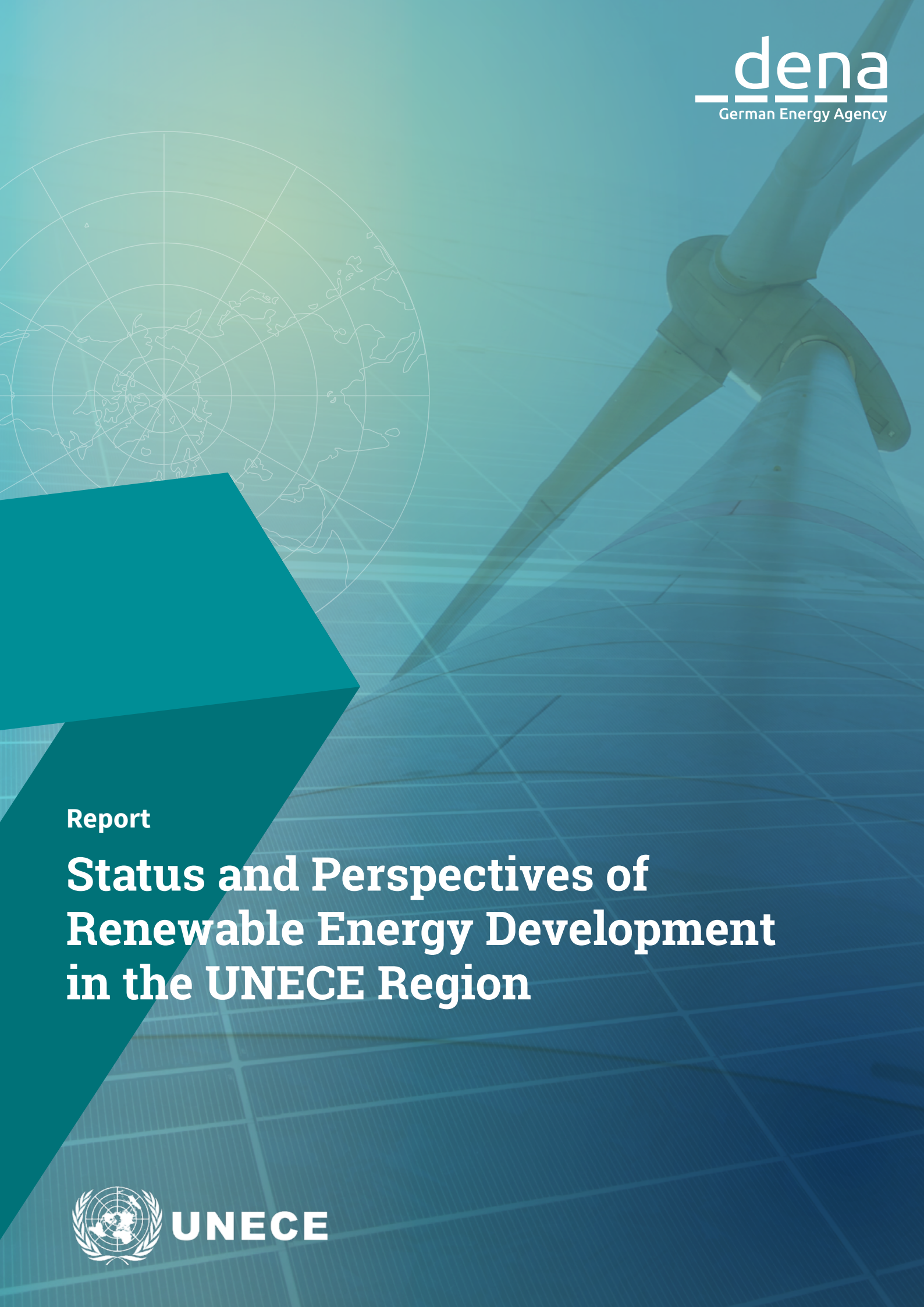

dena
German Energy Agency

Report

Status and Perspectives of Renewable Energy Development in the UNECE Region

UNECE

Legal Information

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This report is an update of the 2017 report "Status and perspectives for renewable energy development in the UNECE region".[1] It is presented as part of the UNECE RE-Uptake Project commissioned by the Federal Ministry for Economic Affairs and Climate Action and executed by the German Energy Agency in collaboration with UNECE and REN21.

