Applied Systems Analysis), Patrick Jochem (Institute for Industrial Production), Peter Yang (Case Western Reserve University), Piotr Comarov (independent technical expert), Rabab Saleh (Friedrich-Alexander-Universität Erlangen-Nürnberg), Robert Rapier (ZHRO LLC), Valeria Gambino (AE Capital), Zvirevo Chisadza (Latent Technologies),

PRODUCTION:

Revelle Group

EDITING, DESIGN AND LAYOUT:

Revelle Group/Jelena Mirković Janković

TABLE OF CONTENTS

FIGURES, TABLES AND SIDEBARS

FIGURES

TABLES

SIDEBARS

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The United Nations Economic Commission for Europe (UNECE) covers a large and diverse region comprising 56 member states. The present report covers 17 of the 56 United Nations Economic Commission for Europe (UNECE) countries – grouped because of their specific needs to establish a data baseline and to track progress made in renewable energy and energy efficiency development. The UNECE has been contributing actively to fulfilling the 17 countries' aspirations in renewable energy by providing a platform for them to collaborate with other UNECE member countries. In 2014, a UNECE Group of Experts on Renewable Energy was established to step up these efforts. Its mandate is to carry out action-oriented, practical activities to greatly increase the uptake of renewable energy, helping to meet the objectives of the Sustainable Energy for All (SEforALL) initiative. *The UNECE Renewable Energy Status Report 2017* strives to present analysis of up-to-date data and information on the status of renewable energy and energy efficiency in the selected countries. This report is the second edition, providing the latest developments since December 2015.

REGIONAL OVERVIEW

Most of the 17 countries continue to progress in increasing renewable energy use and improving energy efficiency. This progress includes creating the necessary regulatory frameworks and adopting targets, policies and regulations. Governments in the region share a variety of energy challenges, which could become drivers for renewable energy deployment as the countries embrace a more active approach through renewable energy policies.

Energy import dependency dominates, as 11 of the 17 countries are net energy importers. Energy subsidies for fossil fuels are still present across the region. Energy intensity in the countries is high in the global context, with continuing improvements. The quality of energy access – mainly access to heat and to some extent to electricity – is an issue in several countries with regard to reliability, affordability and sustainability. Awareness and understanding of renewable energy is an additional obstacle to further development of renewables in the region. The REN21 Hard Talks – policy debates with participation of local stakeholders, held in December 2016 in Georgia and Ukraine in the context of preparing this report – confirmed that local debate on renewable energy can benefit from external support. Overall, it remains a challenge to build sustainable and resilient energy systems that offer reliable and affordable energy to fuel the region's future economic growth.

The share of renewable energy in total final energy consumption (TFEC) varies widely across the 17 countries, with the average share at 18.2% of TFEC in 2014. Armenia, Bosnia and Herzegovina, Georgia, Montenegro and Tajikistan have achieved high shares of renewable energy (above 30% of TFEC), whereas Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan have low shares (less than 3%). The Russian Federation, the region's largest energy system, had a 3.5% share of renewable energy in TFEC in 2014.

The regional co-operation landscape is changing with the end of the European Union's INOGATE programme. The new EU4Energy initiative brings together the Energy Community, the Energy Charter and the International Energy Agency to set up collaboration activities, including on renewable energy. The Energy Community established a Renewable Energy Coordination Group in 2016 to discuss and exchange experience on the legal transposition and implementation of EU directives in EU member countries. UNECE and the International Renewable Energy Agency (IRENA) are ramping up their activities to increase the renewable energy uptake by exploiting untapped potential in these countries. The revamped Covenant of Mayors for Climate and Energy is mobilising activity at the local level. Other donors and development banks also are implementing projects relevant to renewable energy (e.g., CASA-1000 on electricity trade in Central Asia).

RENEWABLE ENERGY MARKET AND INDUSTRY OVERVIEW

During 2015 and 2016, the region continued to build on its substantial renewable energy resources, with new developments arising in the power, heat and transport sectors. The most prominent growth was in the renewable power sector, where further developments beyond traditional technologies (such as hydropower) are occurring. Players with nascent renewable energy markets continue to mature, and utility-scale projects are being commissioned in several countries in the region (such as Kazakhstan). However, challenges to the uptake of renewable energy technologies remain, particularly in the heating and cooling and transport sectors.

By the end of 2016, the total installed renewable power capacity in the region reached 85.4 gigawatts (GW), with more than 2 GW of capacity additions in 2015 and 2016. Hydropower accounted for 70% of these additions; however, the fastest growth occurred outside the hydropower sector. The most significant non-hydro renewable energy capacity additions in

2015 and 2016 were in the Russian Federation (153 megawatts (MW), Kazakhstan (98 MW), Ukraine (97 MW) and Belarus (94 MW).

Hydropower continues to generate a large share of electricity in the region. The Russian Federation added the most new installed capacity in 2015, at 540 MW, for a total installed capacity of 50.2 GW. Due to the significantly larger size of the country's power system, these capacity additions far exceeded those in other countries in the region, although Georgia, Kyrgyzstan and Turkmenistan all witnessed sizable capacity growth by 2016.

Solar photovoltaics (PV) continued to grow in the region, increasing by 268.5 MW during 2015 and 2016 to bring the total regional installed capacity to 1.2 GW. This growth is based on capacity additions in the Russian Federation (104.8 MW), Ukraine (62 MW), Kazakhstan (52.3 MW), Azerbaijan (27.1 MW) and the countries of Belarus, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Moldova and Serbia (41.1 MW combined). Kazakhstan is the only country with local capacity for producing solar PV modules. Uzbekistan has established several joint ventures to develop new solar PV manufacturing capacities, and Turkmenistan announced that it is soliciting commercial proposals.

Sizable wind resource potential is present in the region, with the largest resources in Kazakhstan, the Russian Federation and Ukraine. Uzbekistan is working to identify its wind potential. The region's wind sector added an estimated 212 MW over the 2015-2016 period, for a total installed capacity close to 906 MW. Kazakhstan led in new capacity installations, followed by the Russian Federation, Belarus, Ukraine and Serbia. No off-grid wind power developments are reported to date in the region.

Geothermal energy continued its steady development in the region, gaining increased attention from international developers. During 2015-2016, geothermal power capacity additions were 8.5 MW, for a total installed capacity of 86.5 MW. The region added 42 MW of solid biomass power generation capacity and 18 MW of biogas power generation capacity, for a total installed capacity of 1.56 GW for solid biomass and 64 MW for biogas.

In the heating and cooling sector, renewable energy continued to replace fossil fuels. Solar water heaters have replaced boilers, geothermal energy is consolidating as an option for heat pumps and balneology, and modern biomass-based individual heating technologies are expanding in the district heating sector. As in the rest of the world, however, the region is deploying renewable heating and cooling technologies only modestly. The installed renewable heat capacity rose to 725 megawatts-thermal (MW_{th}), with 54 MW_{th} added in 2015. Albania is the most developed market for solar water heating in the region, and Belarus has the most developed bio-heat sector. Geothermal energy has the potential to be used in direct heat applications using low- to medium-temperature resources.

In the transport sector, countries in the region continued to harness renewable energy potentials, mainly in the form of liquid biofuel production (biodiesel and ethanol in Belarus and the former Yugoslav Republic of Macedonia). Electric mobility promotion programmes also are emerging (e.g., in Georgia and Ukraine).

DISTRIBUTED RENEWABLE ENERGY AND ENERGY ACCESS

Access to clean fuels and technologies for household heating, lighting and cooking is still an issue for more than 17 million of the region's inhabitants. Many rural populations continue to exhibit a high dependence on solid fuels (exceeding 60% in four countries) for residential heating and cooking, as non-solid fuels are difficult to source. National governments and international donors continue to promote renewable energy solutions through initiatives to improve the quality of energy access. Moving from donor-funded pilot projects to widespread adoption of renewable energy for improved quality of energy access across the region remains challenging.

From a global perspective, the region is over-performing in terms of electricity access. Fifteen of the 17 countries reported a 100% electrification rate in 2014, and the remaining countries (Kyrgyzstan and Tajikistan) had rates exceeding 99%. However, these two countries reported a 100% electrification rate in 2012, suggesting that their electrification situation may have deteriorated. Tajikistan's electrification rate is 99.1%, with the remaining 0.9% (nearly 75,000 people) living mainly in rural areas. In Kyrgyzstan, the electrification rate is 99.8%, with more than 11,000 people lacking access to electricity in 2014.

The main energy access issue is the quality of electricity supply, in terms of reliability, affordability and sustainability for the countries considered by the report (and to a certain extent for some other UNECE countries). Power outages still occur in several countries, especially in the Caucasus and Central Asia, where the energy infrastructure is poorly maintained and ageing. In urban areas, affordability remains a concern because energy poverty rates are high. The situation is more pronounced in the heating sector, a crucial sector in some of the countries due to extremely low temperatures in winter.

Access to the use of clean fuels and technologies (CFTs) in the region is growing. All but one of the countries report slow but steady CFT growth, led by Albania, Azerbaijan and Kyrgyzstan with more than 1% growth for the period 2012-2014. Only Bosnia and Herzegovina exhibits negative growth in this area. The opportunity to leverage CFT usage is not yet fully exploited in the region, both in rural areas and in urban heating solutions. Distributed generation combined with net metering could be an important factor in addressing affordability, helping to reduce electricity costs and the effects of energy poverty.

Multilateral and bilateral donors as well as local governments are financing several projects to promote renewable energy solutions for improved energy access. Most of the projects address heating for residential use using solar thermal systems. Distributed generation as a means to increase electrification is of lesser importance due to the high electrification rates. Tajikistan has a renewable energy target specifically for

enabling electricity access in remote communities without grid connection. Several countries (e.g., Bosnia and Herzegovina and Montenegro) are using solar PV as a distributed energy solution.

ENERGY EFFICIENCY

Energy intensity in the region remains high in the global context, despite reductions driven by climatic and structural economic factors and by inefficiency in energy conversion. Reductions in energy consumption alongside simultaneous economic growth have been observed in South East Europe and Moldova. Most energy efficiency policies and projects are targeting buildings, but efficiency in industry and transport also needs to be scaled up, considering the available potential for energy savings.

Energy efficiency markets in the region have been slow to develop. This can be attributed to numerous barriers: regulatory and institutional, financial and market-related, technological and infrastructural as well as social and environmental. Efforts by governments and international donors to address these barriers are becoming more widespread, however, and best practices from more energy-efficient countries are being promoted and introduced in the region.

The efficiency of the electricity supply needs to improve, despite ongoing modernisation of the electricity infrastructure. Projects are under way in, for example, Albania, Azerbaijan, Uzbekistan and the former Yugoslav Republic of Macedonia to improve metering infrastructure, reduce electricity losses and introduce demand-response capabilities.

Energy efficiency in buildings is the area that is most developed for regulatory policies in the region. Projects are ongoing in nearly all countries, supported by financing from international donors such as the World Bank, the German Agency for International Cooperation (GIZ), the United Nations Development Programme (UNDP), the Swedish Development Agency and the US Agency for International Development (USAID). With regard to energy efficiency services, the market for energy service companies (ESCOs) is still nascent in the region, with a presence in Bosnia and Herzegovina, Moldova, Montenegro and Serbia.

Transposing the EU Directive on Energy Performance of Buildings has set a high threshold of energy efficiency measures for buildings in South East Europe. The reporting system of the Energy Community Secretariat provides a useful tool for easy monitoring of progress (or lack thereof). However, improving energy use in buildings requires a more sustainable solution for supplying space and water heating, which is challenged by the use of traditional biomass and inefficient district heating systems in many of the 17 countries.

District heating is important in several countries in the region (Belarus, Kazakhstan, Kyrgyzstan, Moldova, Serbia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan), and the Russian Federation is the largest user of district heating systems in the world. Reform and upgrade of the region's district heating systems can be conducive to increasing renewable energy use. Lighting efficiency measures are most advanced in the countries of the Energy Community based on their obligation to transpose EU acquis[i] on energy efficiency. Programmes are under way to address street lighting in several countries (Armenia, Belarus, Uzbekistan).

Achieving better efficiency in industry faces multiple challenges in the region, including high upfront costs, concerns about competitiveness and the existence of energy subsidies. International donors and development banks are financing projects that target energy efficiency improvements in industry, including voluntary or mandatory energy audits and the introduction of energy management. The transport sector represents a sizable share of the region's total final consumption (TFC), with high annual growth rates in some countries. Energy efficiency measures in transport remain limited, with only a few examples gathered (e.g., the City of Almaty Sustainable Transport project).

POLICY LANDSCAPE

The number of countries in the region with policies relevant to renewable energy and energy efficiency has increased since 2015. Overall the region continues to adopt new policy measures that help to remove barriers for development, attract investment, foster energy security and increase the flexibility of power systems.

Support policies for renewable energy and energy efficiency received increased attention during 2015 and 2016, due in part to the global pressure to mitigate global climate change in advance of and following the December 2015 Paris climate talks. All countries in the region submitted their Intended Nationally Determined Contributions (INDCs) in preparation for the event. Since then, six countries have submitted their Nationally Determined Contributions (NDCs) as a step towards officially joining the Paris Agreement. Furthermore, National Renewable Energy Action Plans and obligations under the Energy Community continued to drive legislative changes in renewable energy in South East Europe. In 2016 Georgia began finalising the process to become a member of the Energy Community.

The region still has room to improve policy making on renewable energy. For example, renewable energy technologies could address some of the trade-offs between water, energy and food production, bringing substantial benefits in all three sectors. By the end of 2016, the total number of countries in the region with renewable energy support policies had increased, with most countries having policies in place, mostly in the form of a feed-in tariff (FIT). Among other developments, Georgia adopted a net metering programme; Moldova enacted a new renewable energy policy with actions for implementing a FIT, net metering and auctions; and several countries approved national action plans.

All countries, except for Turkmenistan, have strategic documents outlining their priorities for at least one renewable

[i] The acquis is the body of common rights and obligations that is binding on all the EU member states.

energy technology. However, the adoption of secondary legislation – detailing legal, regulatory and financial mechanisms and technical rules – is happening at a slower pace in Eastern Europe, the Caucasus and Central Asia than in South East Europe, as countries in the latter sub-region seek to fulfil their legal obligations under the Energy Community, in line with EU sustainability objectives.

Targets for renewable energy are used widely in the region. As of year-end 2016, at least 15 of the 17 countries had renewable energy targets for capacity installed or for the participation of renewables in the energy and/or electricity mix.

Policy makers continued to focus mainly on renewable power generation technologies. As of year-end 2016, 13 countries had enacted feed-in tariffs, making this the most widely adopted regulatory mechanism to promote renewable power in the region. Moldova is the most recent country to approve a FIT programme, which will enter into force in 2017. In addition, six countries – Armenia, Belarus, Georgia, Moldova, Montenegro and Ukraine – enforce net metering or net billing programmes; Georgia and Moldova adopted their net metering policies in 2016.

Electric utility quotas and obligations have been adopted in four countries: Albania, Belarus, Montenegro and the Russian Federation. The Russian Federation uses a mix of policies, including a capacity-based scheme adopted in 2013. While some countries incentivise the electricity produced, the Russian Federation promotes renewable energy through the capacity market.

Policy support for renewable heating and cooling continues to lag behind support in the power sector. By the end of 2016, only Montenegro had a heating target, and Ukraine had an obligation for a 12.4% share of renewable energy in the heating and cooling sector by 2020.

Policies to stimulate renewable energy in the transport sector grew slightly in 2015; however, support remains far below other sectors. Armenia, Kazakhstan and Turkmenistan strengthened their co-operation in the framework of the United Nations global conference on sustainable transport. Several countries have renewable energy targets for the transport sector, including Albania, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia and Ukraine. Two countries – the former Yugoslav Republic of Macedonia and Montenegro – continue to work on legislation to address further support for renewable energy in transport.

The region has the potential to leverage opportunities across several sectors (water, energy and food production) by developing its renewable energy potential, provided that adequate policies are in place. Overall, increasing the renewable energy share can reduce water requirements in power generation; boost water security by improving accessibility, affordability and safety; and contribute to food security objectives.

All 17 countries in the region, except Turkmenistan, have enacted regulatory policies to advance energy efficiency, most commonly in the buildings sector (including lighting and appliances), followed by transport and industry. All countries except Georgia, Kyrgyzstan and Turkmenistan have established energy efficiency targets. To drive the efficiency improvements necessary to achieve these targets, governments are introducing new regulations or updating existing ones. Belarus and Ukraine both have approved National Action Plans for Energy Efficiency.

Eight countries (Albania, Belarus, Bosnia and Herzegovina, Kazakhstan, the former Yugoslav Republic of Macedonia, Montenegro, Serbia and Uzbekistan) are addressing efficiency in the buildings sector through long-term strategic plans and visions at the government level. Albania, Azerbaijan, Belarus, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Moldova, Montenegro and Serbia have targets for energy efficiency in buildings. Varying levels of energy performance requirements exist in all countries except Albania, Georgia and Turkmenistan. Auditing regulations are in force in Bosnia and Herzegovina, Kazakhstan, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia and Uzbekistan. Kazakhstan, Moldova and Ukraine have energy performance contracting to support building retrofits based on energy savings.

Policies to support energy efficiency in lighting and appliance technologies continued to emerge throughout 2016. Serbia adopted a regulation enabling procurement of energy efficiency in municipal services, including street lighting. Policies related to incandescent lighting still lag in some of the countries. Despite global efforts to phase out incandescent bulbs, only Kazakhstan, the Russian Federation and Tajikistan have introduced relevant measures. Kyrgyzstan has adopted a system of standardisation and energy certification for lighting products produced for household domestic use.

Appliance standards and labelling continue to contribute to improving energy efficiency in buildings. Kazakhstan and Uzbekistan have in place comprehensive policies on energy efficiency standards and labelling. In South East Europe, labelling regulations are based on transposition of the EU's Directive 2010/30/EU on labelling of energy-related products.

INVESTMENT FLOWS

Investment in renewable energy in the 17 countries totalled USD 400 million in 2015, a notable decline from USD 700 million in 2014. The region still represented only a fraction – less than 0.2% – of the global investment total in 2015, down from 0.5% in 2014. Data for 2016, although still preliminary at the time of this writing, point to a further reduction in renewable energy investment in the region. This mirrors the overall decline in renewable energy investment globally in 2016, on the back of decreasing equipment costs.

Only three countries – Kazakhstan, the Russian Federation and Ukraine – saw new investment in renewable energy committed

in 2015 (USD 100 million in Kazakhstan and Ukraine and USD 200 million in the Russian Federation), based on the available data from Bloomberg New Energy Finance. An absence of new investment is notable in South East Europe, the Caucasus and Central Asia.

Additional data gathering conducted for this report reveals some positive developments. In Georgia, USD 130 million was invested in small hydropower projects between 2013 and 2016. Armenia aims to attract between USD 200 million and USD 300 million in investment for wind power generation by 2020. Uzbekistan is actively seeking investment for its solar power development programme. In Ukraine, renewable energy projects representing a total investment of more than USD 44.25 million went online in 2016. The European Bank for Reconstruction and Development (EBRD) is considering a senior loan of up to USD 26 million to India's ACME Cleantech Solutions Pvt Ltd for a 29 MW solar project in Kazakhstan.

International donors and development banks continue to be an important source of debt financing and grants for renewable energy projects in the region. This report tracks some of the key activities of donor institutions during the period 2010-2016.

The EBRD leads renewable energy financing in the region, providing more than USD 1.8 billion in lending to renewable energy projects (including large-scale hydropower) between 2010 and 2016, at a total cost of USD 3.9 billion. The World Bank financed USD 152 million in renewable energy projects between 2010 and 2016. The Asian Development Bank, whose mandate covers countries in the Caucasus and Central Asia, funded USD 753.4 million in renewable energy projects between 2010 and 2016; however, 70% of this total, or USD 536.7 million, went to large-scale hydro projects.

In South East Europe, the Western Balkans Investment Framework (WBIF) continues to channel investment from several international donors and multilateral banks, including the European Commission Instrument for Pre-Accession, the Council of Europe Development Bank (CEB), the EBRD, the European Investment Bank, Germany's KfW and the World Bank. The WBIF provided USD 427 million to renewable energy projects between 2010 and 2016 to cover the costs of feasability and other technical studies.

The Green for Growth Fund (GGF) complements the WBIF by specifically addressing renewable energy and energy efficiency, whereas the WBIF is a cross-industry facility. The GGF provides refinancing to financial institutions to enhance their participation in the energy efficiency and renewable energy sectors.

The Climate Investment Funds (CIF) is a climate finance source that can be leveraged for renewable energy investment in the region. The CIF has a 13% allocation for countries in Eastern Europe and Central Asia. As of December 2016, its project pipeline in the 17 countries was the same as in December 2014, except for revised funding allocations. The GEF provided USD 75.5 million in funding, alongside USD 770 million in co-financing from the EBRD, UNIDO, UNDP and the World Bank, to cover 22 projects, 13 of which address renewable energy uniquely or a specific technology (biomass, biogas, bioenergy) and 9 of which include renewable energy along with energy efficiency, green cities or green economy approaches.

CONCLUSIONS

The countries in South East and Eastern Europe, the Caucasus and Central Asia, as well as the Russian Federation, face economic challenges that affect their energy situations and consequently the development of renewable energy and energy efficiency markets. South East Europe and Eastern Europe saw some economic growth in 2015 and 2016, while the Caucasus and Central Asia have faced numerous external economic shocks. The Russian Federation has borne the economic impact of lower oil prices. These economic challenges extend into the energy sector and are reflected in renewable energy deployment in the region, which favours the cheapest energy source in the short term. Energy subsidies for fossil fuel generation persist in the region, presenting an additional obstacle for the deployment of both renewable energy sources and energy efficiency measures.

As a consequence the region is moving only slowly towards more sustainable energy systems, with some countries more active than others. Renewable energy prospects differ by sub-region. South East Europe has interesting potential for cost-competitive deployment of solar and wind power generation. However, renewable energy is being challenged politically, given the cost of government support policies. In the heating sector, the use of solar water heaters and biomass could be expanded in both South East Europe and Eastern Europe; Ukraine, the region's largest renewable energy player, is working to make its market more attractive to investors in Eastern Europe.

In the Caucasus, Azerbaijan is creating opportunities for renewable energy development with the government's support. Georgia is moving from hydropower to other renewable energy sources, such as wind. Armenia is opening opportunities, especially for solar PV, with a strong government push.

In Central Asia, both Kazakhstan and Uzbekistan plan to develop utility-scale power generation projects, based on government support combined with financing from development banks (the EBRD and ADB, respectively). Kyrgyzstan (with the exception of hydropower) and Tajikistan remain on the margins of renewable energy deployment, despite their need to improve the reliability of electricity and heat supplies. Development of the vast renewable energy resource potential in the Russian Federation has been slow, as considerable localisation requirements impede project development.

Investment across the region, except in the Russian Federation, continues to be driven by international donors and development banks. Examples of past investments (Georgia, Kazakhstan and Ukraine), as well as plans by the governments to attract additional investors (Armenia, Georgia, Kazakhstan, Ukraine and Uzbekistan), suggest the potential for future growth.

01

REGIONAL INTRODUCTION

01 REGIONAL INTRODUCTION

OBJECTIVE OF THIS REPORT

The United Nations Economic Commission for Europe (UNECE) covers a large and diverse region comprising 56 member states.[1] These countries have different energy situations and vary in their potential for, and progress on, market, industry and policy development in renewable energy and energy efficiency. The present report covers 17 UNECE countries[i] – grouped because of their specific needs to establish a data baseline – and provides an updated overview of their renewable energy situations. This report is the second edition, providing the latest developments since the launch of the first edition at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change, held in Paris in December 2015.

The 17 countries and their sub-regions (South East and Eastern Europe, the Caucasus, Central Asia and the Russian Federation) cover a vast territory that is extremely rich in natural resources, including those suitable for almost any type of renewable energy technology (see Section 2). During 2015 and 2016, new activity in the region resulted in increased renewable energy use, which is highlighted in this report. The report attempts, through newly gathered data and information, to provide the knowledge that is needed to identify specific obstacles and to highlight possible solutions and opportunities to greatly increase renewable energy uptake in the region.

The UNECE has contributed actively to fulfilling the 17 countries' aspirations in renewable energy by providing a platform for them to collaborate with other UNECE member countries. In 2014, a UNECE Group of Experts on Renewable Energy was established to step up these efforts. Its mandate is to carry out action-oriented, practical activities to greatly increase the uptake of renewable energy, helping to meet the objectives of the Sustainable Energy for All (SEforALL) initiative.

The *UNECE Renewable Energy Status Report 2017* strives to present analysis of up-to-date data and information on the status of renewable energy and energy efficiency in the selected countries of the UNECE region. Data and information contained in this report also intend to provide a reliable baseline on the status, trends and gaps between the current state of play and the renewable energy component of the Nationally Determined Contribution (NDC) targets as part of the Paris Agreement.

DATA COLLECTION FOR THE UNECE RENEWABLE ENERGY STATUS REPORT

The data presented in this report were compiled from governments, international organisations and industry sources. The report builds on national progress in collecting energy statistics as well as on the established data collection process that REN21 uses for its annual *Renewables Global Status Report*. Both formal and informal data sources haven been considered to obtain the timeliest information available. Support from the INOGATE Secretariat in Eastern Europe, the Caucasus and Central Asia, and from the Energy Community Secretariat in South East and Eastern Europe, has helped to improve national statistical systems over the past decade and continues to be leveraged in this report. The data gathering was organised through a network of local co-ordinating contributors who interfaced with national governments.

Most importantly, the International Energy Agency (IEA) provided invaluable co-operation in verifying data and conducting analysis on countries' energy situations. Bloomberg New Energy Finance drew from its global dataset to provide data on renewable energy investment. The UNECE Group of Experts on Renewable Energy (GERE) is the immediate recipient of this report but also is feeding, with the expertise developed since its inception in 2014, the preparation and direct use of this report in UNECE member states.

Although efforts were made to provide the most comprehensive overview of the selected countries, the scope and scale of the material presented in this report reflects some information gaps, including on investment in the region. The exclusion of any programmes, themes, sectors or technologies reflects a lack of information, not a judgment on their importance to the region. The report serves as a baseline to advance future collaboration efforts and data-gathering initiatives at a national or regional level, as well as to track future developments and progress in renewable energy uptake.

[i] Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Russian Federation, Serbia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

REGIONAL OVERVIEW

South East and Eastern Europe, the Caucasus, Central Asia and the Russian Federation are very diverse in terms of their population size and their economic, social and political characteristics, and therefore in their energy systems (see Table 1).[2] However, their energy systems were developed in a similar manner and face some common challenges as they advance in the deployment of renewable energy and in improving energy efficiency.

The region's population is more than 300 million, with the Russian Federation representing nearly half of this, or more than 144 million inhabitants. The smallest country by population is Montenegro, with 622,000 inhabitants. The age structure in the region is closer to the European Union (EU) than to Asia, with youth (below 15 years of age) averaging around 20% of the total population.

This region also shares similar demographic challenges to the EU. Countries in South East and Eastern Europe face some of the greatest declines in the working-age population in Europe, reflecting both unfavourable demographics and emigration.[3] The urban share of the population varies by country, from more than 70% in Bosnia and Herzegovina and the Russian Federation to only 27% in Tajikistan. Central Asian countries are, on average, less urbanised than countries in South East and Eastern Europe. Urbanisation across the region is stagnating or slowing, and there is a continuing need to address energy demand in rural areas.[4]

TABLE 1 | General Overview of the UNECE Region, 2015

	Population	Population density (persons per km²)	Urban population (% of population)	GDP per capita, current USD, PPP
Albania	2,889,167	105.4	57.41%	11,305
Andorra	70,473	149.9	85.12%	N/A
Armenia	3,017,712	106.0	62.67%	8,394
Austria	8,611,088	104.3	65.97%	47,824
Azerbaijan	9,651,349	116.7	54.62%	17,740
Belarus	9,513,000	46.8	76.67%	17,661
Belgium	11,285,721	372.7	97.86%	43,992
Bosnia and Herzegovina	3,810,416	74.4	39.77%	10,510
Bulgaria	7,177,991	66.1	73.95%	17,512
Canada	35,851,774	3.9	81.83%	44,310
Croatia	4,224,404	75.4	58.96%	21,880
Cyprus	1,165,300	126.1	66.92%	30,734
Czech Republic	10,551,219	136.6	72.99%	32,167
Denmark	5,676,002	133.7	87.68%	46,635
Estonia	1,311,998	30.9	67.54%	28,095
Finland	5,482,013	18.0	84.22%	40,601
France	66,808,385	122.0	79.52%	39,678
Georgia	3,679,000	64.3	53.64%	9,679
Germany	81,413,145	233.5	75.30%	47,268
Greece	10,823,732	83.9	78.01%	26,680
Hungary	9,844,686	108.7	71.23%	25,582
Iceland	330,823	3.3	94.14%	46,547
Ireland	4,640,703	67.3	63.24%	54,654
Israel	8,380,400	387.2	92.14%	35,432
Italy	60,802,085	206.7	68.96%	35,896
Kazakhstan	17,544,126	6.5	53.25%	25,877
Kyrgyzstan	5,957,000	31.0	35.71%	3,427
Latvia	1,978,440	31.8	67.38%	24,286
Liechtenstein	37,531	234.5	14.29%	N/A
Lithuania	2,910,199	46.4	66.51%	27,730
Luxembourg	569,676	219.9	90.16%	101,926
FYR of Macedonia	2,078,453	82.4	57.10%	13,908
Malta	431,333	1,347.9	95.41%	N/A
Moldova	3,554,150	123.7	45.00%	5,039
Monaco	37,731	18,865.5	100.00%	N/A
Montenegro	622,388	46.2	64.03%	15,486
Netherlands	16,936,520	503.0	90.50%	48,459

Norway	5,195,921	14.2	80.47%	61,472
Poland	37,999,494	124.1	60.54%	26,135
Portugal	10,348,648	112.9	63.47%	29,214
Romania	19,832,389	86.2	54.56%	21,403
Russian Federation	144,096,812	8.8	74.01%	24,451
San Marino	31,781	529.6	94.19%	N/A
Serbia	7,098,247	81.1	55.55%	13,482
Slovakia	5,424,050	112.7	53.60%	28,877
Slovenia	2,063,768	102.4	49.65%	31,122
Spain	46,418,269	92.8	79.58%	34,527
Sweden	9,798,871	24.0	85.82%	46,420
Switzerland	8,286,976	209.7	73.91%	60,535
Tajikistan	8,481,855	60.6	26.78%	2,780
Turkey	78,665,830	102.2	73.40%	19,618
Turkmenistan	5,373,502	11.4	50.04%	16,499
Ukraine	45,198,200	78.0	69.70%	7,916
United Kingdom	65,138,232	269.2	82.59%	41,325
United States of America	321,418,820	35.1	81.62%	55,837
Uzbekistan	31,299,500	73.5	36.37%	5,996

Note: N/A indicates that the data were not available in the source used for this table.
Source: See endnote 2 for this section.

The countries also differ greatly in their territorial size and population density. Kazakhstan and the Russian Federation have the lowest population densities (6.5 and 8.8 persons per square kilometre, respectively), and Moldova has the highest (123.9 persons per square kilometre). Low population density is better suited for renewable energy technologies that have large land-use requirements; however, some renewable solutions, such as solar rooftop installations, also exist where population densities are high.

Geographical and climatic conditions vary across the region and offer favourable environments for solar, wind and bioenergy technologies (see Section 2). Three of the countries in the region – Kazakhstan, Kyrgyzstan and the Russian Federation – are among the world's coldest countries in terms of heating degree days, with the remaining countries having seasonal heating needs during the winter.[5] Renewable energy solutions have a role to play in addressing the region's heating requirements (see Section 3).

The region's economic history over the past two decades resulted in numerous challenges. The economic crisis of the 1990s resulted in the restructuring and downsizing of energy-intensive industries (steel, ferrous metals, etc.). In 2016, economic growth remained solid in South East and Eastern Europe; however, the rest of the region is gradually recovering from the recession, with the economy of the Russian Federation adjusting to lower oil prices.[6] Since 2014, the Caucasus and Central Asia have suffered from important external shocks, including lower oil prices and economic slowdown of their major economic partners, the Russian Federation and China. These factors will continue to affect economic growth in the region.

The level of economic development still shows major gaps. In 2015, gross domestic product (GDP) per capita based on purchasing power parity ranged from USD 25,877 in Kazakhstan to USD 2,780 in Tajikistan, a nearly 10-fold difference.[7] Consequently, economic factors continue to affect renewable energy markets in the region, both in terms of affordability for end-users (see Section 3) and in terms of investment flows (see Section 6).

The region's vast energy resources play a role in the global supply of fossil fuels. Five countries are net energy exporters (Azerbaijan, Kazakhstan, the Russian Federation, Turkmenistan and Uzbekistan; see Table 2), all of them with sizable oil and gas reserves.[8] Bosnia and Herzegovina, Kazakhstan, Montenegro, the Russian Federation, Serbia and Ukraine have coal reserves. Belarus and the Russian Federation have peat deposits. The region's primary energy supply is geared heavily towards fossil fuels. Non-renewable sources represented 89% of the total primary energy supply in 2014 (see Table 3).

Some countries have high shares of renewable energy, namely Tajikistan (49% of its total primary energy supply), Montenegro (33%), Kyrgyzstan (30%), Albania (27%), Bosnia and Herzegovina (27%) and Georgia (27%). This is driven either by a high share of hydropower in power generation or the use of biomass in heating, or by a combination of both (see Section 3). Hydropower has a significant presence in the power generation of some countries (see Section 2). The share of other renewable technologies is rising, with the fastest growth occurring outside the hydropower sector.

Energy intensity in the region is high in the global context, but improvements continue with the introduction of additional

energy efficiency policies and measures accompanied by international donor funding (see Section 4). For the residential sector, energy use per capita is widely used as an indicator, offering a view of the relative intensity of countries rather than a comparison of their efficiency. Annual energy use per capita in the region ranges from around 12.7 gigajoules (GJ) in Tajikistan to around 213.2 GJ in the Russian Federation (see Table 2).

Annual energy use per capita decreased between 2011 and 2013 in most of the countries except Albania, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan.

The region's ageing electricity generation, transmission and distribution infrastructure results in significant inefficiencies, and some of the countries experience high losses in their networks. In terms of total final consumption[i] (TFC), the main consumers are the residential sector (accounting for more than 30% of TFC in 10 countries), the industry sector (at least 15% of TFC in all countries) and the transport sector (more than 25% of TFC in 10 countries); however, important disparities exist among countries (see Section 3).

TABLE 2 | Energy Overview of the UNECE Region

	Energy imports, net (% of energy use) 2013	Energy subsidies (% of GDP) 2015	Energy use per capita (MJ per capita) 2013	Electrification rate (% of population) 2014
Albania	12%	1.9%	33,518	100%
Andorra	N/A	N/A	N/A	100%
Armenia	72%	4.3%	40,583	100%
Austria	64%	0.9%	164,032	100%
Azerbaijan	-328%	6.3%	61,714	100%
Belarus	85%	7.0%	120,643	100%
Belgium	74%	1.9%	210,972	100%
Bosnia and Herzegovina	28%	37.0%	70,672	100%
Bulgaria	37%	33.9%	97,445	100%
Canada	-72%	2.5%	301,543	100%
Croatia	53%	3.7%	75,946	100%
Cyprus	94%	0.0%	70,803	100%
Czech Republic	28%	8.4%	167,050	100%
Denmark	3%	1.6%	130,090	100%
Estonia	7%	0.5%	193,567	100%
Finland	45%	0.5%	254,338	100%
France	46%	1.0%	160,767	100%
Georgia	63%	5.2%	43,214	100%
Germany	62%	1.4%	161,930	100%
Greece	60%	2.6%	89,351	100%
Hungary	55%	3.9%	95,475	100%
Iceland	10%	0.5%	761,045	100%
Ireland	83%	0.5%	118,913	100%
Israel	73%	2.9%	124,381	100%
Italy	76%	0.6%	107,998	100%
Kazakhstan	-107%	11.0%	200,408	100%
Kyrgyzstan	55%	26.4%	28,906	99.8%
Latvia	51%	1.3%	90,403	100%
Liechtenstein	N/A	N/A	N/A	100%
Lithuania	76%	4.4%	98,668	100%
Luxembourg	96%	3.2%	306,068	100%
FYR of Macedonia	48%	18.7%	56,500	100%
Malta	99%	0.2%	72,624	100%
Moldova	90%	5.6%	36,118	100%
Monaco	N/A	N/A	N/A	100%
Montenegro	26%	16.7%	69,137	100%
Netherlands	10%	1.1%	192,820	100%
Norway	-486%	0.9%	269,578	100%

i For definition, see Glossary.

Poland	27%	9.1%	107,409	100%
Portugal	74%	1.0%	87,203	100%
Romania	19%	6.5%	66,659	100%
Russian Federation	-83%	16.0%	213,236	100%
San Marino	N/A	N/A	N/A	100%
Serbia	24%	34.7%	87,022	100%
Slovakia	61%	3.1%	133,070	100%
Slovenia	48%	2.4%	139,138	100%
Spain	70%	1.7%	104,829	100%
Sweden	29%	0.3%	214,847	100%
Switzerland	52%	0.2%	138,333	100%
Tajikistan	30%	7.1%	12,675	99.1%
Turkey	72%	4.5%	63,983	100%
Turkmenistan	-191%	23.2%	209,826	100%
Ukraine	26%	60.7%	106,896	100%
United States of America	14%	3.8%	289,553	100%
United Kingdom	42%	1.4%	124,669	100%
Uzbekistan	-26%	26.3%	59,431	100%

Note: Electrification rates are as reported by the *Global Tracking Framework Report: Progress Towards Sustainable Energy 2017*, but some countries still have communities without access to electricity (see Section 3, Sidebar 5). Energy subsidies are based on the International Monetary Fund's definition of "post-tax consumer subsidies", which arise when the price paid by consumers is below the supply cost of energy plus an appropriate "Pigouvian" (or "corrective") tax that reflects the environmental damage associated with energy consumption and an additional consumption tax that should be applied to all consumption goods for rising revenues. N/A indicates that the data were not available at the time of publication.
Source: See endnote 8 for this section.

Most of the 17 countries continue to progress in increasing renewable energy use and improving energy efficiency. The World Bank's RISE (Regulatory Indicators for Sustainable Energy) ranking shows that Eastern Europe, the Caucasus and the Russian Federation are among the top tier of 111 countries that were evaluated around the world.[9] Central Asia countries are in the middle tier. Kazakhstan was identified as the top RISE performer for renewable energy, and the Russian Federation was the top performer for energy efficiency. The progress includes creating the necessary regulatory framework, such as adopting targets, policies and regulations. Project deployment is driven by the donor community and to some extent by fiscal and financial incentives.

Although renewable energy investment (in absolute value) may be slowing based on the information available at the time of this writing (see Section 6), the region added more than 2 gigawatts (GW) of renewable energy power capacity in 2015 and 2016 (see Section 2). From a global perspective, the region still needs to catch up with global renewable energy deployment, despite visible growth (see Section 2). The average share of renewable energy in the 17 countries is 3% of total primary energy supply (TPES) (see Table 3).[10]

TABLE 3 | Renewable Energy Share of Total Primary Energy Supply in the UNECE Region, 2014

	Total energy (ktoe)	Non-renewable energy (ktoe)	Renewable energy (ktoe)	Renewable energy share (%)
Albania	2,336	1,698	637	27%
Andorra	208	N/A	N/A	N/A
Armenia	2,959	2,753	206	7%
Austria	32,163	21,673	10,490	33%
Azerbaijan	14,322	14,088	234	2%
Belarus	27,746	26,302	1,444	5%
Belgium	52,775	48,753	4,022	8%
Bosnia and Herzegovina	7,824	5,821	2,003	26%
Bulgaria	17,898	16,109	1,790	10%
Canada	279,880	229,501	50,378	18%
Croatia	8,044	6,033	2,011	25%

Cyprus	1,973	1,835	138	7%
Czech Republic	41,208	37,499	3,709	9%
Denmark	16,211	11,834	4,377	27%
Estonia	6,037	5,192	845	14%
Finland	33,934	23,811	10,123	30%
France	242,642	220,295	22,347	9%
Georgia	4,390	3,191	1,199	27%
Germany	306,070	268,979	37,091	12%
Greece	23,134	20,659	2,475	11%
Hungary	22,836	20,965	1,871	8%
Iceland	5,865	645	5,220	89%
Ireland	12,770	11,748	1,022	8%
Israel	22,696	21,524	1,172	5%
Italy	146,774	120,355	26,419	18%
Kazakhstan	76,667	75,934	734	1%
Kyrgyzstan	3,795	2,649	1,147	30%
Latvia	4,340	2,734	1,606	37%
Liechtenstein	66	N/A	N/A	N/A
Lithuania	7,000	5,740	1,260	18%
Luxembourg	3,817	3,626	191	5%
FYR of Macedonia	2,623	2,334	289	11%
Malta	774	759	15	2%
Moldova	3,302	2,991	311	9%
Monaco	N/A	N/A	N/A	N/A
Montenegro	957	640	316	33%
Netherlands	72,950	69,302	3,647	5%
Norway	28,746	15,523	13,223	46%
Poland	94,018	85,557	8,462	9%
Portugal	21,161	15,659	5,502	26%
Romania	31,688	25,668	6,021	19%
Russian Federation	710,883	692,912	17,970	3%
San Marino	N/A	N/A	N/A	N/A
Serbia	13,259	11,256	2,003	15%
Slovakia	15,948	14,513	1,435	9%
Slovenia	6,673	5,472	1,201	18%
Spain	114,559	96,229	18,329	16%
Sweden	48,155	30,819	17,336	36%
Switzerland	25,057	19,795	5,262	21%
Tajikistan	2,805	1,429	1,376	49%
Turkey	121,541	109,354	12,187	10%
Turkmenistan	26,749	26,742	7	0%
Ukraine	105,683	102,887	2,797	3%
United States of America	2,216,187	2,061,054	155,133	7%
United Kingdom	179,421	166,861	12,559	7%
Uzbekistan	43,677	42,655	1,021	2%
Total	**5,315,196**	**4,832,358**	**482,564**	**9%**
Total for 17 countries covered in the report	**1,049,976**	**1,016,283**	**33,693**	**3%**

Note: N/A indicates that the data were not available at the time of publication.
Source: See endnote 10 for this section.

REGIONAL ENERGY CHALLENGES

Building sustainable and resilient energy systems that offer reliable and affordable energy to fuel the region's economic growth is still a challenge, despite some progress in improving energy efficiency and introducing modern renewable sources in the energy mix. National governments share a variety of energy challenges, which could become drivers for renewable energy deployment as the countries embrace a more active approach through renewable energy policies.

Energy import dependency dominates, given that a majority of the countries (11 out of 17) are net energy importers. In four countries – Armenia, Belarus, Georgia and Moldova – net imports account for more than 60% of energy use, with Moldova's imports at 90% (see Table 2). In the remaining energy importing countries, imports exceed 30%, still constituting an energy challenge. Heavy reliance on a single source at country level for oil and gas imports is a security issue as well. Energy security can be a driver for renewable energy and energy efficiency as countries strive to decrease their share of energy imports and to leverage local energy sources. Modern renewable energy still must compete in some countries with mature technologies such as large-scale hydropower and available unconventional oil and gas resources, such as shale gas or coal-bed methane.

Energy subsidies are present throughout the region (see Table 2), whether in oil and gas exporting or net energy importing countries. The percentage of energy subsidies in the region's GDP is one of the highest in the world, with individual shares ranging from less than 2% in Albania to more than 60% in Ukraine (the world's highest).[11] Bosnia and Herzegovina, Serbia, Kyrgyzstan, Uzbekistan and Turkmenistan are also in the world's top 10.

Energy subsidies increase the vulnerability of countries to volatile international energy prices, reinforcing concerns about the sustainability and reliability of energy systems. Energy subsidies are detrimental to renewable energy and energy efficiency deployment because energy commodities are not priced at market prices, making renewables and efficiency comparatively expensive. Subsidies discourage investment in the region because energy tariffs remain below cost-recovery levels in several countries and do not provide investors with the opportunity to recoup their investment.[12]

Power outages are an issue in some of the countries (see Section 3) and are exacerbated on a seasonal basis due to hydropower fluctuations and to the effects of harsh climatic conditions on ageing energy infrastructure. Countries with recent or ongoing armed conflict are exposed to outages because of physical damage to energy infrastructure. The quality of power and the frequency of outages can be a driver for distributed renewable energy solutions. Seasonal variations in hydropower could be a driver for using non-hydro renewable energy sources in countries with high shares of hydropower generation.