Last updated: 09/2022

Project Overview: UNECE Renewable Energy Uptake

The member states of the United Nations Economic Commission for Europe (UNECE) differ not only in their language, culture and geography, but also in their energy systems. While some countries have already achieved very high shares of renewable energy in the electricity and heating market, others are only at the beginning of this transition. There is therefore great potential in cross-border knowledge transfer.

As part of the project "UNECE Renewable Energy Uptake", the UNECE, the Deutsche Energie-Agentur (dena) - the German Energy Agency - and the Renewable Energy Policy Network for the 21st Century (REN21) facilitate this transfer of knowledge and best practices through various activities. In addition to the presented report "Status and Perspectives of Renewable Energy Development in the UNECE Region", prepared by dena, REN21 delivers its UNECE Renewable Energy Status Report under the project as well.[2]

In addition to the dena and REN21 reports, a series of four Renewable Energy 'Hard Talks' with selected UNECE member states were held as part of the project. The 'Hard Talk' is a discussion format on current topics of renewable energy held with relevant stakeholders of the participating UNECE member nations and international energy community and organized by the UNECE Secretariat and partner organizations. Over the duration of the project in 2021 and 2022, Hard Talks were held with Albania, Georgia, Serbia, and the Republic of Moldova.

Federal Ministry for Economic Affairs and Climate Action

This publication is issued on behalf of the Federal Ministry for Economic Affairs and Climate Action. The German Energy Agency (dena) assists the Federal Government in various projects to implement the energy and climate targets in the context of the energy transition.

UNECE

In cooperation with UNECE: The United Nations Economic Commission for Europe is one of the five regional commissions under the jurisdiction of the United Nations Economic and Social Council. All activities relating to this report and the RE Uptake project in general are implemented in close cooperation with the UNECE Secretariat.

REN21 RENEWABLES NOW

REN21: REN21 is the global community of renewable energy stakeholders from science, academia, governments, NGOs and industry. They provide up-to-date facts, figures and peer-reviewed analysis on global developments in technology, policy and markets, to inform decision makers.

1 Document available at: unece.org/DAM/energy/se/pdfs/gere/publ/2017/DENA_UNECE_Study_Update_final_19_December_2017_web.pdf

2 This in-depth report looking at the renewable energy deployment in 27 selected UNECE member states will be available for download at www.ren21.net

Key Insights

The UNECE's member states are highly diverse with regards to conditions, legal frameworks and motivations for the uptake of renewable energy. The United Nations Economic Commission for Europe (UNECE) region comprises 56 countries throughout Europe, North America and Asia. Their energy systems are characterised by differences in resource availability, market design, regulation and policy as well as existing infrastructure. The main motivations driving the uptake of renewable energy are mitigation of climate change as well as regional pollution, the reconstruction of future-proof economies after the Covid-19 pandemic, improvements of security of affordable energy supply and energy independence.

Between 2018 and 2021 wind and PV markets have expanded dynamically among member states with higher relative growth than other renewable energy sources. The median PV market growth rate in the UNECE region between 2018 and 2021 reached 22.2%. In 2021, PV power plants contributed 9.8% to the total electricity generation capacity. Poland, Estonia, Ukraine, Hungary, Spain, Cyprus and the Netherlands show high growth rates with significant market penetration. For wind the median annual market growth rate was significantly lower than that of PV (7.1%) reaching a median capacity share of 11.3%. Belgium, Greece, Sweden, the Netherlands, Croatia, France, Lithuania, Norway as well as Finland show above-median growth rates in combination with above-median market shares.

Almost all UNECE member states proactively introduced policies aiming to overcome existing challenges that limit further expansion of renewable energy. Despite the recent growth especially in wind and solar capacities, a lack of long-term energy strategies, economic viability, infrastructural flexibility, as well as awareness and acceptance frequently hamper the successful deployment of renewable energy throughout the region. As a consequence, UNECE member states applied a variety of different policies throughout the region such as legally binding expansion goals, guaranteed priority dispatch for renewable power generators and feed-in-tariffs or – premiums.

Given the differences in renewable energy deployment status and approaches to policy-making, there is a large potential for knowledge transfer and mutual learning among UNECE member states. In 2021 and 2022 a series of four Hard Talks were held in the framework of the UNECE Re-Uptake project with selected member states (Albania, Georgia, Serbia and Republic of Moldova) facilitating this knowledge transfer. The dialogues led to concrete recommendations regarding network integration, renewable policy support and bankability of renewable projects in Albania; building support for investments in renewable energy in Georgia; net-metering and renewable energy auctions in Serbia; and successful expansion and integration of renewables, including resilience and flexibility options in the Republic of Moldova. The findings of the Hard Talks are summarised in this report.

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01 Introduction

1.1 Regional Overview

The United Nations Economic Commission for Europe (UNECE) region comprises 56 countries throughout Europe, North America and Asia with a total population of 1.3 billion (figure 1). It accounts for 42% of global GDP[3] and 35% of global carbon emissions from fossil fuel use[4]. The region is geographically, economically and culturally highly diverse. This also holds true for the energy systems of member states, which are characterised by vast differences in resource availability and potential, market design, regulation and policy, and infrastructure.

Table 1: Member States of UNECE region clustered in seven sub-regions

UNECE sub-region	Member States
Caucasus	Armenia, Azerbaijan, Georgia
Central Asia	Kazakhstan, Kyrgyzstan, Tajikistan, Türkiye, Turkmenistan, Uzbekistan
Eastern Europe	Belarus, Israel, Republic of Moldova, Ukraine
North America	Canada, United States of America (United States)
Russian Federation	
Southeast Europe	Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Montenegro, North Macedonia, Romania, Serbia
Western and Central Europe	Andorra, Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, Netherlands, Norway, Poland, Portugal, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom of Great Britain and Northern Ireland (United Kingdom)