Electricity access is not a pressing issue in the region, as electrification is almost universal with the exception of rural areas in a few of the countries (see Section 3). Relevant energy access issues relate to the quality of access – in terms of reliability, affordability and sustainability – as well as to clean heating and cooking sources, which is problematic (especially in rural areas) despite the progress achieved since 1990.[13] This latter concern is not a significant driver for renewable energy and energy efficiency, particularly given the comparatively higher cost of modern renewable energy solutions (see Section 3).

District heating is used in several countries in the region (Belarus, Bosnia and Herzegovina, Kazakhstan, the former Yugoslav Republic of Macedonia, Moldova, the Russian Federation, Serbia, Ukraine and, to a limited extent, Tajikistan).[14] The ageing infrastructure and high energy losses of these systems could be a driver for renewable energy deployment where local sources are available alongside ongoing reforms of district heating systems (see Section 3). Assessment studies in the heating sector are needed to seize the full potential of renewable energy solutions.

Institutional and market structures for energy are an issue in some of the countries. The lack of liberalisation of energy markets and the presence of incumbents makes market entry for new players (in renewable energy or other areas) extremely difficult. Split responsibilities among institutions and complex procedures (for example, to award licences and permits) slow the development of renewable energy projects in several countries.[15] Awareness and understanding of renewable energy can be an additional obstacle to further development of renewables across the region.

Environmental and health concerns are a minor driver of renewable energy and energy efficiency deployment in the 17 countries, except for solid fuel use for heating. However, compliance with international treaties and protocols (such as the Kyoto Protocol, the Energy Charter Protocol for Energy Efficiency and Environmental Aspects, and the Energy Community Treaty), which often are environmentally driven, forces countries to take steps towards adopting renewable energy and energy efficiency policies.

Overall, energy challenges in the region remain as they were in 2015, when the first edition of this report was written. There is a lag time between policy and regulatory reforms that favour renewable energy, and the practical changes that occur in the countries.

PLATFORMS FOR REGIONAL ENERGY CO-OPERATION

Regional energy co-operation is driven through several initiatives (see Table 4).[16] Co-ordination on renewable energy is limited to the Energy Community member countries and is linked only to the transposition of EU legislation, specifically legal obligations to implement the EU Renewable Energy Directive and binding renewable energy targets in 2020. The countries of South East Europe as well as Moldova and Ukraine are members of the Energy Community. The Energy Community notably stepped up its involvement in the region in 2016. Georgia signed the accession protocol to join the Energy Community on 14 October 2016 and was expected to become a member in 2017.

A Renewable Energy Coordination Group, set up by the Energy Community Secretariat, met for the first time in 2016 to discuss and exchange experience on legal transposition and implementation of EU directives in its member countries. This draws on positive experience with a similar co-ordination group covering energy efficiency. Some countries in South East Europe have EU candidate status (Albania, the former Yugoslav Republic of Macedonia, Montenegro and Serbia), and two of them (Montenegro and Serbia) have opened negotiations, thereby advancing the pace of renewable energy policies.

The countries have different levels of commitment to the Energy Charter. Thirteen countries have member status (Belarus is a member and has accepted provisional application of the treaty, but its ratification of the treaty is pending). Serbia is an observer, and the Russian Federation terminated its provisional application to the Energy Charter Treaty.

Across the region, the UNECE has contributed actively to fulfilling the countries' aspirations in renewable energy. The UNECE Group of Experts on Renewable Energy has been working since 2014 with the mandate to carry out action-oriented, practical activities to increase the uptake of renewable energy. Its activities entail the present report as well as efforts to standardise and share best practices, for example on the energy-water-food nexus in the context of renewable energy. The future direction of work aims to support countries directly in the effort to meet their commitments to global processes, from the Paris Agreement to the UN Sustainable Development Goals, through the increase in renewable energy deployment.

Regional co-operation is driven through cross-regional trade in electricity. Transmission investment is supportive and is a pre-requisite for increased integration of renewable power in electricity networks. The Central Asia South Asia Electricity Transmission and Trade Project (CASA-1000) is a flagship project implemented jointly by Kyrgyzstan, Tajikistan, Afghanistan and Pakistan and co-financed by the World Bank and the European Bank for Reconstruction and Development (EBRD).[17]

The Central Asia Regional Economic Cooperation Program (CAREC) covers energy as one of its sectors.[18] The programme was established in 1997 by the Asian Development Bank (ADB) and covers, among other countries, Azerbaijan, Georgia, Tajikistan, Turkmenistan and Uzbekistan. CAREC's strategy and work plan for 2016-2020 includes support for renewables.

The EU's INOGATE programme of energy collaboration with Eastern Europe, the Caucasus and Central Asia ended after two decades in 2016. The EU is putting in place EU4Energy as the new regional collaboration framework programme with three implementing partners: the Energy Community, the Energy Charter and the IEA.[19] Other frameworks of co-operation with the EU include the Association Agreement signed by the governments of Georgia, Moldova and Ukraine in June 2014. Armenia, Georgia, Moldova and Ukraine also are members of the Eastern Europe Energy Efficiency and Environment Partnership (E5P), supported by the European Commission and other bilateral donors.

Eight of the 17 countries are members of the Central European Initiative, which, among other areas, focuses on the topics of renewable energy and energy efficiency. The CEI has been working since 2014 on defining bio-economy strategies, including the creation of regional biomass markets and the promotion of the Danube River as a corridor for sustainable mobilisation of biomass and by-products.

The High Level Group on Central and South Eastern Europe Gas Connectivity (CESEC) was established in February 2015 to accelerate the integration of Central and South East European gas markets and the EU.[20] Six Energy Community Contracting Parties – Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Moldova, Serbia and Ukraine – also joined CESEC. The latest meeting of the High Level Group in September 2016 extended the mandate of CESEC to renewable energy, with the objective of boosting the regional market.

All of the 17 countries – except for the Russian Federation, Turkmenistan and Uzbekistan – have at least one city or town participating as a signatory in the revamped Covenant of Mayors for Climate and Energy initiative.[21] Signatories represent cities or towns, ranging in size from small villages to major metropolitan areas, that have committed in a voluntary manner to reduce carbon dioxide (CO_2) emissions and that, as of 2015, have pledged to reduce their emissions at least 40% by 2030. Signatories also pledge to submit a Sustainable Energy Action Plan outlining how they will reach their targets, thereby improving citizens' quality of life and boosting local economic development. This includes a push for renewable energy and energy efficiency at the city level.

The Eurasian Economic Union, formed by Kazakhstan and Belarus with the Russian Federation in 2014, is another avenue for regional collaboration. Armenia and Kyrgyzstan joined in 2015. Central Asia, the Caucasus and Eastern Europe are covered by China's Belt and Road Initiative, which mirrors the ancient Silk Road.[22] Renewable energy is among the large-scale infrastructure projects being pursued by Chinese authorities with the objective of connecting Asia, Europe and Africa. The Asian Infrastructure Investment Bank plays a support role in the initiative.

The International Renewable Energy Agency (IRENA) has intensified its activities in the region since 2015. South East Europe has been at the centre of its attention.[23] Ukraine had its own REmap analysis published in April 2015, and the Russian Federation is included in IRENA's overall REmap work.[24]

In terms of global co-operation, six countries – Armenia, Kyrgyzstan, Moldova, Montenegro, the Russian Federation and Tajikistan – are partner countries of the SEforALL Initiative (see Table 4). SEforALL is focused on speeding up the necessary actions to achieve truly global energy transformation, working with countries directly and through targeted initiatives. Montenegro and Tajikistan are the only countries in the region that have finalised rapid assessment and gap analysis, which lays the groundwork to scale up actions, undertake strategic reforms and attract new investments and financial support.

Other countries could benefit from increased engagement in this context, based on the challenges across different dimensions of energy access (see Section 3). SEforALL contributes directly to the achievements of the Agenda 2030 on Sustainable Development and its 17 Sustainable Development Goals (SDGs). All 17 countries are contributing to shaping the new sustainable development agenda, including SDG 7 to "Ensure access to affordable, reliable, sustainable and modern energy for all".[25]

TABLE 4 | Overview of Regional Collaboration on Energy Issues

	Sub-region	Energy Community	Energy Charter	SEforALL partner	Central European Initiative	CAREC[1]
Albania	South East Europe	Member	Member	–	Member	–
Armenia	Caucasus	Observer	Member	Partner	–	–
Azerbaijan	Caucasus	–	Member	–	–	Member
Belarus	Eastern Europe	–[2]	Member[3]	–	Member	–
Bosnia and Herzegovina	South East Europe	Member	Member	–	Member	–
Georgia	Caucasus	Observer[4]	Member	–	–	Member
Kazakhstan	Central Asia	–	Member	–	–	Member
Kyrgyzstan	Central Asia	–	Member	Partner	–	Member
FYR of Macedonia	South East Europe	Member	Member	–	Member	–
Moldova	Eastern Europe	Member	Member	Partner	Member	–
Montenegro	South East Europe	Member	Member	Partner	Member	–
Russian Federation	Russian Federation	–	–	Partner	–	–
Serbia	South East Europe	Member	Observer	–	Member	–
Tajikistan	Central Asia	–	Member	Partner	–	Member
Turkmenistan	Central Asia	–	Member	–	–	Member
Ukraine	Eastern Europe	Member	Member	–	Member	–
Uzbekistan	Central Asia	–	Member	–	–	Member

Notes:
1 Central Asia Regional Economic Cooperation
2 Applied to become an observer in October 2016.
3 Pending ratification.
4 Signed accession protocol on 14 October 2016 and expected to become a member in 2017.
(-) means country is not participating.

Partner
Member
Observer

Source: See endnote 16 for this section.

02

RENEWABLE ENERGY MARKET AND INDUSTRY OVERVIEW

02 RENEWABLE ENERGY MARKET AND INDUSTRY OVERVIEW

In 2015 and 2016[i], the region continued to build on its substantial renewable energy resources, and new developments are arising in the power, heat and transport sectors. The most prominent growth was in the power sector, where further developments beyond traditional renewable technologies (such as hydropower) are occurring. Players with nascent renewable energy markets continue to mature, and utility-scale projects are being commissioned in several countries. For example, Kazakhstan commissioned its first 50 megawatt (MW) solar photovoltaic (PV) plant in 2015.[1] However, challenges to the uptake of renewable energy technologies remain, particularly in the heating and cooling and transport sectors.

More than 2 GW of renewable power capacity was added in the region during 2015 and 2016, resulting in a total installed renewable power capacity of 85.4 GW by the end of 2016.[2] Hydropower[ii] accounted for a large portion of these additions; however, the fastest growth rates occurred outside the hydropower sector. The most significant non-hydro renewable power capacity additions in 2015 and 2016 were in the Russian Federation (153 MW), Kazakhstan (98 MW), Ukraine (97 MW) and Belarus (94 MW).

In the heating and cooling sector, renewable energy continued to replace fossil fuels. Solar water heaters are replacing boilers, geothermal energy is consolidating as an option for heat pumps and balneology[iii], and modern biomass-based heating technologies are expanding in the district heating sector. As in the rest of the world, however, the region is deploying renewable heating and cooling technologies only modestly. The installed renewable heat capacity rose to 725 megawatts-thermal (MW_{th}), with 54 MW_{th} added in 2015. In the solar heating and cooling sector, despite capacity additions, the annual growth rate is flattening out globally.[3]

In transport, countries in the region continue to harness the sector's renewable energy potential mainly in the form of liquid biofuel production (biodiesel and ethanol). Electric mobility promotion programmes also are emerging slowly in the region (e.g., in Ukraine).[4]

FINAL ENERGY CONSUMPTION

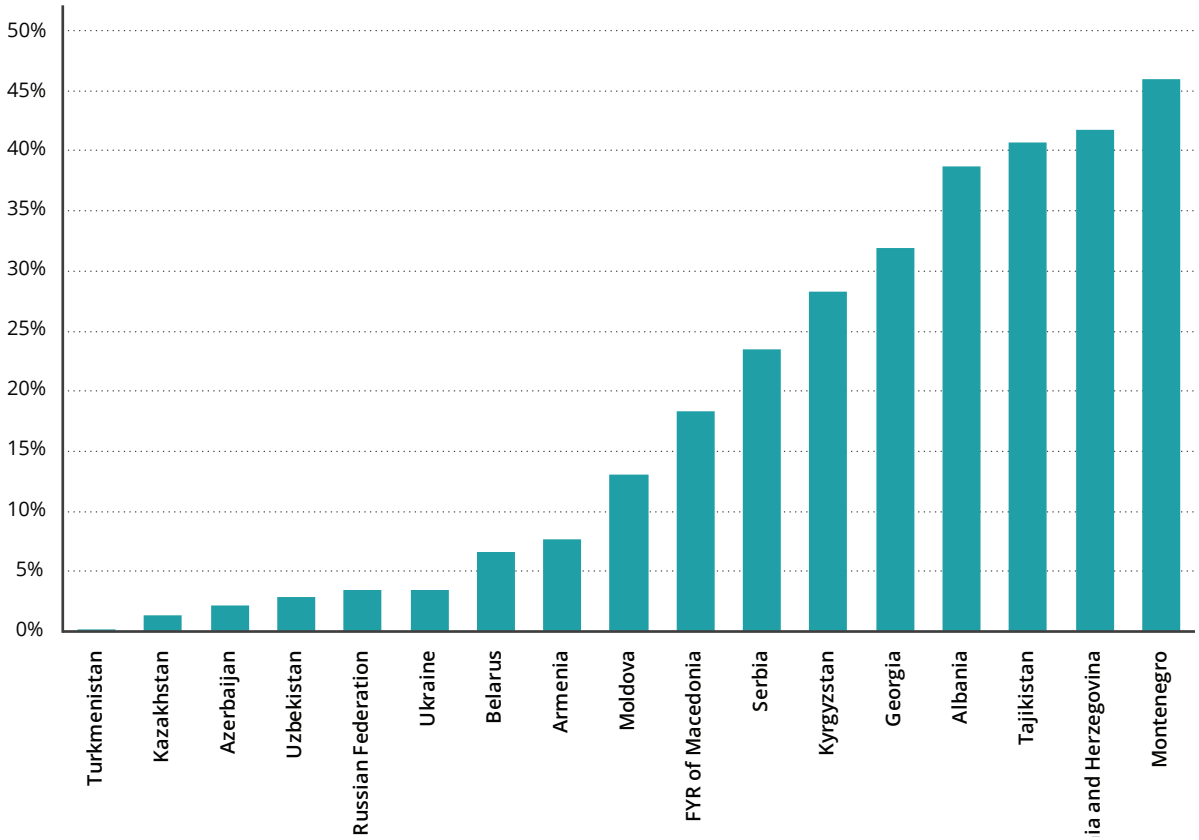
The share of renewable energy in total final energy consumption (TFEC) varies widely across the 17 countries, with the average share standing at 18.2% of TFEC in 2014 (see Figure 1).[5] Georgia, Armenia, Tajikistan, Bosnia and Herzegovina and Montenegro achieved high shares of renewable energy (above 30% of TFEC), while shares in Turkmenistan, Kazakhstan, Azerbaijan and Uzbekistan remain low (less than 3%). The Russian Federation, the region's largest energy system, had a 3.5% share of renewable energy in TFEC in 2014.

Rising shares of renewable energy in TFEC are driven by abundant hydropower generation, by the continuing use of traditional biomass for cooking and heating, and, to a lesser extent, by the uptake of modern renewable energy sources such as solar PV and onshore wind. In 2014, the industry sector accounted for approximately 22% of TFEC in the region, and the transport sector accounted for 24%. The two sectors combined represent almost half of the region's TFEC, but renewable energy deployment in these sectors remains low.

"RISING SHARES OF RENEWABLE ENERGY IN TFEC ARE DRIVEN BY ABUNDANT HYDROPOWER GENERATION, BY THE CONTINUING USE OF TRADITIONAL BIOMASS FOR COOKING AND HEATING, AND, TO A LESSER EXTENT, BY THE UPTAKE OF MODERN RENEWABLE ENERGY SOURCES SUCH AS SOLAR PV AND ONSHORE WIND."

[i] At the time of this writing, 2016 data for installed renewable energy capacities were not available for the former Yugoslav Republic of Macedonia, Moldova, the Russian Federation and Uzbekistan. Data for end-2015 are used instead.
[ii] Hydropower covers a continuum in project scale from large to small, mini, micro and pico. See Glossary.
[iii] Balneology is the practice of using natural mineral water baths for the treatment and cure of disease, among other applications.

FIGURE 1 | Share of Renewable Energy in Total Final Energy Consumption, by Country, 2014



Note: Includes non-renewable waste (industry and municipal).
Source: See endnote 5 for this section.

Looking at long-term trends since 1990, some countries greatly increased their deployment of renewable energy technologies. The region is getting some attention from international investors in addition to support from development banks and international banks; however, the commercial viability of projects remains limited (see Section 6).

Differences among countries in the share of renewable energy in TFEC and in capacity uptake remain significant. For some countries, observed increases and decreases in renewable energy shares are due to factors such as seasonal fluctuations in hydropower generation and to inconsistencies in reporting on biomass consumption for energy use. For example, Bosnia and Herzegovina saw the region's strongest growth in the renewable share of TFEC during 2012-2014, far ahead of the other countries (see Figure 2); however, it is working to improve its renewable energy statistics to incorporate consumption of biomass for energy purposes.[6] Renewable energy shares also increased in Georgia, Moldova and Ukraine during 2012-2014.

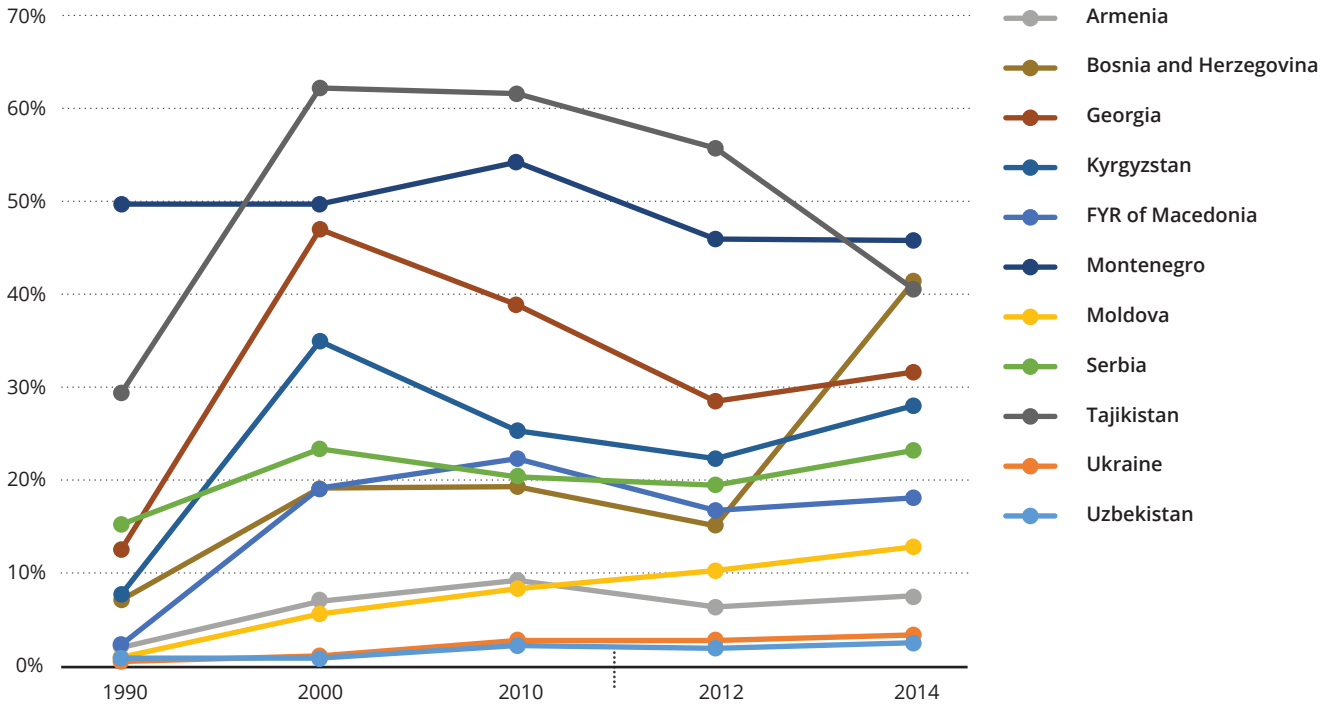
POWER SECTOR

The power sector experienced a sizable increase in renewable energy capacity. In the period 2015-2016, the region added an estimated 2 GW of renewable power, of which 28% (581 MW) came from non-hydropower resources. Bioenergy, solar PV and wind technologies grew the fastest compared to 2014. Ukraine, Kazakhstan and the Russian Federation added the most renewable energy capacity outside of hydropower, nearly 350 MW or some 60% of non-hydro capacity additions (see Figure 3).[7]

Kazakhstan reached a notable milestone in 2015 with the inauguration of its first utility-scale solar PV and wind plants.[8] Azerbaijan commissioned the 20 MW Nakhchivan Solar Power Plant at the end of 2015, and Georgia completed its first wind plant, the 20.7 MW Kartli Wind Power Plant, in 2016.[9]

Several additional utility-scale wind power plants are under construction in Azerbaijan, Bosnia and Herzegovina and Serbia. Planned improvements in transmission infrastructure connecting Armenia and Georgia could improve the conditions for more integration of renewable power without grid constraints.[10] South East Europe has sizable potential for renewable power generation, particularly wind and solar PV, which can be deployed in a cost-competitive manner already today (see Sidebar 1).[11]

FIGURE 2 | Share of Renewable Energy in Total Final Energy Consumption in Selected Countries, 1990-2014



Source: See endnote 6 for this section.

Sidebar 1. Cost-competitive Renewable Power Generation in South East Europe

The five countries of South East Europe added an estimated 297.3 MW of renewable power capacity during 2015 and 2016. Only 158.2 MW of this was from non-hydro sources, despite the region's potential for solar, wind and biomass-based renewable power. Solar PV and wind energy already are viable options in the sub-region, based on a study published by IRENA in January 2017.

IRENA concludes that South East Europe has vast technical renewable energy potential, equal to 812 MW for the seven countries covered in the present report (Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia, and Ukraine). The analysis reveals that 59.7 GW of this potential could be implemented in a cost-competitive way today under a medium cost-of-capital scenario.

Hydropower, both large and small applications, is one of the most economically viable renewable energy sources. An additional 13.3 GW can be deployed today, out of a technical potential of 29.1 GW.

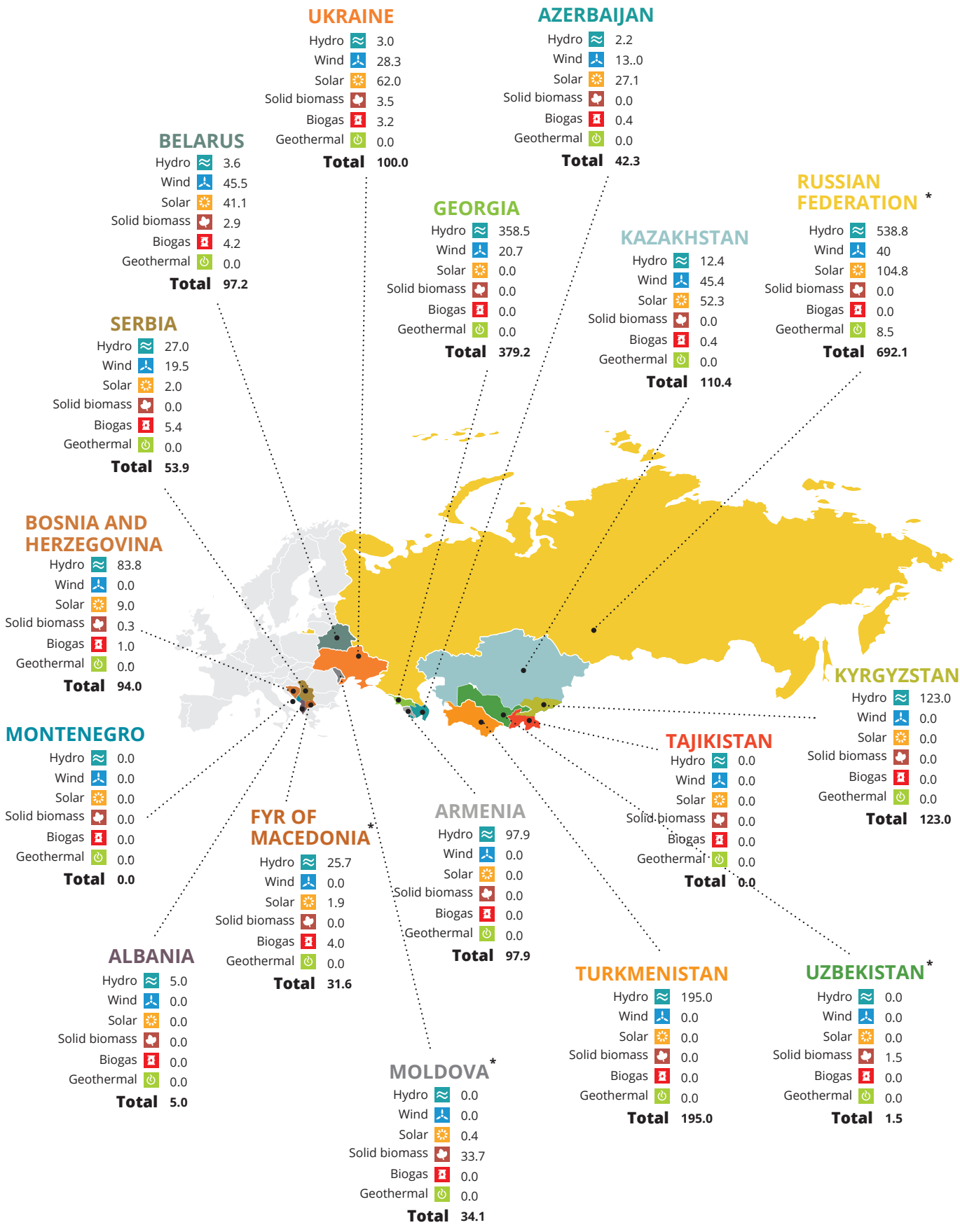
Wind energy is the most abundant renewable energy source in the region, with an overall technical potential of 399.6 GW. This compares to only 579.2 MW of installed capacity currently in place in the seven countries. An estimated 44.4 GW of the total technical potential can be deployed today in a cost-competitive manner.

For solar, of the 89.7 GW of technical potential, 71 MW could be developed today in a cost-competitive manner under a medium-cost scenario. A decline in technology costs as well as satisfactory irradiation levels in the region can help push future deployment. If a low-cost scenario (lower by two percentage points) is applied, 4.49 GW can be deployed in a cost-competitive manner.

Additional cost-competitive opportunities are in biomass. Biomass power generation could offer 2 GW of additional generation capacity that can be deployed today in a cost-competitive manner, out of a total technical potential of 20.2 GW. Geothermal potential is more limited, at 29 MW, and can be deployed in a cost-effective manner only under the low cost-of-capital scenario.

Source: See endnote 11 for this section.

FIGURE 3 | Renewable Power Capacity Additions, by Country, 2015/2016



*Data are for year 2015; data for Ukraine include Crimea.
Source: See endnote 7 for this section.

HYDROPOWER

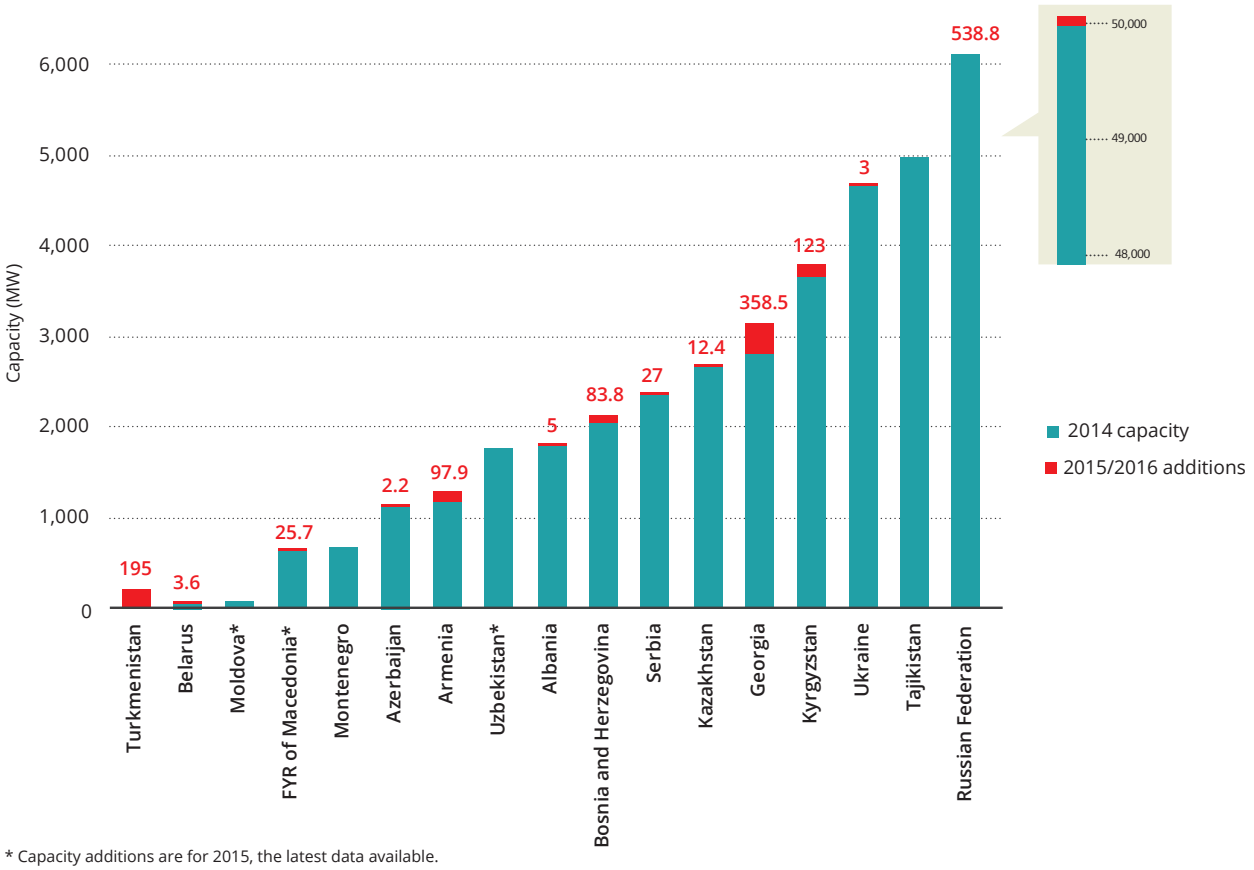
Hydropower continues to generate a large share of electricity in the region. The Russian Federation added the most new installed capacity in 2015, at 540 MW, for a total installed capacity of 50.2 GW. Because of the much larger size of the country's power system, these additions were far greater than those elsewhere in the region. Georgia, Kyrgyzstan and Turkmenistan all witnessed sizable capacity growth by the end of 2016 (see Figure 4).[12]

Further hydropower development is under way in many countries, especially in the small hydro sector. Armenia is developing multiple small hydro projects, some of them under the Clean Development Mechanism.[13] The Georgian Energy Development Fund, set up by the government to facilitate investment in renewables and to identify potential development sites for hydropower, is developing several projects jointly funded with private investors.[14] Project development has been driven not only by internal demand, but also by the prospect of electricity exports to Turkey.

Kyrgyzstan is developing some 20 MW of small hydro projects under the Small Hydro Power Development initiative, with technical assistance from the Global Environment Facility (GEF) administered by the United Nations Development Programme (UNDP).[15] Tajikistan restarted development of its 3,600 MW Rogun hydropower plant on the Vaksh River, and the first unit is expected to be online in 2018.[16] Originally, some 189 plants were targeted to be built by 2020, but due to the success of the programme, some 300 plants were added by the end of 2013, when the country's small hydro capacity reached 132 MW. The government envisages up to 3 GW of small hydro capacity to be added over time, especially in remote areas.[17]

Pumped hydropower storage plants can add flexibility to power systems and provide regulation services. Pumped hydro plants in the region total 3.4 GW of installed capacity and are located in the Russian Federation, Bosnia and Herzegovina, Serbia and Ukraine. The Russian Federation and Ukraine both increased their pumped storage capacity in 2016. Pumped hydro plays a crucial role in safely integrating variable renewable energy sources such as wind and solar PV into grids (see Sidebar 11).

FIGURE 4 | Hydropower Installed Capacity and 2015/2016 Additions, by Country



* Capacity additions are for 2015, the latest data available.
Note: Russian Federation has a separate vertical axes given the size of its generation capacity.
Source: See endnote 12 for this section.

GEOTHERMAL

Geothermal energy continued its steady development, receiving increased attention from international developers. During 2015-2016, the region added 8.5 MW of geothermal power capacity, for a total installed capacity of 86.5 MW. No additional plants were commissioned in Armenia, which continues to explore high-enthalpy geothermal resources with support from the World Bank. If the geothermal resource at Karkar field in Armenia's Sjunik region is confirmed, a geothermal plant of approximately 28 MW could be built.[18]

The region's geothermal energy potential is characterised by a relatively low-enthalpy resource base that is more appropriate for non-power applications.[19] Although there is increasing interest in exploring the geothermal resources in the region, future development is uncertain. Challenges such as high project development risk due to uncertainty of the geothermal resource in the early stages of a project have created unfavourable conditions for geothermal power development across the region (see Sidebar 2).[20]

Sidebar 2. Geothermal Development for Electricity and Direct Use

Geothermal energy can provide power and heat generation in a cost-effective manner. Geothermal resources have been explored and harnessed in the region for more than 60 years. However, the potential remains underdeveloped.

Studies suggest that significant geothermal resources exist in the Russian Federation, including in the central region, the Northern Caucasus, Dagestan and Siberia. In South East Europe, the geothermal energy potential is characterised mainly by low-enthalpy resources. In the seven countries covered in this report, the 29 MW of estimated potential can be deployed in a cost-effective manner only under a low cost-of-capital scenario. Outside of these countries, however, Romania and to a lesser extent Croatia, Bulgaria and Slovenia, have the estimated potential to develop up to 473 MW with binary plants, of which 31 MW is planned to be developed by 2020.

High-enthalpy geothermal resources can generate baseload power from indigenous resources, contributing to a country's energy security. In view of this benefit, countries are showing increasing interest in geothermal energy.

Armenia, with an estimated potential of around 150 MW, is committed to developing its high-enthalpy geothermal resources. The most promising sites include Karkar, Jermaghbyur and Grizor. The World Bank is supporting Armenia to undertake exploratory drilling in Karkar, where, if resources are confirmed, an estimated 28 MW of geothermal power potentially could be constructed at the site.

The Russian Federation harnesses its geothermal resources mostly for electricity generation and is the regional leader, with 82 MW of capacity operating successfully. The oldest power plant, Pauzhetskaya, dates to 1966. The country is interested in further harnessing its widely available low-temperature resources (in Krasnodar Krai and in the Kaliningrad and Kamchatka regions) for district heating, heat pumps and industrial processes.

Medium- to low-enthalpy geothermal resources also offer opportunities for direct heat applications such as heat pumps, space heating, industrial processes, greenhouse heating, drying, space cooling, snow melting, bathing and swimming, among others.

Serbia uses its geothermal resources for balneology, swimming pools, space heating, pig and poultry farms, and industrial processes. However, the country has a promising potential yet to be harnessed in areas such as Bogatic, Mataruska Banja and Vrbas for applications beyond balneology. Serbia is exploring opportunities for geothermal power, and in 2015 it established a co-operation agreement with Chinese and Icelandic partners that aims to develop production fields in the country's north.

Albania, Belarus, Bosnia and Herzegovina, Georgia and Ukraine are endowed with a large number of low-enthalpy sites, which have been used for balneology and heat pumps for heating and cooling.

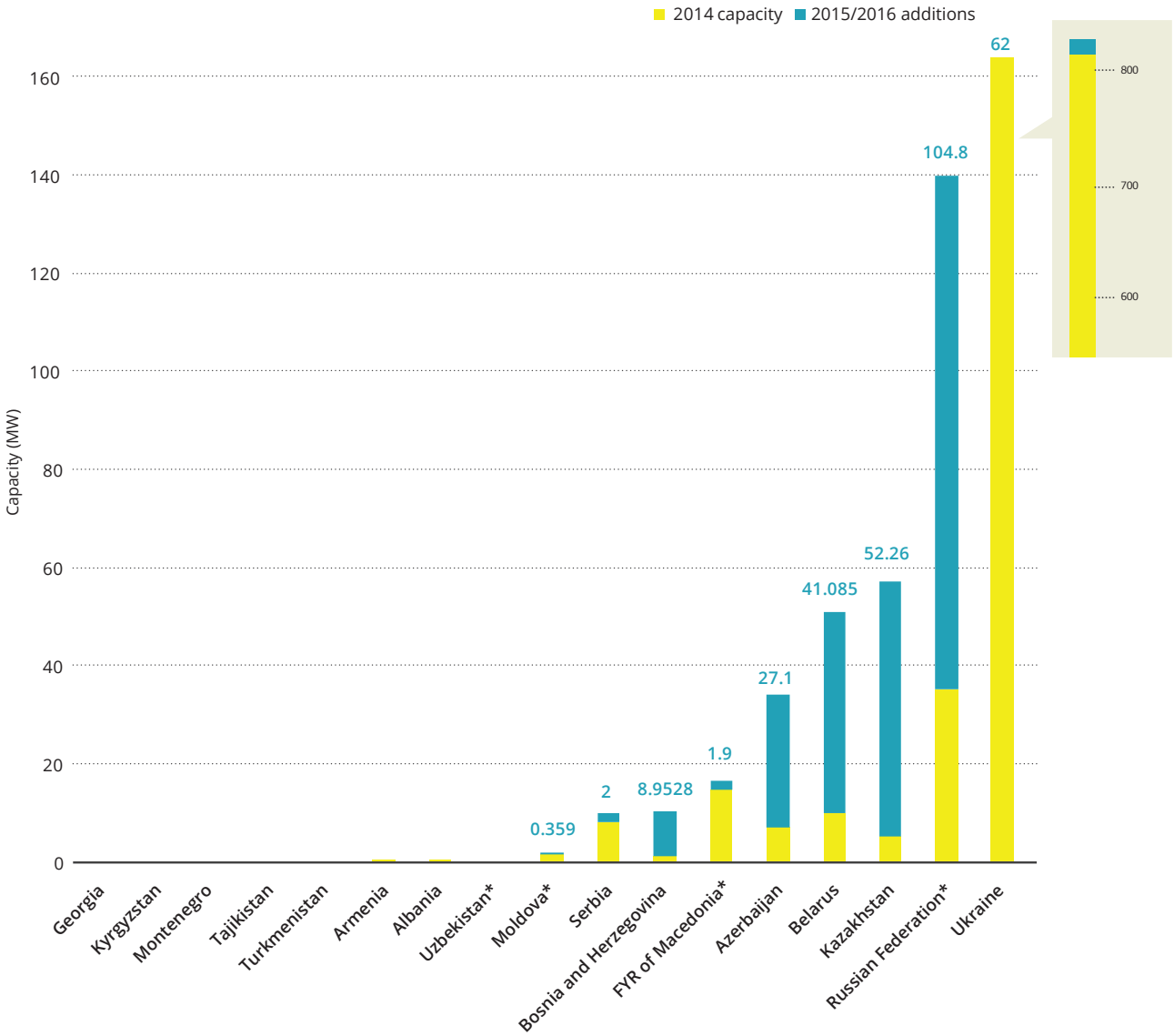
Despite these vast resources, challenges lie ahead for further scaling up geothermal energy in the region. Barriers to development include financial (high development risk), regulatory (lack of policies that minimise barriers for development, as well as complicated procedures) and institutional (lack of reliable data). Moreover, exploring underground resources can be particularly sensitive in countries that have a history of oil and gas production and where access to reliable geothermal resource assessments is limited.

Source: See endnote 20 for this section.

SOLAR ENERGY MARKET

Solar PV continued to grow in the region. In 2015 and 2016 the installed capacity increased by 268.5 MW, bringing the total regional capacity to 1.2 GW (see Figure 5).[21] This growth is based on capacity additions in the Russian Federation (104.8 MW), Ukraine (62 MW), Kazakhstan (52.3 MW) and Azerbaijan (27.1 MW), as well as in Belarus, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Moldova and Serbia (41.1 MW combined).

FIGURE 5 | Solar PV Installed Capacity and 2015/2016 Additions, by Country



* Capacity additions are for 2015, the latest data available.
Note: Ukraine has a separate vertical axes given the size of its generation capacity.
Source: See endnote 21 for this section.

Several countries are adding new utility-scale solar PV plants. Ukraine, the largest solar market in the region, commissioned 37 MW of new capacity in the first half of 2016 to reach a total installed capacity of at least 881 MW by year's end, with several more projects in the pipeline.[22] The country's cumulative solar installed capacity has almost doubled since 2012 thanks to the feed-in tariff programme. Ukraine could be positioned to surpass 1 GW of installed solar PV capacity by the end of 2017.[23]

The Russian Federation has ambitious plans to develop its solar PV market and aims to add 1.5 GW of capacity by 2021.[24] In 2015 the country experienced the highest annual growth in solar PV in the region, adding at least 104 MW, and projects in the pipeline are expected to reach a total capacity of some 800 MW.[25]

Kazakhstan experienced the second largest growth in solar PV installed capacity, adding the 50 MW Burnoye Solar 1 plant for a total of 57 MW of capacity by the end of 2015.[26] Burnoye Solar 1, the country's first utility-scale solar plant, was co-financed by the EBRD and the Clean Technology Fund.[27] The EBRD recognised the plant as "Sustainable Energy Project of the Year" at its annual Sustainability Awards.[28] Other solar PV projects in the pipeline include a second phase of the Burnoye plant in southern Kazakhstan.[29]

In Azerbaijan, the 20 MW Nakhchivan Solar Power Plant was completed at the end of 2015. Located near Khal-khal village in Babek district, the plant was implemented under an agreement between the State Energy Agency of Nakhchivan Autonomous Republic and the Belgian Soltech Company.[30]

Uzbekistan continued to develop the 100 MW solar PV plant in the Samarkand area, financed by a loan from the ADB and the Uzbek Fund for Reconstruction and Development (see Sidebar 3).[31] Three solar PV plants (100 MW each) remain in the pipeline, as well as two concentrating solar thermal power (CSP) projects: one 10 MW plant and one 130 MW hybrid fossil-solar plant, which is an integrated solar combined-cycle (ISCC) plant with 30 MW of solar capacity.[32]

Sidebar 3. Uzbekistan's Solar Opportunities

Solar energy is Uzbekistan's most promising renewable energy resource, and the country aims to become the region's knowledge hub for solar technologies. The history of solar energy in Uzbekistan dates back to the Soviet era, when the country was selected to conduct research on CSP based on its abundant solar irradiance. Solar experimentation has been ongoing since 1925 with actinometrical measurements at the Uzbek Hydro Meteorological Institute, and a 1 MW solar furnace was operating in the country as early as 1987 under the Uzbekistan Academy of Science. Consequently, Uzbekistan has a good technical capacity and knowledge of CSP, solar materials and PV technology. It also boasts an incipient solar component industry.

Solar energy has the potential to bring numerous benefits to the country, most importantly improved energy security given that Uzbekistan is heavily dependent on oil and gas imports from the Russian Federation. Solar generation also can help reduce greenhouse gas emissions in Uzbekistan, which is one of the most energy- and carbon-intensive countries in the region.