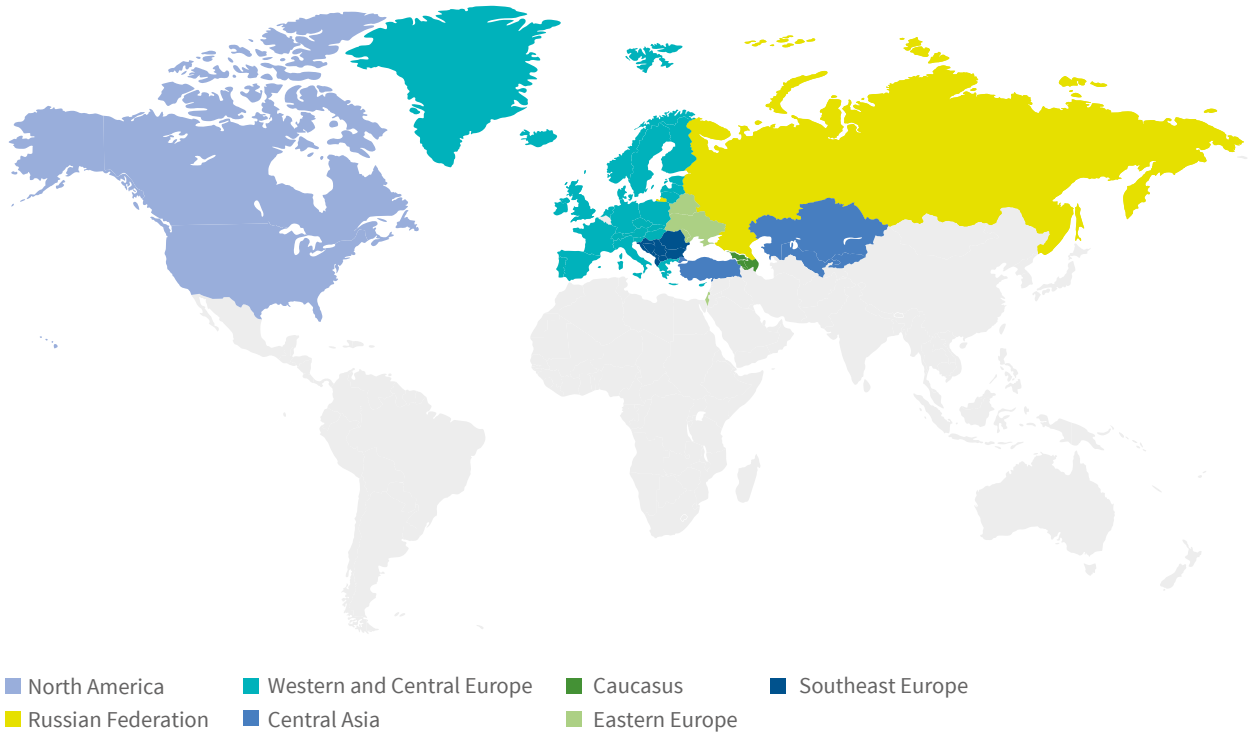


Figure 1: Map of the UNECE region with 56 countries in seven sub-regions

3 GDP, PPP (constant 2017 international USD).
4 Worldbank 2022. Data from 2020.

1.2 Scope of the Report

This report provides an overview of renewable energy deployment and policymaking in the region. It points out recent trends and developments in both the deployment of different renewable energy technologies and supporting policies in the UNECE member states. By doing so, it establishes a basis for discussion among UNECE member countries and informs policy making in the transition to a more sustainable energy supply. In turn, this will help achieve national and global energy and climate targets and the United Nations Sustainable Development Goals (SDGs).

Renewable energy sources include hydropower, wind, solar photovoltaic (PV), solar thermal, geothermal, ocean energy (tidal/wave), renewable municipal waste, solid biofuels, liquid biofuels and biogases.[5] Renewable energy can be utilised for various applications including electricity generation, heating and cooling, and mobility. Renewable electricity plays a central role as it provides the basis for the utilisation and dissemination of renewable energy across all energy consumption sectors through sector coupling. The direct use of electricity is also the most efficient means by which the majority of modern energy needs can be met.

The presented analysis therefore has a particular focus on the status of electricity generation from renewable energy sources in the region. Within this context, the report takes an in-depth look at PV and wind energy, as they have been the most rapidly expanding technologies in recent years and constitute the most significant renewable energy sources with the greatest resource potential across the region. This has created particularly dynamic market and policy development.

In addition, the report provides information on the status of renewable heat generation throughout the region. Heating remains the single largest energy application, accounting for nearly half of global final energy consumption.[6] This includes process heat for industrial manufacturing, spatial heating in residential and commercial buildings as well as water heating for cooking and hygiene. Despite this significance, public discussion around the use of renewables still mainly focuses on the power sector. Taking this into account, the presented report also reflects on initiatives for renewable heating, with the aim of creating awareness for the importance of sustainable heating in the energy transition as a whole.

1.3 Structure of the Report

This report is divided into six chapters. Following this introduction, the second chapter provides a status quo of renewable energy deployment in the UNECE region. The third chapter presents an overview of barriers and challenges that hinder renewable energy development in the UNECE region and provides a set of guiding questions that can help policymakers approach the identified challenges. Chapter four analyses which renewable energy policies are applied throughout the region, looking at both renewable electricity and heat. The fifth chapter then provides a more detailed look at concrete challenges to and recommendations for the uptake of renewable energy in four selected UNECE member states. These were established through four country-specific stakeholder dialogues (Renewable Energy “Hard Talks”) under the Renewable Uptake Project. The sixth and final chapter conculdes the report.

5 In line with the Tracking SDG7 The Energy Progress Report 2022 (IEA, IRENA, UNSD, World Bank, WHO 2022)
6 IEA 2022

02 Status Quo of Renewable Energy Deployment in the UNECE Region

2.1 Motivations for the Uptake of Renewable Energy

As the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report highlighted once again, the world is set on a global warming trajectory leading to potentially devastating effects for nature and human life due to the excessive emission of carbon into the atmosphere.[7] Acknowledging this, more and more countries, regions, and institutions in the UNECE region came forward with pledges to reach carbon neutrality or at least substantially reduce their carbon emissions in the years leading up to 2050. One of the most significant sources of carbon emissions causing global warming is the combustion of fossil fuels for energy generation. Consequently, the deployment and rapid expansion of low-carbon, renewable energy is one of the central levers in order to mitigate climate change. As a result, interest in renewable energy sources is stronger than ever – not only in the UNECE region, but also globally. In addition to climate change mitigation, renewable energy also holds other environmental benefits such as the reduction of air pollution, which has been a particularly important driver in East Asia.

Within the last decade, economies of scale and advances in technology have driven down the costs of various renewable energy technologies, substantially improving their economics. Levelised cost of electricity (LCOE; €/kWh) for solar and wind power technologies have declined rapidly, with solar PV seeing the steepest reduction of LCOE with 82%. Today, "more than half of the renewable capacity added […] achieves lower power costs than the cheapest new coal plants".[8] In fact, "for projects with low-cost financing that tap high-quality resources, solar PV is now the cheapest source of electricity in history".[9] Aligning environmental benefits with economic realities, this development is another major driver for the deployment of wind and PV assets for electricity generation.

In the aftermath of the COVID19-pandemic, economic recovery has also been high on the agenda of political decision-makers. In an effort to connect recovery programs with necessary infrastructure investments and to promote economic activity, renewable energy projects have gained even more interest. Frequently, this is coupled with intentions to enable long-term economic growth through the establishment of new, future-proof industries and value chains.

In addition to environmental and economic arguments, the role of renewable energy in improving security of energy supply and energy independence has become more important. As generating energy from renewable sources is local and largely independent from global fuel markets, it reduces dependencies on energy imports and increases a country's energy security. By diversifying the national energy mix, it further increases energy security and resilience.

While several of the above benefits and drivers play a more significant role than others in different UNECE member states, both from a resource availability and political standpoint, it is a combination that ultimately leads countries to pursue and deploy renewable energy. The following subchapters will explore to which extent these efforts have been successful in the UNECE region.

2.2 Renewable Energy Deployment Trends

In the past decade, the expansion of renewable energy in the UNECE region has progressed rapidly. In 2021, the installed electricity generation capacity of renewable energy sources amounted to 1,211 GW, 460 GW of which were hydropower assets (excluding pumped storage hydro). This share of the UNECE region represents about 39% of the 3,074 GW of renewable generation capacity installed worldwide. Renewable energy has developed faster and more dynamically than any other source of energy in recent years. Between 2018 and 2021, 214 GW of renewable generation capacity was added in the region. In the same period the installed fossil capacity declined by 60 GW. However, the accumulated renewable energy generation capacity of 1,211 GW remains smaller than total fossil generation capacity of 1,500 GW.[10]

7 IPCC 2022
8 IRENA 2020, 6/2
9 IEA 2020
10 As of 2021. IRENA Renewable Energy Capacity Statistics (IRENA 2022). Excluding Pumped Storage Hydropower.

Deployment of renewable energy relative to total energy consumption

In conjunction with and as a result of the expansion of renewables, the share of renewable energy in total final energy consumption (TFEC) has also increased throughout the UNECE region (see Figure 2). Looking at the sub-region-level, Southeast Europe showed the fastest growth while the Russian Federation had the least growth, where the share of renewable energy in TFEC fell by 0.6% when comparing 2019 to 1990. From 2004 onwards, Western and Central Europe substantially increased their share of renewable energy in TFEC to 19.2% in 2019, showing the steadiest growth of all regions in the past decade. Renewable energy use also grew steadily, but slower, in North America and Eastern Europe reaching 11.7% and 7.5% of TFEC, respectively. Both Central Asia and the Caucasus showed growing renewable shares in TFEC before a decline from 2004 to 2006 followed by stagnating growth to date.