Despite assets including a vast resource potential, plentiful land to develop solar energy, and local experts, barriers to solar development persist, including the lack of a policy and regulatory framework and insufficient reliable data on solar irradiance. The ADB has provided technical assistance to Uzbekistan to create an enabling environment for solar development, to undertake resource assessments, and to prepare utility-scale projects. Among the efforts to facilitate the creation of a solar market in the country was the establishment of the International Solar Energy Institute, a research centre that aims to bring technology innovation, transfer technology and stimulate solar use, with the vision of transforming Uzbekistan into an international knowledge hub and solar technology exporter.

Uzbekistan's solar market began to materialise in 2014 with the commissioning of the first solar power project, a 130 kilowatt (kW) solar PV installation in Namangan province. The country is rapidly consolidating its solar PV market, and to date its total pipeline of solar PV projects includes 300 MW of installed capacity and an estimated investment of nearly USD 700 million. The first utility-scale solar PV project is expected to be the 100 MW plant in Samarkand, which secured a USD 110 million loan from the ADB in 2013 as well as support from Uzbekistan's Fund for Reconstruction and Development (UFRD) and Uzbekenergo. The project developer is China Singyes Solar Technologies Holdings, which won an engineering, procurement, and construction contract on behalf of Uzbekenergo via a tender. Two more projects are on the way in the Namangan and Surkhandarya regions, financed by the ADB and UFRD and with an estimated combined cost of USD 420 million.

The government plans to further develop its installed capacity with three additional solar PV projects in the preparation stage: 100 MW in Kashkadarya, 130 MW in Navoi and 10 MW in Tashkent. Uzbekistan is actively working to become the region's solar energy knowledge and technology hub.

Source: See endnote 31 for this section.

SOLAR ENERGY INDUSTRY

Kazakhstan and Uzbekistan continue to engage in domestic solar PV module production, supported by special premiums for solar projects built with local equipment. The Decree of the Government of the Republic of Kazakhstan No. 644, dated 12 June 2014, and the feed-in tariff premium for using local equipment outline the details of the localisation requirements.[33]

Kazakhstan produces silicon PV modules manufactured by the company Astana Solar in a production plant with a design capacity of 50 MW, expandable up to 100 MW. The plant employs more than 200 professionals and is equipped with European automated equipment; the resulting modules meet European quality norms and certification.[34]

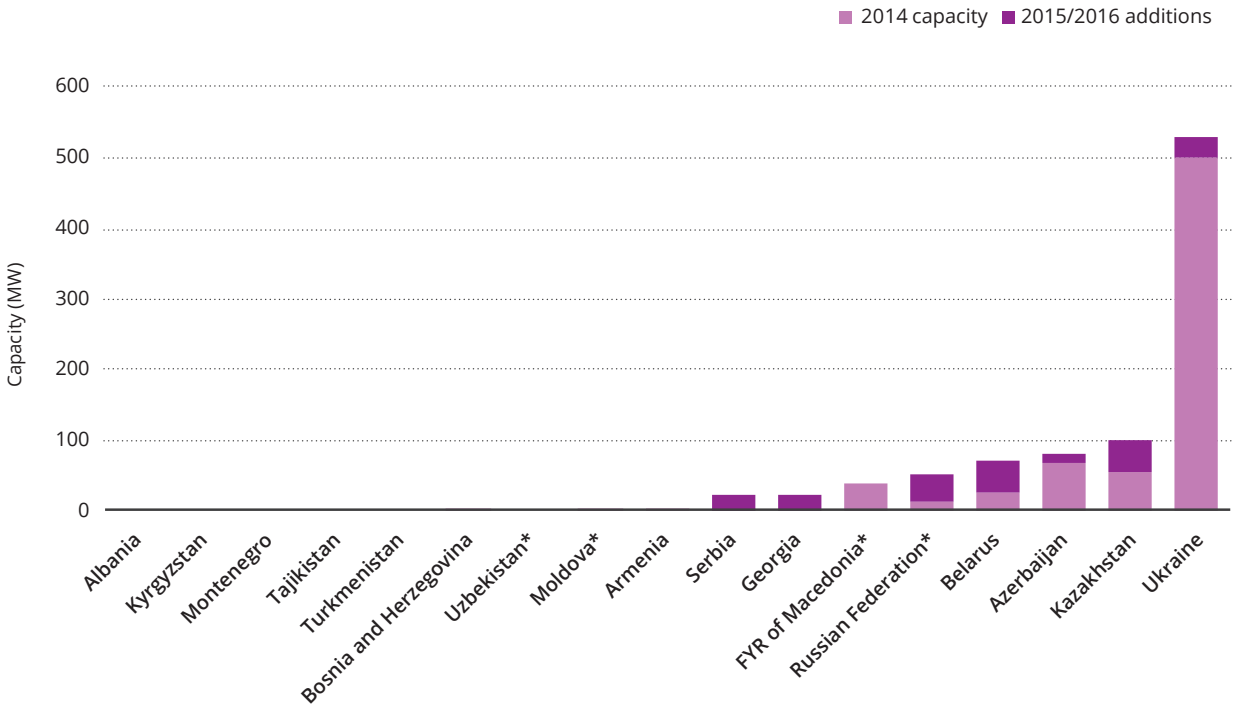
In Uzbekistan, several joint ventures were established recently to manufacture silicon PV panels. For example, the company Uzeltechsanoat plans to develop solar PV power plants with a capacity of up to 500 kW in Navoi province, relaying largely on its own technology for the production of PV equipment.[35] About 30 local companies are engaged in manufacturing, assembling, installing and providing after-sale servicing of renewable equipment/systems, and this sector is growing constantly.[36]

Turkmenistan continues to develop experimental solar prototypes at the Solar Energy Research Institute under the Academy of Science.[37] In 2015, the Ministry of Industry announced that it was soliciting commercial proposals for the creation of a joint venture for the production of solar panels, although no results have been reported to date.[38]

WIND ENERGY

Sizable wind resource potential is present across the region, with the largest resources in Kazakhstan, the Russian Federation and Ukraine. Uzbekistan is working to identify its wind potential.[39] The region's wind sector added an estimated 212 MW over the 2015-2016 period, for a total installed capacity of 906 MW.[40] Kazakhstan led in new capacity installations, followed by the Russian Federation, Belarus, Ukraine and Serbia (see Figure 6).[41] No off-grid wind energy developments have been reported to date in the region, although Azerbaijan has expressed interested in transforming its existing offshore oil platforms into offshore wind; a project off the coast of Pirallahi Island is expected to be the first wind farm built in an offshore oil production area.[42]

FIGURE 6 | Wind Power Installed Capacity and 2015/2016 Additions, by Country



* Capacity additions are for 2015, the latest data available.
Source: See endnote 41 for this section.

Kazakhstan continues to tap into its vast wind potential. In 2015, it commissioned its first utility-scale wind farm, a 45 MW facility in the Akmola region financed by the Eurasian Development Bank.[43] The country's wind power market is expected to grow rapidly in the next 10 years, with several fully permitted projects ready to be built and others in different stages of the permitting process.[44] Local manufacturing capabilities are growing as well, and in 2016 the Almaty-based company Tree Energy launched a challenge to produce wind generators and water power stations using 90% of components made in Kazakhstan.[45]

In Serbia, a dozen utility-scale wind projects are under development, for a cumulative capacity of at least 400 MW. The most advanced projects are Cibuk 1 Dolovo wind park (158 MW), Plandiste wind park (102 MW), Kovacica wind park (95 MW) and Alibunar wind park (42 MW), plus several smaller projects of up to 10 MW each. All of the projects are fully permitted and ready for the start of construction as soon as the government enacts a power purchase agreement (PPA).[46]

Ukraine added 28.3 MW of new wind power capacity in 2015-2016, for a total of 525.6 MW.[47] As of 1 October 2016, 10 wind generators were selling electricity based on the country's feed-in tariff, called "the green tariff".[48] The growth of the wind industry might be impacted by recent changes to the FIT (including the return of a premium for local content), hampering the investment climate in the country.

Bosnia and Herzegovina expects its first utility-scale wind power plant to be commissioned in 2017. At least three plants are in the development phase, with permits secured and loans from Germany's development bank KfW.[49] The state-owned utility Elektroprivreda (ERS) from Trebinje has a 50-year concession to build and operate the 48 MW Hrgud wind farm in Berkovići municipality.[50] The other two wind farms, Mesihovina and Podveležje, received KfW loans of USD 77.2 million and USD 69.7 million, respectively.[51]

In Azerbaijan, wind development continues including the 80 MW Absheron project, the 50 MW Yeni Yashma Wind Farm and the 52.8 MW Shurabad project.[52] In Montenegro, development of the Krnovo and Mozura wind farms continues.[53] The 72 MW Krnovo project, valued at around USD 128.6 million, started construction in summer 2015; it is implemented by Austria's Krnovo Ivica Consulting and France's Akuo Energy and is financed by the EBRD, KfW and Proparco.[54]

Several projects are planned in the Russian Federation, including a 51 MW wind park being developed in Kalmykia and a USD 139.4 million offshore wind park planned in the White Sea area off the coast of Karelia.[55] Local authorities and private investors also plan to invest up to USD 894 million in eight wind farms in the Yeisk, Temryuk, Shcherbinovsky and Kanev districts of the southwest Krasnodar region.[56] Additionally, Chinese turbine manufacturer Dongfang signed an agreement in 2016 with the local government of Ulyanovsk and the Ulanotech research centre to build a blade production facility in southwest Russia.[57]

Belarus added 45.5 MW of wind power capacity in 2015-2016, including its largest wind farm of 7.5 MW (see Sidebar 4).[58]

Sidebar 4. Wind Power Development in Belarus

The hilly landscape of Belarus – especially in Minsk in the west and in the cities of Vitebsk and Polotsk – makes the country suitable for wind energy development. Wind resources benefit from feed-in tariffs under the Presidential Decree on the Use of Renewable Energy. They also are supported through the State Programme on Energy Efficiency for 2015-2020 and the Comprehensive Development Plan for the Electricity Sector to 2025.

However, the country's wind energy potential is unknown. In October 2016, the Ministry of Natural Resources and Environmental Protection held an open bidding process to execute the undertaking of a wind resource measurement project. The government also is working to remove barriers to wind power development and to assist in the development (permitting, financing and construction) of sites for a new 25 MW wind plant. These actions are expected to pave the way for future development of wind turbines by private companies.

Wind resource development is supported by the donor community. Since 2014, Belarus has hosted the technical assistance project "Removing Barriers to Wind Power Development", funded by UNDP/GEF. The project proposes establishing a financially viable private company to facilitate investment in wind energy in Belarus. It aims to provide first-loss capital and to establish market-based empirical precedents.

Because of these efforts, Belarus is emerging as a wind energy market in Eastern Europe. The installed capacity currently comprises just over 60 wind power plants with a total capacity of about 70.4 MW. The largest wind plant, a 7.5 MW plant in Navahrudak district, started operating in 2016. The country is expected to commission a 2.5 MW wind farm in 2017 to be built by FWT, a German manufacturer of wind turbines.

Source: See endnote 58 for this section.

BIOENERGY (BIO-POWER)

Bioenergy draws on a wide range of potential feedstock materials, including forestry and agricultural residues, wastes of many sorts, and material grown specifically for energy purposes. The raw materials can be converted to electricity or heat for use in buildings and industry, or into gaseous or liquid fuels that can be used in transport, for example. In 2015-2016 the region added 42 MW of solid biomass and 18 MW of biogas power generation capacity, for a total installed bioenergy electricity production capacity of 1.56 GW for solid biomass and 64 MW for biogas.

South East Europe, Eastern Europe and the Russian Federation have large biomass resources that are only partially exploited. Bioenergy production remains nascent in the region. Wood chips or pellets are produced in South East Europe for export to fuel several combined heat and power (CHP) plants in Belarus, the Russian Federation and Ukraine.[59] Azerbaijan is preparing a 18.2 MW bioenergy project with support from the ADB in the Oguz, Samukh and Agcjabady regions.[60] Belarus annually produces about 200,000 tonnes of fuel briquettes of sawdust, flax shive and other wood residues as well as wood pellets made from wood residues for export.[61]

HEATING AND COOLING SECTOR

The growth of renewables in the heating and cooling sector remained nascent during 2015-2016[i]. The region has good potential for using solar, geothermal and biomass for renewable heating and cooling. Solar water heating continues to grow in several countries (see Figure 7).[62]

Albania is the most developed market for solar water heating in the region. The government, with support from UNDP/GEF, is working to replace electric boilers with solar water heaters by securing an enabling policy framework, increased awareness and advocacy, a suitable financing mechanism and a supply of reliable technology (e.g., through labelling and quality control).[63]

In Armenia, solar water heating capacity continued to grow thanks to funding programmes such as the soft loans of the commercial banks of Armenia and Germany's KfW development bank. Additionally, at least 7 hotels, 4 catering businesses and more than 20 service companies have benefited from the Green Leasing programme to fund solar thermal systems for small and medium-sized enterprises.[64]

The region has vast bioenergy resources that could be used for bio-heat for buildings and industrial processes. Eastern European countries have seen progress in the use of biomass for district heating.

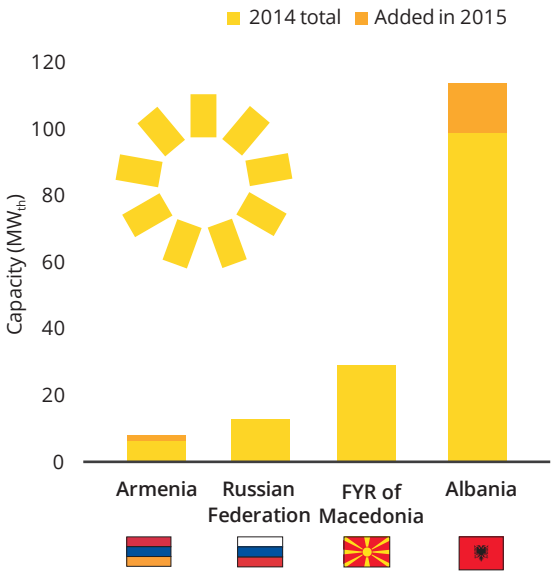
Belarus continues to have the most developed bio-heat sector, with 7 solid biomass-based and 16 biogas-based CHP plants feeding district heating networks, as well as more than 3,000 biomass-based boilers for heating public buildings and houses in rural areas.[65] Belarus' example is replicable in countries with existing and functioning district heating networks, as these can be converted to be fuelled by solid biomass or biogas where local supply is available. Individual heating systems also can take advantage of local biomass resources.

Moldova continued to promote renewable heating systems through the Moldova Energy and Biomass Project funded by the EU. The programme supplies municipal institutions with biomass heating systems (burning mainly biomass briquettes and pellets from agricultural waste).[66] The government and the Japanese International Cooperation Agency are installing biomass heating systems in schools and kindergartens using agricultural by-products and residuals (such as straw, sunflower and maize stalks) as well as orchard and vineyard residuals.[67]

Montenegro is implementing the Energy Wood project – which provides soft loans for heating systems fuelled by modern biomass, such as wood pellets or briquettes – with support from Luxembourg's Agency for Development Cooperation.[68]

In Bosnia and Herzegovina, a co-financing agreement for a new biomass heating system was signed by the Czech Development

FIGURE 7 | Solar Water Heating Installed Capacity and 2015 Additions, by Country



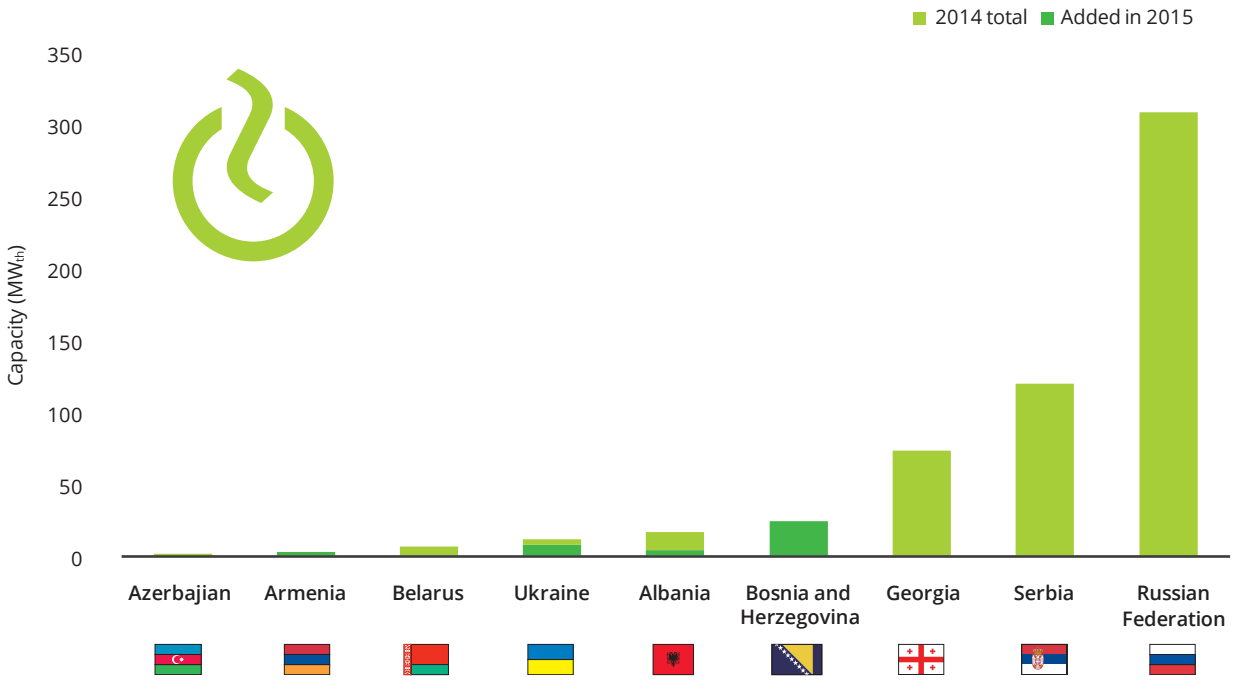
Note: Data for 2015 are not available for the Russian Federation and the former Yugoslav Republic of Macedonia.
Source: See endnote 62 for this section.

[i] Data for the heating and cooling sector as well as for the transport sector are limited.

Agency. The project covers heaters, external piping and an integrated heating control system for the Cantonal Hospital in Bihać. The hospital will be funded by the Agency, through a UNDP-managed project, for more than USD 821,777, and the regional government will contribute USD 537,316 for a new facility to host the heating system. The new heating system will allow energy savings of up to 50%, which will be redirected to other health services for regional residents.

Geothermal energy has the potential to be used in direct heat applications using low- to medium-temperature resources (see Sidebar 2). Geothermal direct use in the region totalled an estimated 561 MW_{th} in 2015 (see Figure 8).[69]

FIGURE 8 | Geothermal Heat Installed Capacity and 2015 Additions, by Country



Source: See endnote 69 for this section.

TRANSPORT SECTOR

Renewable energy can be used in the transport sector to replace fossil fuels with liquid or gaseous biofuels, and to power electric vehicles. Countries in the region continued to harness renewable energy in transport. Belarus has a reported liquid biofuels production capacity of 50 million litres of biodiesel per year, the former Yugoslav Republic of Macedonia has a production capacity of 30,000 tonnes of biodiesel per year, and Ukraine has a production capacity of 500,000 tonnes of biodiesel and 131,000 tonnes of ethanol per year.[70]

Biodiesel production in the former Yugoslav Republic of Macedonia started in 2007 and is based on rapeseed (canola).[71] The production is used for the sale of a B6 blend with diesel as well as for pure B100 biodiesel.[72] Two additional biodiesel refineries have been announced for the country, one of which will use sunflower and soya as feedstock and is expected to produce 13,000 tonnes of biodiesel per year.

Electric mobility promotion programmes also are emerging in the region. In Ukraine, electric vehicles are developing rapidly. At least 1,700 electric vehicles were operational in 2016, and this number is expected to increase to 7,000 by the end of 2017.[73] In Georgia, Tbilisi City Hall opened two electric vehicle charging stations, and the number of stations is expected to reach 100 by 2018. Currently, some 50 electric vehicles are being driven in the country.[74] Belarus started a pilot production of electric buses in 2016. The country expects to reach 30,000 electric vehicles by 2025.[75] With this target in mind, 20 charging stations are planned to be put into operation every year.

Sidebar 5 showcases the example of Kazakhstan, which is leading the "green" agenda in Central Asia.[76]

Sidebar 5. Kazakhstan Leading the Green Agenda in Central Asia

Kazakhstan plans to obtain 50% of its total energy consumption from alternative and renewable energy sources by 2050. Currently the renewable share in TFEC is 1.4%. The target is part of the country's 2050 strategy, centred on the principles of a green economy. Kazakhstan is positioning itself as a leader of the green agenda in Central Asia. In 2017 it will be the first Central Asian country to host EXPO, which will be dedicated to the topic "Energy of the Future".

In 2016, Kazakhstan reported a 0.9% share of renewable energy in TPES and a total installed renewable energy capacity of 2,855 MW, including 2,688 MW of large-scale hydropower, 98.52 MW of wind and 57.3 MW of solar PV.

That year, the country took additional steps to amend its legislation on renewable energy through the law on "amendments and additions to some legislative acts of Kazakhstan on the transition of the Republic of Kazakhstan to the green economy" and the law on "supporting the use of renewable sources of energy". The changes, which aim to facilitate the development of a renewable energy market in the country, include:

- annual indexation of approved fixed tariffs for renewable power generation,
- creation of a reserve fund to cover cash deficiencies of the financial settlement centre responsible for the centralised purchase and sale of energy generated by designated renewable energy facilities,
- extension of the deadline for concluding a sale and purchase agreement with the financial settlement centre to 60 days, and
- changes to the agreement on connection of renewable energy facilities to the power grid and to the obligations of renewable energy producers.

Kazakhstan has intermediate targets to 2050, aiming for a 3% share of renewable energy in TFEC by 2020 and a 10% share by 2030. By the end of 2020, Kazakhstan plans to introduce some 52 renewable power facilities with a total installed capacity of 2 GW (22 wind plants for a total of 957 MW, 18 solar plants for a total of 750 MW and 13 hydroelectric plants for a total of 268 MW). The targets were approved in 2016 through two legislative acts: the "Order of the Republic of Kazakhstan Minister of Energy on November 7, 2016 № 478 on approval of the targets for renewable energy sector" and the "Order of the Republic of Kazakhstan Minister of Energy of December 21, 2016 №544 on approval of maximum allowable power facilities renewable energy sources in the zones (areas) of the unified power system of the Republic of Kazakhstan for 2017".

Source: See endnote 76 for this section.

03

DISTRIBUTED RENEWABLE ENERGY AND ENERGY ACCESS

03 DISTRIBUTED RENEWABLE ENERGY AND ENERGY ACCESS

Access to affordable, reliable and sustainable energy, especially for low-income and rural populations, remains a challenge for the region despite its endowment in energy sources. The quality and reliability of the electricity supply is problematic in several countries. Access to a sustainable and affordable heat supply is challenging in those countries that have a cold climate and long heating seasons that span from one-third to one-half of the year.

Access to clean fuels and technologies for household heating, lighting and cooking remains an issue for more than 17 million of the region's inhabitants, and many rural populations continue to exhibit a high dependence on solid fuels (exceeding 60% in four countries) for residential heating and cooking, as non-solid fuels are difficult to source. National governments and international donors continue to promote renewable energy solutions through initiatives to improve the quality of energy access. Moving from donor-funded pilot projects to widespread adoption of renewable energy for improved quality of energy access across the region remains challenging.

TRENDS AND CURRENT SITUATION OF ENERGY ACCESS

Access to energy is a multi-dimensional issue, involving many variables. In many parts of the world, physical availability (of fuel, or connection to a distribution system for gas, heat or power) is a fundamental concern. Issues such as affordability, reliability and sustainability of energy and its sources are especially relevant in developing societies and emerging economies. The UN's Sustainable Development Goal 7 provides for access to affordable, reliable, sustainable and modern energy for all.

The multi-dimensional character of energy access requires methodologically suitable measurement and reporting tools that move beyond the binary dimension ("having electricity or not having electricity") and that adopt a multi-tier approach to measuring energy access.[1] Multi-tier approaches measure energy access as a continuum of improvement, based on the performance of the energy supply. This methodological approach is particularly suitable in assessing the situation across South East and Eastern Europe, the Caucasus, Central Asia and the Russian Federation, where electrification rates are above the global average but where a multi-tiered approach shows that many challenges remain.

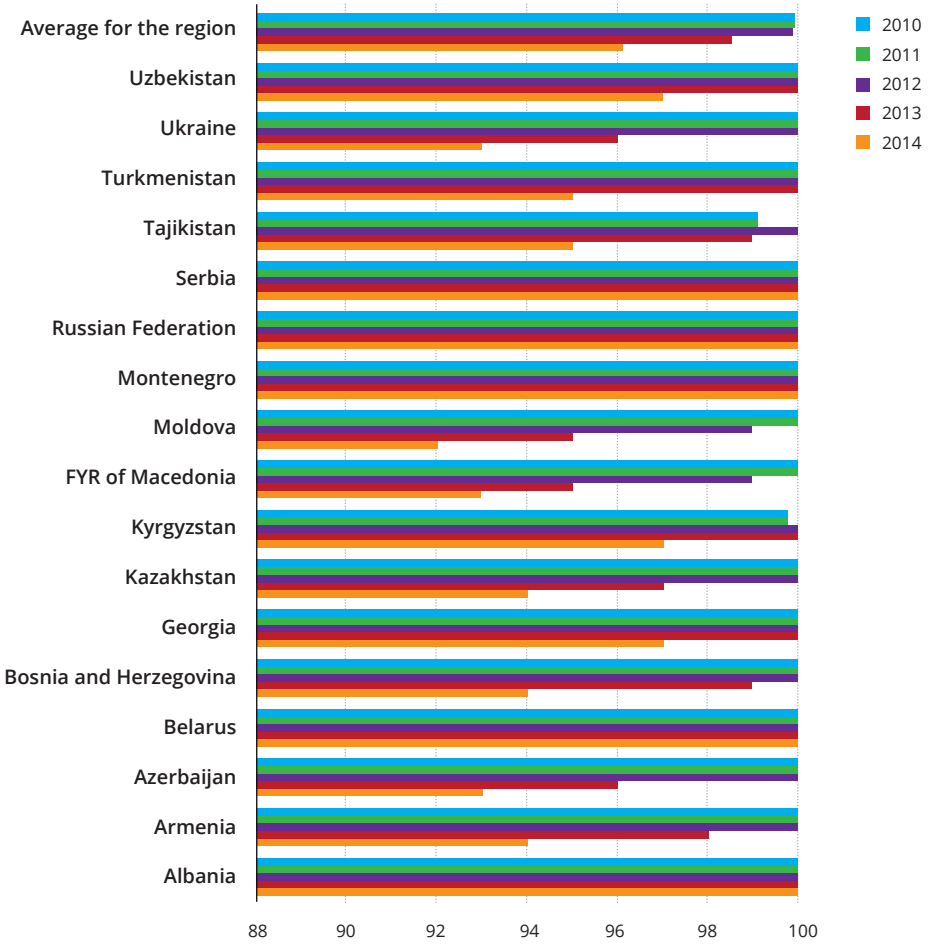
Two dimensions of energy access emerge as having particular importance in the region: 1) the expansion of infrastructure to provide service to areas with poor access, and 2) upgrading or replacing infrastructure to improve access to areas already served. Despite the importance of both issues, the second (improving infrastructure to existing connections) is a larger task in the region, where the number of non-served communities is below the global average but where the quality of supply remains a major issue.[2]

From a global perspective, the region over-performs in terms of electricity access. Whereas 1.2 billion people worldwide lack access to electricity networks, 15 of the 17 countries in the region reported a 100% electrification rate, and the 2 remaining countries had rates higher than 99% in 2014 (see Figure 9).[3] The electricity access situation in the region is a notable improvement over 1990, when 12 countries reported access rates of between 90% and 100%.[4] Albania, Belarus, Montenegro, the Russian Federation and Serbia have reported 100% electrification rates since 1990.

Kyrgyzstan and Tajikistan both reported a 100% electrification rate in 2012, suggesting that their electrification situation may have deteriorated since that year. In 2014, Tajikistan's electrification rate was 99.1%, with the remaining 0.9% (or almost 75,000 people) living mainly in rural areas. Kyrgyzstan's electrification rate was 99.8%, with more than 11,000 people lacking access to electricity.[5]

A discrepancy remains between reported rates and the situation on the ground, where a small number of remote settlements and rural communities continues to lack access to electricity (see Sidebar 6).[6]

FIGURE 9 | Access to Electricity, by Country, 1990-2014



Source: See endnote 3 for this section.

Sidebar 6. Communities Without Electricity Access

The World Bank's World Development Indicators report that in 15 of the 17 countries in the region, 100% of the population had access to electricity in 2014, while the remaining two countries (Kyrgyzstan and Tajikistan) had electrification rates higher than 99%. However, information gathering indicates that several communities across five countries, particularly in rural or remote areas, still lack access to electricity.

In **Bosnia and Herzegovina**, problems with electrification remain, and despite efforts by international donors to establish pilot projects and develop innovative solutions, widespread adoption was still lacking as of December 2016. Beyond physical grid access, barriers involve prohibitive grid connection costs and slow administrative approval of new connections for displaced families that have returned, particularly in Kraiina and Eastern Bosnia. The homes of at least 1,765 returnees across the country have been identified as in need of connection to the grid, and a political initiative of September 2016 undertook to resolve the issue within six months.

In **Georgia**, electrification efforts have been completed with the exception of around 130 settlements in rural areas and mountain regions. These settlements are mostly seasonal residences occupied only during the summer. Electrification of the off-grid villages was completed based on government efforts during 2012-2016. As many as 29 villages that were without electricity for more than 25 years now have access and are connected to the national grid. Since mid-2015 several projects have been implemented, including a 100 kW micro-hydropower plant, Mutso HPP, built to bring electricity to the high mountain village of Mutso. Rehabilitation of the Shatili micro power plant, which operates as a stand-alone system, increased its capacity to 600 kW.

In **Kyrgyzstan**, about 20 settlements are not provided with electricity in the Batken region on the border with Uzbekistan and Tajikistan. Electricity traditionally was supplied from a power plant located outside of Kyrgyzstan, but supplies were ceased in 2013. The Islamic Development Bank continues to provide funding for projects through 2017 that will improve electricity supply in the region. Sourcing surplus power from Tajikistan (which neighbours the Batken region) during the summer months also has been under way. The State Committee for Industry, Energy and Mining of Kyrgyzstan subcontracted a private company to execute works to improve transmission networks in the region in 2016.

Tajikistan is focused on utilising its significant hydropower potential and its even distribution of rivers throughout the country to create distributed small hydro solutions to provide electricity access for the approximately 10% of the population that lives in remote, mountainous regions. The country's Long-term Programme for Building Small Hydropower Plants 2009-2020 foresees construction of 190 small hydro plants with a total capacity of 100 MW, with run-of-the-river solutions being the preferred approach for remote, sparsely inhabited regions.

Uzbekistan has about 1,500 communities without connection to the centralised electricity supply. In these remote settlements, seasonal dwellings and farms, installing solar home systems has become the preferred solution. The Ministry of Agriculture and Water Resources is promoting installation of mini and micro hydropower stations to address local electricity needs.

Source: See endnote 6 for this section.

A major electricity access issue in parts of the region remains the quality of electricity supply, particularly in terms of reliability, affordability and sustainability. Despite physical connection to the grid, the quality of supply in certain cases is unreliable, especially during periods of high demand. Power outages still occur in several countries, especially in the Caucasus and Central Asia, where the energy infrastructure is poorly maintained and ageing. This is an issue for both residential and commercial electricity use.[7] Rolling blackouts during winter are a fact of life in Tajikistan (see Sidebar 7), Uzbekistan and Kyrgyzstan, although in the latter case recent and timely infrastructure works during summer 2016 reportedly resulted in a 10% reduction of outages that winter.[8] The outages are attributable mainly to an inflexible electricity generation mix with high reliance on seasonal patterns combined with increased electricity demand for heat during winter.

Beyond electricity, the region is challenged on other dimensions of energy access. The dichotomy between rural and urban areas is pronounced: populations in many urban areas, despite having physical access to various energy sources, face issues with affordability of energy, reflected in high rates of energy poverty (see Table 5). In rural areas, the problems relate to the quality of supply and health issues because households lack widespread access to clean fuels and technologies (CFTs) for heating and cooking (see Table 5).

Access to CFTs at the household level for cooking, heating and lighting is one of the most significant indicators affecting energy access, and both aspects (the fuel and the technology used) must be tracked and reviewed to adequately protect public health.[9] In monitoring progress towards SDG 7, the Inter-Agency Expert Group on SDG Indicators uses the new indicator "Percent of population with primary reliance on clean fuels and technologies at the household level" in place of non-solid fuel usage.[10] The new indicator includes kerosene in the polluting fuels and tracks the use of inefficient technology to better reflect residential energy reliance. Polluting fuels (especially unprocessed coal and kerosene) and obsolete technologies for cooking, cleaning and lighting continue to play an important role in many countries of the region.

More than 17 million people across the region, or approximately 6% of the total population, still rely on polluting and health-damaging fuels and technologies to meet their cooking, heating and lighting needs (see Table 5).[11] In eight countries, access to CFTs is available to less than 90% of the population (see Figure 10), and in two of them (Bosnia and Herzegovina and Georgia) the share is below 60%. Closely related, Georgia shows evidence of an alarmingly high mortality rate attributed to air pollution (the world's highest, with close to 300 deaths per 100,000 people).[12] From a population standpoint, in eight countries more than 1 million people lack CFT access, and in four of them (Bosnia and Herzegovina, Serbia, Tajikistan and Uzbekistan) the figure exceeds 2 million.

Sidebar 7. Quality of Electricity Supply in Tajikistan

An estimated 70% of Tajikistan's population suffers from frequent power outages, particularly during the winter when the demand for electricity for heating is high and hydropower generation (the country's main electricity source) is low due to reduced water flows. Apart from detrimental effects on the commercial sector, the lack of supply heavily affects social and welfare services, in addition to schools and hospitals.

The energy supply deficit affects rural populations in particular. In winter, 70% of the population living in rural areas has about three hours of electricity supply per day. Rural households struggle to meet their heating needs and rely increasingly on solid fuels for heat, as electricity is not readily available. Rural households also report cutting back on food expenditure to supplement their heating budget. Vulnerable social groups (pensioners, single mothers, people with disabilities, households with many children) are particularly affected.

In urban areas outside the capital city of Dushanbe the problem is still pronounced, with many of the poorest households spending a large share of their budget on electricity for heat despite the low tariffs. The monthly electricity consumption of the Tajik population in cities other than Dushanbe is only half that of the population of the capital, and rural areas consume 75% less electricity than the population living in the capital.

The government recognises this problem, and the planned National Development Strategy of Tajikistan for 2016-2030 foresees tripling the country's electricity generation (from 17 TWh to 45 TWh annually) to address the electricity deficit. Development donors also are cognisant of the issue and are actively increasing their efforts to address the electricity supply crisis, focusing on sectoral reforms (for example, ADB's contribution towards unbundling and the adoption of a new tariff-setting methodology) as well as infrastructure and power plant modernisation projects (for example, Phase II of the Qairokkum Hydro Power Plant Climate Resilience Upgrade, initiated in April 2016). The commencement of works on the 3,600 MW Rogun Hydro Power Plant in November 2016 also was foreseen to greatly increase Tajikistan's electricity production.

In addressing this supply crisis, renewable energy sources can provide a valuable alternative. Small hydropower is a priority, and a number of small hydro projects are in the pre-development stage, according to the national "Program for renewable energy and construction of small hydroelectric power plants for the period 2016-2020". Several wind power projects are in the data collection phase. Solar is also an option, with a potential of 25 TWh per year, especially in mountainous regions with high irradiation.

Distributed generation can be crucial for the country, given its mountainous terrain. About 75% of the Tajik population lives in rural areas, and 93% of the country is covered by mountains. This makes physical grid access problematic and expensive and grid losses significant, and international donors are providing financing to alleviate the country's energy supply issues.

Source: See endnote 8 for this section.

TABLE 5 | Overview of the Quality of Energy Access, by Country

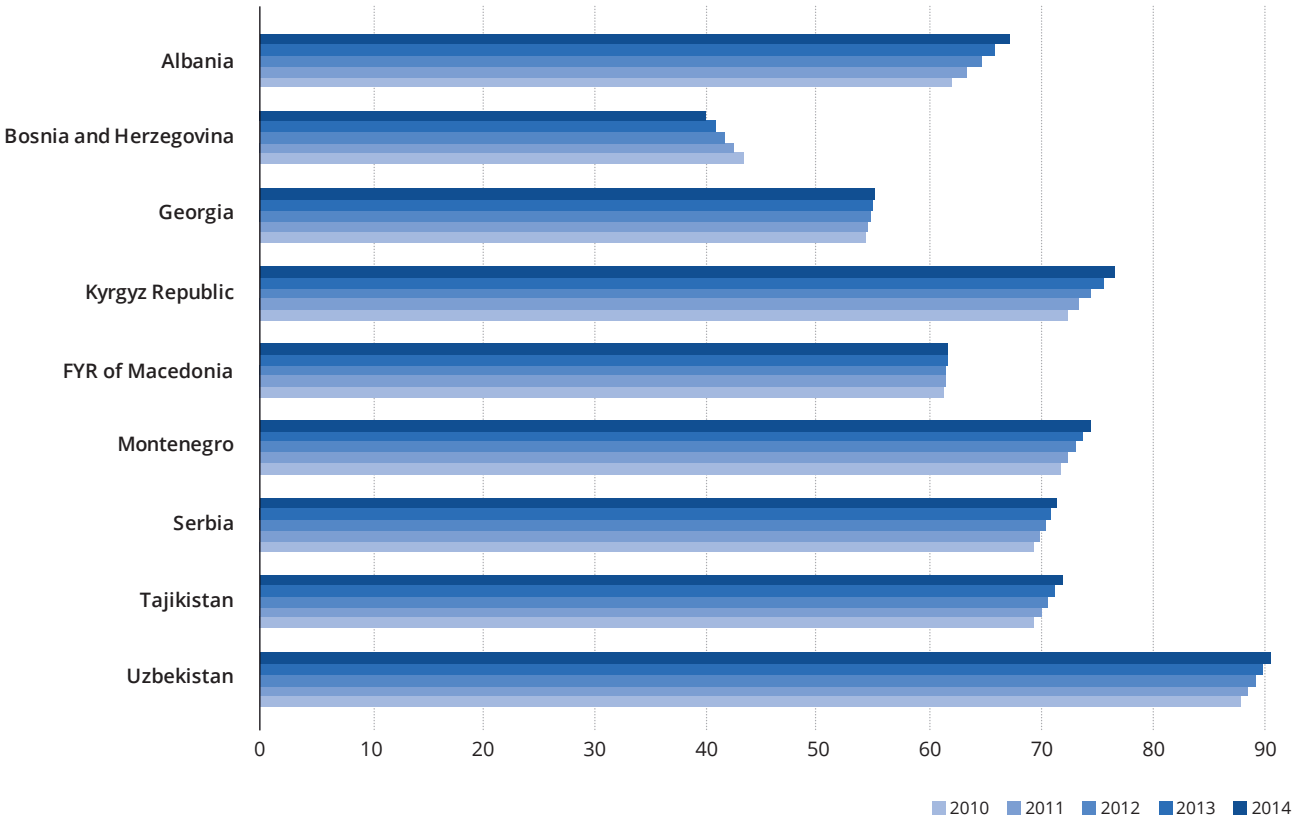
	Clean fuels and technologies (CFT) use rate % 2014	Average annual growth rate of CFTs % 2012-2014	Population without CFTs 2014	Energy poverty rate[1] % 2012	Share of sales lost due to electrical outages % 2013[2]
Albania	67	1.33	952,630	46%	2.6%
Armenia	100	0.30	865	35%	0.1%
Azerbaijan	97	1.79	292,061	21%	0.1%
Belarus	100	0.14	1,811	6%	0.1%
Bosnia and Herzegovina	40	-0.85	2,299,720	29%	0.3%
Georgia	55	0.22	1,677,968	39%	0.5%
Kazakhstan	92	0.59	1,409,585	27%	0.4%
Kyrgyzstan	76	1.06	1,376,130	25%	2.3%
FYR of Macedonia	61	0.07	799,152	N/A	1.2%

Moldova	93	0.74	231,832	52%	0.2%
Montenegro	74	0.65	160,689	35%	0.8%
Russian Federation	100	0.13	27,621	29%	0.2%
Serbia	71	0.52	2,053,697	49%	0.3%
Tajikistan	72	0.63	2,348,856	60%	4.4%
Turkmenistan	100	0.00	531	N/A	N/A
Ukraine	98	0.51	1,121,736	15%	0.2%
Uzbekistan	90	0.66	2,991,001	N/A	2.2%

Notes: The CFT indicator tracks the percentage of population with primary reliance on clean (i.e., excluding unprocessed coal and kerosene) fuels and technologies at the household level for cooking, lighting and heating. Data are tracked by the World Health Organization in partnership with UN Energy and the SEforALL Global Tracking Framework Consortium. N/A indicates that the data were not available at the time of publication.
1 Energy poverty rate is the share of households spending more than 10% of their budgets on energy.
2 Data for the Russian Federation are from 2012.
Source: See endnote 11 for this section.

Access to CFT use is growing in the region, as evidenced by the annualised growth rates for the share of the population using CFTs for the period 2012-2014 (see Figure 10).[13] All but one of the countries reported slow but steady increases in CFT growth, with Albania, Azerbaijan and Kyrgyzstan leading with more than 1% growth for the reference period. Only Bosnia and Herzegovina exhibited negative growth, regressing further in its use of polluting fuels and technologies for household use.

FIGURE 10 | Use Rate of Clean Fuels and Technologies in Selected Countries, 2010-2014



Source: See endnote 13 for this section.

The use of solid fuels for cooking and heating in rural areas (see Sidebar 8) is important.[14] A variety of factors explain the high level of solid fuel use, including in particular the limited access and affordability of other energy sources for cooking (such as electricity and gas).[15] Widespread availability of fuel wood (obtained cheaply through social assistance programmes, such as those in Georgia, or through illegal logging, as is occurring in South East Europe) also contributes to increased reliance on solid fuels for domestic use.

Sidebar 8. Solid Fuel Dependence in Rural Households and Indoor Air Pollution

Solid fuel use by households is closely linked to indoor air pollution. The World Health Organization (WHO) has documented the detrimental health effects of traditional biomass and other solid fuels in residential applications, mainly in cooking. The WHO raised the issue of indoor air pollution to the level of a "health crisis", attributing more than 4.3 million premature deaths in 2012 to this cause.

Women, children and the elderly are particularly vulnerable to the effects of indoor air pollution because they spend more time inside the house. Other adverse effects include those related to the environment, such as deforestation, as well as to the welfare of children, who usually are tasked with fuel collection at a cost to their education and social development.

In the region covered in the present report, the problem is especially pronounced outside of urban centres. In rural areas, reliance on solid fuels as the primary fuel available for heating and cooking surpasses 50% in six countries: Albania, Bosnia and Herzegovina, Georgia, the former Yugoslav Republic of Macedonia, Montenegro and Serbia. Among these six countries, 84% of Georgia's rural population and 77% of Bosnia and Herzegovina's depends entirely on solid fuel for household needs.

Even more importantly, in only two countries in the region (Belarus and Turkmenistan) does less than 5% of the rural population rely on solid fuels. This indicates the pervasiveness (to a greater or lesser extent) of solid fuels in almost all rural populations across the region.

Sources: See endnote 14 for this section..

In urban areas, affordability remains an important issue since energy poverty rates remain high. The energy poverty rate is defined as the share of households in a country that spend more than 10% of their household budget on energy.[16] The situation is more pronounced in the heat sector, a crucial sector in some countries of the region due to extremely low temperatures in winter (see Sidebar 8).

Where district heating is available, usually the equipment is obsolete and the infrastructure is inefficient. Moving away from subsidised fuel to more market-oriented approaches is driving up the final costs of heat to the consumer (see Sidebar 9).[17] Heat, which in many parts of the region was formerly understood to be a "social right", is turning into a commodity. Moreover, district heating systems, where present, rarely use metering on a building basis and even less so for different apartments within the same building. Instead, they usually allocate costs based on inflexible parameters (such as building floor area). There often is no choice to adjust demand, and households that cannot pay for the heat may be forced to be totally disconnected.

In other cases, the collapse of district heating systems or the increasing costs associated with them drive households to private heating solutions. This approach potentially could result in more efficient use by adopting renewable technologies in boilers and reducing transmission losses through distributed generation of heat. The widespread adoption of renewable heat solutions is limited, however, by high costs for new installations, by the unreliability of fuel supply and by high costs of renewable fuels. Reliance on electricity for heating needs varies across the region and is intensive in Albania, the former Yugoslav Republic of Macedonia and Montenegro.[18] Some countries (Kyrgyzstan, Serbia and Tajikistan) use electricity as a supplementary heat source in winter, resulting in demand peaks that sometimes directly affect the availability of electricity in winter (see Sidebar 7 for Tajikistan).[19] Other households, even if power supply is available, cannot afford the additional electricity expenditures and turn to other solutions.

Sidebar 9. Affordability of District Heating

District heating systems in Eastern Europe, Central Asia and the Caucasus have undergone significant transformation since the early 1990s. They still represent a significant share of urban heating in the Russian Federation (representing over 70% of the housing stock), Ukraine (over 60%), Belarus (over 50%), Kazakhstan (over 50%), Uzbekistan and Kyrgyzstan, but their operation relies on decades-old generation systems and transmission infrastructure, resulting in low efficiency and high losses. District heating systems have partially or entirely collapsed in Armenia, Georgia, Moldova and Tajikistan.

Part of the problem lies with the allocation of costs. District heating systems are heavily subsidised across the region and recover only a part of their costs. Even though subsidies appear on the surface to benefit the poorer segment of the population, they often are regressive rather than progressive, proving more beneficial to the richer parts of the population. Moreover, tariff increases to cover system costs and to transition to a more market-oriented approach are not allocated proportionally and create social tension. Lack of transparency and trust in tariff setting is also widespread.

In **Belarus**, where heat tariffs recover only 30% of the costs of district heating, a 2015 World Bank study proposed rethinking the tariff methodology and cost allocation in combination with mitigation measures to alleviate the social impact of increased tariffs.

In **Armenia**, a multi-part heat tariff was proposed during a UNDP/GEF study and pilot project for Yerevan that was reported under the UN Environment Programme (UNEP) initiative "District Energy in Cities". The project encouraged reduction in demand-side consumption while also focusing on ensuring that the fixed element of the tariff covered the fixed costs of the connection.

In **Kyrgyzstan**, where 25% of the population was considered "energy poor" in the 2015 World Bank study, subsidies and cross subsidies in the heating sector are regressive, benefiting the upper 50% of the population much more than the lower 50%. Tariff reforms are considered the single most important policy action needed to improve the financial viability of the heating sector and to incentivise end-user energy efficiency.

In **Ukraine**, the World Bank's District Heating Regulatory Reform Program provides technical assistance with the tariff calculation methodology for district heating, with the objective of moving from a "cost-plus" system to an incentives-based method.

In **Moldova**, a comprehensive assessment of electricity and district heating tariffs in 2015 concluded that tariff increases are necessary for the viability of the system and should be adopted urgently. However, considering that as much as 80% of the population may be in energy poverty, tariff increases should be mitigated by appropriately planned amendments to existing social assistance programmes.

The question of balance between affordable energy and economically viable heat systems, with the fair allocation of costs as a constant through the whole system, is at the heart of the heat affordability discussion, and substantial technical assistance is required to address it.

Source: See endnote 17 for this section.

DISTRIBUTED RENEWABLE ENERGY SOLUTIONS FOR ENERGY ACCESS

Multilateral and bilateral donors as well as government programmes continue to finance various projects to promote renewable energy solutions for improved energy access (see Table 6). Nevertheless, the affected countries have yet to benefit from their participation in energy access initiatives, such as SEforALL (see Section 1), that can bring them to the mainstream of energy access innovation using renewable energy technologies. The main gaps continue to persist in communities without electricity access or with high use of solid fuels for heating.

Most of the projects in the region address heating for residential use using solar thermal systems. Albania and the former Yugoslav Republic of Macedonia have sizable installed capacities of solar thermal (see Section 2). In Uzbekistan, the deployment of solar water heaters produced by a local joint venture between the country's utility and a foreign manufacturer increased during 2015 and 2016. The manufacturing facility, situated in the economic zone of the city of Jizzakh in the country's east, has an annual production capacity of around 3,000 collectors, although long-term capacity may increase to around 50,000 collectors per year.[20]

Distributed generation as a means to increase electrification is of lesser importance in the region due to the high electrification rates. Tajikistan has a renewable energy target specifically for enabling electricity access in remote communities that are not connected to the national grid.[21] The target addresses mountainous areas of the country where laying power lines is not economically feasible.[22] Georgia, Kyrgyzstan, Tajikistan and Turkmenistan all integrate electrification into their small hydropower development strategies (see Section 2).

Several countries are using solar PV as a distributed energy solution (see Table 6).[23] In 2011 and 2012 the government of Montenegro implemented the Solarni Katuni programme to subsidise the installation of solar PV systems on remote farms. The programme offered 80% government support for the initial investment (both the national and local government contribution) combined with a 20% contribution from the end-user. Some 189 systems were installed during the two phases of the project, which continued through 2016 with additional funding of USD 59,000.[24] Bosnia and Herzegovina offered an example of technology innovation for renewables at costs rivalling connection to the national grid.[25]

> **ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR HOUSEHOLD HEATING, LIGHTING AND COOKING REMAINS AN ISSUE FOR MORE THAN 17 MILLION OF THE REGION'S INHABITANTS, AND MANY RURAL POPULATIONS CONTINUE TO EXHIBIT A HIGH DEPENDENCE ON SOLID FUELS (EXCEEDING 60% IN FOUR COUNTRIES) FOR RESIDENTIAL HEATING AND COOKING, AS NON-SOLID FUELS ARE DIFFICULT TO SOURCE.**

Distributed generation combined with net metering can be an important factor in addressing affordability, reducing electricity costs and the effects of energy poverty, increasing the availability of supply, disassociating from solid fuel use while encouraging the use of renewable energy sources in more residential activities (heating, cooking, lighting) and reducing the burden on the system during peak demand periods. In Georgia, a new amendment to the Law on Electricity and Natural Gas was adopted in May 2016, on micro generation from renewable energy sources with a capacity of up to 100 kW, and net metering. Consequently, consumers will be able to connect to the network in order to be provided with additional electricity from the power dispatching network in case a micro generation installation does not provide sufficient electricity, as well as to sell the surplus electricity to the power network.

In Ukraine, the number of solar rooftops increased from 244 at the end of 2015 to 625 at the end of the third quarter of 2016.[26] In Moldova, the adoption in 2016 of net metering for electricity producers with installations up to 100 kW set the tone for more distributed generation in the country for 2017 (see Section 5). In Uzbekistan, regulation to allow distributed generation facilities to sell surplus power to the grid was introduced in 2015 and is still in the preliminary stage of implementation. The system takes into consideration transmission grid costs when pricing the tariff, one of the main concerns in implementing net metering policies in a fair and sustainable way.[27] In Armenia, the combination of distributed generation and net metering is projected to achieve energy savings of 1,781 megawatt-hours (MWh) in 2017, 2,141 MWh in 2018 and 2,851 MWh in 2020.[28]

TABLE 6 | Distributed Renewable Energy Initiatives Improving the Quality of Energy Supply

	PROJECT TITLE	DESCRIPTION
Montenegro	Biomass heating systems	The Ministry of Economy of Montenegro, in co-operation with the Luxembourg Agency for Development Cooperation (Lux-Dev) and the Norwegian government, implemented the Energy Wood project providing interest-free loans for the purchase and installation of modern biomass heating systems (pellet, briquette), including in rural areas. During the first phase of the project (2013-2015), 243 heating systems were installed, and during the second phase, 500 systems had been installed by May 2016.
Tajikistan	Solar cookers in mountain villages	The non-governmental organisation Little Earth continued its initiative (ongoing since 2014) to provide solar cookers in mountainous villages of the wester Pamir with the provision of solar parabolic cookers to nine families in earthquake-afflicted villages and setting up a 50%-50% buying scheme for the local population.
Uzbekistan	Solar PV with storage	A battery-supported PV power plant pilot project was installed at Furqat farm in the Pakhtakor district of Jizzakh region, under the project "Climate change mitigation in rural areas of Uzbekistan" implemented by GIZ and utilising co-operation between Jizzakh Polytechnic Institute and Hamburg University of Technology.

Source: See endnote 23 for this section.

04

ENERGY EFFICIENCY

04 ENERGY EFFICIENCY

Energy efficiency is a way of managing the growth in energy consumption. Increasing energy efficiency means delivering more services for the same amount of energy consumed, or the same services for less energy. The UNECE countries covered in this report are exhibiting steady progress in increasing energy efficiency in several sectors, assisted by a series of measures from international donors. Energy intensity in the region remains high in the global context, despite reductions driven by climatic and structural economic factors.[1] Reduction in energy consumption with a simultaneous increase of economic growth is observed in South East Europe and Moldova.[2] Most policies and projects are targeting buildings; however, energy efficiency in industry and transport also needs to be scaled up, considering the available potential for energy savings.

REGIONAL OVERVIEW

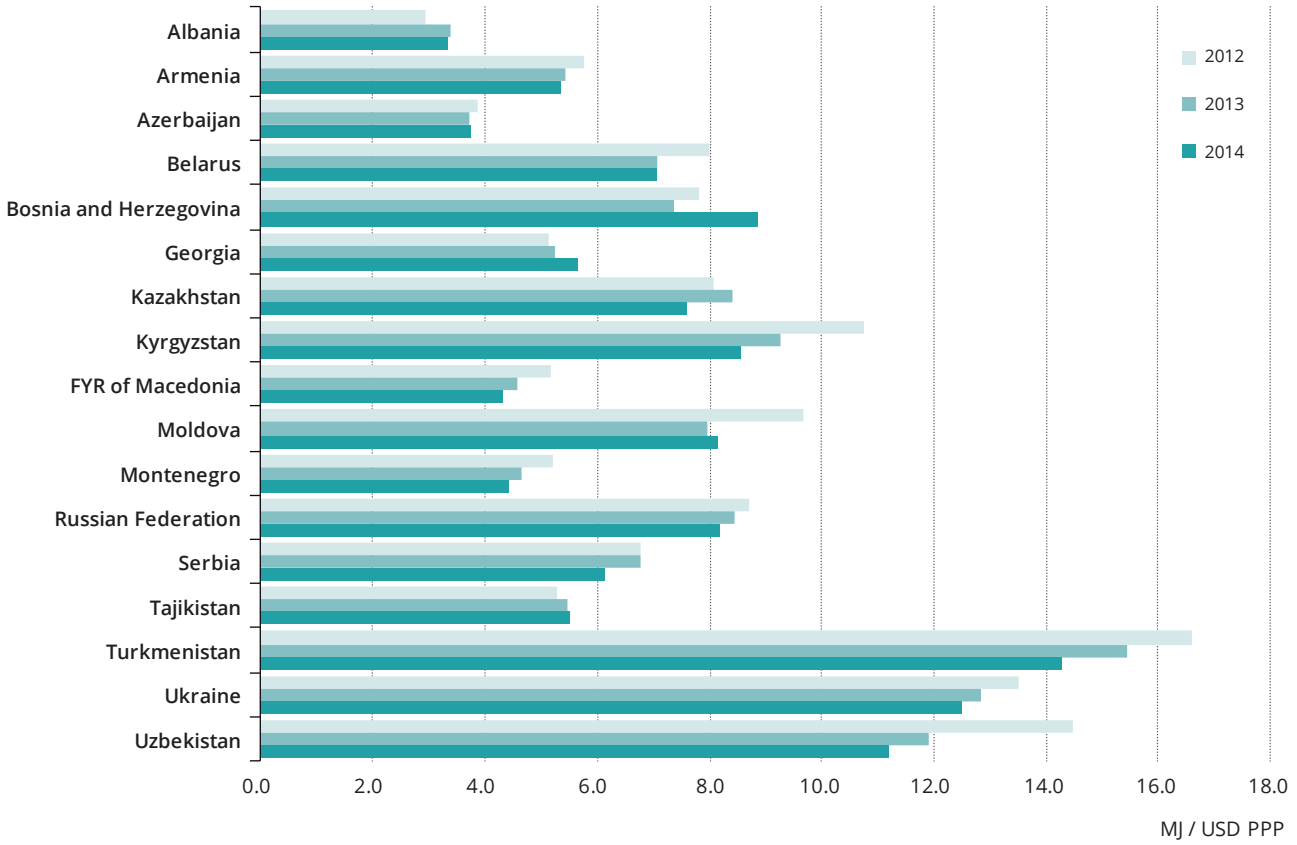
Energy intensity can be used to describe trends over time, bearing in mind that efficiency is only one driver of intensity.[3] Decomposition analysis is a helpful tool for quantifying the effect of different drivers and for isolating the actual intensity component for the period from 1990 until today.[4] For South East Europe, energy efficiency's contribution in reducing energy consumption was limited until the mid-1990s. For that period, intensity reduction could be attributed mainly to the structural socio-economic changes that the region experienced, since the reduction in energy use was accompanied by (and in large part justified by) a reduction in economic output.[5]

Since 1996, economic growth in the region has been associated with a steady decrease in the total primary energy supply. This absolute decoupling of energy and GDP growth rates continued into 2014. For example, the former Yugoslav Republic of Macedonia, Moldova, Montenegro and Serbia have achieved reductions in primary energy consumption while increasing their GDPs, effectively decoupling energy consumption from economic growth.[6] Serbia, in particular, managed to decrease its energy intensity from 23,860 megajoules (MJ) per USD in 2011 to 19,670 MJ per USD in 2014, on its way towards reversing the highly energy-intensive nature of its economy (in 2011, Serbia's primary energy consumption per dollar of GDP was six times higher than Germany's).[7] In Albania, in contrast, an increase in total primary energy supply since 2012 continued into 2014 (from 87,830 terajoules (TJ) in 2013 to 89,760 TJ) without a proportional increase in GDP, resulting in an increase in energy intensity.[8] An overview of primary energy intensity in the region for 2012-2014 is illustrated in Figure 11.[9]

In Eastern Europe, the Caucasus and Central Asia the initial period lasted until the end of the 1990s, leading to the same conclusion about reduction in intensity being correlated closely with a decrease in output.[10] In the new millennium, the trend reversed, with economic growth proportionally exceeding the increase in energy demand.[11] The trend for Eastern Europe, the Caucasus and Central Asia therefore is similar to that of South East Europe but much less pronounced over the long term. Eastern Europe, the Caucasus and Central Asia have energy intensities above 5 MJ per USD of GDP PPP.[12] Nevertheless, significant reductions in intensity (more than 4% annually) were achieved in 2013 and 2014.[13] Regional exceptions to this trend include Georgia and Tajikistan, which exhibited a steady increase in primary energy intensity during 2012-2014 (see Figure 11).

> **THE UNECE COUNTRIES COVERED IN THIS REPORT ARE EXHIBITING STEADY PROGRESS IN INCREASING ENERGY EFFICIENCY IN SEVERAL SECTORS, ASSISTED BY A SERIES OF MEASURES FROM INTERNATIONAL DONORS.**

FIGURE 11 | Primary Energy Intensity, by Country, 2012, 2013 and 2014



Source: See endnote 9 for this section.

Sectoral analysis of total final consumption (TFC) in 2014 (see Figure 12) indicates that the residential sector (representing more than 30% of TFC in 10 countries) consumes the largest share of energy in the region.[14] It is the largest sector in TFC in Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kyrgyzstan, Moldova, Montenegro, Serbia, Ukraine (tied with the industry sector) and Uzbekistan. The residential sector accounts for more than 40% of TFC in Bosnia and Herzegovina, Montenegro and Uzbekistan.

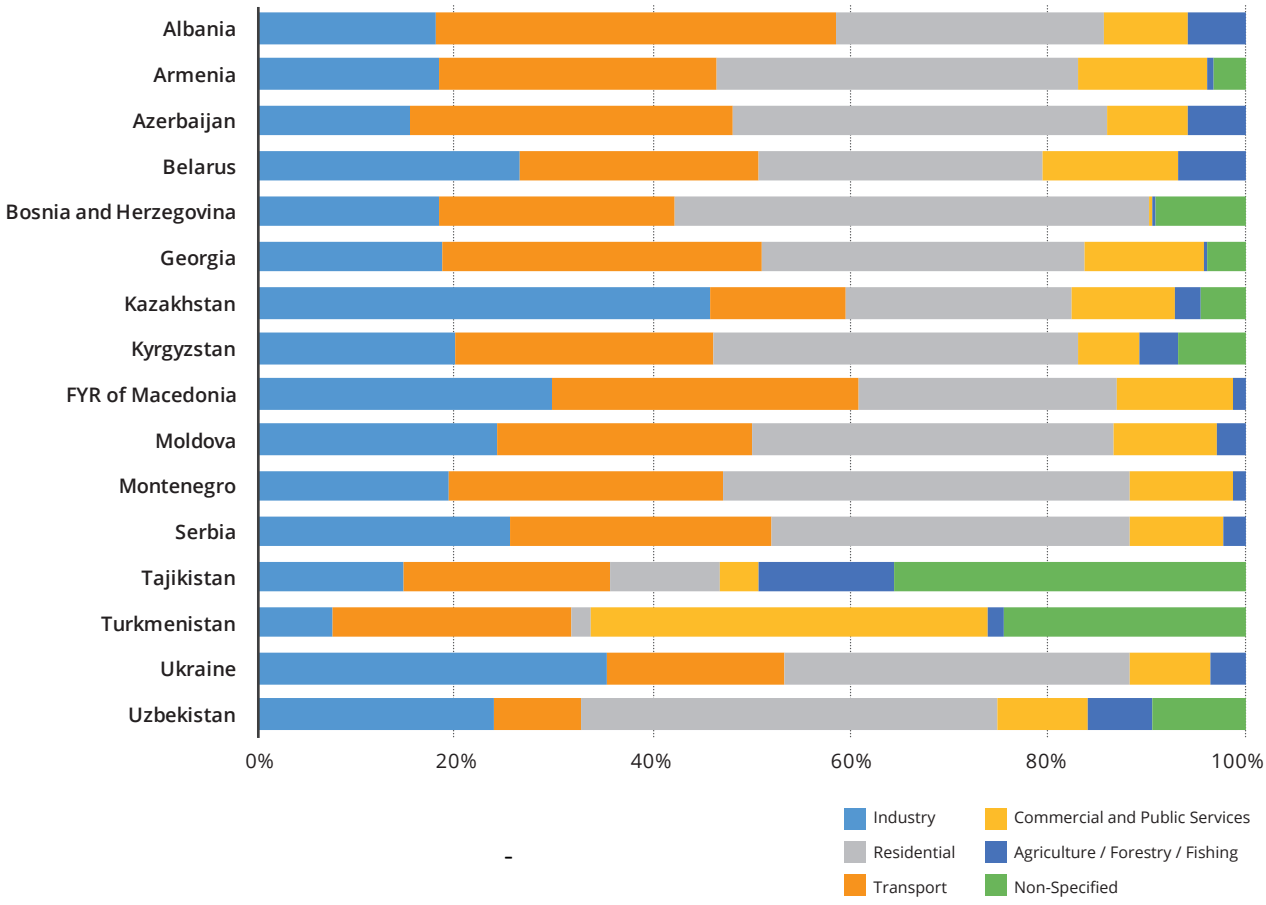
The industry sector remains an important factor in regional energy use. It represents at least 15% of TFC across all countries in the region and is the most energy-consuming sector in three countries: Kazakhstan, the Russian Federation and Ukraine (tied with the residential sector).

The transport sector (with a share exceeding 25% of TFC in 10 countries) remains a consistently high-energy sector in the region, which intersects two continents and historically has been a nexus of trade routes and movement of populations. In Albania, the former Yugoslav Republic of Macedonia, Tajikistan and Turkmenistan, transport is the most energy-consuming sector. Reporting gaps in the sectoral analysis also exist, however, as three countries (Tajikistan, Turkmenistan and Uzbekistan) report double-digit figures for energy consumption "non-specified" by sector.

High shares of energy consumption do not necessarily indicate that these sectors are inefficient. For example, the industry sector's prominence over the residential sector in the TFC of certain countries can be attributed to the existence of energy-intensive industries, such as iron and steel, in countries such as Kazakhstan and Ukraine.[15] Kazakhstan's industrial sector, the largest consumer of energy in the country due to many energy-intensive industries, consistently lags in intensity compared to international best practices, but significant steps were taken during 2012-2014 to address the enormous potential for energy savings.[16]

The residential sector continues to be a dominant energy consumer (48% of TFC) in Bosnia and Herzegovina, with substantial room for improvement in residential uses such as heating and cooking. Advances continue to be made in several countries towards promoting energy efficiency in buildings, mostly in the residential and public sectors. Energy efficiency policies for industry are slowly being introduced and are showing results (for example, in Moldova), but policies for transport are still lagging (see Section 5).[17]

FIGURE 12 | Share of Total Final Consumption, by Country and Sector, 2014



Source: See endnote 14 for this section.

Energy efficiency markets in the region have been slow to develop, despite the significant potential that the energy services sector manifests globally.[18] This can be attributed to the existence of various barriers: regulatory and institutional, financial and market-related, technological and infrastructural, and social and environmental.[19] Efforts by governments and international donors to address these barriers are becoming more widespread, however, and best practices from more energy-efficient countries are being promoted and introduced in the region.

Regulatory barriers, including the existence of subsidies and the lack of metering at the customer level for selected sub-sectors, continue to present the main obstacle. Subsidies for energy use in particular remain widespread (for example, in the heat and industry sectors), and price signals are not sufficient to drive the adoption of new, efficient and more costly technologies or upgrades.[20]

Among the institutional barriers is the lack of dedicated agencies to co-ordinate policies from the government side (see Section 5), despite the effectiveness of such agencies in many countries that have introduced them. In Ukraine, the State Agency on Renewable Energy and Energy Efficiency has played a central role in co-ordinating energy efficiency measures in the country (including compliance with EU acquis).[21] In Serbia, in contrast, the decision to abolish the Energy Efficiency Agency in 2012 created concerns (which continued to be relevant in 2016) about the country's capacity to successfully implement energy efficiency changes.[22] Albania set up an Energy Efficiency Agency in December 2016 with the main goal of implementing policies and measures that promote energy efficiency; the Energy Community advocates this approach for all member countries that do not have a similar agency set up yet.[23]

Another barrier to deployment of energy efficiency projects is the availability of sizable public or private funding and the capacity to utilise existing funding opportunities. This is more relevant in Eastern Europe, the Caucasus and Central Asia than in South East Europe, where funding from international donors is available but the absorption capacity at the local level is weak.[24] Beyond traditional donor-based funding or concessional loans, the creation of energy efficiency-focused funds offers a more market-oriented approach.

In Bosnia and Herzegovina, a new Revolving Fund for Energy Efficiency was created in 2016 with contributions from the Government of Sweden and UNDP through the Green Economic Development Project.[25] In Ukraine, the planned Energy Efficiency Fund is supported by several international stakeholders (including the Government of Germany and the European Commission) and was foreseen to be operational by April 2017.[26] Moldova's Energy Efficiency Fund, supported by the EU Delegation in Moldova, finances small energy efficiency projects by public or private entities, in the range of USD 10,720 to USD 176,880.[27] During the first call for proposals it financed 87 projects (out of 303 applications received) for a total value of approximately USD 10.5 million.[28]

A leading technical barrier is the availability of data at the user level. Tracking performance indicators for energy efficiency, such as kWh per floor area, is challenging, and individual metering in district heating is not available systematically at the end-user level.[29] In Belarus, where heat tariffs recover only 30% of the costs of district heating, the introduction of apartment-level heat metering is considered a prerequisite to the proposed rethinking of tariff methodology and cost allocation.[30]

Social barriers include low public awareness of energy efficiency and a lack of skilled labour, as technical and technology know-how are still being built in the local market.[31] Increasing public awareness has been a mainstay of international assistance in the region through campaigns and pilot projects.

These diverse barriers continue to hinder progress in energy efficiency in the region; however, an assortment of government targets, regulatory policies and support mechanisms attempts to eliminate them, with varying levels of success for each respective barrier and country. The following sections highlight the latest developments in the main energy efficiency sectors.

ELECTRICITY SUPPLY

Countries in South East and Eastern Europe, the Caucasus and Central Asia continue to face challenges in improving the energy efficiency of their electricity supply, despite ongoing modernisation of their electricity infrastructure. Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan continue to have high levels of transmission and distribution losses, with Kyrgyzstan reporting losses of 20.3% in 2013 (well below the 34.5% reported eight years earlier) and Tajikistan reporting losses of 14.8%.[32] Uzbekistan reported losses of less than 10%.[33]

In South East and Eastern Europe, high levels of losses were still reported in 2015 for Albania (2% in transmission and 31.3% in distribution), the former Yugoslav Republic of Macedonia (1.7% in transmission and 14.8% in distribution), Montenegro (3.8% in transmission and 17.6% in distribution) and Serbia (2.2% in transmission and 14.1% in distribution) (see Table 7).[34]

TABLE 7 | Transmission and Distribution Losses In Selected Countries of South East and Eastern Europe, 2014 and 2015

	Transmission losses (%)		Distribution losses (%)	
	2014	2015	2014	2015
Albania	2.1	2	37.8	31.3
Bosnia and Herzegovina	1.7	2	10.7	10.4
FYR of Macedonia	1.9	1.7	15.5	14.8
Moldova	2.7	2.7	9.7	8.5
Montenegro	3.9	3.8	17.6	17.6
Serbia	2.44	2.22	14.4	14.1
Ukraine	2.7	3	10.1	9.8

Note: Transmission losses are a percentage of total losses in the transmission system (relative to the total electricity injected into the transmission network). Distribution losses are a percentage of total losses in the distribution system (relative to the total electricity injected into the distribution system).
Source: See endnote 34 for this section.

Modernisation of the transmission and distribution network remains a governmental priority in several countries. Significant donor attention also is focused on the issue. In 2016, the ADB approved a USD 750 million multi-tranche programme loan facility to upgrade power distribution networks in Azerbaijan that is foreseen to address grid losses and benefit more than 1.4 million consumers.[35] The World Bank had several important grid-related projects running as of end-2016, including the Second Power Transmission Project in Ukraine, the Electricity Transmission Network Improvement Project in Armenia, the Transmission Grid Strengthening Project in Georgia and the Power Recovery Project in Albania (which addresses grid losses under the Second Component).[36] Since early 2016, the EBRD has provided support of USD 8.8 million for improvement of the transmission grid of Bosnia and Herzegovina.[37]

In electricity distribution, the importance of advanced metering infrastructure and "smart meters" in grid management, the reduction of losses (including revenue losses and meter tampering) and better demand response has become increasingly important in the region. Albania invested more than USD 50 million in 2015 to improve its distribution network (including rollout of smart meters), to improve the quality of supply and to reduce technical losses.[38] In Uzbekistan, following the approval of a USD 300 million loan from the ADB in late 2015, a large-scale rollout of smart meters began in 2016.[39] The former Yugoslav Republic of Macedonia had installed 35,000 smart meters and 347 transformer substations as of November 2016.[40] Most of the aforementioned projects for transmission grid improvement have a component related to advanced metering infrastructure (for example, the World Bank's Power Recovery Project in Albania foresees the rollout of smart metering under its Third Component, and the ADB-funded project in Azerbaijan provides for the installation of 108,400 smart meters).[41]

International donors contribute to electricity network infrastructure in the region. Better regional interconnections can allow for more efficient use of available resources and optimisation of dispatch, resulting in fewer grid losses.[42] This adds to other benefits such as increased security of supply and more flexible capacity planning. An increased security of supply offered by regional interconnections eases the development of renewable energy generation, since the larger, interconnected system has more resources available to offset the intermittent aspect of some renewable generation.

Several interconnection projects were launched in 2015 and 2016. The CASA-1000 Power Line Project, which will move electricity at high voltages between Kyrgyzstan and Tajikistan (the first 477 kilometres) and from Tajikistan to Afghanistan and Pakistan (the next 750 kilometres) was launched in 2016.[43] Assistance towards its budget of more than USD 1 billion is provided by the World Bank, the Islamic Development Bank, the European Investment Bank (EIB), the US Agency for International Development (USAID), the US State Department, the UK Department for International Development, the Australian Agency for International Development (AusAID) and other donors. Other regional interconnection projects include the Georgia–Armenia High-Voltage Interconnection (financed by KfW on behalf of the German government, the EU Neighbourhood Investment Facility, EIB and the governments of Georgia and Armenia) and the Albania–former Yugoslav Republic of Macedonia Interconnection (financed mainly by KfW and the EBRD).[44]

BUILDINGS

Globally, buildings account for 31% of final energy consumption and are the largest energy-consuming sector, with space and water heating accounting for the highest share of building energy consumption.[45] Residential energy use accounts for a sizable share of TFC in the region. For all but 3 of the 17 countries, residential energy use accounts for at least one-quarter of TFC, and even in countries with energy-intensive industry (such as Russia and Ukraine) it amounts to more than 30% of TFC (see Figure 12).

Energy efficiency in buildings is the most developed area for regulatory policies in the region (see Section 5), and projects are ongoing in almost all countries, supported by financing from international donors such as the World Bank, GIZ, UNDP, the Swedish Development Agency, USAID and others.[46]

From a legislative perspective, the harmonisation of relevant regulations by the Energy Community for its member states through transposition and implementation of the EU Directive on Energy Performance of Buildings sets a high threshold of energy efficiency measures for buildings.[47] The reporting/monitoring system of the Energy Community Secretariat also provides a useful tool for easy monitoring of progress (or lack thereof). However, improving energy use in buildings requires a more sustainable solution for supplying space and water heating, which is challenged by the use of traditional biomass and inefficient district heating systems.

Building stocks vary across the 17 countries, given differences in both climates and economies (see Section 1). However, they also share some common features. In the residential sector, most buildings were constructed after World War II and comprise large, identical residential blocks with poor energy performance.[48] In rural areas of South East Europe, large numbers of houses are not completed and lack external insulation and window sealing.[49]

For existing buildings, the potential for energy savings is

estimated at 30-75%, with efficiency improvements targeting mainly external insulation and windows.[50] Increasing technical capacity and research on modern, energy-efficient construction materials and techniques is crucial. The Tashkent Architecture and Construction Institute of Uzbekistan invested in research and development by introducing a laboratory and research facility to improve the energy efficiency of buildings that will increase both academic knowledge and professional techniques. The laboratory seeks funding to acquire research equipment and offers seminars and workshops on energy efficiency.[51]

In Armenia, the National Programme on Energy Saving and Renewable Energy estimates the potential for energy savings in the buildings sector at 40%.[52] In the Russian Federation, where buildings account for more than 35% of final energy consumption, the potential for savings from deep energy efficiency renovation in multi-story residential buildings is estimated at 50% of their energy consumption.[53] In South East Europe, where buildings represent around 50% of final energy consumption, there is the opportunity to achieve energy savings of 20-40%.[54] The highest potential is estimated in the public sector (35-40%) and the residential sector (10-35%).[55]

International donors are active in supporting energy efficiency projects for buildings across the region through policy development, institutional capacity building and financing of retrofits. Donor initiatives continued through 2015 and 2016. In Belarus, the UNDP/GEF project "Improving Energy Efficiency in Residential Buildings in the Republic of Belarus" has achieved significant progress since January 2016. It has produced several technical guidelines, among them the Energy Efficiency in Buildings Technical Code, which was to be adopted into legislation in 2017. Energy audits of 55 residential buildings also have been carried out successfully using modern software tools and protocols, and the project is providing support for the construction of three pilot energy-efficient multi-apartments in Minsk, Hrodna and Mahilou.[56]

In Montenegro, the Montenegrin Energy Efficiency Project, funded by a loan from the International Bank for Reconstruction and Development (IBRD), aims to improve energy efficiency in healthcare facilities and to increase public awareness of energy efficiency measures. The project entered its second phase in 2015 and refurbished 5 healthcare facilities (in addition to the 14 facilities renovated under the first phase).[57]

In Kazakhstan, the UNDP/GEF showcased in 2016 a series of "Success Stories" in retrofitting residential buildings and schools with modern energy efficiency equipment, including pipe/valve replacements, installation of heat meters, insulating and replacing windows and doors. In one case, a retrofitted public school showed 80% annual savings for hot water and 29% annual savings for heat.[58]

Public awareness of energy efficiency in buildings is of extreme importance, and significant donor resources are addressing the issue. In 2016, the inauguration of INOGATE Information Centres in Georgia and Moldova helped the public obtain information on energy efficiency measures and decide on small, affordable ways to better manage their energy consumption. Increasing human capacity also is a focus, and in 2016 GIZ continued to offer assistance to Ukrainian municipalities to train experts and implement energy efficiency upgrades through the Energy Efficiency in Municipalities programme.

Space and water heating typically is the most important component of residential energy use, even if consumption patterns vary by country based on different climatic conditions and the specific energy performance of the building stock. In South East Europe, 65% of residential energy is used for space and water heating.[59] Heating solutions across the region rely primarily on solid fuels (see Section 3).

District heating is important in several countries (Belarus, Kazakhstan, Kyrgyzstan, Moldova, Serbia, Ukraine, Uzbekistan, Tajikistan and Turkmenistan), and the Russian Federation is the largest user of district heating systems in the world.[60] In most of these countries, however, the systems remain inefficient and have continued to deteriorate since the 1990s, leading the IEA to identify district heating as an area of high savings potential.[61] Significant donor-funded projects to reform district heating are under way or planned in Belarus, Kazakhstan, Kyrgyzstan, Serbia and Ukraine (see Table 8).[62]

> **ENERGY EFFICIENCY IN BUILDINGS IS THE MOST DEVELOPED AREA FOR REGULATORY POLICIES IN THE REGION, AND PROJECTS ARE ONGOING IN ALMOST ALL COUNTRIES, SUPPORTED BY FINANCING FROM INTERNATIONAL DONORS SUCH AS THE WORLD BANK, GIZ, UNDP, THE SWEDISH DEVELOPMENT AGENCY, USAID AND OTHERS.**

TABLE 8 | District Heating Projects Planned or Under Way in the Region

	PROJECT TITLE	DURATION	DESCRIPTION
Belarus	Belarus Biomass District Heating Project	2014-2019	Aims to scale up the efficient use of renewable biomass in heat and electricity generation in selected towns.
Kazakhstan	Reconstruction of Heating Networks	2015, ongoing	Provides funding to continue modernisation of district heating in several cities, including Pavlodar, Ekibastuz, Petropavlovsk and Aktobe.
Kyrgyzstan	Bishkek District Heating Network	2016, ongoing	Includes modernisation of pumping stations, with replacement of the main-line pumps with variable frequency drive, installation of remote control and the introduction of water and heat distribution monitoring and heat network mode control (SCADA system modernisation).
Moldova	District Heating Efficiency Improvement Project	2014-2020	Aims to improve the operational efficiency and financial viability of the district heating company of Chisinau and to improve the quality and reliability of heating services delivered to the city's population.
Serbia	Rehabilitation of District Heating System in Serbia – Phase IV	2012-2018 (overall 2001-2018)	So far has covered 22 district heating companies with about 450,000 households as well as about 30,000 industrial customers, representing approximately 90% of all district heating users in Serbia. Phase IV continues to contribute to improving infrastructure, reducing grid losses and advancing boiler efficiency.
Ukraine	District Heating Energy Efficiency	2014-2020	Aims to improve the energy efficiency of 10 district heating utilities around the country – saving energy, reducing CO_2 emissions and improving heat supply for more than 3 million beneficiaries.

Sources: See endnote 62 for this section.

The reforms and upgrades of district heating systems in the region can be conducive to increasing renewable energy use, and certain projects listed in Table 8 include a renewable energy component in their planning. In Belarus, the World Bank's project includes investment in baseload biomass boilers, biomass-based small CHP plants and, in some towns, wood chipping equipment. In Serbia, a KfW project, aims to introduce biomass (in the towns of Mali Zvornik, Prijepolje, Novi Pazar and Nova Varoš) and geothermal energy (in the town of Bečej) in district heating systems.

Public sector buildings account for a large share of commercial buildings in the 17 countries and represent an opportunity for energy savings. In South East Europe, central government buildings represent 11% to 37% of the total floor space of commercial buildings, and in three countries (Moldova, Montenegro and Ukraine) public building floor space amounts to more than 70% of total commercial floor space, and central government building floor space represents from 28% to 37% of total commercial floor space.[63]

International donor-supported projects in the region have focused on improving energy efficiency in public buildings, given the role of public institutions in leading by example and helping to create local markets.[64] In 2016, UNDP in Bosnia and Herzegovina signed a cost-sharing agreement with the Sarajevo Canton government to increase insulation, replace heat boilers and perform other energy-efficient retrofits in seven public buildings (four elementary schools, an orphanage, a youth theatre and a health centre).[65]

In 2016, Montenegro also began implementing the second phase of the Energy Efficiency Program in Public Buildings, financed by a combined loan and grant from KfW. Under the first phase, 20 schools and 1 student dormitory were reconstructed under a USD 13.7 million budget, and the second phase has a budget of approximately USD 23.2 million.[66]

In Moldova, the successful Energy and Biomass Project, funded by the EU and implemented by UNDP, was extended until November 2017. The project aims to increase the use of biomass, the most readily available renewable energy source in the country. During its first phase the project installed 144 biomass-fired heating systems in public buildings in rural communities, and Phase II aims to install 80 more systems (in schools, kindergartens and community centres).[67]

Donor interest extends to the residential sector, given its potential for energy savings in combination with energy efficiency policies.[68] The planned Energy Efficiency Fund, to be launched in Ukraine in 2017, will target primarily residential users.[69]

The market for energy service companies (ESCOs) was valued at about USD 24 billion globally in 2015, but it remains nascent in the region.[70] ESCO schemes, which provide a full range of services, including design, implementation and financing for energy efficiency projects, are present in some countries, including Bosnia and Herzegovina, Moldova, Serbia and Montenegro (which is piloting an ESCO scheme).[71]

The EBRD and the Energy Community Secretariat continue to support Bosnia and Herzegovina under the Regional Energy Efficiency Programme, targeting the development of ESCO-enabling regulations (among others).[72] In Moldova, the UNDP/GEF ESCO-Moldova project continues to support the creation of a functioning, sustainable and effective ESCO market by converting existing energy service provider companies into ESCOs.[73] In Ukraine, the ESCO law was adopted in October 2015, and a new legislative initiative to amend public procurement requirements and facilitate energy services procurement by public entities passed its first reading in the Parliament. In 2016, 25 tenders were announced in different regions of Ukraine for ESCO services, and 19 energy performance contracts were signed in Kyiv, Odessa, Vinnytsia, Poltava and elsewhere.[74] In Serbia, the first tender for a municipal ESCO street lighting project was published in June 2016.[75]

LIGHTING, APPLIANCES AND COOKING

Globally, lighting, appliances and cooking account for 45% of energy consumption in buildings.[76] Although significant improvement in energy efficiency is possible today based on the introduction of modern technologies, their deployment in the market is complex, and the availability, price and sales of energy-efficient appliances, equipment and lighting are driven mainly by regulatory policies. For members of the Energy Community, the obligation to adopt energy efficiency policies and legislation in those sectors that are compatible with the *acquis communautaire* is monitored and evaluated, but results often fall short of full implementation.[77] In the remaining countries, adoption of relevant policies is even more inconsistent with regard to both the specific measures adopted as well as their legally binding nature and actual enforcement by competent authorities.

The recommended policy tool for improving lighting efficiency is the phase-out of inefficient technologies, such as incandescent light bulbs. Lighting accounts for approximately 15% of electricity consumption worldwide.[78] Georgia and the Russian Federation have joined the Global Efficient Lighting Partnership Programme, which collaborates with the UNEP/GEF en.lighten initiative and other countries within a specific region to achieve a co-ordinated, sustainable transition to efficient lighting. Technical assistance in phasing out obsolete lighting technologies in an economically sustainable manner can prove to be a difficult exercise. The en.lighten initiative is a public-private partnership that involves industry leaders and provides a comprehensive set of guidebooks, toolkits and policy guides to facilitate the transition to energy-efficient lighting.[79]

Street lighting also presents an opportunity for lighting replacement at a larger scale, and projects have been implemented in several of the countries with international donor support. The Green Urban Lighting Program for Armenia, financed by UNDP/GEF, will continue to support the replacement of incandescent/sodium street lamps with light-emitting diode (LED) lightning into 2017.[80] The EBRD has offered a co-financing grant of USD 2 million) (funded by the E5P multi-donor fund) for street lighting replacement in Yerevan as well as USD 12.5 million from the EBRD-administrated Green Energy Special Fund funded by the Taiwanese International Cooperation and Development Fund, further topped up by USD 10.85 million from the EIB.[81] In Belarus, part of a USD 10.5 million grant for environmental projects granted by the GEF will be allocated to energy-efficient illumination of cities.[82] The Islamic Development Bank approved a USD 36 million project for the Efficient Outdoor Lighting for Tashkent City, and the realisation process begun in 2015.[83]

In appliances and labelling, members of the Energy Community are required to transpose the EU acquis, and progress has been steady, although many aspects of secondary legislation must be introduced in some countries (such as Albania, Montenegro and Serbia).[84] Other countries in the region have adopted a variety of measures, from voluntary labelling to complete mandatory labelling schemes with incentives for purchase of higher-rated appliances (see Section 5).

The use of energy for cooking varies across the region, with cooking in several countries dominated by traditional biomass rather than electricity. The main priority in the region is to increase access to non-solid fuels for rural populations (see Section 3). The proliferation of energy-efficient appliances, initially through policy measures and subsequently through market conditions, is an equally important priority once access to clean fuels for cooking is achieved. Labelling policies and initiatives are crucial in countries that have widespread access to non-solid fuels (see Section 5).

OTHER SECTORS

The industry and transport sectors play an important role in total final consumption in most of the 17 countries. Industry accounts for more than 25% of TFC in nine of the countries (see Figure 12). In South East Europe, industry's share in TFC is between 19% and 33%, and it is the third largest energy-consuming sector in the region. Achieving better efficiency in industry faces multiple challenges in the region, including high upfront costs, concerns about competitiveness and the existence of energy subsidies.[85]

Nevertheless, global energy efficiency investment in industry is estimated at USD 39 billion in 2015 (including USD 20 billion of investment in non-energy-intensive industry and USD 19 billion in energy-intensive industry). To reach international climate change goals, USD 35 billion in annual energy efficiency investment in energy-intensive industry is needed by 2020, an 84% increase from current levels.[86] This indicates that both the need and the opportunity for substantial investment exist.

International donors and development banks are financing projects that target energy efficiency improvements in industry, including voluntary or mandatory energy audits and the introduction of energy management, either directly or indirectly (such as by financing energy efficiency renovations to an enterprise's facilities or equipment).[87] For example, the World Bank continues to support the USD 100 million Energy Efficiency Facility for Industrial Enterprises Project (UZEEF) in Uzbekistan, which has provided financing for 81 sub-projects by 32 enterprises around the country. These sub-projects will save more than 539 GWh of electricity and 252 million cubic metres of gas every year – an energy savings that is large enough to supply electricity to 850,000 families annually (if one family consumes 3,600 kWh).[88]

Incremental energy efficiency investment in transport totalled USD 64 billion in 2015, with passenger vehicle energy efficiency investment amounting to USD 35 billion, freight transport to USD 2 billion and other transport to USD 28 billion.[89] More than 88 million road vehicles were sold worldwide in 2015, with the highest share being light-duty vehicles used for passenger transport and other commercial purposes (e.g., taxi and delivery services).[90]

The transport sector represents a sizable share of the region's TFC (see Figure 12), with high annual growth rates in some countries.[91] Several countries are located on the transit route between Europe and Asia and have high road transport flows.[92] In Kazakhstan, where the number of vehicles has almost tripled since the 1990s and 80% of vehicles have been in service for over 10 years, a study of the country's transport sector prepared under the UNDP/GEF City of Almaty Sustainable Transport project proposed a series of measures to increase energy efficiency in the sector, ranging from exempting vehicles using clean fuels from tax to promoting cycling and improving public transport routes.[93] The project also contributed to improving public transport and traffic management in the city of Almaty.[94]

THE INDUSTRY AND TRANSPORT SECTORS PLAY AN IMPORTANT ROLE IN TOTAL FINAL CONSUMPTION IN MOST OF THE 17 COUNTRIES. INDUSTRY ACCOUNTS FOR MORE THAN 25% OF TFC IN NINE OF THE COUNTRIES. IN SOUTH EAST EUROPE, INDUSTRY'S SHARE IN TFC IS BETWEEN 19% AND 33%, AND IT IS THE THIRD LARGEST ENERGY-CONSUMING SECTOR IN THE REGION.