Share of renewable energy in energy consumption

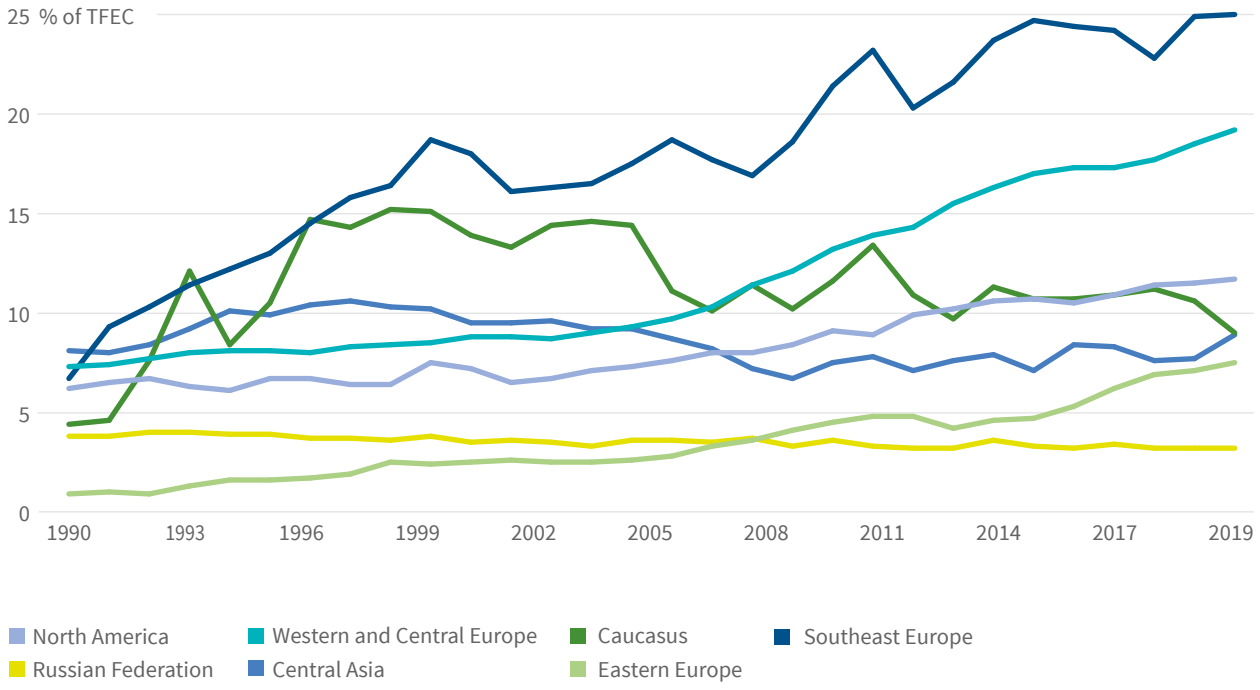


Figure 2: Development of renewable energy in TFEC in UNECE regions from 1990 to 2019[11]

Figures 3 to 6 illustrate in greater detail the share of different renewable energy sources in the TFEC of the UNECE regions. Figure 3 suggests that the prevalent use of bioenergy[12] is behind the remarkably high share of renewable energy in Southeast Europe indicated in Figure 2. Although slowly declining since 2008, the majority of bioenergy used in Southeast Europe stems from solid biofuels (indicated by the additional semi-transparent line in figure 3 showing the share of solid biofuels in TFEC).

Solid biofuels are associated with the combustion of organic and raw material, such as wood. In Southeast Europe, it is primarily used for heating applications in the residential sector, which accounted for 80% of total bioenergy use. Solid biofuels however, are a major source of local air pollution, especially when used with inefficient indoor stoves. In addition, the unsustainable use of solid biofuels through illegal deforestation or a lack of sustainable forest management processes and regulation can drive deforestation and loss of natural habitat, leading to further environmental issues. Such issues lend to scrutiny as to whether traditional, solid biofuels can be considered a truly sustainable source of renewable energy.[13] Modern bioenergy solutions (e.g. wood pellets, bio-diesel, energy crop cultivation), on the other hand, address such problems, particularly in connection with legislation enforcing sustainable agriculture and forestry practices.[14]

11 Illustration based on IEA, IRENA, UNSD, World Bank, WHO (2022). Countries are weighted within their region according to their total energy consumption (in TJ).
12 IRENA defines bioenergy as "energy derived from organic, non-fossil material of biological origin (biofuels), which can be used for the generation of heat or electricity."
13 The Tracking SDG 7 report (IEA, IRENA, UNSD, World Bank, WHO 2022) distinguishes between modern and traditional use of biomass. Traditional biomass refers to solid biofuels like wood, charcoal and agricultural residues. It should be noted that exact data on the use of traditional biomass is scarce, as a lot of this type of energy is not traded and/or accounted for before combustion. By definition, the use of traditional biomass refers only to the residential sector in countries outside the OECD and thus Southeast Europe. IRENA (2019) shows that the majority of solid biofuels used in Southeast Europe can be interpreted in the traditional sense.
14 IRENA 2019

Countries in Eastern Europe, Caucasus, Central Asia and the Russian Federation consume almost all of their bioenergy in the form of solid biofuels. As such, Figure 3 does not include an additional indicator for purely solid biofuels (semi-transparent line) in these regions. Besides Southeast Europe, only Western and Central Europe and North America reduced the use of solid biofuels in recent years and instead, increased the share of modern bioenergy in TFEC.