05
POLICY LANDSCAPE

05 POLICY LANDSCAPE

Policies and targets are essential drivers for attracting investment to renewable energy and energy efficiency projects. The REN21 *Renewables Global Status Report* 2016 highlights that nearly all countries worldwide now have renewable energy support policies in place. The 17 countries in the present report also follow this trend, and the number of countries with relevant policies has increased since 2015. The region overall continues to adopt new policy measures for renewable energy and energy efficiency that help to remove barriers for development, attract investment, foster energy security and increase the flexibility of power systems.

Renewable energy and energy efficiency support policies received increased attention in 2015 and 2016 in part because of the international pressure to mitigate climate change in advance of and following the UN climate talks in Paris in December 2015. All countries in the region submitted their Intended Nationally Determined Contributions (INDCs) in preparation for the Paris event, sending a government signal of commitment to addressing climate change and supporting renewable energy development and increased energy efficiency.[1] Since then, six countries have submitted their Nationally Determined Contributions (NDCs) as a step for those officially joining the Paris Agreement.

In South East Europe, National Renewable Energy Action Plans and obligations under the Energy Community continued to drive legislative changes in renewable energy. In 2016, Georgia began finalising the process to become a member of the Energy Community.[2]

The region overall has considerable room to improve policy making on renewable energy (see Sidebar 10).[3] For example, renewable energy technologies could address some of the trade-offs between water, energy and food production, bringing substantial benefits in all three sectors.

By the end of 2016, the total number of countries in the region with renewable energy policies again increased, and most countries had renewable energy support policies in place, mostly in the form of a feed-in tariff. Among other developments, Georgia adopted a net metering programme; Moldova enacted a new renewable energy policy with actions for implementing a FIT, net metering and auctions; and several countries approved national action plans.

All 17 countries, except for Turkmenistan, have strategic documents outlining their priorities for at least one renewable energy technology. The adoption of secondary legislation – detailing legal, regulatory and financial mechanisms and technical rules – is happening at a slower pace in Eastern Europe, the Caucasus and Central Asia than in South East Europe, as countries in this latter sub-region seek to fulfil their legal obligations under the Energy Community, in line with EU sustainability objectives.[4]

Sidebar 10. REN21–UNECE Renewable Energy Hard Talks

The importance of international assistance in promoting policy dialogue and building human capacity in renewable energy in the countries of the region cannot be overstated. Against this background, REN21 and UNECE launched a new initiative, the Renewable Energy Hard Talks.

The Hard Talks are two-day events. The first day is an expert-level workshop for energy professionals and practitioners from public and private institutions of the host country and the international donor community. Debate focuses on a Discussion Paper prepared by the organisers and on important issues of the energy sector of the host country. Conclusions from the first day are reflected in the Discussion Paper and are debated by decision makers on the second day during a high-level policy dialogue. The Discussion Paper contains practical and concrete recommendations for tackling key issues and priority areas pointed out during the discussion.

The first two Renewable Energy Hard Talks were held in Tbilisi (Georgia) and Kyiv (Ukraine) in December 2016. In Kyiv, the event was hosted at the Verkhovna Rada, Ukraine's parliament. The event's objective was to discuss, very concretely, how to reach Ukraine's target of 11% renewable energy in final energy consumption by 2020 (as outlined in the National Renewable Energy Action Plan), with an estimated investment requirement of USD 16.9 billion.

In Tbilisi, the event was hosted by the Ministry of Energy and held at a crucial time for Georgia as the country aims to diversify its renewable energy mix. In addition, Georgia's membership in the Energy Community will require energy reforms, including for renewable energy. At the event, Georgian authorities confirmed, for the first time, a renewable energy target for 2017.

The events were welcomed as an opportunity to openly debate the topic of renewable energy among the more than 70 participants present at each. Success is owed in part to the talks' unique format: a combination of expert-level, direct and pragmatic debate of stakeholders during the first day and high-level policy discussions the second day, focused around a concrete and actionable Discussion Paper that actively follows and incorporates the discussions.

Source: See endnote 3 for this section.

Eight countries – Albania, Bosnia and Herzegovina, Kazakhstan, the former Yugoslav Republic of Macedonia, Montenegro, Moldova, Serbia and Ukraine – have renewable energy action plans at the national level, including Albania's recently approved National Renewable Energy Action Plan (January 2016), the former Yugoslav Republic of Macedonia's National Renewable Energy Action Plan (November 2015) and Bosnia and Herzegovina's Action Plan for the Use of Renewable Energy.[5] For energy efficiency, both Belarus and Ukraine approved their National Action Plans.[6]

In Moldova, the Law on the Promotion of Energy from Renewable Sources, approved in early 2016, aims to secure more local renewable energy generation and to increase competition among stakeholders such as electricity generators to help the country transition to a cleaner, more competitive energy sector.[7] Moldova is determined to modernise its grid and has set a target for an 11% reduction of transmission and distribution losses by 2020.

Armenia and Uzbekistan have roadmaps for the development of renewable energy, and Azerbaijan, Belarus, Georgia and Kyrgyzstan have state programmes dedicated to renewables development. In the Russian Federation, a government resolution prioritises the development of renewable energy within the country's energy strategy.

RENEWABLE ENERGY TARGETS AND POLICIES

Worldwide, targets for renewable energy continue to be a primary means for governments to express their commitment to renewable energy deployment. Targets for renewable energy remain widely used in the region covered by this report. As of year-end 2016, at least 15 of the 17 countries had renewable energy targets for capacity installed or for the participation of renewables in the energy and/or electricity mix (see Table 9).[8]

Although neither Turkmenistan nor Georgia had targets, both countries showed advancements in sustainable energy. Georgia announced the coming of a target in 2017 and adopted a net metering policy after amending its Law on Electricity and Natural Gas to promote net metering and micro-generation.[9] Turkmenistan adopted a Law on "protection of the atmosphere" that promotes the use of solar, wind and geothermal, among other renewable energy technologies.[10]

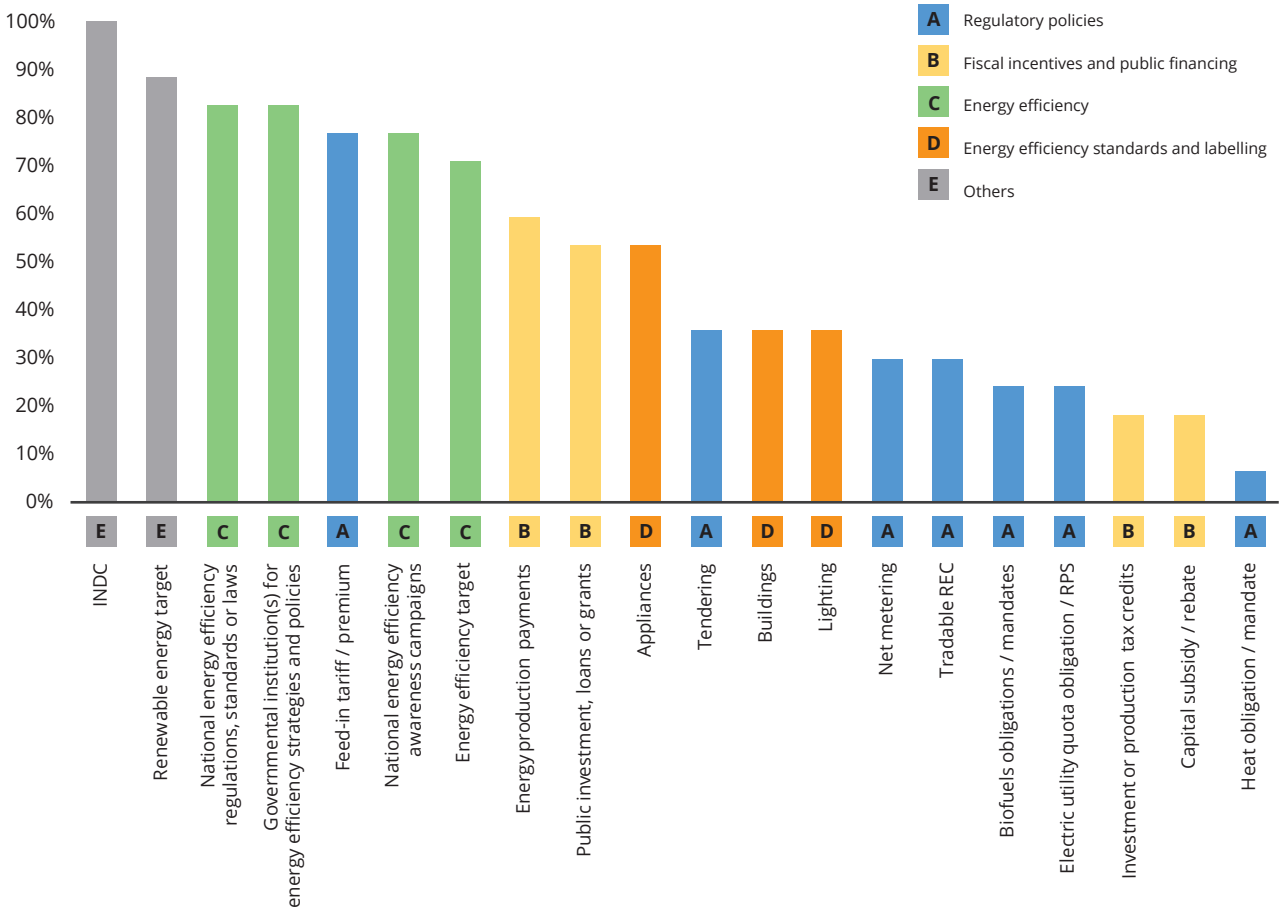
Source: See endnote 8 for this section.

TABLE 9 | Overview of Renewable Energy Targets

COUNTRY	SECTOR/TECHNOLOGY	TARGET
Albania	Energy	38% of gross final energy consumption by 2020
	Transport	10% biofuels in total fuel consumption of transport sector by 2020
Armenia	Small hydro	397 MW by 2025
	Wind	100 MW by 2025
	Solar PV	80 MW by 2025
	Geothermal	100 MW by 2025
	Geothermal heat pumps	25 MW by 2025
	Solar thermal	20 MW by 2025
Azerbaijan	Energy	9.7% of total energy consumption by 2020; 1 GW of capacity by 2020
	Electricity	20% of electricity consumption from renewable energy sources by 2020
	Wind	350 MW of new generation capacity
	Solar	50 MW of new generation capacity
	Bioenergy	20 MW of new generation capacity
Belarus	Energy	6% of gross energy consumption by 2020, 7% by 2025, 8% by 2030 and 9% by 2035
Bosnia and Herzegovina	Energy	40% share of renewable energy sources in the gross final energy consumption by 2020
Georgia		None
Kazakhstan	Energy	3% alternative sources (solar and wind) in energy production by 2020
	Hydropower	539 MW at 41 hydroelectric power stations by 2020
	Wind	1,787 MW at 34 wind-power stations by 2020
	Solar	713.5 MW at 28 solar electric plants by 2020
	Bioenergy	15.05 MW at 3 bioelectric stations by 2020
	Electricity	50% share of renewable energy in power generation by 2050
Kyrgyzstan	Energy	1.5% share of electric energy by 2017, 100 MW on the basis of RES by 2025
FYR of Macedonia	Energy	28% of gross final energy consumption by 2020
	Electricity	9% by 2020
	Heating and cooling	11% by 2020
	Transport	2% by 2020
Moldova	Energy	20% by 2020
	Electricity	10% of final gross electricity consumption by 2020
	Heating and cooling	27% of gross final energy consumption by 2020
	Transport	10% biofuels in fuel consumption by 2020
Montenegro	Energy	33% of gross final consumption by 2020
	Electricity	51.4% by 2020
	Heating and cooling	38.2% by 2020
	Transport	10.2% by 2020
Russian Federation	Electricity	4.5% of power generation by 2024, excluding large hydro, 5.9 GW by 2024
	Hydro	0.9 GW by 2020
	Wind	3.5 GW by 2024
	Solar PV	1.5 GW by 2020
Serbia	Energy	27% of gross final energy consumption by 2020
	Electricity	37% of gross final energy consumption by 2020
	Heating and cooling	30% of gross final energy consumption by 2020
	Transport	10% of gross final energy consumption by 2020
Tajikistan	Electricity	10% of the electricity balance
Turkmenistan		None
Ukraine	Energy	11% of the primary energy balance by 2020
	Electricity	11% of generation by 2020
	Heating and cooling	12.4% of gross final energy consumption by 2020
	Transport	10% (including electricity in transport) by 2020
Uzbekistan	Electricity	16% of total generation by 2030; 19% by 2050

Renewable energy targets in the power sector continued to be the most popular and were present in 11 countries at the end of 2016: Azerbaijan, Kazakhstan, Kyrgyzstan, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, the Russian Federation, Serbia, Tajikistan, Uzbekistan and Ukraine. Six countries (Albania, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia and Ukraine) have targets for heating and cooling, and seven countries (Albania, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia and Ukraine) have targets for the transport sector.

FIGURE 13 | Share of Countries with Selected Renewable Energy and Energy Efficiency Policies, 2016



Source: See endnote 11 for this section.

POWER SECTOR

Policy makers continued to focus mainly on renewable power generation technologies (see Figure 13).[11] As of year-end 2016, 13 countries had enacted feed-in policies, making this the most widely adopted regulatory mechanism to promote renewable power in the region (see Table 10).[12]

Moldova is the most recent country to approve a FIT programme, which will enter into force in 2017. In addition to the FIT, Law No. 10 of 26 February 2016 establishes a set of policy changes that includes consideration of a net metering scheme for systems up to 100 kW and sets a maximum generation equivalent of the total electricity consumption. The Law also introduces the idea of renewable energy auctions for utility-scale systems.[13]

Ukraine modified its FIT policy by first abolishing the local content requirement in 2016 and then introducing a premium to the FIT of 5% if at least 30% of the equipment is from domestic sources and of 10% if at least 50% is from domestic sources.[14] Technology-specific FITs include Georgia's FIT for small hydropower plants (under 0.1 MW) as well as two Albanian measures: a FIT for small hydro plants (under 10 MW) and 15-year concession agreements for larger-scale hydro plants (between 10 MW and 15 MW of capacity).[15]

TABLE 10 | FIT Rates in Selected Countries

Albania	Hydro	Existing plants up to 10 MW: EUR 0.06 per kWh
		New plants up to 15 MW: EUR 0.07 per kWh
Armenia	Small hydro	Plants built on natural water streams: EUR 0.036 per kWh (VAT excluded)
		Plants built on irrigation systems: EUR 0.024 per kWh (VAT excluded)
		Plants built on natural drinking sources: EUR 0.016 per kWh (VAT excluded)
	Wind	EUR 0.065 per kWh (VAT excluded)
	Biomass	EUR 0.069 per kWh (VAT excluded)
Azerbaijan	Private small hydro	EUR 0.027 per kWh
	Wind	EUR 0.029 per kWh
	Other renewable energy sources*	EUR 0.03 per kWh
Belarus[1]	Hydro	EUR 0.14 per kWh for the first 10 years for systems up to 300 kW
	Wind	EUR 0.14 per kWh for the first five years
	Solar PV	EUR 0.29 per kWh for the first 10 years for systems up to 300 kW
	Biomass	EUR 0.15 per kWh for the first 10 years for systems up to 300 kW
	Biogas	EUR 0.15 per kWh for the first 10 years for systems up to 300 kW
	Geothermal	EUR 0.14 per kWh for the first 10 years for systems up to 300 kW
	Renewable energy	EUR 0.8 per kWh for the first 10 years
Bosnia and Herzegovina - Federation of Bosnia and Herzegovina	Hydro	Micro: EUR 0.1484 per kWh
		Mini: EUR 0.093 per kWh
		Small: EUR 0.0703 per kWh
		Medium: EUR 0.0632 per kWh
	Wind	Micro: EUR 0.189 per kWh
		Mini: EUR 0.1131 per kWh
		Small: EUR 0.0 967 per kWh
		Medium: EUR 0.0 819 per kWh
		Large: EUR 0.0754 per kWh
	Solar	Micro: EUR 0.3160 per kWh
		Mini: EUR 0.2419 per kWh
		Small: EUR 0.2010 per kWh
	Biomass	Micro: EUR 0.1599 per kWh
		Mini: EUR 0.1277 per kWh
		Small: EUR 0.0123 per kWh
		Medium: EUR 0.0116 per kWh
	Biogas	Micro: EUR 0.4683 per kWh
		Mini: EUR 0.3406 per kWh
		Small: EUR 0.1425 per kWh
Bosnia and Herzegovina – Republika Srpska	Hydro	Up to 1 MW: EUR 0.0788 per kWh
		1-5 MW: EUR 0.0678 per kWh
		5-10 MW: EUR 0.0637 per kWh
	Wind	Up to 10 MW: EUR 0.0845 per kWh
	Solar (rooftop)	Up to 50 kW: EUR 0.1635 per kWh
		50-250 kW: EUR 0.1414 per kWh
		250 kW-1 MW: EUR 0.1128 per kWh
	Solar (ground-mounted)	Up to 250 kW: EUR 0.1312 per kWh
		250 kW-1 MW: EUR 0.1044 per kWh
	Solid biomass	Up to 1 MW: EUR 0.1234 per kWh
		1-10 MW: EUR 0.1156 per kWh
	Biogas	For agricultural biogas up to 1 MW: EUR 0.1228 per kWh
	Landfill gas	Up to 1 MW: EUR 0.0357 per kWh
		1-10 MW: EUR 0.0277 per kWh

* created exclusively for the energy supply of business activities of legal entities and individual entrepreneurs

FYR of Macedonia	Hydropower	≤ 85,000 kWh of electricity delivered per block: EUR 0.12 per kWh
		> 85,000 and ≤ 170,000 kWh of electricity delivered per block: EUR 0.08 per kWh
		> 170,000 and ≤ 350,000 kWh of electricity delivered per block: EUR 0.06 per kWh
		> 350,000 and ≤ 700,000 kWh of electricity delivered per block: EUR 0.05 per kWh
		> 700,000 kWh of electricity delivered per block: EUR 0.045 per kWh
	Wind	EUR 0.089 per kWh (Art. 8 par. 2 FiT Decree)
	Solar	≤ 0.05 MW: EUR 0.16 per kWh
		> 0.05 MW: EUR 0.12 per kWh
Montenegro[2]	Hydro	3 GWh of produced electricity: EUR 0.1044 per kWh[3]
		3-15 GWh of produced electricity: EUR 0.0744 per kWh[3]
		More than 1 GWh of produced electricity: EUR 0.0504 per kWh[3]
	Wind	EUR 0.0961 per kWh (Art. 4 Tariff System Decree)
	Solar	EUR 0.15 per kWh (Art. 4 Tariff System Decree) for power plants using solar energy on buildings and engineering constructions equally
	Biomass	EUR 0.1371 per kWh for power plants using biomass from forestry and agriculture
		EUR 0.1231 per kWh for power plants using biomass from wood processing industry
	Biogas	EUR 0.08 per kWh for power plants using waste gas
		EUR 0.15 per kWh for power plants using biogas (Art. 4 Tariff System Decree).
Serbia	Hydro	Up to 0.2 MW: EUR 0.1240 per kWh (Art. 13 § 3 Item No. 1.1 Incentive Measures Decree)
		0.2-0.5 MW: EUR 0.13727 per kWh -6.633xP[4] per kWh (Art. 13 § 3 Item No. 1.2 Incentive Measures Decree)
		0.5-1 MW: EUR 0.1041 per kWh (Art. 13 § 3 Item No. 1.3 Incentive Measures Decree)
		1-10 MW: EUR 0.10747 per kWh -0.337xP[4] per kWh (Art. 13 § 3 Item No. 1.4 Incentive Measures Decree)
		10-30 MW: EUR 0.0738 per kWh (Art. 13 § 3 Item No. 1.5 Incentive Measures Decree)
		For plants up to 30 MW using existing infrastructure (see Art. 2 Nr. 2 Privileged Power Producer Decree): EUR 0.059 per kWh (Art. 13 § 3 Item No. 1.6 Incentive Measures Decree).
	Wind	EUR 0.0920 per kWh (Art. 13 § 3 Item No. 5 Incentive Measures Decree)
	Solar	Roof-mounted power plants up to 0.03 MW: EUR 0.2066 per kWh (Art. 13 § 3 Item No. 6.1 Incentive Measures Decree)
		Roof-mounted power plants of 0.03-0.5 MW: EUR 0.20941 per kWh - 9.383xP4 per kWh (Art. 13 § 3 Item No. 6.2 Incentive Measures Decree)
		Ground-mounted power plants: EUR 0.1625 per kWh (Art. 13 § 3 Item No. 6.3 Incentive Measures Decree)
	Biomass	Up to 1 MW: EUR 0.1326 per kWh (Art. 13 § 3 Item No. 2.1 Incentive Measures Decree)
		1-10 MW: EUR 0.1382 per kWh -0.56xP[4] per kWh (Art. 13 § 3 Item No. 2.2 Incentive Measures Decree)
		Over 10 MW: EUR 0.0822 per kWh (Art. 13 § 3 Item No. 2.3 Incentive Measures Decree)
	Biogas	Up to 0.2 MW: EUR 0.1566 per kWh (Art. 13 § 3 Item No. 3.1 Incentive Measures Decree)
		0.2-1 MW: EUR 0.16498 -4.188xP[4] per kWh (Art. 13 § 3 Item No. 3.2 Incentive Measures Decree)
		Over 1 MW: EUR 0.1231 per kWh (Art. 13 § 3 Item No. 3.3 Incentive Measures Decree)
		For power plants using animal waste: EUR 0.1231 per kWh (Art. 13 § 3 Item No. 3.4 Incentive Measures Decree)
		For power plants using landfill and sewage gas (see Art. 2 Nr 6 and 7 Privileged Power Producer Decree): EUR 0.0691 per kWh (Art. 13 § 3 Item No. 4 Incentive Measures Decree)
	Geothermal	Up to 1 MW: EUR 0.0967 per kWh (Art. 13 § 3 Item No. 7.1 Incentive Measures Decree)
		1-2 MW: EUR 0.10385 per kWh -0.688xP[4] per kWh (Art. 13 § 3 Item No. 7.2 Incentive Measures Decree)
		Over 5 MW: EUR 0.0692 per kWh (Art. 13 § 3 Item No. 7.3 Incentive Measures Decree)
Ukraine	Small hydro	EUR 0.105- 0.175 per kWh until 2019
	Wind	EUR 0.102 per kWh for capacity of more than 2 MW
		EUR 0.116 per kWh until 2019 for systems up to 30 kW
	Solar[5]	EUR 0.17 per kWh (or capacity installed in 2016)
		EUR 0.15 per kWh (or capacity installed in 2017-2019)
	Solar (rooftop)	Households with systems up to 30 kW:
		EUR 0.2 per kWh (for capacity installed in 2015)
		EUR 0.19 per kWh (for capacity installed in 2016)
		EUR 0.18 per kWh (for capacity installed in 2017-2019)
	Biomass	EUR 0.124 per kWh until 2019
	Biogas	EUR 0.124 per kWh until 2019
	Geothermal	EUR 0.15 per kWh until 2019

Notes: 1 Tariff for the first 10 years of commissioning up to 300 kW, except wind which is the first 5 years of commissioning regardless of the size. After that FIT progressively decreases.
2 Small hydro plants, plants using biomass, biogas, solid waste or landfill gas and co-generation plants are limited to a maximum capacity of 10 MW (MWe), while solar power plants are restricted to a maximum capacity of 1 MW limited only to rooftops or building structures. Only for wind power plants there is no prescribed maximum size.
3 If the small hydro plant has been built on an existing pipeline or dam, the incentive price is reduced to 80% of the above mentioned value (Art. 5 § 3 Tariff System Decree).
4 "P" stands for the value in MW of the installed power of the power plant.
5 Households are eligible for the FIT if total power capacity of their installations using solar and/or wind energy does not exceed 30 kW.
Source: See endnote 12 for this section.

In addition, six countries – Armenia, Belarus, Georgia, Moldova, Montenegro and Ukraine – enforce **net metering / net billing** programmes. Georgia and Moldova both adopted net metering policies in 2016. Georgia's programme was introduced in an amendment to the Law on Electricity and Natural Gas, which now states that renewable energy systems (under 100 kW capacity) are eligible for self-consumption and also can connect to the grid to buy or sell the electricity surplus at the end of the year.[16]

Four other regulatory policies are being used in the region (see Table 11). **Tendering** is used in six countries (Albania, Bosnia and Herzegovina, Georgia, Moldova, Montenegro and the Russian Federation), and **tradable renewable energy certificates** are used in five countries (Albania, Belarus, Kyrgyzstan, the Russian Federation and Tajikistan). Under Albania's Law on Renewable Energy, the support scheme is to be based on "contracts for difference" for which the total support available will be determined by tenders. Renewable energy producers will sell the electricity in the market and receive the variable premium as the difference between the auction price and the electricity market price.[17]

Electric utility quotas and obligations have been adopted in four countries: Albania, Belarus, Montenegro and the Russian Federation. The Russian Federation uses a mix of policies, including a capacity-based scheme adopted via Decree No. 449 in 2013. While some countries incentivise the electricity produced, the Russian Federation uses a different approach, promoting renewable energy through the capacity market. The International Finance Corporation is supporting Russia in the development of enabling policies (see Sidebar 11).[18]

Sidebar 11. Enabling Renewable Energy Integration Through Pumped Storage

Renewable energy technologies that are variable in nature – such as wind and solar – are becoming an important component of power systems around the world. Despite the benefits that wind and solar bring (such as energy security), the variable output can lead to frequency and voltage fluctuations, which could adversely affect grid stability. Furthermore, climate impacts on hydropower – the backbone of electricity generation in a variety of countries – is driving modernisation of power systems to improve their flexibility and resilience.

Pumped storage, a proven grid-scale energy storage solution, can help countries balance generation from variable renewable energy sources and reduce the amount of new transmission required to integrate the renewable capacity needed to meet set targets. In the region covered in the present report, 4 of the 17 countries – Bosnia and Herzegovina, the Russian Federation, Serbia and Ukraine – have pumped storage plants, which have been providing affordable water regulation and peak demand shaving in the region for decades.

The Russian Federation commissioned its first pumped storage plant in 1967. The 15.9 MW Stavropolskaya plant is used for seasonal water level regulation in the Great Stavropol Canal, filling it with water during the shallow autumn-winter period. A second pumped storage plant, the 1,200 MW Zagorskaya [GAES] plant located in the Moscow region, provides peak smoothing services. The country also has an ambitious pipeline of more than 2 GW of pumped hydro projects for further peak shaving for the Moscow region as well as added flexibility in view of coming nuclear power plants.

Ukraine's electricity system, dominated by nuclear power, has been undergoing a transformation. It is rapidly integrating significant solar and wind capacity and is looking to add pumped storage to assist with peak shaving and to provide effective load regulation for wind and solar plants. Dniester pumped storage plant is planned to reach an installed capacity of 2.27 GW, becoming the sixth largest pumped storage plant in the world. As of end-2016, 972 MW was in operation. The plant will store the electricity generated during low demand times and re-inject it to the grid during peak hours. Also in the pipeline is the Kaniv Pumped Storage Plant, with an expected capacity of 1,000 MW. However, the plant is on hold due to licensing and financing hurdles.

Pumped storage in Bosnia and Herzegovina dates back to 1979, when the Čapljina facility started operation as the first pumped storage power plant in the former Yugoslavia. The plant contributes to the reliability of the power system as well as addressing the peak load challenge. In Serbia, the 614 MW Bajina Basta pumped storage plant was commissioned in 1982 and is operated by Elektroprivreda Srbije (EPS) as part of the power system. The plant helps maintain the reliability of the electricity supply and operates based on electricity price arbitrage opportunities.

Despite the rising interest in pumped storage, the lack of a specific regulation to support energy storage (especially for pumped hydro) has confined its development to only projects where the economics of electric arbitrage are sufficient for investors. Projects also are facing permitting challenges related to environmental concerns. Pumped hydro, with its balancing attributes, can enable the efficient integration of variable renewable energy into the system while increasing resiliency and energy security.

Source: See endnote 18 for this section.

HEATING AND COOLING SECTOR

Policy support for renewable heating and cooling continues to lag behind such support in the power sector. By the end of 2016, only Montenegro had a heating target, and Ukraine had an obligation for a 12.4% share of renewable energy sources in the heating and cooling sector by 2020.[19] Bosnia and Herzegovina was one of the pioneering countries to include planned measures for renewable energy in heating in its INDC submitted to the UNFCCC, but implementation on this commitment is lacking.[20] The Energy Community, in its *Annual Implementation Report* for 2016, highlighted the lack of progress in the countries of South East Europe in complying with EU rules on heating and cooling.[21]

Albania's National Renewable Energy Action Plan establishes a target for 38% renewable energy consumption by 2020, including a contribution from the heating and cooling sector via biomass (wood/waste) and heat pumps. The Plan also states Albania's intention to introduce support schemes for the use of renewable energy for heating and cooling.[22]

Montenegro continues to be the only country with a mandate for renewable heating and cooling in new buildings; depending on the climate zone, a quota of hot water needs must be met using renewable energy sources (solar energy and biomass boilers, among others).[23]

TRANSPORT SECTOR

The number of policies in the region to stimulate renewable energy in the transport sector increased slightly in 2015; however, support remains far below other sectors. Armenia, Kazakhstan and Turkmenistan strengthened their co-operation in the framework of the UN global conference on the sustainable transport.[24]

Several countries have renewable energy targets for the transport sector, including Albania, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia and Ukraine. Two countries – the former Yugoslav Republic of Macedonia and Montenegro – continue to work on legislation to address further support for renewable energy in transport.

The National Renewable Energy Action Plans of Albania and Ukraine indicate 10% renewable energy targets in the transport sector by 2020.[25] In Moldova, the renewable energy policy (Law No. 10) tasks the Ministry of Environmental Protection to develop a regulation on sustainability criteria for transport to be submitted by the government for adoption by 2017. Bosnia and Herzegovina (Republika Srpska) has committed to a yearly increase of 0.5% in the use of renewable energy in the transport sector, to reach a 10% share by 2020.[26]

Early in 2016, Moldova adopted a Law on Promotion of Energy from Renewable Sources, a breakthrough towards establishing a solid regulatory framework that enables the development of renewable energy projects.[27] The Law addresses issues related to Moldova's compliance with the EU's renewable energy acquis emanating from the country's membership in the Energy Community. The entry into force of the legislation was delayed to March 2017 to give the concerned authorities time to adopt the necessary secondary legislation. The Law envisions the introduction of support schemes for renewable power projects in the form of tendering, as well as for renewable heating and cooling. It also requires that renewable energy technologies be included when planning, constructing and renovating buildings or industrial sites.

FISCAL INCENTIVES AND PUBLIC FINANCING

Various types of fiscal incentives and public financing for renewable energy are present in all countries in the region except three (the former Yugoslav Republic of Macedonia, Turkmenistan and Uzbekistan (see Table 11).[28]

Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia and the Russian Federation use capital subsidies or rebates. In the former Yugoslav Republic of Macedonia, the government introduced capital subsidies of 30% of the total investment cost for a household's solar water heater.[29]

Energy production payments are used in Albania, Armenia, Azerbaijan, Belarus, Georgia, Kyrgystan, Montenegro, the Russian Federation, Tajikistan and Ukraine. Kyrgyzstan, Tajikistan and Ukraine use investment or production tax credits. Public investment, loans or grants are used in nine countries (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Montenegro, Serbia and Tajikistan), and reduction in sales, energy, CO_2, value-added tax (VAT) or other taxes is used in three countries (Kyrgyzstan, Moldova and Ukraine).

In Moldova, for example, construction works on wind and solar installations are exempted of VAT. Also, wind turbines with a capacity of more than 1 MW are exempted of VAT and other customs taxes.[30] The country is using fiscal incentives to develop its biomass market as well, making available a wide range of biomass baling, milling, briquetting and pelleting equipment under advantageous conditions for a three-year period with 0% commission, 0% interest and zero-rate VAT.[31]

Ukraine provides import tax exemptions for renewable energy materials, equipment and installations, as well as a significant reduction of the land tax for owners of renewable energy projects, who pay only 25% of the land tax (and others). Montenegro provides an interest-free credit line for the installation of heating systems (modern biomass fuels) as part of Phase II of the Energy Wood project.[32]

In Georgia, Energocredit, a dedicated programme of the EBRD, supports local businesses and individuals in implementing energy efficiency measures and renewable energy projects. The EBRD provides USD 125 million to local financial institutions in the Caucasus region, for on-lending. Creditworthy private companies and Individuals, as well as suppliers of eligible equipment and materials, can apply for Energocredit loans through commercial banks. Residential customers also can apply for an incentive payment amounting to 10% of the Energocredit loan value for installations with the highest energy efficiency standards.[33]

TABLE 11 | Overview of Renewable Energy Policies, by Country

			Regulatory policies							Fiscal incentives and public financing				
	INDC	Renewable energy target	Biofuels obligation / mandate	Electric utility quota obligation / RPS	Feed-in tariff / premium payment	Heat obligation / mandate	Net metering	Tendering	Tradable REC	Capital subsidy / rebate	Energy production payment	Investment or production tax credits	Public investment, loans or grants	Reduction in sales, energy, CO_2, VAT or other taxes
Albania	✘	✓	✓	✓	✓	✘	✘	✓	✓	✘	✓	✘	✘	✘
Armenia	✘	✓	✘	✘	✓	✘	✓	✘	✘	✘	✓	✘	✓	✘
Azerbaijan	✘	✓	✘	✘	✓	✘	✘	✘	✘	✘	✓	✘	✓	✘
Belarus	✘	✓	✓	✓	✓	✘	✓	✘	✓	✘	✓	✘	✘	✘
Bosnia and Herzegovina	✘	✓	✓	✘	✓	✘	✘	✓	✘	✓	✘	✘	✘	✘
Georgia	✘	✘	✘	✘	✓	✘	✓	✓	✘	✘	✓	✘	✓	✘
Kazakhstan	✘	✓	✘	✘	✓	✘	✘	✓	✘	✘	✘	✘	✓	✘
Kyrgyzstan	✘	✓	✘	✘	✓	✘	✘	✘	✓	✘	✓	✓	✓	✓
FYR of Macedonia	✘	✓	✘	✘	✓	✘	✘	✘	✘	✘	✘	✘	✘	✘
Moldova	✘	✓	✘	✘	✓	✘	✘	✘	✘	✘	✘	✘	✓	✓
Montenegro	✘	✓	✘	✓	✓	✓	✓	✓	✘	✘	✓	✘	✓	✘
Russian Federation	✘	✓	✘	✓	✘	✘	✘	✓	✓	✓	✓	✘	✘	✘
Serbia	✘	✓	✘	✘	✓	✘	✘	✘	✘	✘	✘	✘	✓	✘
Tajikistan	✘	✓	✘	✘	✘	✘	✘	✘	✓	✘	✓	✓	✓	✘
Turkmenistan	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘
Ukraine	✘	✓	✘	✘	✓	✘	✓	✘	✘	✘	✓	✓	✘	✓
Uzbekistan	✘	✓	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘

Note: Check marks indicate the presence of, and "x's" indicate the absence of, a policy or regulatory measure. Information for Albania Renewable Energy Sources Action Plan was approved in 2016.
Source: See endnote 28 for this section.

CITY AND LOCAL GOVERNMENT POLICIES

In 2016, more than 350 representatives of central, regional and local authorities of the Eastern Partnership gathered in Armenia to launch the new Mayors for Economic Growth initiative (M4EG) and the second phase of Covenant of Mayors East (CoM East), to support local sustainable development and economic growth in the Eastern Partnership countries.[34] In 2017, a new round of Call for Proposals would make available USD 10.5 million in grants for municipalities in the Eastern Partnership countries for the implementation of their Sustainable Energy and Climate Action Plans.[35]

The region has potential to leverage opportunities across several sectors (water, energy and food production) through development of its renewable potential, provided that adequate policies are in place. Sidebar 12 discusses the intersection between renewable energy deployment and the water-energy-food nexus.[36]

RENEWABLE ENERGY AND NATIONALLY DETERMINED CONTRIBUTIONS UNDER THE PARIS AGREEMENT

All countries in the region submitted Intended Nationally Determined Contributions (INDCs) outlining their commitments to tackling climate change in advance of the UNFCCC Conference of the Parties (COP21) in Paris in December 2015.[37] As participating countries officially join the Paris Agreement, their INDCs will be converted into Nationally Determined Contributions (NDCs), which will become the national climate action plans. Countries must update their NDCs every five years. As of February 2017, 120 countries worldwide had submitted their NDCs, including 5 countries covered in this report: Albania, Belarus, Kazakhstan, Turkmenistan and Ukraine.

NDCs can play a role in advancing renewable energy targets by incorporating the appropriate level of ambition. However, based on IRENA analysis in selected countries, including

Sidebar 12. Intersectoral Synergies to Deploy Renewable Energy: The Water-Energy-Food Nexus Approach

Renewable energy technologies could address some of the trade-offs between water, energy and food production, bringing substantial benefits in all three sectors. They can moderate competition by providing energy services using less resource-intensive processes and technologies compared to conventional energy, especially in transboundary river basins in South East Europe, the Caucasus and Central Asia.

In most of these basins, the riparian countries have active hydropower development but also have the potential to exploit other renewable sources such as solar, wind and geothermal energy. The distributed nature of many renewable energy technologies means that they can offer integrated solutions for expanding sustainable energy while enhancing security of supply across the three sectors. This contributes to addressing the region's strategic energy challenges. Distribution of small scale-solutions also can reduce environmental impacts of fossil fuel use.

The meaning of "nexus" in the context of energy, water and food (agriculture) refers to these sectors being inseparably linked so that actions in one sector commonly have impacts on the others, as well as on ecosystems. The nexus approach aims to support more sustainable renewable energy deployment by building synergies, increasing efficiency, reducing trade-offs and improving governance among sectors. The emphasis is on transboundary co-operation in both energy sector development and water management. The nexus approach has been adopted to stimulate renewable energy deployment in the region by the Group of Experts on Renewable Energy of the UNECE, in co-operation with the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention).

The work resulted in policy recommendations on how the nexus consideration can be leveraged for better resource management, with a focus on renewable energy deployment across the basins. Full and fair access to the existing grid is required for electricity produced from renewable energy. The energy system of the future needs to be considered in planning grid infrastructure development or replacement. System costs need to be reduced by means of market reforms, normative instruments (such as standards), business models and targeted financing instruments. Barriers faced by new generation, non-conventional renewable energy technologies need to be removed to promote their penetration into national energy systems. Targeted instruments need to be developed to reduce renewable energy financing costs, and decentralised direct uses of renewable energy need to be promoted as a way to provide on-site energy services, including through micro-, mini- and off-grid renewable energy options for remote areas.

Overall, increasing the renewable energy share can help to reduce water requirements in power generation; boost water security by improving accessibility, affordability and safety; and contribute to food security objectives. All of the countries involved may share the benefits.

Source: See endnote 36 for this section.

Kazakhstan, the Russian Federation and Ukraine, renewable energy does not play an adequate role in the design of the contributions (see Table 12).[38] Renewable energy commitments are not always included, and countries do not necessarily take into account deployment of the most cost-effective renewable energy options. In addition, the NDCs examined have underestimated the potential for renewable energy in 2030 by a factor of five. More emphasis must be put on examining how renewable energy can mitigate greenhouse gas emissions at the national and regional levels.

TABLE 12 | Overview of Submitted Nationally Determined Contributions and Renewable Energy in the Region

	Renewable Energy Targets or Measures	Remarks
Albania	Not included	Albania argues that it already has a very high share of renewable energy in its energy mix and that hence there is little room for further decarbonisation of its energy system with renewables.
Azerbaijan	Included	The NDC calls for a 35% reduction of CO_2 by 2030 in comparison with 1990 and for a 420 MW increase in renewable energy capacity by 2020.
Belarus	Included	–
Kazakhstan	Included	Renewable energy is a central pillar of the country's Green Economy Strategy.
Turkmenistan	Included	Renewable energy development is one of the main priorities under the NDC.
Ukraine	Included	–

Source: See endnote 38 for this section.

ENERGY EFFICIENCY TARGETS AND POLICIES

Energy efficiency represents the opportunity to deliver more services for the same energy input, or the same amount of services for less energy input. Support policies for energy efficiency are a complex body of instruments including regulations, standardisation and certification, and monitoring rules. Enforcement requires the allocation of resources, and the results of these measures (in terms of energy savings) take time to realise, creating a challenge for managing expectations.

All 17 countries in the region except for Turkmenistan have enacted regulatory policies to advance energy efficiency, most commonly in the buildings sector (including lighting and appliances) followed by transport and industry. All of the countries except Georgia, Kyrgyzstan and Turkmenistan have established energy efficiency targets (see Table 13).[39] To drive the efficiency improvements necessary to achieve their targets, governments are introducing new regulations or updating existing ones. Belarus and Ukraine both have approved their National Action Plans for Energy Efficiency.

Azerbaijan approved its Energy Efficiency Action Plan for 2020 in 2016, and Armenia approved its second National Action Plan for Energy Efficiency in 2017.[40] Belarus approved its National Programme on Energy Efficiency and Energy Saving for 2016-2020, which aims to improve data, monitoring, education, training and international collaboration, among others.[41] Albania adopted a new Law on Energy Efficiency in November 2015, replacing the outdated Law on Energy Efficiency of 2005. The Law envisages institutional and financial reinforcement, such as the establishment of an energy efficiency agency and an energy efficiency fund.[42] Also in November 2015, Ukraine adopted its National Energy Efficiency Action Plan to 2020, which foresees an overall national indicative energy savings target of 9% of final energy consumption until 2020.[43]

In Central Asia, Kazakhstan amended its Law on Energy Efficiency in 2015 and is implementing its Energy Efficiency Programme 2020, aimed at reducing the energy intensity of the national economy 10% by 2015 and 25% by 2020.[44] Turkmenistan's government acknowledges the importance of energy efficiency and increased use of renewable energy sources as key priorities of the policy for limiting greenhouse gas emissions envisaged in the country's National Strategy on Climate Change.[45] Georgia is in the process of producing its first National Energy Efficiency Action plan.[46] Only Kyrgyzstan and Turkmenistan do not have mandated government institutions (dedicated agencies or appointed ministries) to formulate and implement energy efficiency strategies and policies.

BUILDINGS SECTOR

Energy efficiency in buildings is addressed through a mix of instruments including mandatory building standards, minimum energy performance requirements, support mechanisms (such as energy audits, energy labels and certificates), awareness campaigns and trainings.

Eight countries – Albania, Belarus, Bosnia and Herzegovina, Kazakhstan, the former Yugoslav Republic of Macedonia, Montenegro, Serbia and Uzbekistan – address efficiency in the buildings sector through long-term strategic plans and visions at the government level.

In addition, eight countries – Albania, Azerbaijan, Belarus, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Moldova, Montenegro and Serbia – have targets for energy efficiency in buildings. Varying levels of energy performance requirements exist in all countries except Albania, Georgia and Turkmenistan.[47] The regulatory landscape in this area is still under development, with technical assistance support from international donors.

TABLE 13 | Overview of Energy Efficiency Policies, by Country

	Energy efficiency target	National energy efficiency awareness campaigns	National energy efficiency regulations, standards or laws	Governmental institution(s) to formulate and implement energy efficiency strategies and policies
Albania	✓	✘	✓	✓
Armenia	✘	✘	✓	✓
Azerbaijan	✘	✓	✓	✓
Belarus	✓	✓	✓	✓
Bosnia and Herzegovina	✓	✓	✓	✓
Georgia	✘	✓	✘	✓
Kazakhstan	✓	✓	✓	✓
Kyrgyzstan	✘	✓	✘	✘
FYR of Macedonia	✓	✓	✓	✓
Moldova	✓	✓	✓	✓
Montenegro	✓	✓	✓	✓
Russian Federation	✓	✓	✓	✘
Serbia	✓	✓	✓	✓
Tajikistan	✓	✓	✓	✓
Turkmenistan	✘	✘	✘	✘
Ukraine	✓	✘	✓	✓
Uzbekistan	✓	✓	✓	✓

Note: Check marks indicate the presence of, and "x's" indicate the absence of, a policy or regulatory measure.
Source: See endnote 39 for this section.

In Turkmenistan, UNDP has worked to improved energy efficiency in residential buildings by introducing improved design measures and by supporting pilot projects.[48] Mandatory building labelling has been adopted in Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Montenegro, the Russian Federation, Serbia and Uzbekistan (see Table 14).[49]

Auditing regulations are in force in Bosnia and Herzegovina, Kazakhstan, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia and Uzbekistan. Kazakhstan, Moldova and Ukraine have energy performance contracting to support building retrofits based on energy savings.[50]

However, support for building retrofits is translated into financial, fiscal or economic instruments only in Albania, Kazakhstan, the former Yugoslav Republic of Macedonia, Moldova, Montenegro and Ukraine. For example, the former Yugoslav Republic of Macedonia and Moldova use grants, rebates and subsidies. Montenegro and Ukraine have preferential loans. Kazakhstan provides state support for energy-saving equipment.[51]

Other countries have opened dedicated credit lines with the support of international donors, such as the EBRD in Georgia and the World Bank in Kyrgyzstan.[52] Support mechanisms for energy efficiency in buildings have been adopted in Albania, Belarus, Kazakhstan, Kyrgyzstan, the former Yugoslav Republic of Macedonia, Montenegro and Ukraine.

TABLE 14 | Overview of Mandatory Labelling Policies, by Country

	Buildings	Lighting	Appliances
Albania	✘	✘	✘
Armenia	✘	✘	✘
Azerbaijan	✘	✘	✘
Belarus	✘	✓	✓
Bosnia and Herzegovina	✓	✘	✓
Georgia	✘	✘	✘
Kazakhstan	✘	✘	✘
Kyrgyzstan	✘	✘	✘
FYR of Macedonia	✓	✓	✓
Moldova	✘	✘	✓
Montenegro	✓	✓	✓
Russian Federation	✓	✘	✓
Serbia	✓	✓	✓
Tajikistan	✘	✘	✓
Turkmenistan	✘	✘	✘
Ukraine	✘	✓	✓
Uzbekistan	✓	✓	✓

Note: Check marks indicate the presence of, and "x's" indicate the absence of, a policy or regulatory measure.
Source: See endnote 49 for this section.

LIGHTING AND APPLIANCES SECTOR[i]

Policies to support energy efficiency for lighting and appliance technologies continued to be pursued slowly during 2016. Serbia adopted a regulation enabling procurement of energy efficiency in municipal services, including street lighting.

Lighting standards exist in nine countries of the region and are absent in Armenia, Azerbaijan, Georgia, Tajikistan and Turkmenistan. Mandatory labelling for lighting has been adopted in Belarus, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Ukraine and Uzbekistan.

Four countries – Georgia, Kazakhstan, Kyrgyzstan and the former Yugoslav Republic of Macedonia – use support mechanisms such as advice and aid services to promote energy-efficient lighting and appliances. In Georgia, Bolnisi municipality is working with USAID to installed LED street lights powered by solar energy.[53]

Kazakhstan and Kyrgyzstan work with international and educational campaigns to promote standards for efficient lighting, Belarus and Kazakhstan have professional training programmes and research and development, and the former Yugoslav Republic of Macedonia uses voluntary approaches. Kazakhstan and Kyrgyzstan have public awareness campaigns on lighting efficiency. Only Belarus, Montenegro, Serbia and Uzbekistan use a mix of support instruments[ii] to create a comprehensive approach that is conducive to more efficient lighting performance.

Policy regarding incandescent lighting is still lagging in some of the countries. Despite global efforts to phase out incandescent bulbs, only Kazakhstan, the Russian Federation and Tajikistan have introduced such measures. Kyrgyzstan has adopted a system of standardisation and energy certification for lighting products that are produced for household domestic use.

Appliance standards and labelling continue to contribute to improving energy efficiency in buildings. Five countries – Albania, Montenegro, Serbia, Tajikistan and Ukraine – have long-term strategic plans and visions for appliances. Albania, Belarus, Montenegro and Serbia have energy efficiency targets for appliances. Nine countries – Belarus, Bosnia and Herzegovina, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, the Russian Federation, Serbia, Ukraine and Uzbekistan – have adopted mandatory labelling for appliances.[iii]

Kazakhstan and Uzbekistan have in place comprehensive policies on energy efficiency standards and labelling. In the countries of South East Europe, labelling regulations are based on transposition of the EU's Directive 2010/30/EU on labelling of energy-related products. Belarus has advice and aid services, international and educational campaigns, professional training programmes and research and development on appliances. Kazakhstan has international and educational campaigns and professional training programmes, and Ukraine has professional training programmes.

[i] Includes cooking equipment. Energy use in cooking is addressed in Section 3.
[ii] The support mechanisms include advice and aid services, international and educational campaigns, professional training programmes, voluntary approaches and RD&D.
[iii] Montenegro was still in the progress of adopting the legislation at the time of this report preparation.

06

INVESTMENT FLOWS

06 INVESTMENT FLOWS

GLOBAL OVERVIEW[1]

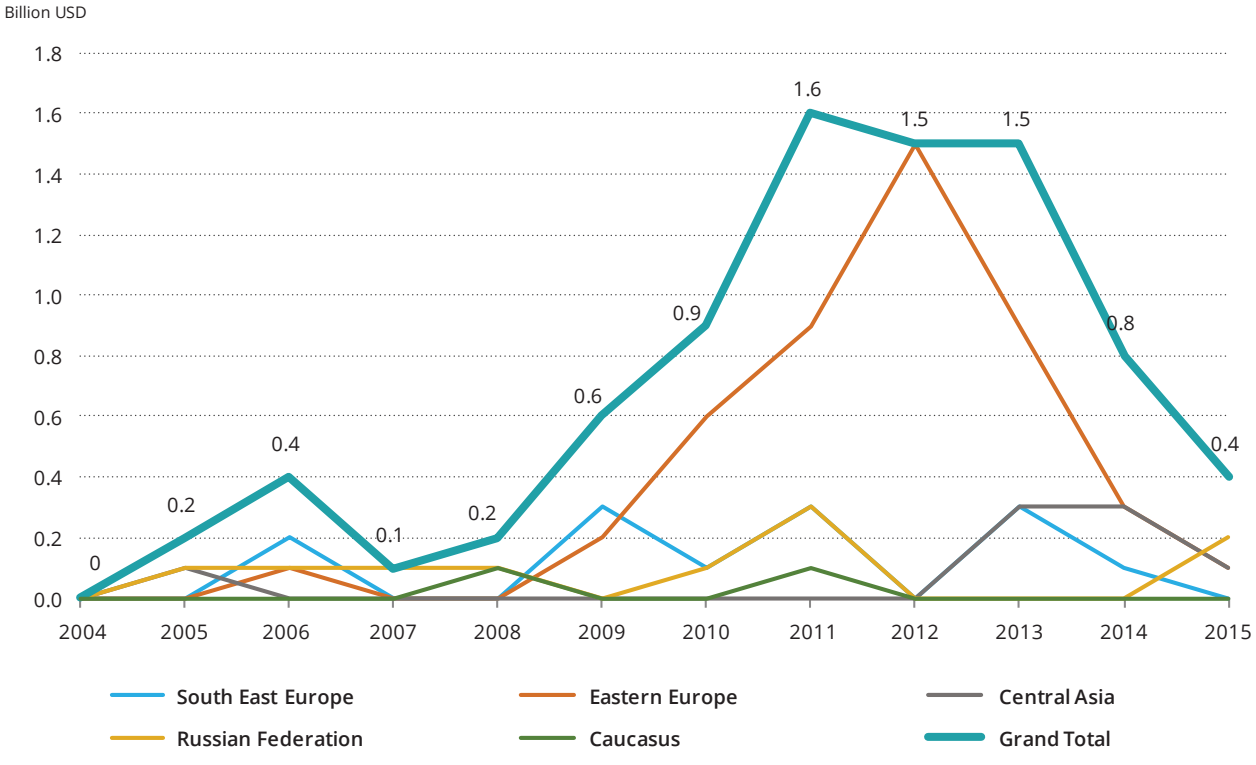
Global new investment in renewable power and fuels (not including hydropower above 50 MW) grew in 2015 to USD 285.9 billion, a 5% increase compared to 2014.[2] Global investment in renewable power, at USD 265.8 billion, was twice the amount for new coal and natural gas power generation capacities. 2015 was the first year that renewable energy investment in developing countries, at USD 156 billion, outweighed that in developed countries, at USD 130 billion.

However, none of the 17 countries covered in this report ranked among the top 10 countries in renewable energy investment, nor has any surpassed the USD 500 million mark to join the group of top-performing developing countries that includes Brazil, Chile, China, Honduras, Mexico, Morocco, Pakistan, the Philippines, South Africa and Uruguay. Solar and wind power were the leading technologies by far in global investment. Solar (mostly solar PV) accounted for USD 161 billion of new investment in renewable power and fuels (not including hydropower above 50 MW), and wind's share was USD 109.6 billion.

Renewable energy investment in the 17 countries of the region totalled USD 400 million in 2015, a notable decline from USD 700 million in 2014. The region still represented a fraction – less than 0.2% – of the global total in 2015, compared to 0.5% in 2014 (see Figure 14).[3]

While the data for 2016 were preliminary at the time of this writing, they point to further reductions in investment in the region. This reflects the overall trend of decreased investment in renewable energy globally in 2016 on the back of declining equipment costs.

FIGURE 14 | Renewable Energy Investment in the Region, 2004-2015



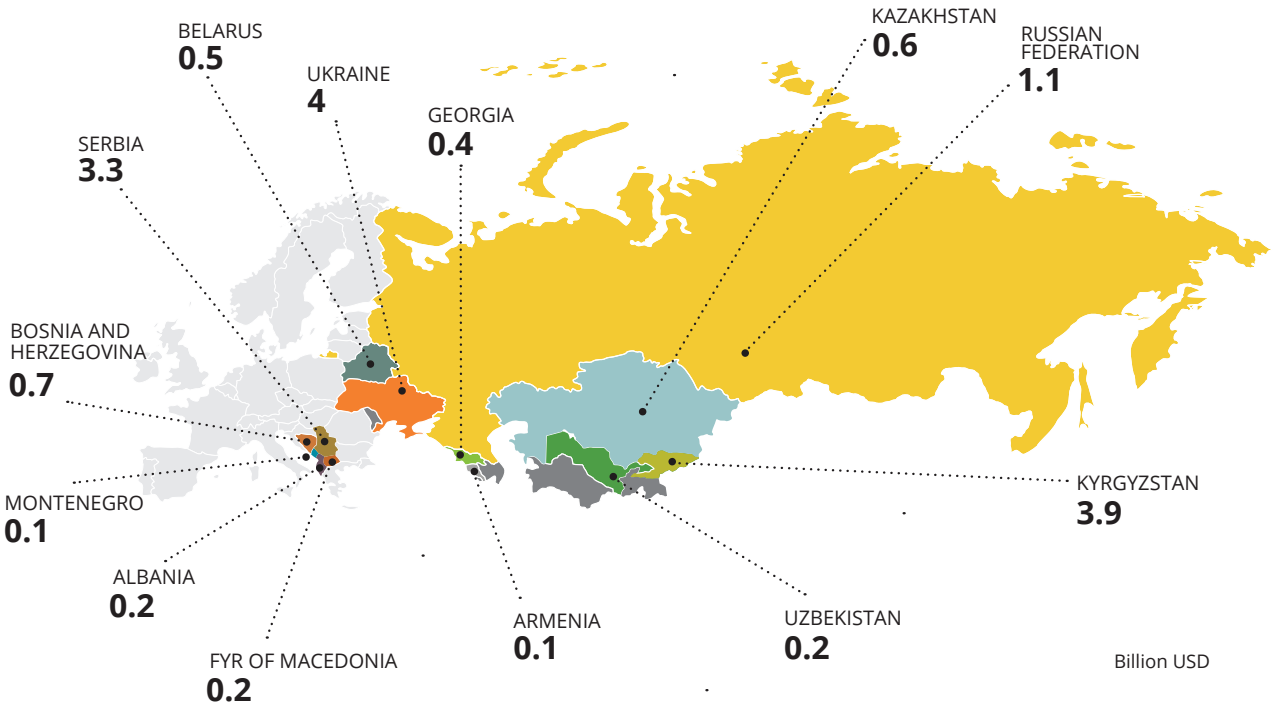
Source: BNEF

Source: See endnote 3 for this section.

Only three countries – Kazakhstan, the Russian Federation and Ukraine – saw new investment committed in 2015 (USD 100 million in Kazakhstan and Ukraine and USD 200 million in the Russian Federation), based on the available data from Bloomberg New Energy Finance. The absence of new investment is notable in South East Europe, the Caucasus and Central Asia.

Ukraine still dominates the region in cumulative renewable energy investment since 2004 (see Figure 15), despite a slowdown since 2014.[4] Only the Russian Federation (USD 1 billion), Kazakhstan (USD 600 million) and Bosnia and Herzegovina (USD 500 million) have achieved or surpassed the USD 500 million in cumulative investment, with the remaining countries trailing below this mark.

FIGURE 15 | Cumulative Renewable Energy Investment in Selected Countries, 2004-2015



Source: See endnote 4 for this section.

Additional data gathering conducted for this report reveals some positive developments. In Georgia, USD 130 million was invested in small hydro projects between 2013 and 2016 (see Sidebar 13).[5] Armenia aims to attract between USD 200 million and USD 300 million in investment for wind power generation by 2020.[6] Uzbekistan is actively seeking investment for its solar power development programme.[7] In Ukraine, renewable energy projects representing more than USD 44.25 million in investment reportedly went online in 2016.[8] The EBRD is considering providing a senior loan of up to USD 26 million to India's ACME Cleantech Solutions Pvt Ltd for a 29 MW peak solar project in Kazakhstan.[9]

Sidebar 13. Investment in Small Hydropower in Georgia

Georgia is one of the world's leading countries in water resources per capita. The Ministry of Energy estimates Georgia's hydropower potential at 40 terawatt-hours, yet currently only 20% of the country's hydro resources are realised. Between 2013 and 2016, Georgia's hydropower development programme attracted more than USD 92 million for 13 small hydro projects (installed capacity less than 50 MW), with state and private participation totalling 87.95 MW. During the same period, two large-scale hydro plants (capacity over 50 MW) attracted almost USD 309 million, with a combined installed capacity of 195 MW. This brings the average investment for small hydro to USD 1.05 million per MW, and for large-scale projects to USD 1.046 million per MW.

Hydropower development in Georgia offers interesting lessons as the country's renewable energy sector gears up to diversify into other technologies. Georgia's first 20.7 MW wind farm in Gori was in test operations in 2016. The EBRD contributed to its financing, building on the bank's role as a financier of hydropower development. The Ministry of Energy estimates 1,500 MW of wind energy potential. Ten wind power plants are undergoing feasibility studies, with a total installed capacity of 822 MW and an estimated USD 1.3 billion of investment required.

Georgia's success in attracting private investors to its hydropower programme based on key elements of the country's overall framework, in particular the government's investor-friendly business climate. Georgia's liberal and attractive legal and tax framework is attractive for private investors (the country has no VAT nor any special fees for hydro resource utilisation). Tariff policy has been forthcoming to newly built hydropower plants. Regulatory reforms are under way, based on harmonisation with the EU power market regulations and pointing in the direction of a deregulated and day-ahead energy market. Georgia offers simplified procedures for hydropower developers: for example, small-scale generation (13 MW installed capacity or less) does not require a generation licence.

Yet the hydropower programme also has shed light on existing challenges. The framework lacks a structured administrative approach regarding applicable permits and agreements, including PPAs. Government policy is not perceived as stable. Affordable financing is an issue, especially beyond institutional investors such as the EBRD. Access to local industry professionals is limited. The focus of hydropower developers on the potential for export to Turkey is being challenged by the reduction in Turkey's tariffs and limited cross-border trade capacities. Finally, buy-in from local communities has been difficult, especially for larger hydropower projects. Georgia's hydro projects have been challenged by environmental issues, geological hazards and resettlement issues, making it harder to attain public buy-in for these renewable technologies.

The Georgian government is addressing the above issues with a series of measures. The length of PPAs was extended to incentivise further investments. The Law on Environmental Impact Assessment is being revised in line with the relevant EU directive. A Memorandum of Understanding was signed between the government and developers of large-scale hydropower plants to address the issues around involuntary resettlement.

Source: See endnote 5 for this section.

REGIONAL FINANCING SOURCES

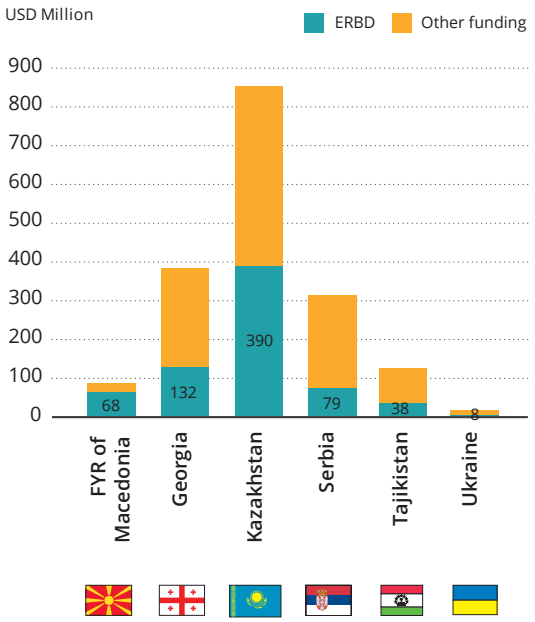
Debt is the major source of financing for utility-scale renewable energy projects globally. It is complemented by bond issuance, including growing issuance of green bonds. Utilities are an important source of equity financing. A specific breakdown of sources is not available for the region covered in this report. However, information is available about donor community activities in the region, including lending, which is analysed below.

International donors and development banks continue to be an important source of debt financing and grants for renewable energy projects in the region. This edition tracks some of the key activities of donor institutions during the period 2010-2016. The EBRD and the World Bank currently have the largest mandates in the region, covering all 17 countries. The ADB has a mandate for the Caucasus and Central Asia. South East Europe benefits from dedicated donor funds, which also are available for lending to renewable energy.

The EBRD leads renewable energy financing in the region, providing more than USD 1.8 billion in lending to renewable energy (including large-scale hydro) projects between 2010 and 2016. The total cost of the projects was USD 3.9 billion.[10] The highest share of lending went to hydropower projects, at USD 993 million. Lending to wind projects totalled USD 224 million and to solar projects totalled USD 180 million. A non-technology-specific amount of USD 495 million covered several financing facilities and financing frameworks in Armenia, Georgia, Kazakhstan and Ukraine.

During 2015 and 2016, the EBRD's activity was spread across several countries in the region (see Figure 16).[11] Kazakhstan captured the highest amount, USD 390 million, of which USD 1.18 billion is dedicated to utility-scale solar projects. The rest of the funding is spread over large hydropower projects, totalling USD 103 million in Georgia and Tajikistan, and wind projects totalling USD 95 million in Georgia, Serbia and Ukraine. The EBRD announced in December 2016 that it had earmarked EUR 200 million (US 214.4 million) to finance primarily private renewable energy projects in Kazakhstan within the next five years, with a total generating capacity of 300 MW.[12] EBRD will allocate EUR 160 million (US 172 million) to the construction of generating capacity (wind, solar, small hydro plants or biogas) and EUR 40 million (US 43 million) to electricity grid modernisation.

FIGURE 16 | EBRD Country-Level Renewable Energy Funding in the Region, 2015-2016

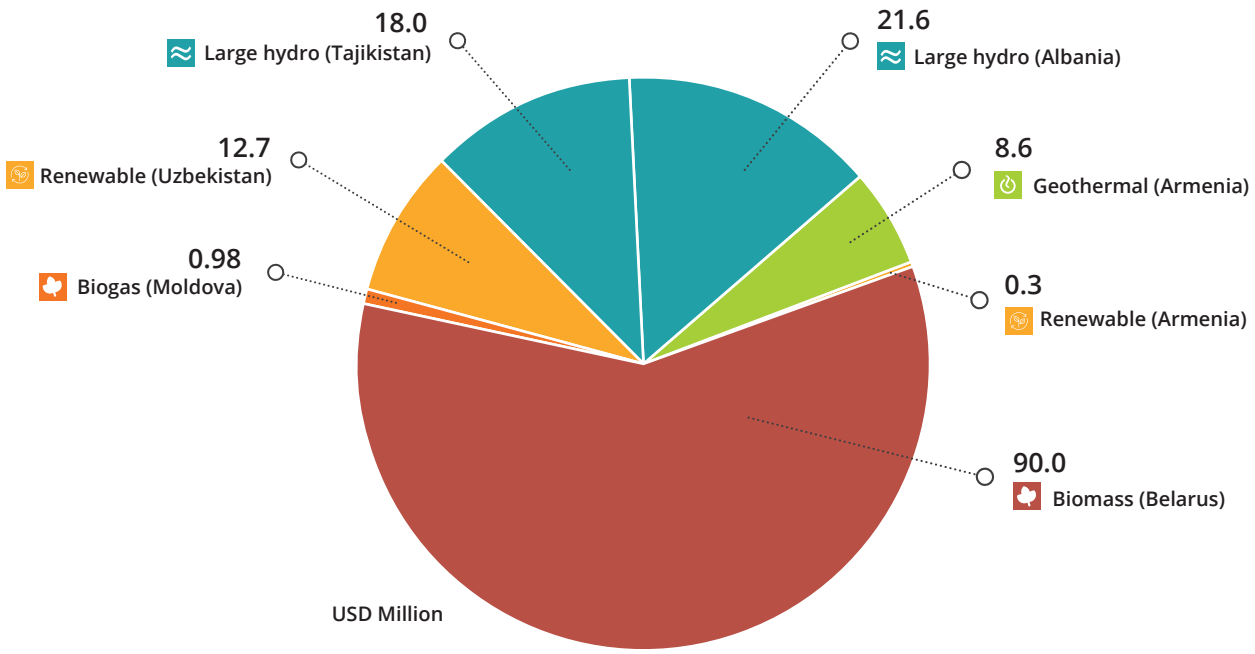


Source: See endnote 11 for this section.

The World Bank financed USD 152 million in renewable energy projects in the region between 2010 and 2016 (see Figure 17).[13] More than 50% of this was financing for a single biomass district heating project in Belarus. In Armenia, the World Bank supported the preparation of a renewable energy action plan and is financing preparatory work for geothermal energy. The World Bank is funding biogas development in Moldova and renewable energy use in agriculture in Uzbekistan.

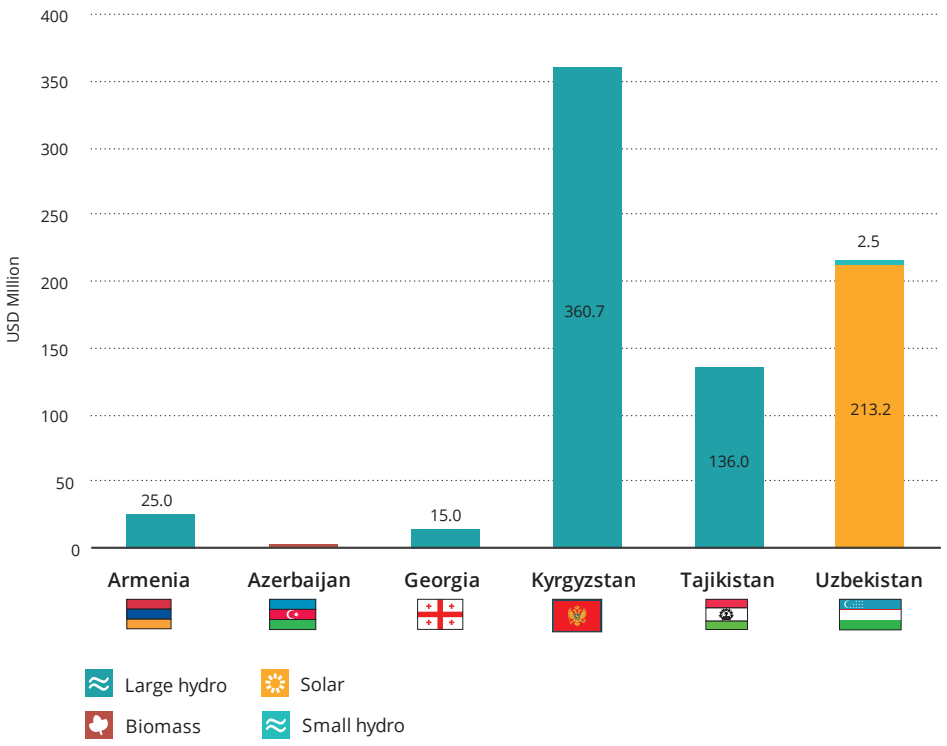
The mandate of the ADB covers countries in the Caucasus and Central Asia. The ADB funded USD 753.4 million in renewable energy projects in the region between 2010 and 2016 (see Figure 18).[14] However, 70% of the total, or USD 536.7 million, went to large-scale hydropower projects. The non-hydro renewable energy funding, USD 216.7 million, was split almost equally between grants (USD 106.73 million) and loans (USD 110 million). The non-hydro funding was dominated by ADB's activity in Uzbekistan, where the bank has allocated USD 213.2 million for solar projects. The remaining funding is split between biomass projects in Azerbaijan (USD 1 million) and small hydro in Uzbekistan (USD 2.5 million).

FIGURE 17 | World Bank Renewable Energy Funding in the Region, 2010-2016



Source: See endnote 13 for this section.

FIGURE 18 | ADB Renewable Energy Funding in the Caucasus and Central Asia, 2010-2016

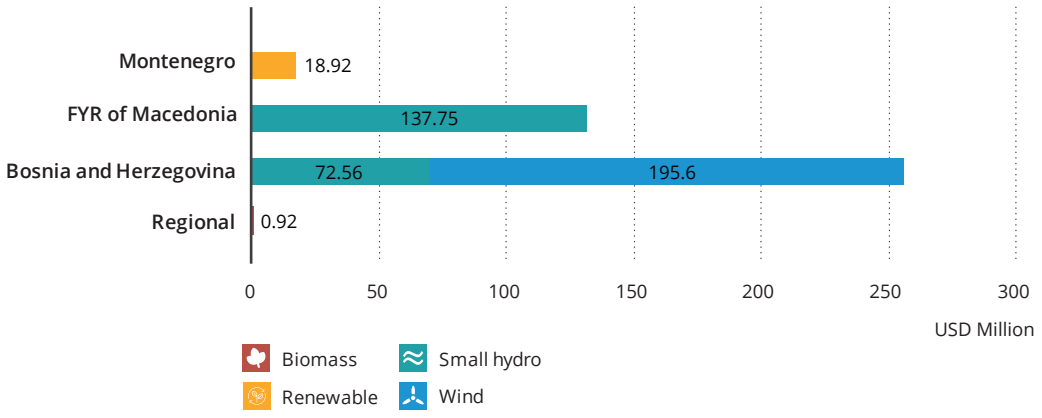


Source: See endnote 14 for this section.

In the countries of South East Europe, the Western Balkans Investment Framework (WBIF) continues to channel investment from several international donors and multilateral banks, including the European Commission Instrument for Pre-Accession, CEB, the EBRD, EIB, KfW and the World Bank.

The WBIF provided USD 426.2 million to renewable energy projects between 2010 and 2016 (see Figure 19) to cover the costs of feasability and other technical studies.[15] Bosnia and Herzegovina received the highest amount for small hydro projects (9.75 MW of installed acapacity in Kruševo, 2.12 MW in Zeleni Vir and 11.5 MW in Babino Selo) and wind projects (50 MW of installed capacity in Vlašić-Travnik and increasing installed capacity to 108 MW in Poklečani), amounting to EUR 256 million (USD 274 million). The former Yugoslav Republic of Macedonia received EUR 131 million (USD 140 million) for the 36.8 MW Bogdanci wind farm. In Montenegro, the WBIF provided EUR 18 million (USD 18.9 million) to fund electricity network expansion for the development of renewable energy sources. The WBIF also allotted EUR 875,000 EUR (USD 940,000) for a regional study on biomass-based heating in the Western Balkans.

FIGURE 19 | Renewable Energy Projects of the Western Balkans Investment Framework, 2010-2016



Source: See endnote 15 for this section.

The Green for Growth Fund (GGF) is complementary to the WBIF because it addresses renewable energy and energy efficiency specifically, whereas the WBIF is a cross-industry facility. The GGF provides refinancing to financial institutions to enhance their participation in the energy efficiency and renewable energy sectors. It also makes direct investments in non-financial institutions with projects in these areas. The GGF has disbursed nearly EUR 300 million (USD 322 million) since its inception in December 2009, with 19.1% for the use of renewables for commercial energy generation and 3.4% for the use of renewables by households and businesses.

Germany's KfW is another development bank whose mandate covers the funding of renewable energy projects in South East Europe. Since 2010, KfW financed the Podvelezje wind farm in Bosnia and Herzegovina with a EUR 65 million (USD 70 million) loan and the Bogdanci wind farm in the former Yugoslav Republic of Macedonia with a EUR 33 million (USD 35 million) loan.[16] In the former Yugoslav Republic of Macedonia, KfW also provided EUR 32 million (USD 34 million) for the rehabilitation of six hydropower plants.[17] In addition KfW jointly funded, with the German Federal Ministry for Economic Cooperation and Development, a Balkan wind atlas to faciliate investment opportunities in the region.[18]

Other funding sources for renewable energy in the region included the EU Investment Facility for Central Asia (IFCA), which co-financed five sustainable energy projects totalling EUR 29 million (USD 31 million) between 2010 and 2015.[19]

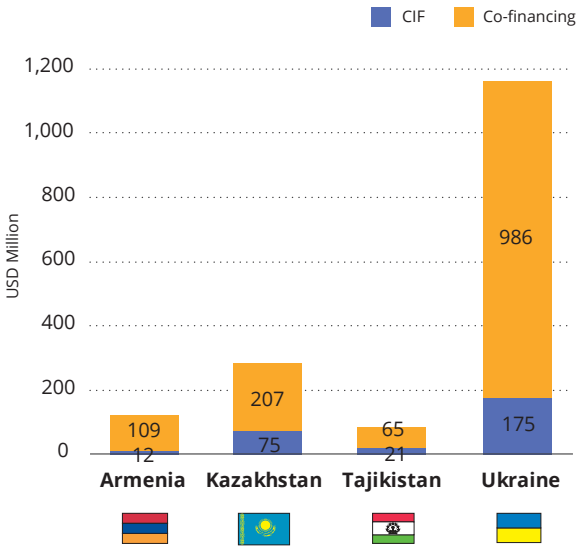
POTENTIAL OF CLIMATE FINANCE

Climate finance consists of mitigation and adaptation funds. Renewable energy falls under mitigation funds, which can constitute an additional source of financing for projects in the region. Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, the former Yugoslav Republic of Macedonia, Moldova, Montenegro, Serbia, Tajikistan, Turkmenistan and Uzbekistan are all non-Annex I Parties under the UNFCCC and therefore are expected to be receivers of climate funds.

The Climate Investment Funds (CIF) is one source that can be leveraged for renewable energy investment in the region. The CIF was established in 2008 to trigger investments at scale to empower climate-smart growth and transformation in developing and middle-income countries. The CIF has available USD 8.3 billion in pledged resources that can be leveraged further through private and public co-financing.[20] The CIF covers both the construction of installed capacity as well as accompanying support, such as technical assistance and advisory services.

The CIF has a 13% allocation for Eastern Europe and Central Asia countries.[21] As of December 2016, CIF's project pipeline in the 17 countries remained the same as in December 2014, except for revised funding allocations. The CIF has endorsed 13 renewable energy projects in Armenia, Kazakhstan and Ukraine and has allocated USD 262 million, with an estimated co-financing of USD 1.3 billion (see Figure 20).[22] The projects fall under the CIF's Clean Technology Fund and, for projects in Armenia, under the Scaling Up Renewable Energy Programme. The CIF also has committed USD 21 million, with USD 65 million in co-financing, for large-scale hydropower in Tajikistan under its pilot programme for climate resilience.

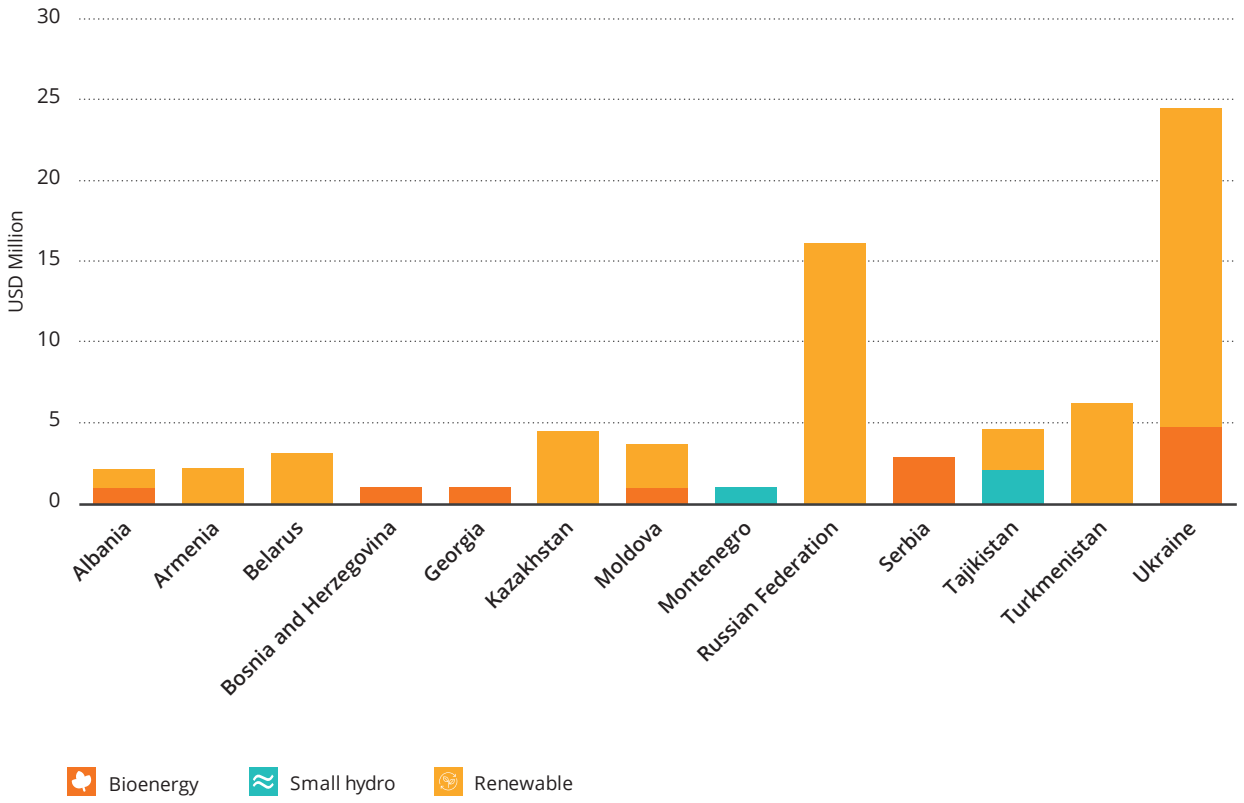
FIGURE 20 | Updated Financing of Climate Investment Fund-Endorsed Renewable Energy Projects in the Region, as of December 2016



Source: See endnote 22 for this section.

The Global Environment Facility has been in operation since 1991 and can be tapped for renewable energy financing. The GEF channels investment from several international development partners, and multilateral development is leveraged through additional co-financing. Figure 21 provides an overview of GEF-supported projects during 2010-2016, which cover renewable energy either under the main project scope or as a part of project activities.[23] GEF funding totalling USD 76 million, with USD 770 million in co-financing from the EBRD, UNIDO, UNDP and the World Bank, covers 22 projects in the region, 13 of which focus uniquely on renewable energy or a specific technology (biomass, biogas, bioenergy) and 9 of which include renewable energy along with energy efficiency, green cities or green economy approaches.

FIGURE 21 | Renewable Energy Projects with GEF Funding in the Region, 2010-2016



Source: See endnote 23 for this section.

CONCLUSION

CONCLUSION

The countries in South East and Eastern Europe, the Caucasus and Central Asia, as well as the Russian Federation, face economic challenges that affect their energy situations and the development of renewable energy and energy efficiency markets. South East and Eastern Europe saw some economic growth in 2015 and 2016, while the Caucasus and Central Asia have faced numerous external economic shocks. The Russian Federation has borne the economic impact of lower oil prices. The economic challenges extend into the energy sector and are reflected in renewable energy deployment in the region, which favours the cheapest energy source in the short term. Energy subsidies to fossil fuel generation persist and present an additional obstacle for the deployment of both renewable energy sources and energy efficiency measures in the region.

As a consequence the region is moving only slowly in the direction of **more sustainable energy systems**, with some countries being more active than others. Hydropower accounts for 70% of renewable power capacity additions in the region. Six countries (Albania, Armenia, Kyrgyzstan, Montenegro, Tajikistan and Turkmenistan) did not add any non-hydro renewable power in 2015 and 2016, while four countries (Belarus, Kazakhstan, the Russian Federation and Ukraine) added more than 90 MW each.

With the end of the INOGATE programme, the region has witnessed several **sub-regional energy collaboration** initiatives, including in renewable energy. The new EU programme EU4Energy involves collaborations with the Energy Community, the Energy Charter and the IEA. The EU also has included renewable energy in the remit of the High Level Group on Central and South Eastern Europe Gas Connectivity. UNECE and IRENA are pushing the region's renewable energy policy agenda in a regional setting. Energy efficiency continues to be tackled under the successful Covenant of Mayors initiative.

All 17 countries in the region submitted their INDCs prior to the December 2015 UN climate talks in Paris. Since then, six countries have submitted their NDCs, with five countries including plans to increase renewable energy deployment.

Access to affordable, reliable and sustainable energy remains a challenge for the region despite its endowment in energy sources, especially for low-income and rural populations. The quality and reliability of the electricity supply is problematic in several countries. Access to a sustainable and affordable heat supply is challenging in those countries that have long heating seasons. Access to clean fuels and technologies for household heating, lighting and cooking is still an issue for more than 17 million people in the region. Improving the quality of energy access in rural and to some extent urban communities through renewable energy (bioenergy and solar PV) will continue to be a topic of focus, especially in the Caucasus and Central Asia and in parts of South East and Eastern Europe.

Even though **energy intensity** in the 17 countries is high in the global context, improvements continue with the introduction of additional policies and energy efficiency measures. The region exhibits steady progress in increasing energy efficiency in several sectors, assisted by financial support from international donors. Most policies and projects are targeting buildings, but energy efficiency in industry and transport also needs to be scaled up, considering the available potential for energy savings. Encouraging reductions in energy consumption alongside simultaneous economic growth have been observed in South East Europe and Moldova.

Renewable energy markets continue to grow in the region, with new developments arising in the power, heat and transport sectors. The most prominent growth was experienced in power generation, where further developments beyond traditional technologies (such as hydropower) are occurring. Players with nascent renewable energy markets continue to mature, and utility-scale projects are being commissioned in several countries in the region (Azerbaijan, Belarus, Kazakhstan, the Russian Federation, Serbia and Ukraine).

The region added more than 2 GW of renewable power capacity in 2015 and 2016, to reach a total installed capacity of 85.4 GW. The most significant renewable power capacity additions in 2015 and 2016, outside of hydropower, were in the Russian Federation (153 MW), Kazakhstan (98 MW), Ukraine (97 MW) and Belarus (94 MW).

In the heating and cooling sector, renewable energy continued to replace fossil fuels. Solar water heaters are replacing boilers, geothermal energy is consolidating as an option for heat pumps and balneology, and modern biomass-based individual heating technologies are expanding in the district heating sector. As in the rest of the world, however, the region is deploying renewable heating and cooling technologies only modestly.

Overall, the share of renewable energy in total final energy consumption diverges widely across the 17 countries, with a regional average of 18.2% of TFEC in 2014. Georgia, Albania, Tajikistan, Bosnia and Herzegovina and Montenegro have achieved high shares of renewable energy of above 30%, whereas Turkmenistan, Kazakhstan, Azerbaijan and Uzbekistan have low shares of less than 3% of TFEC.

New policy measures for renewable energy and energy efficiency in the region have progressively helped to remove barriers, attract investment, drive deployment, foster energy security and increase the flexibility of power systems. Renewable energy and energy efficiency support policies have received increased attention since 2015, due in part to the global pressure to mitigate global climate change in advance of and following the Paris climate talks.

By the end of 2016, the number of countries in the region with renewable energy policies had again increased. At least 15 countries had renewable energy targets in place, and most countries had renewable energy support policies in place, mostly in the form of a feed-in tariff. More than one-third of the 17 countries are pursuing renewable energy tendering, mimicking the global trend for this regulatory policy.

Renewable energy prospects differ by sub-region. In South East Europe, there is interesting potential for cost-competitive deployment of solar and wind power generation. However, renewable energy is being challenged politically, given the cost of government support policies. In the heating sector, the use of solar water heating and biomass could be expanded in both South East and Eastern Europe. Ukraine, the largest renewable energy player, is working to make its market more attractive to investors in Eastern Europe.

In the Caucasus, Azerbaijan is creating opportunities for renewable energy development with the government's support. Georgia is moving from hydropower to other renewable energy sources, such as wind. Armenia is opening opportunities for solar PV in particular, with strong government push.

In Central Asia, the development of utility-scale projects for renewable power generation is expected in in Kazakhstan and Uzbekistan, bolstered by government support combined with financing from development banks (EBRD and ADB, respectively). Kyrgyzstan (with the exception of hydropower) and Tajikistan remain on the margins of renewable energy deployment, despite the need to improve the reliability of electricity and heat supplies. Development of the Russian Federation's vast renewable energy resource potential has been slow, as considerable localisation requirements impede project development.

Investment across the whole region, except for in the Russian Federation, continues to be driven by international donors and development banks. Examples of past investments (in Ukraine, Georgia and Kazakhstan), as well as government plans to attract more investors (in Armenia, Georgia, Kazakhstan, Ukraine and Uzbekistan), suggest the potential for future growth.

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
CAREC	Central Asia Regional Economic Cooperation Program
CEB	Council of Europe Development Bank
CESEC	Central and South Eastern Europe Gas Connectivity
CF	Clean fuels and technologies
CHP	Combined heat and power
CIF	Climate Investment Funds
CO_2	Carbon dioxide
COP	Conference of the Parties
CSP	Concentrating solar (thermal) power
E5P	Eastern Europe Energy Efficiency and Environment
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
ESCO	Energy service company
EU	European Union
EUR	Euro
FIT	Feed-in tariff
FYR	Former Yugoslav Republic
GDP	Gross domestic product
GEF	Global Environment Facility
GGF	Green Growth Fund
GIZ	German Agency for International Cooperation
GJ	Gigajoule
GW/GWh	Gigawatt/Gigawatt-hour
IEA	International Energy Agency
INDC	Intended Nationally Determined Contribution
IRENA	International Renewable Energy Agency
ISCC	integrated solar combined-cycle
kW/kWh	Kilowatt/kilowatt-hour
LED	Light-emitting diode
MEPS	Minimum Energy Performance Standards
MJ	Megajoule
MW/MWh	Megawatt/Megawatt-hour
MW_{th}	Megawatt-thermal
NDC	Nationally Determined Contribution
PPA	Power purchase agreement
PPP	Purchasing power parity
PV	Photovoltaic
REN21	Renewable Energy Network for the 21st Century
RISE	Regulatory Indicators for Sustainable Energy
SDG	Sustainable Development Goal
SEforALL	United Nations Sustainable Energy for All initiative
TFC	Total final consumption
TFEC	Total final energy consumption
TJ	Terajoule
TPES	Total primary energy supply
UFRD	Uzbekistan Fund for Reconstruction and Development
UNDP	United Nations Development Programme

GLOSSARY

BIODIESEL. A fuel produced from oilseed crops such as soy, jatropha, 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.

BIOENERGY. Energy derived from any form of biomass, including bio-heat, bio-power and biofuel. Bio-heat arises from the combustion of solid biomass (such as dry fuel wood) or other liquid or gaseous energy carriers. The heat can be used directly or used to produce bio-power by creating steam to drive engines or turbines that drive electricity generators. Alternatively, gaseous energy carriers such as biomethane, landfill gas, or synthesis gas (produced from the thermal gasification of biomass) can be used to fuel a gas engine. Biofuels for transport are sometimes also included under the term bioenergy (see Biofuels).

BIOFUELS. A wide range of liquid and gaseous fuels derived from biomass. Biofuels – including liquid fuel ethanol and biodiesel, as well as biogas – 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). Advanced biofuels are made from sustainably produced non-food biomass sources using technologies that are still in the pilot, demonstration or early commercial stages. One exception is hydro-treated vegetable oil (HVO), which is now produced commercially in several plants.

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 micro-organisms 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 can also be transformed into biomethane through a simple process known as scrubbing that removes impurities including carbon dioxide, siloxanes and hydrogen sulphides. Biomethane can be injected directly into natural gas networks and used as a substitute for natural gas in internal combustion engines without fear of corrosion.

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. These can take many forms, including liquid biofuels, biogas, biomethane, pyrolysis oil or solid biomass pellets.

BIOMASS PELLETS. Solid biomass fuel produced by compressing pulverised dry biomass, such as waste wood and agricultural residues. Torrefied pellets produced by heating the biomass pellets have higher energy content per kilogramme, as well as better grindability, water resistance and storability. Pellets are typically 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 combined heat and power.

BRIQUETTES. Blocks of flammable matter made from solid biomass fuels, including cereal straw, that are compressed in a process similar to the production of wood pellets. They are physically much larger than pellets, with a diameter of 50–100 millimetres and a length of 60–150 millimetres. They are less easy to handle automatically but can be used as a substitute for fuelwood logs.

CAPACITY. The rated capacity of a heat or power generating plant 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).

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.

CONCENTRATING SOLAR THERMAL POWER (CSP) (also called concentrated solar power or solar thermal electricity, STE). Technology that uses mirrors to focus sunlight into an intense solar beam that heats a working fluid in a solar receiver, which then drives a turbine or heat engine/generator to produce electricity. The mirrors can be arranged in a variety of ways, but they all deliver the solar beam to the receiver. There are four types of commercial CSP systems: parabolic troughs, linear Fresnel, power towers and dish/engines. The first two technologies are line-focus systems, capable of concentrating the sun's energy to produce temperatures of 400°C, while

the latter two are point-focus systems that can produce temperatures of 800°C or higher. These high temperatures make thermal energy storage simple, efficient, and inexpensive. The addition of storage – using a fluid (most commonly molten salt) to store heat – usually gives CSP power plants the flexibility needed for reliable integration into a power grid.

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

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 to end-use facilities (such as electricity to an electrical outlet), where it becomes usable energy and can provide services such as lighting, refrigeration, etc. When primary energy is converted into useful energy, there are always losses involved.

ETHANOL (FUEL). A liquid fuel made from biomass (typically corn, sugar cane or small cereals/grains) that can replace gasoline 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". Note that some ethanol production is used for industrial, chemical and beverage applications and not for fuel.

FEED-IN TARIFF (FIT). The basic form of feed-in policies. A guaranteed minimum price (tariff) per unit (normally kWh or MWh) is guaranteed over a stated fixed-term period when electricity can be sold and fed into the electricity network, normally with priority or guaranteed grid access and dispatch.

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 electricity, district heating, mechanical energy, liquid hydrocarbons such as kerosene or fuel oil, and various gaseous fuels such as natural gas, biogas and hydrogen. Final energy accounts only for the conversion losses that occur upstream of the end-user, such as losses at refineries and power plants.

FISCAL INCENTIVE. An economic incentive that provides individuals, households or companies with a reduction in their contribution to the public treasury via income or other taxes, or with direct payments from the public treasury in the form of rebates or grants.

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 or steam. It can be used to generate electricity in a thermal power plant or to provide heat directly at various temperatures for buildings, industry and agriculture.

GEOTHERMAL HIGH-ENTHALPY (OR HIGH-TEMPERATURE). A geothermal resource for which the reservoir temperature is at least 225°C, making it suitable for power generation.

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 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 this report, new investment in renewable energy refers to investment in: technology research and development, commercialisation, construction of manufacturing facilities and project development (including construction of wind farms and 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/KILOJOULE/MEGAJOULE/GIGAJOULE/TERAJOULE/ PETAJOULE/ EXAJOULE. A Joule (J) is a unit of work or energy equal to the energy expended to produce one Watt of power for one second. For example, one Joule is equal to the energy required to lift an apple straight up by one metre. The energy released as heat by a person at rest is about 60 J per second. A kilojoule (kJ) is a unit of energy equal to one thousand (103) Joules; a megajoule (MJ) is one million (106) Joules; and so on. The potential chemical energy stored in one barrel of oil and released when combusted is approximately 6 GJ; a tonne of oven dry wood contains around 20 GJ of energy.

MANDATE/OBLIGATION. A measure that requires designated parties (consumers, suppliers, generators) to meet a minimum, and often gradually increasing, target for renewable energy, such as a percentage of total supply or a stated amount of capacity. Costs are generally 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 biofuels into transport fuel.

MODERN BIOMASS ENERGY. Energy derived from combustion of solid, liquid and gaseous biomass fuels in efficient small domestic appliances to large-scale industrial conversion plants for modern applications of space heating, electricity generation, combined heat and power, and transport (as opposed to traditional biomass energy).

NET METERING. A regulated arrangement in which utility customers who have installed their own generating systems pay only for the net electricity delivered from the utility (total consumption minus on-site self-generation). A variation that employs two meters with differing tariffs for purchasing electricity and exporting excess electricity off-site is called "net billing".

POWER. The rate at which energy is converted per unit of time, expressed in Watts (Joules/second).

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.

PUBLIC COMPETITIVE BIDDING (ALSO CALLED AUCTION OR TENDER). A procurement mechanism by which public authorities solicit bids for a given amount of renewable energy supply or capacity, generally based on price. Sellers offer the lowest price that they would be willing to accept, but typically at prices above standard market levels.

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, biofuel blending mandates and renewable heat obligations.

RENEWABLE ENERGY 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 by a future date. Some targets are legislated while others are set by regulatory agencies or ministries.

SOLAR HOME SYSTEM (SHS). A stand-alone system composed of a relatively small power photovoltaic module, battery and sometimes a charge controller, that can power small electric devices and provide modest amounts of electricity to homes for lighting and radios, usually in rural or remote regions that are not connected to the electricity grid.

SOLAR PHOTOVOLTAICS (PV). A technology used for converting solar radiation (light) into electricity. PV cells are constructed from semi-conducting materials that use sunlight to separate electrons from atoms to create an electric current. Modules are formed by interconnecting individual solar PV cells. Monocrystalline modules are more efficient but relatively more expensive than polycrystalline silicon modules.

SOLAR WATER HEATER (SWH). An entire system – consisting of a solar collector, storage tank, water pipes and other components – that converts the sun's energy into "useful" thermal (heat) energy for domestic water heating, space heating, process heat, etc. Depending on the characteristics of the "useful" energy demand (potable water, heating water, drying air, etc.) and the desired temperature level, a solar water heater is equipped with the appropriate solar collector. 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 thermo-siphon solar water heaters make use of buoyancy forces caused by natural convection (passive systems).

SUBSIDIES. Government measures that artificially reduce the price that consumers pay for energy or reduce production costs.

TOTAL FINAL CONSUMPTION (TFC). The sum of consumption by the different end-use sectors. TFC is broken down into energy demand in the following sectors: industry, transport, buildings (including residential and services) and other (including agriculture and non-energy use). It excludes international marine and aviation bunkers, except at the world level where it is included in the transport sector.

TOTAL FINAL ENERGY CONSUMPTION (TFEC). A measure that covers all energy supplied to the final consumer for all energy uses. It is usually disaggregated into the final end-use sectors: industry, transport, households, services and agriculture.

TRADITIONAL BIOMASS. Solid biomass, including gathered fuel wood, charcoal, agricultural and forest residues, and animal dung, that is usually produced unsustainably and typically used in rural areas of developing countries by combustion in polluting and inefficient cook stoves, furnaces or open fires to provide heat for cooking, comfort and small-scale agricultural and industrial processing (as opposed to modern biomass energy).

WATT/KILOWATT/MEGAWATT/GIGAWATT/TERAWATT-HOUR. A Watt is a unit of power that measures the rate of energy conversion or transfer. A kilowatt is equal to one thousand (10^3) Watts; a megawatt to one million (10^6) Watts; and so on. A megawatt electrical (MW) is used to refer to electric power, whereas a megawatt-thermal (MW_{th}) refers to thermal/heat energy produced.

ENDNOTES

1. REGIONAL INTRODUCTION

1. United Nations Economic Commission for Europe (UNECE), "Member States and Member States Representatives", http://www.unece.org/oes/nutshell/member_States_representatives.html.

2. **Table 1** from World Bank, World Development Indicators, http://data.worldbank.org/data-catalog/world-development-indicators, viewed 20 December 2016.

3. International Monetary Fund (IMF), *Central, Eastern, and Southeastern Europe: How to Get Back on the Fast Track* (Washington, DC: May 2016), p. 23, http://www.imf.org/external/pubs/ft/reo/2016/eur/eng/erei0516.htm.

4. Wolfgang Lutz, *Emerging Population Issues in Eastern Europe and Central Asia* (New York: United Nations Population Fund, 2010), p. 26, https://www.unfpa.org/sites/default/files/pub-pdf/bmsablon.pdf.

5. Tarek Atallah, Silvio Gualdi and Alessandro Lanza, *A Global Degree Days Database for Energy-related Applications* (Riyadh: King Abdullah Petroleum Studies and Research Center, 2015), p. 27, http://www.kapsarc.org/en/Publications/KS-1514-DP08A-A%20global%20degree%20days%20database%20for%20energy-related%20applications_for%20web.pdf.

6. IMF, *Central, Eastern, and Southeastern Europe: Effective Government for Stronger Growth* (Washington, DC: November 2016), p. 7, https://www.imf.org/external/pubs/ft/reo/2016/eur/eng/erei1116.htm.

7. World Bank, "GDP per capita growth (annual %)", World Development Indicators, http://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD, viewed 2 January 2017.

8. **Table 2** from the following sources: energy imports and use per capita from World Bank, op. cit. note 2; subsidies from IMF, "Counting the Cost of Energy Subsidies", IMF Survey, 17 July 2015, http://www.imf.org/external/pubs/ft/survey/so/2015/new070215a.htm; electrification from Sustainable Energy for All (SEforALL), *Global Tracking Framework 2017: Progress Toward Sustainable Energy* (Washington, DC: April 2017), http://www.worldbank.org/en/topic/energy/publication/global-tracking-framework-2017.

9. World Bank, *Regulatory Indicators for Sustainable Energy: A Global Scorecard for Policy Makers* (Washington, DC: 2017), pp. xv-xviii, http://documents.worldbank.org/curated/en/538181487106403375/pdf/112828-REVISED-PUBLIC-RISE-2016-Report.pdf.

10. **Table 3** from International Energy Agency (IEA), *World Energy Balance*, https://www.iea.org/countries/non-membercountries/, viewed 23 January 2017.

11. David Coady et al., *How Large Are Global Energy Subsidies?* (Washington, DC: IMF, May 2015), p. 41, https://www.imf.org/external/pubs/cat/longres.aspx?sk=42940.0.

12. IEA, *Eastern Europe, Caucasus and Central Asia: Energy Policies Beyond IEA Countries* (Paris: 2015), https://www.iea.org/publications/freepublications/publication/IDR_EasternEuropeCaucasus_2015.pdf.

13. SEforALL, op. cit. note 8.

14. Caterina Ruggeri Laderchi, Anne Olivier and Chris Trimble, *Balancing Act: Cutting Energy Subsidies While Protecting Affordability* (Washington, DC: World Bank, 2013), p. 165, https://openknowledge.worldbank.org/bitstream/handle/10986/12296/9780821397893.pdf?sequence=7.

15. Ingrid Barnsley, Amanda Blank and Adam Brown, *Enabling Renewable Energy and Energy Efficiency Technologies* (Paris: IEA, 2015), p. 14, https://www.iea.org/publications/insights/insightpublications/EnablingRenewableEnergyandEnergyEfficiencyTechnologies.pdf, p. 24.

16. **Table 4** from the following sources: Energy Community website, https://www.energy-community.org, viewed 30 March 2017; Encharter website, http://www.encharter.org, viewed 30 March 2017; SEforALL website, http://www.SEforALL.org, viewed 30 March 2017; Central Asia Regional Economic Cooperation (CAREC), "The CAREC countries", http://www.carecprogram.org/index.php?page=carec-countries, viewed 30 March 2017.

17. World Bank, "Central Asia South Asia Electricity Transmission and Trade Project (CASA-1000)", http://www.worldbank.org/projects/P145054?lang=en, viewed 7 September 2015.

18. CAREC website, http://www.carecprogram.org/, viewed 2 January 2017.

19. Energy Community, "EU4ENERGY", https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/EU4Energy, viewed 5 April 2017.

20. European Commission, "Central and South Eastern Europe Gas Connectivity", https://ec.europa.eu/energy/en/topics/infrastructure/central-and-south-eastern-europe-gas-connectivity, viewed 2 January 2017.

21. Covenant of Mayors for Climate and Energy, "About", http://www.covenantofmayors.eu/about/covenant-of-mayors_en.html, viewed 2 April 2017.

22. Norton Rose Fulbright, "The Belt & Road Initiative' – a modern day silk road", May 2016, http://www.nortonrosefulbright.com/knowledge/publications/139223/the-belt-road-initiative-a-modern-day-silk-road.

23. International Renewable Energy Agency (IRENA), "South

East Europe Regional Consultation Meeting", http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=30&CatID=79&SubcatID=3759, viewed 24 February 2017.

24. IRENA, *REmap 2030: Renewable Energy Prospects for Ukraine* (Abu Dhabi: 2015), https://www.irena.org/remap/IRENA_REmap_Ukraine_paper_2015.pdf.

25. United Nations, "Resolution adopted by the General Assembly on 25 September 2015: Transforming our world: the 2030 Agenda for Sustainable Development" (New York: 21 October 2015), http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

2. RENEWABLE ENERGY MARKET AND INDUSTRY OVERVIEW

1. Svitlana Pyrkalo, "First large-scale solar plant in Kazakhstan receives EBRD backing", European Banks for Reconstruction and Development (EBRD), 3 June 2015, http://www.ebrd.com/news/2015/first-largescale-solar-plant-in-kazakhstan-receives-ebrd-backing.html.

2. As more and better-quality data became available since the previous edition of this report, we revised the baseline for total installed power capacity in 2014 upward by 3.27 MW, of which revisions outside hydropower amounted to 1,435 GW.

3. Franz Mauthner, Werner Weiss and Monika Spörk-Dür, *Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2014* (Gleisdorf, Austria: International Energy Agency (IEA) Solar Heating & Cooling Programme, June 2016), p. 9, http://www.iea-shc.org/data/sites/1/publications/Solar-Heat-Worldwide-2016.pdf.

4. "Over five hundred electric vehicles registered in Ukraine already this year", Ukrinform, 27 March 2017, https://www.ukrinform.net/rubric-economics/2200798-over-five-hundred-electric-vehicles-registered-in-ukraine-already-this-year.html.

5. **Figure 1** from Sustainable Energy for All (SEforALL), *Global Tracking Framework 2017: Progress Toward Sustainable Energy* (Washington, DC: April 2017), http://www.worldbank.org/en/topic/energy/publication/global-tracking-framework-2017.

6. **Figure 2** from Ibid.

7. **Figure 3** compiled from information from local co-ordinating contributors to this report and from International Renewable Energy Agency (IRENA), "Resource", http://resourceirena.irena.org/gateway/, viewed 1 October 2016 to 30 March 2017.

8. Svitlana Pyrkalo, "EBRD award for Burnoye, first solar in Kazakhstan", EBRD, 10 May 2016, http://www.ebrd.com/news/2016/ebrd-award-for-burnoye-first-solar-in-kazakhstan.html; Tom Kenning, "EBRD to provide US$26 million for ACME's 29MW Kazakhstan solar project", PV-Tech, 18 August 2016, http://www.pv-tech.org/news/ebrd-to-provide-us26-million-for-acmes-29mw-kazakhstan-solar-project; John Parnel, "EBRD mulls funds for another 48MW of solar in Kazakhstan", 8 November 2016, PV-Tech, http://www.pv-tech.org/news/ebrd-mulls-funds-for-another-48mw-of-solar-in-kazakhstan; Aynur Karimova, "Kazakhstan ups energy production from renewable resources", AzerNews, 22 February 2016, http://www.azernews.az/region/93219.html.

9. Peter Tase, "Nakhchivan region welcomes Azerbaijan President Ilham Aliyev", Eurasia Review, 9 December 2015, http://www.eurasiareview.com/09122015-nakhchivan-region-welcomes-azerbaijan-president-ilham-aliyev-oped/; "Watch how Georgia's first wind plant was built [VIDEO]", Agenda.Ge, 7 October 2016, http://agenda.ge/news/67030/eng.

10. KfW, "Reliable electricity supply for Armenia", press release (Frankfurt: 9 December 2014), https://www.kfw.de/KfW-Group/Newsroom/Aktuelles/Pressemitteilungen/Pressemitteilungen-Details_249920.html.

11. **Sidebar 1** from IRENA, *Cost-competitive Renewable Power Generation: Potential Across South-east Europe* (Abu Dhabi: January 2017), http://balkangreenenergynews.com/wp-content/uploads/2017/01/IRENA_Cost-competitive_power_potential_SEE_2017.pdf.

12. **Figure 4** from local co-ordinating contributors to this report and from IRENA, *Renewable Energy Statistics 2016* (Abu Dhabi: 2016), http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Capacity_Statistics_2016.pdf.

13. United Nations Framework Convention on Climate Change (UNFCCC), "Cascade Credit small-scale hydro bundled project in Armenia", http://cdm.unfccc.int/Projects/Validation/DB/4P61F8C5GBVORDJ5XVPS12B6KK9H-DJ/view.html, viewed 2 September 2015.

14. IEA, *Eastern Europe, Caucasus and Central Asia: Energy Policies Beyond IEA Countries* (Paris: 2015), https://www.iea.org/publications/freepublications/publication/IDR_EasternEuropeCaucasus_2015.pdf.

15. Global Environment Facility (GEF), "Detail of GEF Project #3931", https://www.thegef.org/gef/project_detail?projID=3931, viewed 27 July 2015; IEA, op. cit. note 14, p. 229.

16. Michael Harris, "Work begins on Tajikistan's 3,600-MW Rogun hydroelectric plant", HydroWorld, 31 October 2016, http://www.hydroworld.com/articles/2016/10/

work-begins-on-tajikistan-s-3-600-mw-rogun-hydroelectric-plant.html.

17. IEA, op. cit. note 14, p. 295.

18. World Bank, "World Bank supports exploration of geothermal resources in Armenia", press release (Washington, DC: 8 June 2015), http://www.worldbank.org/en/news/press-release/2015/06/08/world-bank-supports-exploration-of-geothermal-resources-in-armenia.

19. IRENA, op. cit. note 11.

20. **Sidebar 2** from the following sources: Svalova Valentina and Povarov Konstantin, "Geothermal energy use in Russia. Country update for 2010-2015", *Proceedings World Geothermal Congress 2015, Melbourne, Australia, 19-25 April 2015*, https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/01061.pdf; World Bank, *Country Program Snapshot – Armenia Partnership* (Washington, DC: April 2016), http://pubdocs.worldbank.org/en/291641460382841836/Armenia-Snapshot-April-2016.pdf; World Bank, op. cit. note 18; Alexander Richter, "Russia, its renewable energy drive and the geothermal opportunity", ThinkGeoEnergy, 2 September 2015, http://www.thinkgeoenergy.com/russia-its-renewable-energy-drive-and-the-geothermal-opportunity/; Ruggero Bertani, "Geothermal power generation in the world: 2010-2014 update report", *Proceedings World Geothermal Congress 2015, Melbourne, Australia, 19-25 April 2015*, https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/01001.pdf; Helga Tulinius et al., "Promotion of geothermal energy in Serbia", *Proceedings World Geothermal Congress 2015, Melbourne, Australia, 19-25 April 2015*, https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/16084.pdf; Alexander Richter, "New cooperation agreement signed for geothermal development in Serbia", ThinkGeoEnergy, 26 October 2016, http://www.thinkgeoenergy.com/new-cooperation-agreement-signed-for-geothermal-development-in-serbia/; John W. Lund and Tonya L. Boyd, "Direct utilization of geothermal energy: 2015 worldwide review", *Proceedings World Geothermal Congress 2015, Melbourne, Australia, 19-25 April 2015*, https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/01000.pdf; IRENA, op. cit. note 11.

21. **Figure 5** from local co-ordinating contributors to this report and from IRENA, op. cit. note 12.

22. Adilya Zaripova, "Ukraine exceeds 1 GW of installed renewable capacity", *PV Magazine*, 1 August 2016, http://www.pv-magazine.com/news/details/beitrag/ukraine-exceeds-1-gw-of-installed-renewable-capacity_100025629/#axzz4RX4CBUp5.

23. Climate Action, "Solar capacity in Ukraine to reach 1 GW in 2017", 3 February 2017, http://www.climateaction-programme.org/news/solar_capacity_in_ukraine_to_reach_1_gw_in_2017.

24. Sam Pothecary, "Russia's solar energy given the all clear to develop 90 MW of solar plants", *PV Magazine*, 8 August 2016, http://www.pv-magazine.com/news/details/beitrag/russias-solar-energy-given-the-all-clear-to-develop-90-mw-of-solar-plants_100025697/#ixzz4S1lSRCrd.

25. Georgy Ermolenko, Energy Institute, National Research University – Higher School of Economics, Moscow, "Renewable energy: status in Russian wholesale market of power (capacity)", presentation at the International Conference on Renewable Energy and the UNECE Group of Experts on Renewable Energy, Baku, Azerbaijan, 18-21 October 2016.

26. Pyrkalo, op. cit. note 1.

27. Pyrkalo, op. cit. note 8.

28. Ibid.

29. Parnel, op. cit. note 8.

30. Tase, op. cit. note 9.

31. Energy Charter, "Investment opportunities in Uzbekistan", 25 April 2016, http://www.energycharter.org/media/news/article/investment-opportunities-in-uzbekistan/; **Sidebar 3** from the following sources: Asian Development Bank (ADB), "ADB to help Uzbekistan build Central Asia's first solar power plant", press release (Tashkent, Uzbekistan: 22 November 2013), https://www.adb.org/news/adb-help-uzbekistan-build-central-asias-first-solar-power-plant; ADB, "ADB helps Uzbekistan establish Solar Energy Institute", press release (Tashkent, Uzbekistan: 16 February 2012), https://www.adb.org/news/adb-helps-uzbekistan-establish-solar-energy-institute; ADB, "Uzbekistan: Solar Energy Development", https://www.adb.org/projects/45120-001/main#project-pds, viewed 30 March 2017; Smiti Mittal, "Uzbekistan starts work on 300 MW worth of solar power projects", CleanTechnica, 27 August 2015, https://cleantechnica.com/2015/08/27/uzbekistan-starts-work-300-mw-worth-solar-power-projects/; Tom Kenning, "Singyes Solar wins EPC contract for 100MW solar plant in Uzbekistan", PV-Tech, 23 December 2016, http://www.pv-tech.org/news/singyes-solar-wins-epc-contract-for-100mw-solar-plant-in-uzbekistan.

32. Cindy Tiangco, Energy Division, Central and West Asia Department, ADB, "Update on Solar Development in Uzbekistan", presentation at the 8th Meeting of the Asia Solar Energy Forum, Manila, Philippines, 15 June 2015, p. 14, http://d335hnnegk3szv.cloudfront.net/wp-content/uploads/sites/837/2015/06/ASEF-8th-Meeting-Presentation-UZB-Solar-Power-Development-CTiangco-1.pdf.

33. "Order of the Government of the Republic of Kazakhstan about approval of the flat fare for projects of the solar power plants using photo-electric modules on the basis of the Kazakhstan silicon (Kaz PV) for transformation of energy of sunlight", CIS Legislation, 12 June 2014, https://cis-legislation.com/document.fwx?rgn=67957; DLF Attorneys at Law, *Renewable Energy in Ukraine* (Kyiv: May 2016),

http://www.flandersinvestmentandtrade.com/export/sites/trade/files/attachments/Renewable%20energy%20in%20Ukraine.pdf.

34. Astana Solar, "About Company", http://www.astanasolar.kz/en/about-us, viewed 30 December 2016.

35. Sara Rajabova, "Uzbek company to launch photovoltaic power plants", AzerNews, 8 April 2015, http://www.azernews.az/region/80129.html.

36. Information provided by local co-ordinating contributor.

37. Ibid.

38. Ministry of Industry, request for proposals in *Neutral Turkmenistan* newspaper, no. 342, 16 December 2015.

39. "Tashkent hosts II national conference on wind energy potential development", 16 June 2016, http://uzbekistan.nsk.ru/index.php?option=com_content&view=article&id=4207:tashkent-hosts-ii-national-conference-on-wind-energy-potential-development&catid=42:news&Itemid=138.

40. IRENA, op. cit. note 12.

41. **Figure 6** from local co-ordinating contributors to the report and from IRENA, op. cit. note 12.

42. "Azerbaijan plans to construct wind farm in area of offshore oil production for AZN 450 million", ABC.AZ, 16 April 2015, http://abc.az/eng/news/87802.html.

43. Karimova, op. cit. note 8.

44. American Chamber of Commerce in Kazakhstan, "Kazakhstan Power and Renewable Energy Investment Conference – Astana", 20 April 2016, http://www.amcham.kz/regional-events/united-nations-conference-on-sustainable-development-copy-4.

45. Yerbolat Uatkhanov, "Almaty Company wind generator company uses Kazakh components", *Astana Times*, 20 May 2016, http://astanatimes.com/2016/05/almaty-company-wind-generator-company-uses-kazakh-components.

46. EBRD, "Dolovo Cibuk Wind Farm", http://www.ebrd.com/work-with-us/projects/esia/dolovo-cibuk-i-wind-farm.html, viewed 30 December 2016.

47. IRENA, op. cit. note 12.

48. Information provided by local co-ordinating contributor.

49. "KfW approves loan for Hrgud wind farm", Balkan Green Energy News, 16 March 2016, http://balkangreenenergynews.com/kfw-approves-loan-for-hrgud-wind-farm/.

50. "Republic of Srpska and KfW agreed EUR 60 million credit for Hrgud wind farm", Balkan Green Energy News, 15 October 2016, http://balkangreenenergynews.com/republic-of-srpska-and-kfw-agreed-eur-60-million-credit-for-hrgud-wind-farm/.

51. "KfW approves loan for Hrgud wind farm", op. cit. note 49.

52. Samir Rahimov, *Directions of Development in the Field of Renewable Energy Sources in Azerbaijan* (Islamabad, Pakistan: 18 July 2016), http://www.carecprogram.org/uploads/events/2016/15-ESCC-Meeting-July/Presentation-Materials/Country%20Presentation%20Azerbaijan.pdf; contribution of the State Agency for Renewable Energies in Azerbajian.

53. Akuo Energy, "Krnovo – 72 MW – Montenegro", http://www.akuoenergy.com/en/what-we-do/wind/krnovo.html, viewed 29 September 2015; UNFCCC, "Project 9241: Mozura Wind Farm", https://cdm.unfccc.int/Projects/DB/RINA1356551429.6/view, viewed 29 September 2015.

54. "The first wind farm came on Krnovo", Crna Gora, 1 June 2016, http://crna.gora.me/vijesti/ekonomija/prva-vjetro-elektrana-stigla-na-krnovo/; Milica Dakovic, E3 Consulting, "Financing wind projects – case study: Montenegro", presentation to Energy Community Secretariat, Vienna, Austria, 3-4 March 2016, http://www.irena.org/EventDocs/E3%20Consulting,%20Financing%20wind%20projects-case%20study%20of%20Montenegro.pdf.

55. "51 MW wind farm project in Russia", Sun & Wind Energy, 14 July 2016, http://www.sunwindenergy.com/wind-energy/51-mw-wind-farm-project-russia; "Russia will build its first offshore wind farm in the White Sea", CleanTechnica, 9 December 2016, https://cleantechnica.com/2016/12/09/russia-will-build-first-offshore-wind-farm-white-sea/.

56. Eugene Gerden, "Southwest Russia plans €834m wind investment", *Wind Power Monthly*, 26 September 2016, http://www.windpowermonthly.com/article/1410053/southwest-russia-plans-%E2%82%AC834m-wind-investment.

57. David Weston, "Dongfang to build blades in Russia", *Wind Power Monthly*, 16 September 2016, http://www.windpowermonthly.com/article/1409177/dongfang-build-blades-russia.

58. **Sidebar 4** from the following sources: United Nations Development Programme (UNDP), "Wind energy in the Republic of Belarus", http://www.windpower.by/en/project/, viewed 30 March 2017; Belarussian webportal on renewable energy, "Wind energy overview", http://re.energybel.by/en/renewable-energy-technologies/wind/, viewed 30 March 2017; "Wind Power in Belarus", The Dialogue, http://www.the-dialogue.com/en/en16-wind-power-in-belarus/; "Resolution of the Council of Ministers of the Republic of Belarus, March 28, 2016 No. 248, on Approval of the State Program 'Energy Saving' in the Years 2016-2020, http://www.pravo.by/main.aspx?guid=3871&p0=C21600248, viewed 30 March 2017.

59. Vojislav Milijić, "Biomass in the Western Balkans: Why

don't we use our wood biomass potentials?" Balkan Green Energy News, 29 April 2015, http://balkangreenenergynews.com/biomass-in-the-western-balkans-why-dont-we-use-our-wood-biomass-potentials/.

60. Jamil Malikov, State Agency on Alternative and Renewable Energy Sources of the Republic of Azerbaijan, "Opportunities and challenges for the development of the renewable energy in Azerbaijan", presentation at the 7th International Forum on Energy for Sustainable Development, Baku, Azerbaijan, 20 October 2016, https://www.unece.org/fileadmin/DAM/energy/se/pp/gere/gere.3_Baku.Oct.2016/20_IRENA_CIS/J.Malikov.pdf.

61. Olga Dovnar, national Statistics Committee of the Republic of Belarus, personal communication with REN21, 20 April 2017.

62. **Figure 7** compiled from information from local co-ordinating contributors and from Mauthner, Weiss and Spörk-Dür, op. cit. note 3, p. 11.

63. UNDP Albania, "The Country Program of Albania under the Global Solar Water Heating Market Transformation and Strengthening Initiative", http://www.al.undp.org/content/albania/en/home/operations/projects/environment_and_energy/the-country-program-of-albania-under-the-global-solar-water-heat.html, viewed 27 July 2015.

64. ACBA Leasing website, http://www.acbaleasing.am/?lang=1, viewed 16 December 2016.

65. "Беларусь Агенцтва па статыстыцы, Дэпартамент энергаэфектыўнасці, Развитие важнейших отраслей национальной экономии неразрывно связано с энергосбережением", http://energoeffekt.gov.by/news/22-news/1903-2015-02-19-06-26-58.html, viewed 25 July 2015.

66. Bärbel Epp, "Moldova: National programme to promote solar thermal installations", solarthermalworld, 22 October 2015, http://www.solarthermalworld.org/content/moldova-national-programme-promote-solar-thermal-installations.

67. Project Implementation Unit for Increase of Food Production, "Biomass Project", http://www.2kr.md/index.php/introduction-to-biomass, viewed 30 December 2016.

68. Energetska Efikasnost u Crnoj Gori, "Energy Wood", http://www.energetska-efikasnost.me/ee.php?id=24&l=en, viewed 30 December 2016.

69. **Figure 8** from Lund and Boyd, op. cit. note 20, and from George Melikadze, Georgian Geothermal Association, "Development possibility of Geothermal energy in Georgia", undated presentation, http://www.islandsstofa.is/files/geothermal---george-melikadze.pdf, viewed 2 March 2017.

70. Based on information compiled from local co-ordinating contributors and from IRENA, *REmap 2030: Renewable Energy Prospects for Ukraine* (Abu Dhabi: April 2015), p. 11, http://www.irena.org/remap/IRENA_REmap_Ukraine_paper_2015.pdf.

71. Energy Agency of the Republic of Macedonia, "Renewable Energy", http://www.ea.gov.mk/index.php?option=com_content&view=article&id=53&Itemid=&lang=en, viewed 30 December 2016.

72. Makpetrol, "Biodiesel B100", https://www.makpetrol.com.mk/biodizelb100_en.asp, viewed 30 December 2016.

73. "Ukraine ranks fifth in top EV countries list", Ukrinform, 20 March 2017, https://www.ukrinform.net/rubric-economics/2196575-ukraine-ranks-fifth-in-top-ev-countries-list.html.

74. Tbilisi City Hall Department of Economic Development, "Two new electric vehicles charging stations opened in Tbilisi", 5 November 2016, http://www.tbilisi.gov.ge/news/3086?lang=en.

75. Dovnar, op. cit. note 61.

76. **Sidebar 5** from "Law on the transition to a green economy presented in Kazakhstan", Lexology, http://www.lexology.com/library/detail.aspx?g=8a10a790-9165-48a8-a6de-af45ca382c6b, viewed 23 January 2017, and from Bulekbayev Raigul Bazarbaevna, Ministry of Energy of the Republic of Kazakhstan, personal communication with REN21, 13 January 2017.

3. DISTRIBUTED RENEWABLE ENERGY AND ENERGY ACCESS

1. Nicolina Angelou, *A New Multi-Tier Approach to Measuring Energy Access* (Washington, DC: World Bank Energy Sector Management Assistance Program (ESMAP), 19 February 2014), p. 33, http://www.esmap.org/sites/esmap.org/files/DocumentLibrary/Multi-tier%20BBL_Feb19_Final_no%20annex.pdf.

2. Sustainable Energy for All (SEforALL), *Global Tracking Framework 2017: Progress Toward Sustainable Energy* (Washington, DC: April 2017), p. 18, http://www.worldbank.org/en/topic/energy/publication/global-tracking-framework-2017.

3. IEA, World Energy Outlook Energy Access Database, http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/#d.en.8609, viewed 2 January 2017.

4. SEforALL, op. cit. note 2.

5. **Figure 9** from Ibid.

6. **Sidebar 6** from the following sources: "Bosnia and Herzegovina & Croatia: Energizing innovation", The Medium, 3 November 2015, https://medium.com/innovation-in-the-age-of-the-sustainable-developme/bosnia-and-herzegovina-global-renewable-energy-challenge-651ef86564cb#.ebl3xz32t; "Bosnia's war-displaced families still waiting for electricity", Balkan Insight, 16 December 2016, http://www.balkaninsight.com/en/article/bosnia-s-displaced-people-await-electricity-12-15-2016; Islamic Development Bank, "General Procurement Notice for the Improvement of Electricity Supply in the Arka Area of Batken Region", 10 December 2014, http://www.isdb.org/irj/servlet/prt/portal/prtroot/tenderuser.TenderEndUser?Title=GENERAL%20PROCUREMENT%20NOTICE%20%20FOR%20THE%20IMPROVEMENT%20OF%20ELECTRICITY%20SUPPLY%20IN%20THE%20ARKA%20AREA%20OF%20BATKEN%20REGION; Bakhtiyar Sadriddinov, independent consultant, personal communication with authors, 24 January 2017; Payrav Chorshanbiyev, "Tajikistan begins supplying surplus electricity to Kyrgyzstan after all", Asia-Plus Media Group, 20 September 2016, https://news.tj/en/news/tajikistan/economic/20160920/231062.

7. IEA, *Eastern Europe, Caucasus and Central Asia: Energy Policies Beyond IEA Countries* (Paris: 2015), http://www.iea.org/bookshop/705-Eastern_Europe,_Caucasus_and_Central_Asia; World Bank, World Development Indicators, http://data.worldbank.org/indicator, viewed 2 January 2017.

8. "Kyrgyzstan cuts electricity losses in the power system", East Time, 28 August 2016, http://easttime.info/news/kazakhstan/kyrgyzstan-cuts-electricity-losses-power-system. **Sidebar 7** from the following sources: World Bank, *Tajikistan Partnership Program Snapshot* (Washington, DC: October 2015), http://pubdocs.worldbank.org/pubdocs/publicdoc/2015/10/645741444794465533/Tajikistan-Snapshot.pdf; Rob Swinkels, *Assessment of Household Energy Deprivation in Tajikistan: Policy Options for Socially Responsible Reform in the Energy Sector* (Washington, DC: World Bank Group, 2014), p. vi, http://documents.worldbank.org/curated/en/944321468341064427/Assessment-of-household-energy-deprivation-in-Tajikistan-policy-options-for-socially-responsible-reform-in-the-energy-sector; ADB, *Country Partnership Strategy: Tajikistan, 2016–2020, Sector Assessment: Energy (Summary)* (Manila: 2016), https://www.adb.org/sites/default/files/linked-documents/cps-taj-2016-2020-ssa-02.pdf; Organisation for Economic Co-operation and Development, *Financing Climate Action in Tajikistan: Country Study* (Paris: 2016), p. 19, http://www.oecd.org/environment/outreach/Tajikistan_Financing_Climate_Action.Nov2016.pdf; Khasan S. Karimov et al., "Effective management of combined renewable energy sources in Tajikistan", *Science of the Total Environment*, vols. 461-462 (1 September 2013), pp. 835–838, http://www.sciencedirect.com/science/article/pii/S0048969713006487; Daryl Fields et al., *Tajikistan's Winter Energy Crisis: Electricity Supply and Demand Alternatives* (Washington, DC: World Bank, November 2012), p. 38, http://siteresources.worldbank.org/ECAEXT/Resources/TAJ_winter_energy_27112012_Eng.pdf; United Nations Development Programme (UNDP), *Tajikistan: Accelerating Progress Toward the MDGs by Improving Access to Energy* (New York: February 2012), p. 23, http://www.tj.undp.org/content/tajikistan/en/home/library/poverty/Accelerating_Progress_Toward_the_MDGs_by_Access_to_Energy.html; UNDP, "Renewable Energy Snapshot: Tajikistan", http://www.undp.org/content/dam/rbec/docs/Tajikistan.pdf, viewed 2 January 2017.

9. World Health Organization (WHO), *WHO Guidelines for Indoor Air Quality: Household Fuel Combustion* (Geneva: 2014), http://apps.who.int/iris/bitstream/10665/141496/1/9789241548885_eng.pdf?ua=1.

10. United Nations Statistics Division, Inter-agency Expert Group on SDG Indicators, "Compilation of Metadata for the Proposed Global Indicators for the Review of the 2030 Agenda for Sustainable Development", http://unstats.un.org/sdgs/iaeg-sdgs/metadata-compilation/, viewed 2 January 2017.

11. **Table 5** from the following sources: SEforALL, op. cit. note 2; United Nations Statistics Division, Inter-agency Expert Group on SDG Indicators, "Compilation of Metadata for the Proposed Global Indicators for the Review of the 2030 Agenda for Sustainable Development – Metadata for Goal 7", Indicator 7.1.2, p. 4 http://unstats.un.org/sdgs/files/metadata-compilation/Metadata-Goal-7.pdf; Caterina Ruggeri Laderchi, Anne Olivier and Chris Trimble, *Balancing Act: Cutting Energy Subsidies While Protecting Affordability* (Washington, DC: World Bank, 2013), p. 62, https://openknowledge.worldbank.org/bitstream/handle/10986/12296/9780821397893.pdf?sequence=7; World Bank, "Value lost due to power outages", World Development Indicators, http://data.worldbank.org/data-catalog/world-development-indicators, viewed 2 January 2015.

12. IEA, *Energy and Air Pollution – World Energy Outlook Special Report 2016* (Paris: 2016), p. 34, Figure 1.8, https://www.iea.org/publications/freepublications/publication/WorldEnergyOutlookSpecialReport2016EnergyandAirPollution.pdf.

13. **Figure 10** from SEforALL, op. cit. note 2.

14. **Sidebar 8** from the following sources: WHO, *Burning Opportunity: Clean Household Energy for Health, Sustainable Development and Wellbeing of Women and Children* (Geneva: 2016), p. 10; WHO Global Health Observatory Data Repository, "Population using solid fuels (estimates), Data by country", 2013, http://apps.who.int/gho/data/view.main.1701?lang=en, viewed 2 January 2017; Global Alliance for Clean Cookstoves website, http://cleancookstoves.org, viewed 30 March 2017.

15. World Bank, *Keeping Warm: Urban Heating Options in the Kyrgyz Republic (Summary Report)* (Bishkek: February 2015), p. 28, http://documents.worldbank.org/curated/en/555021468011161504/pdf/97409-WP-P133058-Box391503B-PUBLIC-Heating-Assessment-for-Kyrgyz-P133058-Final.pdf.

16. Ruggeri Laderchi, Olivier and Trimble, op. cit. note 11.

17. **Sidebar 9** from the following sources: United Cities and Local Governments, ed., *Third Global Report on Local Democracy and Decentralization (GOLD III): Basic Services for All in an Urbanizing World* (London: Routledge, 2014), p. 75, https://www.uclg.org/en/issues/access-basic-services-gold-iii-report; Fan Zhang and Denzel Hankinson, *Belarus Heat Tariff Reform and Social Impact Mitigation* (Washington, DC: World Bank ESMAP, 2015), https://openknowledge.worldbank.org/bitstream/handle/10986/22574/9781464806964.pdf?sequence=1&isAllowed=y; United Nations Environment Programme, *District Energy in Cities: Unlocking the Potential of Energy Efficiency and Renewable Energy* (Paris: 2015), p. 112, http://www.unep.org/energy/portals/50177/DES_District_Energy_Report_full_02_d.pdf; World Bank, op. cit. note 15, pp. 26, 27, 75; World Bank ESMAP, *Moldova District Heating and Electricity Tariff and Affordability Analysis* (Washington, DC: October 2015), http://pubdocs.worldbank.org/en/9631446482837463/Moldova-Tariff-and-Afordability-Study-2015-10-26-FINAL.pdf; World Bank, "Assistance to the National Commission for Regulation of Communal Services: District Heating Regulatory Reform Support Program", http://projects.worldbank.org/P151321/?lang=en&tab=overview, viewed 23 January 2017.

18. Ruggeri Laderchi, Olivier and Trimble, op. cit. note 11, p. 165.

19. World Bank, op. cit. note 15, p. 36; Serbia from IEA, *Energy in the Western Balkans* (Paris: 2008), p. 412.

20. Silk Road Reporters, "Uzbekistan looks to solar power", 27 January 2015, http://www.silkroadreporters.com/2015/01/27/uzbekistan-looks-solar-power/; Global Solar Thermal Energy Council, "Uzbekistan: State-owned utility to increase solar thermal deployment", solarthermalworld, 8 June 2015, http://www.solarthermalworld.org/content/uzbekistan-state-owned-utility-increase-solar-thermal-deployment.

21. Barqi Tojik website, http://www.barqitojik.tj/, viewed 2 January 2017.

22. Ibid.

23. **Table 6** from the following sources: Timur Idrisov, "Solar cookers for affected families in Tajikistan", Youth and Environment Europe, http://yeenet.eu/index.php/projects/yee-ongoing-projects/1327-strategic-partnership-qenvironmental-challenge-acceptedq, viewed 2 January 2017; Timur Idrisov, "Solar cookers in Tajik mountain valley", Mountain Partnership, 8 January 2016, http://www.mountainpartnership.org/news/news-detail/en/c/359419/; Zhenya Tsoy, "Kyrgyzstan keeps half an eye on renewables", Global Voices, 14 March 2016, https://globalvoices.org/2016/03/14/kyrgyzstan-keeps-half-an-eye-on-renewables/; "ENERGY WOOD II", http://www.energetska-efikasnost.me/ee.php?id=150&l=en, viewed 2 January 2017; UNDP Bosnia and Herzegovina, "Investments of 2.5 million BAM for a new heating system in the Cantonal Hospital in Bihać", 9 December 2015, http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/presscenter/articles/2015/12/09/investicije-od-2-5-miliona-km-za-novi-sistem-grijanja-kantonalne-bolnice-u-biha-u.html; "Solar energy in Tajikistan's mountains", *Wind Energy and Electric Vehicle Review*, 26 March 2016, http://www.evwind.es/2015/03/26/solar-energy-in-tajikistans-mountains/51200.

24. CDM, "Energetski efikasniji javni objekti i domaćinstva", 5 March 2015, http://cdm.me/ekonomija/energetski-efikasniji-javni-objekti-i-domacinstva/.

25. UNDP Bosnia and Herzegovina, "UNDP/Nesta renewable energy challenge: can you help people affected by war?" 25 May 2013, http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/presscenter/articles/2013/05/25/undp-nesta-renewable-energy-challenge-can-you-help-people-affected-by-war-.html.

26. State Agency on Energy Efficiency and Energy Savings of Ukraine, "Ukrainians choose power generation from solar energy", 15 August 2016, http://saee.gov.ua/en/news/1296.

27. Bakhtiyar Sadriddinov, Country Collaborator for Uzbekistan, personal communication with authors, 2 January 2017.

28. Astghine Pasoyan, "Draft 2nd National Energy Efficiency Action Plan for the Republic of Armenia", undated presentation, https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/4062399/2DC80ACE5D-DE36BFE053C92FA8C0D222.pdf.

4. ENERGY EFFICIENCY

1. Ingrid Barnsley, Amanda Blank and Adam Brown, *Enabling Renewable Energy and Energy Efficiency Technologies* (Paris: International Energy Agency (IEA), 2015), p. 14, https://www.iea.org/publications/insights/insightpublications/EnablingRenewableEnergyandEnergyEfficiency-Technologies.pdf.

2. Energy Community, A*nnual Implementation Report* (Vienna: September 2016), p. 21, https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/4332394/3D790302C9FD5024E053C92FA8C0D492.pdf.

3. Barnsley, Blank and Brown, op. cit. note 1.

4. This report uses decomposition analysis, available in Sustainable Energy for All (SEforALL), *Progress Toward Sustainable Energy 2015: Global Tracking Framework Sum-*

mary Report (Washington, DC: IEA and World Bank, June 2015), http://trackingenergy4all.worldbank.org/~/media/GIAWB/GTF/Documents/GTF-2015-Summary-Report.pdf.

5. The intensity reduction is attributable mainly to structural changes in their economies and to decreasing economic outputs, especially in the late 1990s, from IEA, *Eastern Europe, Caucasus and Central Asia: Energy Policies Beyond IEA Countries* (Paris: 2015).

6. Energy Community, op. cit. note 2, pp. 93, 111, 127, 147.

7. Ibid., p. 147; World Bank, *Serbia Partnership Program Snapshot* (Washington, DC: 2016), p. 13, http://pubdocs.worldbank.org/en/965411463032908821/Serbia-Snapshot-April-2016.pdf.

8. Albania's energy intensity for 2014 is increasing according to Energy Community, op. cit. note 2 (with data drawn from the country's energy balance), but it is decreasing according to data SEforALL, *Global Tracking Framework 2017: Progress Toward Sustainable Energy* (Washington, DC: April 2017), p. 18, http://www.worldbank.org/en/topic/energy/publication/global-tracking-framework-2017; Energy Community, op. cit. note 2, p. 36.

9. **Figure 11** from SEforALL, op. cit. note 8.

10. IEA, op. cit. note 5.

11. SEforALL, op. cit. note 8.

12. Data for the region include Turkey and Israel, per Ibid.

13. Ibid.

14. **Figure 12** based on Ibid.

15. Barnsley, Blank and Brown, op. cit. note 1, p. 115.

16. Copenhagen Centre on Energy Efficiency, *Accelerating Energy Efficiency: Initiatives and Opportunities – Eastern Europe, the Caucasus and Central Asia* (Copenhagen: 2015), p. 135, Figure 8.1. Progress scoring shows Kazakhstan leading in energy efficiency industrial sector reforms for the period 2012-2014, per idem, p. 44. Kazakhstan manifests the largest potential for energy efficiency among nine other Central Asia and Eastern Europe countries, with the largest sector being industry, per idem, p. 46.

17. Energy Community, op. cit. note 2, p. 111.

18. Energy service companies (ESCOs) alone represented a market of USD 24 billion in 2015. IEA, *Energy Efficiency Market Report 2016* (Paris: 2016), p. 109, https://www.iea.org/eemr16/files/medium-term-energy-efficiency-2016_WEB.PDF.

19. Barnsley, Blank and Brown, op. cit. note 1, p. 115.

20. David Coady et al., *How Large Are Global Energy Subsidies?* (Washington, DC: International Monetary Fund, May 2015), p. 41, https://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf.

21. State Agency on Energy Efficiency and Energy Saving of Ukraine website, http://saee.gov.ua/en, viewed 2 January 2017.

22. Energy Community, op. cit. note 2, p. 148.

23. "Albania to set up Agency for Energy Efficiency", Balkan Green Energy News, 12 December 2016, http://balkangreenenergynews.com/albania-to-set-up-agency-for-energy-efficiency/; Energy Community, op. cit. note 2.

24. Energy Community, *Energy Community – Tapping on Its Energy Efficiency Potential* (Vienna: 1 June 2015), https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3750146/18B2AB6BA84663F2E053C-92FA8C064DA.PDF.

25. United Nations Development Programme (UNDP) Bosnia and Herzegovina, "A Revolving Fund for Energy Efficiency established and enabled continuation of additional EE activities through UNDP's Green Economic Development project", 7 April 2016, http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/presscenter/articles/2016/04/07/uspostavljen-revolving-fond-za-energetsku-efikasnost-i-omogu-en-nastavak-realizacije-dodatnih-ee-aktivnosti-kroz-undp-projekat-zeleni-ekonomski-razvoj.html.

26. Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine, "Concept for Energy Efficiency Fund" (Kyiv: February 2016), http://www.minregion.gov.ua/wp-content/uploads/2016/02/Concept_of_Energy_Efficiency_Fund.pdf; "Energy Efficiency Fund will start operations in April 2017 – Official", Ukraine Open For Business, 19 October 2016. http://open4business.com.ua/energy-efficiency-fund-will-start-operations-in-april-2017-official/.

27. Moldova Energy Efficiency Fund website, http://www.fee.md, viewed 2 January 2017.

28. Scurtu Nicolae, "Energy Efficiency Fund of the Republic of Moldova", unpublished presentation, April 2014, http://www.inogate.org/documents/05_Minsk_FEE_En.pdf.

29. IEA, op. cit. note 5.

30. Fan Zhang and Denzel Hankinson, *Belarus Heat Tariff Reform and Social Impact Mitigation* (Washington, DC: World Bank Energy Sector Management Assistance Program, 2015), p. 32, https://openknowledge.worldbank.org/bitstream/handle/10986/22574/9781464806964.pdf?sequence=1&isAllowed=y.

31. Barnsley, Blank and Brown, op. cit. note 1, p. 115; ENPI Regional East Action Programme, *Energy Saving Initiative in the Building Sector in Eastern Europe and the Central Asian Countries: Completion Report* (Brussels: October 2014), p. 13, http://www.inogate.org/documents/ESIB_Final_Completion_Report_with_country_reports.pdf.

32. World Bank, World Development Indicators, http://data.worldbank.org/data-catalog/world-development-indicators, viewed 23 January 2017.

33. Ibid.

34. **Table 7** based on Energy Community, op. cit. note 2.

35. Asian Development Bank (ADB), "ADB approves $750 million loan facility to lift power reliability In Azerbaijan", press release (Manila: 12 July 2016), https://www.adb.org/news/adb-approves-750-million-loan-facility-lift-power-reliability-azerbaijan.

36. World Bank, "Second Power Transmission Project", http://projects.worldbank.org/P146788?lang=en, viewed 2 January 2017; World Bank, "Electricity Transmission Network Improvement Project", http://projects.worldbank.org/P146199?lang=en, viewed 2 January 2017; World Bank, "Transmission Grid Strengthening Project", http://projects.worldbank.org/P147348?lang=en, viewed 2 January 2017; World Bank, "Power Recovery Project", http://projects.worldbank.org/P144029?lang=en, viewed 2 January 2017.

37. Axel Reiserer, "EBRD boosts power system in Bosnia and Herzegovina", European Bank for Reconstruction and Development (EBRD), 26 February 2016, http://www.ebrd.com/news/2016/ebrd-boosts-power-system-in-bosnia-and-herzegovina-.html.

38. "Albania's energy distribution plans to invest over 50 million US dollars this year to improve its distribution network", Balkans.com, 15 January 2015, http://www.balkans.com/open-news.php?uniquenumber=200396.

39. ADB, "Uzbekistan: Advanced Electricity Metering Project", https://www.adb.org/projects/41340-013/main, viewed 2 January 2017.

40. "EVN Macedonia installs 35,000 ADDAX smart meters", Metering and Smart Energy International, 1 November 2016, https://www.metering.com/news/evn-macedonia-35000-smart-meters/.

41. "Azerbaijan and ADB sign agreement on grid development", Metering and Smart Energy International, 28 July 2016, https://www.metering.com/news/azerbaijan-adb-33-grid/.

42. Anatole Boute, *Towards Secure and Sustainable Energy Supply in Central Asia: Electricity Market Reform and Investment Protection* (Vienna: Energy Charter, 2015), p. 29 and references therein, http://www.energycharter.org/fileadmin/DocumentsMedia/Thematic/Power_Sector_Reform_in_Central_Asia_2015_en.pdf.

43. CASA-1000 website, http://www.casa-1000.org/MainPages/CASAAbout.php#objective.

44. European Investment Bank, "EIB supports high voltage interconnection of Armenia and Georgia", press release (Luxembourg: 16 March 2015), http://www.eib.org/infocentre/press/releases/all/2015/2015-056-eib-supports-high-voltage-interconnection-of-armenia-and-georgia.htm; Albanian Telegraphic Agency, "Agreement on 400 kV line Albania-Macedonia signed", 18 November 2016, https://www.ata.gov.al/en/agreement-on-400-kv-line-albania-macedonia-signed/; EBRD, "MEPSO: Macedonia – Albania Transmission Phase 1", Procurement Notice, 6 January 2016, http://www.ebrd.com/work-with-us/procurement/p-pn-160106a.html.

45. Diana Ürge-Vorsatz et al., "Heating and cooling energy trends and drivers in buildings", *Renewable and Sustainable Energy Reviews*, vol. 41 (January 2015), pp. 85-98, http://www.sciencedirect.com/science/article/pii/S1364032114007151.

46. Several publications provide an overview of ongoing donor activity in the area of energy efficiency. The main sources include: Energy Community, op. cit. note 24, pp. 24-48; Komila Nabiyeva, *Renewable Energy and Energy Efficiency in Central Asia: Prospects for German Engagement* (Istanbul: Michael Succow Foundation for the Protection of Nature, May 2015), pp. 12, 15, 16, http://www.iea.org/media/workshops/2015/platformistanbul2015/First_Steps_towards_Energy_Transition_in_Central_Asia__Opportunities_for_German_and_EU_Engagement.pdf; Copenhagen Centre on Energy Efficiency, *Energy Efficiency Orbits for Transition Economies: Final Report* (Copenhagen: 2015), p. 227, http://www.cenef.ru/file/Final%20Report_C2E2_CENEf_June2_2015.pdf.

47. European Commission, "Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, OJ L 153, 18.6.2010" (Brussels: 2010), pp. 13-35, http://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32010L0031.

48. Uwe Deichmann and Fan Zhang, *Growing Green: The Economic Benefits of Climate Action* (Washington, DC: World Bank, 2013), p. 385, https://openknowledge.worldbank.org/handle/10986/13194.

49. Energy Community, op. cit. note 24.

50. ENPI Regional East Action Programme, *Energy Saving Initiative in the Building Sector in Eastern Europe and the Central Asian Countries: Completion Report*, 2013, p. 13, http://www.inogate.org/documents/ESIB_Final_Completion_Report_with_country_reports.pdf.

51. Bakhtiyar Sadriddinov, Country Collaborator for Uzbekistan, personal communication with authors, 2 January 2017.

52. UNDP Armenia, "Energy Efficient Public Buildings and Housing in Armenia, NAMA Project Document" (Yerevan: 10 June 2014), p. 50, http://www.nama-database.org/images/5/5c/NAMA_public_buildings_and_housing_Arme-

nia_project_document_15.10.2014.pdf.

53. IEA, *Russia 2014: Energy Policies Beyond IEA Countries* (Paris: 2014), https://www.iea.org/bookshop/474-Russia_2014.

54. Energy Community, op. cit. note 24, p. 12.

55. Ibid.

56. UNDP Belarus, *Improving Energy Efficiency in Residential Buildings in the Republic of Belarus* (Minsk: 2016), http://www.by.undp.org/content/belarus/en/home/operations/projects/environment_and_energy/project_sample.html.

57. Energy Community, *Exemplary Energy Efficiency Projects and Good Implementing Practices – Montenegro* (Vienna: June 2016), https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/4174451/344ADD26CE7E36C3E053C92FA8C0D92C.pdf.

58. Global Environment Facility, "Success Stories of GEF/UNDP Projects in Kazakhstan on Energy Saving in Housing and Community Utilities and Construction" (Washington, DC: 6 September 2016), https://www.thegef.org/publications/energy-efficiency-success-stories-kazakhstan.

59. World Bank, *Status of Energy Efficiency in the Western Balkans. A Stocktaking Report* (Washington, DC: 2010), p. 83, http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2010/10/26/000334955_20101026030914/Rendered/PDF/AAA490ESW0p11010Box353763B01PUBLIC1.pdf.

60. In Uzbekistan, district heating reaches approximately 80% of households; in Kyrgyzstan, four cities have district heating: Bishkek (85% of households), Osh (35-40%), Kyzyl-Kiya (60%) and Karakol (26%); in Tajikistan, only Dushanbe does, per IEA, op. cit. note 5; IEA, Russia 2014: Energy Policies Beyond IEA Countries (Paris: OECD/IEA, 2014), https://www.iea.org/bookshop/474-Russia_2014.

61. Marina Olshanskaya, "Overheated: Two decades of energy transition in the Former Soviet Union", *UNDP/LSE Development and Transition Newsletter*, no. 14 (2009), p. 7, http://europeandcis.undp.org/uploads/public1/files/vulnerability/Senior%20Economist%20Web%20site/Readings/Olshanskaya.pdf; Barnsley, Blank and Brown, op. cit. note 1, p. 115.

62. **Table 8** from the following sources: Ukraine from World Bank, "District Heating Energy Efficiency", http://projects.worldbank.org/P132741/district-heating-energy-efficiency?lang=en, viewed 2 January 2017; Belarus from World Bank, "Belarus Biomass District Heating Project", http://projects.worldbank.org/P146194?lang=en, viewed 2 January 2017; Kyrgyzstan from EBRD, "Bishkek District Heating Network", http://www.ebrd.com/work-with-us/projects/psd/bishkek-district-heating-network.html, viewed 2 January 2017; Kazakhstan from Yerkyn Amirkhanov, "Reconstruction of heating networks of Pavlodar, Ekibastuz and Petropavlovsk cities", Central-Asian Electric Power Corporation, 19 October 2016, http://caepco.kz/en/press-centre/novosti-kompanii/rekonstrukcziya-teplovyix-setej-pavlodara-ekibastuza-i-petropavlovska.html, and from EBRD, "Aktobe District Heating Project", http://www.ebrd.com/cs/Satellite?c=Content&cid=1395252218261&pagename=EBRD%2FContent%2FContentLayout&rendermode=preview, viewed 2 January 2017; Moldova from World Bank, "District Heating Efficiency Improvement Project", http://projects.worldbank.org/P132443/district-heating-efficiency-improvement-project?lang=en, viewed 2 January 2017; Serbia from KfW, "Serbia: Rehabilitation of District Heating Systems (Phase I – IV) – update & outlook", 1 June 2016, https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/4174433/344A4A5B9E9C407DE053C92FA8C07C20.pdf.

63. Energy Community, *Energy Community 2012: Impact Assessment of the Energy Efficiency Directive (2012/27/EU) for the Energy Community* (Vienna: July 2014), p. 108, https://www.energy-community.org/portal/page/portal/0633975ADB617B9CE053C92FA8C06338.

64. Claire Chrétien and Jelena Djukic, *Financing Energy Efficiency Investments in the Western Balkans* (Brussels: Western Balkans Investment Framework, May 2013), p. 31, https://www.energy-community.org/pls/portal/docs/2144178.PDF.

65. UNDP Bosnia and Herzegovina, "Increasing of energy efficiency in seven public buildings in Sarajevo Canton", 21 April 2016, http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/presscenter/articles/2016/04/21/pove-anje-energijske-efikasnosti-sedam-javnih-objekata-u-kantonu-sarajevo.html.

66. Energy Community, op. cit. note 57.

67. UNDP Moldova, "Energy and Biomass (Phase 2)", http://www.md.undp.org/content/moldova/en/home/operations/projects/climate_environment_energy/moldova-energy-and-biomass-project0.html, viewed 2 January 2017.

68. Bernd Kalkum, *Scaling Up Energy Efficiency in Buildings in the Western Balkans, Financing Energy Efficiency Measures for Residential Building Stock* (Washington, DC: World Bank, May 2014), p. 28, https://openknowledge.worldbank.org/bitstream/handle/10986/20044/893240WP0P133200000020140060160 18.42.pdf?sequence=1.

69. Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine, op. cit. note 26.

70. IEA, op. cit. note 18, p. 111.

71. Ministry of Economy of Montenegro, Directorate for Energy Efficiency, "Project for establishing the framework for ESCO concept started", http://www.energetska-efikasnost.me/ee.php?v=187&l=en, viewed 2 January 2017.

72. Regional Energy Efficiency Programme (REEP) for the Western Balkans website, http://www.wb-reep.org, viewed 2 January 2017.

73. Moldovan Residential Energy Efficiency Financing Facility

(MOREEFF) website, http://moreeff.info/en/, viewed 2 January 2017.

74. Yulia Usenko, Country Collaborator for Ukraine, personal communication with authors, 9 December 2017.

75. Energy Community, op. cit. note 2, p. 147.

76. IEA, *Transition to Sustainable Buildings* (Paris: 2013), p. 284, https://www.iea.org/publications/freepublications/publication/Building2013_free.pdf.

77. Energy Community, op. cit. note 2.

78. IEA Technology Collaboration Programmes website, https://www.iea.org/tcp/end-use-buildings/4e/, viewed 2 January 2017.

79. en.lighten initiative website, "Publications", http://www.enlighten-initiative.org/ResourcesTools/Publications.aspx, viewed 2 January 2017.

80. UNDP Armenia, "Green Urban Lighting", http://www.am.undp.org/content/armenia/en/home/operations/projects/environment_and_energy/green-urban-lighting.html, viewed 2 January 2017.

81. Loretta Martikian, "€1.9 million grant for street lighting in Yerevan", EBRD, 20 October 2015, http://www.ebrd.com/news/2015/19-million-grant-for-street-lighting-in-yerevan-.html; Kasia Kukula, "EBRD funds energy-efficient street lighting in Chișinău", EBRD, 22 October 2015, http://www.ebrd.com/news/2015/ebrd-funds-energyefficient-street-lighting-in-chiinu.html.

82. "GEF to allocate $10.5m for environmental projects in Belarus", Belta News Agency, 23 September 2015, http://atom.belta.by/en/sciense_block/view/gef-to-allocate-105m-for-environmental-projects-in-belarus-6597.

83. Islamic Development Bank, "Procurement of electrical lighting equipment for lighting the streets of Tashkent", http://www.isdb.org/irj/servlet/prt/portal/prtroot/tenderuser.TenderEndUser?Title=Procurement%20of%20Electrical%20lighting%20equipment%20for%20lighting%20the%20streets%20of%20Tashkent, viewed 2 April 2017.

84. Energy Community, op. cit. note 2.

85. Barnsley, Blank and Brown, op. cit. note 1, p. 115; Yeen Chan and Ravi Kantamaneni, *Study on Energy Efficiency and Energy Saving Potential in Industry and on Possible Policy Mechanisms* (London: ICF International, December 2015), p. 171 and references therein, https://ec.europa.eu/energy/sites/ener/files/documents/151201%20DG%20ENER%20Industrial%20EE%20study%20-%20final%20report_clean_stc.pdf.

86. IEA, op. cit. note 18, p. 102.

87. Copenhagen Centre on Energy Efficiency, op. cit. note 16, p. 227.

88. World Bank, "For Uzbekistan, energy efficiency is smart economics", 10 November 2016, http://www.worldbank.org/en/news/feature/2016/11/10/for-uzbekistan-energy-efficiency-is-smart-economics.

89. IEA, op. cit. note 18, p. 103.

90. Ibid.

91. Regional Environmental Center for Central Asia (CAREC), *Vehicle Emissions, Fuel Quality Standards and Fuel Economy Policies in Kazakhstan* (Almaty: 2013), p. 25, http://www.unep.org/Transport/new/PCFV/pdf/cleanfue_transport_UNEP-CARECreport.pdf.

92. Ibid.

93. UNDP/GEF, *Energy Efficiency in Transport Sector of the Republic of Kazakhstan: Current Status and Measures for Improvement* (Almaty: 2015), p. 37.

94. UNDP, "City Almaty Sustainable Transport", http://www.kz.undp.org/content/kazakhstan/en/home/operations/projects/environment_and_energy/city-almaty-sustainable-transport.html, viewed 2 January 2017.

5. POLICY LANDSCAPE

1. United Nations Framework Convention on Climate Change (UNFCCC), "INDC – Submissions", http://www4.unfccc.int/submissions/indc/ Submission Pages/submissions.aspx, viewed 3 December 2016.

2. Energy Community, "Ministerial Council approves Georgia's accession to the Energy Community, adopts new environmental legislation", 14 October 2016, https://www.energy-community.org/portal/page/portal/ENC_HOME/NEWS/News_Details?p_new_id=13463.

3. **Sidebar 10** from United Nations Economic Commission for Europe (UNECE), "REN 21-UNECE Renewable Energy Hard Talks in UNECE Countries", https://www.unece.org/energywelcome/areas-of-work/renewable-energy/unece-ren21-hard-talks.html, viewed 24 February 2017.

4. International Energy Agency (IEA), *Eastern Europe, Caucasus and Central Asia: Energy Policies Beyond IEA Countries* (Paris: 2015), p. 27, http://www.iea.org/bookshop/705-Eastern_Europe,_Caucasus_and_Central_Asia; Energy Community, *Annual Implementation Report 2013-14* (Vienna: 1 August 2014), p. 207, https://www.energy-community.org/pls/portal/docs/3356393.PDF.

5. Energy Community, "Albania Renewable Energy", https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Albania/Renewable_Energy, viewed 30 December 2016; Energy Community, *Annual Implementation Report* (Vienna: September 2016), https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/4332394/3D-790302C9FD5024E053C92FA8C0D492.pdf; Ministry of

Foreign Trade and Economic Relations of Bosnia and Herzegovina, "Adoption of an Action Plan for the use of renewable energy in Bosnia and Herzegovina (NREAP)", 10 April 2016, http://www.mvteo.gov.ba/vijesti/saopstenja/default.aspx?id=7957&langTag=en-US; Energy Community, "Bosnia and Herzegovina Renewable Energy", https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Bosnia_Herzegovina/Renewable_Energy, viewed 30 December 2016

6. Energy Community, "Ukraine Energy Efficiency", https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Ukraine/Energy_Efficiency, viewed 30 December 2016.

7. National Association of Regulatory Utility Commissioners (NARUC), "Moldova spurs efforts to improve sustainability and energy security", http://naruc.org/international/news/moldova-spurs-efforts-to-improve-sustainability-and-energy-security/, viewed 30 December 2016.

8. **Table 9** from the following sources: information from local co-ordinating contributors; Energy Community, "Albania Renewable Energy", op. cit. note 5; Energy Community, "Bosnia and Herzegovina Renewable Energy", op. cit. note 5; United Nations Development Programme (UNDP) Uzbekistan, "Targets to Reduce Energy Consumption and Greenhouse Gas Emissions in Key Sectors of the Economy of Uzbekistan", prepared under the UNDP project Supporting Uzbekistan in Transition to a Low-Emission Development Path, http://www.uz.undp.org/content/uzbekistan/en/home/operations/projects/environment_and_energy/supporting-uzbekistan-in-transition-to-a-low-emission-development-path.html, viewed 26 October 2015; Russia Federation from Dr. Georgy Ermolenko, presentation at the international Conference on Renewable Energy and UNECE Group of Experts on Renewable Energy in Baku, October 2016. Nazir Ramazanov, The State Agency on Alternative and Nazir Ramazanov, State Agency on Alternative and Renewable Energy Sources of Azerbaijan Republic, "Current situation of renewable energy development, renewable energy targets and support schemes in Azerbaijan", presentation at International Renewable Energy Agency (IRENA) workshop on Central Asia, 26 April 2017, p. 3; IRENA, *REmap 2030: Renewable Energy Prospects for Russian Federation* (Abu Dhabi, 2017), pp. 25-26, www.irena.org/remap

9. NARUC, "Georgian regulator boosts security and clean energy opportunities", http://naruc.org/international/news/georgian-regulator-boosts-security-and-clean-energy-opportunities/, viewed 30 December 2016; "Law of Georgia Electricity and Natural Gas, consolidated 22 June 2016", Legislative Herald of Georgia, https://matsne.gov.ge/ka/document/view/31744, viewed 30 December 2016.

10. State News Agency of Turkmenistan, "Law of Turkmenistan 'On Air Protection' is aimed at minimizing negative anthropogenic factors", 10 June 2016, http://en.trend.az/casia/turkmenistan/2512282.html, http://www.turkmenistan.gov.tm/_eng/?id=5998.

11. **Figure 13** based on information from local co-ordinating contributors.

12. **Table 10** from the following sources: Armenia Renewable Resources and Energy Efficiency Fund, "Tariffs", http://r2e2.am/en/2011/06/tariffs/; Azerbaijan from country contributor, considering an exchange rate of EUR 1 = AZN 1.8532; Belarus from country contributor, from Belarusian web portal on renewable energy, "Feed in Tariffs", http://re.energybel.by/en/le/belarus/promotion/fit/, viewed 2 March 2017, and from "Resolution of the Ministry of Economy dated April 8, 2014 No. 29 on Amendments to the Decree of the Ministry of Economy of the Republic of Belarus of June 30, 2011 number 100", http://www.pravo.by/main.aspx?guid=3871&p0=W21428632&p1=1; Bosnia and Herzegovina (Republika Srbska) from Energy Regulatory Commission, Republika Srbska, http://www.reers.ba/sites/default/files/Odluka_visina_garantovanih_otkupnih_cijena_okt2014.pdf, viewed 26 October 2015; Ukraine from DLF Attorneys at Law, *Renewable Energy in Ukraine* (Kyiv: May 2016), http://www.flandersinvestmentandtrade.com/export/sites/trade/files/attachments/Renewable%20energy%20in%20Ukraine.pdf, from communication with Julia Usenko, and from "Electricity law, Document 575/97-VR, version of 16 July 2015", http://zakon4.rada.gov.ua/laws/show/575/97-%D0%B2%D1%80/paran447#n447; remaining countries from Legal Sources on Renewable Energy, http://www.res-legal.eu/search-by-country/.

13. Vitaliy Daviy, "Moldova adopted feed-in tariffs for renewable energy projects", 10 March 2016, https://www.linkedin.com/pulse/moldova-adopted-feed-in-tariffs-renewable-energy-projects-daviy.

14. Zaripova Adilya, "Ukraine exceeds 1 GW of installed renewable capacity", *PV Magazine*, 1 August 2016, http://www.pv-magazine.com/news/details/beitrag/ukraine-exceeds-1-gw-of-installed-renewable-capacity_100025629/#axzz4SfiOBW9B; Dr. Galyna Trypolska, Institute for Economics and Forecasting, Ukrainian National Academy of Sciences, personal communication with authors, 30 March 2017; DLF Attorneys at Law, op. cit. note 12.

15. United Nations Industrial Development Organization and International Center on Small Hydro Power, *World Small Hydropower Development Report 2013: Georgia* (Vienna and Hangzhou: 2013), p. 7, http://www.smallhydroworld.org/fileadmin/user_upload/pdf/Asia_Western/WSHP-DR_2013_Georgia.pdf; Republic of Albania, "Law on Concessions", 18 December 2006, http://faolex.fao.org/docs/pdf/alb85809E.pdf.

16. NARUC, op. cit. note 9; "Law of Georgia Electricity and Natural Gas", op. cit. note 9.

17. Energy Community "Albania Renewable Energy", op. cit. note 5.

18. International Finance Corporation, "Russia Renewable Energy Program", http://www.ifc.org/wps/wcm/connect/RegProjects_Ext_Content/IFC_External_Corporate_Site/Home-RREP/, viewed 30 December 2016. **Sidebar 11**

based on the following sources: National Hydropower Association of USA, Pumped Storage Development Council, *Challenges and Opportunities for New Pumped Storage Development* (Washington, DC: 2014), http://www.hydro.org/wp-content/uploads/2014/01/NHA_Pumped-Storage_071212b12.pdf; Elizabeth Ingram, "Balancing renewables with pumped storage", *Power Engineering International*, August 2011, http://www.powerengineeringint.com/articles/print/volume-19/issue-8/features/balancing-renewables-with-pumped-storage.html; IRENA, *Renewable Energy Statistics 2016* (Abu Dhabi: 2016), http://resourceirena.irena.org/gateway/dashboard/; David Appleyard and Michael Harris, "Hydroelectric power and Russia's energy future", HydroWorld, 2 October 2016, http://www.hydroworld.com/articles/2014/02/hydroelectric-power-and-russia-s-energy-future.html; Julia Usenko, independent expert, 30 March 2017, personal communication with authors, 6 December 2016; Jean-François Marquaire and Paul Miasnikof, "CMS Guide to Energy Storage: Russia", 1 September 2016, http://www.lexology.com/library/detail.aspx?g=0a6eb9ed-6ff5-4d89-ba47-fb00c3697867; Ukraine Government portal, "Volodymyr Groysman launched three new hydroelectric units at Dniester PSP", 10 June 2016, http://www.kmu.gov.ua/control/en/publish/article?art_id=249105757&cat_id=244314975; UAEnergy, "Первая очередь Днестровской ГАЭС полностью подключена к энергосистеме", 10 June 2016, http://uaenergy.com.ua/post/26216; Serbia from Julia Usenko, personal communication with authors, 30 March 2017;. Galyna Trypolska, Institute for Economics and Forecasting of the Ukrainian National Academy of Sciences, personal communication with authors, 30 December 2016; Nadia Shevchenko et al., *What Is Wrong with Kaniv PSP? Kaniv Pump Storage Plant: Project's Risks* (Kyiv: National Ecological Centre of Ukraine, July 2016), http://en.necu.org.ua/files/2016/01/Kaniv_PSP_short_eng_updated_2015.pdf; DOE Global Energy Storage Database, "Crpna Hidroelektrana Capljina – Čapljina Pumped Hydro Storage (Bosnia and Herzegovina)", http://www.energystorageexchange.org/projects/2111, viewed 30 December 2016.

19. Cabinet of Ministers of Ukraine, "National Renewable Energy Action Plan Up to 2020", 1 October 2014, https://www.iea.org/media/pams/ukraine/Ukraine_NREAP_adopted_1Oct2014_ENG.pdf.

20. UNFCCC, "Intended Nationally Determined Contributions (INDC) – Bosnia and Herzegovina", 8 October 2015, http://www4.unfccc.int/submissions/INDC/Published%20Documents/Bosnia-Herzegovina/1/INDC%20Bosnia%20and%20Herzegovina.pdf.

21. Energy Community, op. cit. note 5, p. 35.

22. Ministry of Energy and Industry, *National Action Plan for Renewable Energy Resources in Albania 2015-2020*, January 2016.

23. Ministry of Economy of the Government of Montenegro, http://www.minekon.gov.me/biblioteka/strategije?alphabet=lat, 30 March 2017.

24. Ministry of Foreign Affairs of Turkmenistan, "A number of documents were signed within the framework of the UN Global Conference on the Sustainable Transport", 14 December 2016, http://www.mfa.gov.tm/en/news-en/4945-a-number-of-documents-were-signed-within-the-framework-of-the-un-global-conference-on-the-sustainable-transport.

25. Energy Community "Albania Renewable Energy", op. cit. note 5; Cabinet of Ministers of Ukraine, op. cit. note 19.

26. Energy Community, "Bosnia and Herzegovina Renewable Energy", op. cit. note 5.

27. Energy Community, "Moldova", https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Moldova, viewed 3 January 2017.

28. **Table 11** from the following sources: data gathering undertaken for this report by local co-ordinating contributors; Energy Community "Albania Renewable Energy", op. cit. note 5; Belarus from Pravo, "ПОСТАНОВЛЕНИЕ МИНИСТЕРСТВА ЭКОНОМИКИ РЕСПУБЛИКИ БЕЛАРУСЬ", http://www.pravo.by/main.aspx?guid=3871&p0=W21530189, viewed 30 December 2016; Georgia from "Law of Georgia Electricity and Natural Gas", op. cit. note 9.

29. Government of Macedonia, *Renewable Energy Action Plan for the Republic of Macedonia until 2025 with Vision Until 2030*, November 2015, https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/3996377/2AEF1526B32439F9E053C92FA8C03714.pdf.

30. Moldova Online Questionnaire – Laws and Government Decisions, available at www.lex.justice.md.

31. UNDP Moldova, "Green energy creates new opportunities for women", 8 May 2013, http://www.md.undp.org/content/moldova/en/home/ourwork/climatechangeenvironmentandenergy/successstories/energy_efficient_woman.html.

32. Energy Community, *Exemplary Energy Efficiency Projects and Good Implementing Practices* (Vienna: June 2016), https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/4174451/344ADD26CE7E36C3E053C-92FA8C0D92C.pdf.

33. Energocredit Georgia website, http://www.energocredit.ge, viewed December 2016.

34. European Union, "European Union launches new initiatives in support to local authorities of the Eastern Partnership Countries", press release (Yerevan: 26 October 2016), http://www.covenantofmayors.eu/IMG/pdf/High_

Level_Conference_CoM_East_Launch_Yerevan_Press-Release_Final_ENG.pdf.

35. EU in Ukraine, "Mayors against climate change: EU continues supporting the cities of the EaP countries", 31 October 2016, https://euukrainecoop.com/2016/10/31/eap-climate-change/.

36. **Sidebar 12** from Secretariat of the UNECE Group of Experts on Renewable Energy, "Good Practices and Policies for Intersectoral Synergies to Deploy Renewable Energy: The Water-Energy-Food Ecosystems Nexus Approach to Support the Sustainable Development Goals (SDGs)", 10 August 2016, http://www.unece.org/fileadmin/DAM/energy/se/pdfs/gere/GERE_October_2016/6._ECE_ENERGY_GE7_2016_6_Nexus_Final.pdf, and from IRENA, *Renewable Energy in the Water, Energy & Food Nexus* (Abu Dhabi: 2015), http://www.irena.org/documentdownloads/publications/irena_water_energy_food_nexus_2015.pdf.

37. UNFCCC, op. cit. note 1.

38. **Table 12** from the Nationally Determined Contributions submitted by the countries covered and accessible at the NDC interim registry, http://www4.unfccc.int/ndcregistry/Pages/All.aspx, viewed 23 January 2017.

39. **Table 13** from the following sources: data gathering undertaken for this report by local co-ordinating contributors; Energy Community, "Albania Energy Efficiency", https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Albania/Energy_Efficiency, viewed 30 December 2016; Kazakhstan from "Президент РК одобрил поправки в закон об энергосбережении. https://kapital.kz/gosudarstvo/36653/prezident-rk-odobril-popravki-v-zakon-ob-energosberezhenii.html, viewed 30 December 2016.

40. Information provided by local co-ordinating contributor.

41. "Беларусь. Принят новый закон 'Об энергосбережении'", http://portal-energo.ru/articles/details/id/877, viewed 9 February 2016.

42. Energy Community, "Albania Energy Efficiency", op. cit. note 39.

43. Energy Community, "Ukraine Energy Efficiency", https://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/Ukraine/Energy_Efficiency, viewed 30 December 2016.

44. "Президент РК одобрил поправки в закон об энергосбережении", https://kapital.kz/gosudarstvo/36653/prezident-rk-odobril-popravki-v-zakon-ob-energosberezhenii.html, viewed 30 December 2016.

45. UNFCCC, *Intended Nationally Determined Contribution of Turkmenistan in Accordance with Decision 1/CP. 20 UNFCCC*, 21 October 2016, http://www4.unfccc.int/ndcregistry/PublishedDocuments/Turkmenistan%20First/INDC_Turkmenistan.pdf.

46. Information provided by local co-ordinating contributor.

47. Albania from Energy Community, op. cit. note 2, pp. 42-43; Georgia from idem, p. 101.

48. UNDP Turkmenistan, "Improving Energy Efficiency in the Residential Building Sector of Turkmenistan", http://www.tm.undp.org/content/turkmenistan/en/home/operations/projects/environment_and_energy/improving-energy-efficiency-in-the-residential-building-sector-o.html, viewed 12 September 2015.

49. **Table 14** from UNDP Uzbekistan, Global Environment Facility (GEF) and State Committee of the Republic of Uzbekistan for Architecture and Construction, *Results, Lessons Learned and Strategy for Transition and Sustainability Upon Completion of the UNDP/GEF Full-Sized Project* (Tashkent: 2015), p. 32, http://uz.beeca.net/userfiles/files/Final%20report%20EEPB%20Uz%20Chao%20incl%20LL%20transition%20and%20sustainability_ENG.pdf, and from information from local co-ordinating contributor.

50. Government of the Kazakh Republic, "Law of Kazakhstan of January 13, 2012 No. 541-IV 'On energy saving and energy efficiency'", the official publication of Adilet, 15 June 2015, http://online.zakon.kz/Document/?doc_id=31112351; Moldova from Copenhagen Centre on Energy Efficiency, *Energy Efficiency Orbits for Transition Economies: Final Report* (Copenhagen: 2015), p. 118, http://www.cenef.ru/file/Final%20Report_C2E2_CENEf_June2_2015.pdf; Ukraine from "Асоціація енергоаудиторів, 'Підписано закони щодо діяльності енергосервісних компаній в Україні'", http://aea.org.ua/2015/05/pidpisano-zakoni-shhodo-diyal-nosti-energo-servisnih-kompanij-v-ukrayini/, viewed 26 June 2015.

51. Government of the Kazakh Republic, op. cit. note 50.

52. Copenhagen Centre on Energy Efficiency, op. cit. note 50, pp. 98, 140.

53. US Agency for International Development, *Project Proposal: Utilization of Solar Energy through Centralized Solar Farm in Bolnisi*, May 2016, http://pdf.usaid.gov/pdf_docs/PA00M6TM.pdf.

6. INVESTMENT FLOWS

1. This section is derived from Bloomberg New Energy Finance (BNEF) Clean Energy Investment Trends and Asset Finance Records. Figures are based on the output of the desktop databases of BNEF unless otherwise noted. Only renewable energy power generation projects greater than 1 MW are included. Programmes for grid access and/or residential PV schemes or solar water heating are not within the scope of the BNEF database and therefore are excluded here. Large-scale hydropower projects with installed capacity above 50 MW also are excluded. BNEF provided its complete data sets up to the end of 2015.

2. Frankfurt School–UNEP Collaborating Centre for Climate

and Sustainable Energy Finance and BNEF, *Global Trends in Renewable Energy Investment 2016* (Frankfurt: 2016), http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016low-res_0.pdf.

3. **Figure 14** from BNEF, op. cit. note 1.

4. **Figure 15** from Ibid.

5. **Sidebar 13** from the following sources: Information from local co-ordinating contributor; Giorgi Abramishivli, "Private sector perspective: a hydro project developer's point-of-view", presentation, Tbilisi, Georgia, 12 December 2017; discussion during REN21 Hard Talks held in Tbilisi on 12 December 2017; Natalia Jamburia, Ministry of Energy of Georgia, personal communication with authors, 21 March 2017.

6. Ivan Shumkov, "Armenia seeks to attract up to USD 300m of wind investments", Renewables Now, 24 November 2016, http://renewables.seenews.com/news/armenia-seeks-to-attract-up-to-usd-300m-of-wind-investments-548259#.

7. Energy Charter, "Investment opportunities in Uzbekistan", http://www.energycharter.org/media/news/article/investment-opportunities-in-uzbekistan/, viewed 2 April 2017.

8. Adilya Zaripova, "Ukraine exceeds 1 GW of installed renewable capacity", *PV Magazine,* 1 August 2016, https://www.pv-magazine.com/2016/08/01/ukraine-exceeds-1-gw-of-installed-renewable-capacity_100025629/.

9. Plamena Tisheva, "EBRD considering loan for 29-MW solar project in Kazakhstan", Renewables Now, 18 April 2016, http://renewables.seenews.com/news/ebrd-considering-loan-for-29-mw-solar-project-in-kazakhstan-536879.

10. European Bank for Reconstruction and Development (EBRD), "Project Summary Documents", http://www.ebrd.com/work-with-us/project-finance/project-summary-documents.html, viewed 2 January 2017.

11. **Figure 16** from Ibid.

12. Svitlana Pyrkalo, "EBRD earmarks €200 million for renewables in Kazakhstan", EBRD, 16 December 2016, http://www.ebrd.com/news/2016/ebrd-earmarks-200-million-for-renewables-in-kazakhstan.html.

13. **Figure 17** from World Bank, "Projects", http://projects.worldbank.org/search?lang=en&searchTerm=&countrycode_exact=AL, viewed 2 January 2017.

14. **Figure 18** from Asian Development Bank, "Project Records", https://www.adb.org/projects/search/status/approved, viewed 24 February 2017.

15. **Figure 19** from Energy Community, "Conclusions: 1st Meeting Renewable Energy Coordination Group" (Vienna: 2 March 2016), https://www.energy-community.org/portal/page/portal/ENC_HOME/DOCS/4122384/314BBEBCD3236853E053C92FA8C0D687.pdf.

16. Energis, "KfW approved a 65 million euro loan to Elektroprivreda BiH Wind Farm 'Podvelezje'", 18 December 2013, http://energis.ba/kfw-approved-a-65-million-euro-loan-to-elektroprivreda-bih-wind-farm-podvelezje/?lang=en; MINA, "Construction of wind park in Bogdanci begins", 19 May 2013, http://macedoniaonline.eu/content/view/23360/45/.

17. "On-going projects financed by German Development Bank – KfW as of 7th July 2014 inclusive", http://www.finance.gov.mk/files/u5/KfW%20proekti-2014-07-03.doc, viewed 2 April 2017.

18. Wind Atlas Balkan, http://balkan.wind-index.com/, viewed 2 April 2017.

19. European Commission, "Investment facility for Central Asia (IFCA)", http://ec.europa.eu/europeaid/regions/central-asia/investment-facility-central-asia-ifca_en, viewed 30 March 2017.

20. Climate Investment Funds (CIF), *Empowering a Greener Future: CIF Annual Report 2015* (Washington, DC: 2016), p. 4, http://www-cif.climateinvestmentfunds.org/empowering-greener-future.

21. Ibid.

22. **Figure 20** from CIF, "Projects", https://www-cif.climateinvestmentfunds.org/projects, viewed 2 January 2017.

23. **Figure 21** from GEF, "Projects", https://www.thegef.org/gef/gef_projects_funding, viewed 2 January 2017.

2017 UNECE RENEWABLE ENERGY STATUS REPORT

978-3-9818107-5-2

REN21 Renewable Energy Policy Network for the 21st Century

REN21
c/o UN Environment
1 rue Miollis
Building VII
75015 Paris
France
www.ren21.net