Bioenergy

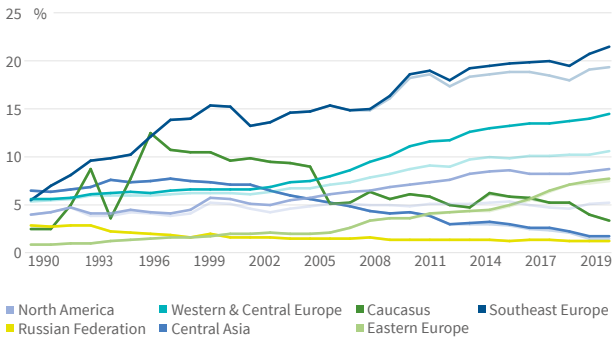


Figure 3: Development of bioenergy in TFEC in UNECE regions from 1990 to 2019. Semi-transparent lines indicate the share of purely solid biofuels[15]

Figure 4 shows that hydropower contributes a major share of renewable energy in TFEC not only in Southeast Europe but also in the Caucasus. Although subject to regular yearly fluctuations due to rain fall and increasing vulnerability to climate change, hydropower covers around 7% of the TFEC in both regions. North America, Western and Central Europe, the Russian Federation and Central Asia show similar regular patters; however, the share in TFEC is generally lower ranging between 2 to 5%.

Hydropower

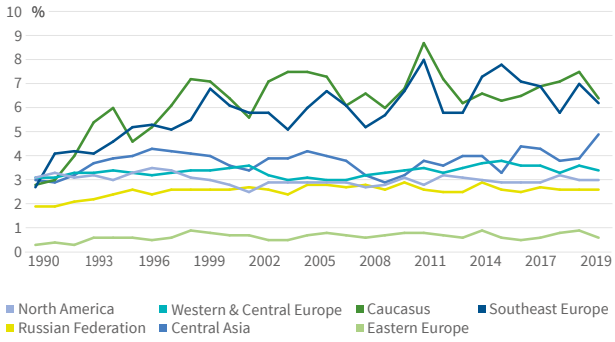


Figure 4: Development of hydropower in TFEC in UNECE regions from 1990 to 2019[15]

Figure 5 indicates that the share of wind energy in TFEC remains small in all UNECE sub-regions but is constantly growing, especially in Western and Central Europe and North America and recently in Southeast Europe and Central Asia also. Western and Central Europe exhibit the highest proportion with over 3% of TFEC in 2019.

Wind Energy

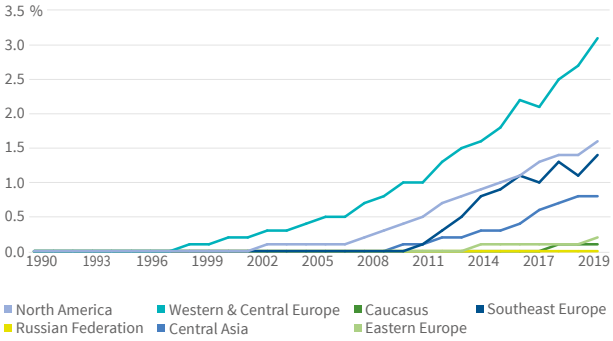


Figure 5: Development of wind energy in TFEC in UNECE regions from 1990 to 2019[15]

The share of solar energy in TFEC ranges behind or is equal to that of wind power in all regions aside from Eastern Europe, as can been seen in Figure 6. However, the share continues to grow year on year in all regions except the Russian Federation, with Western and Central Europe leading at around 1.2% of TFEC in 2019.

Solar Energy

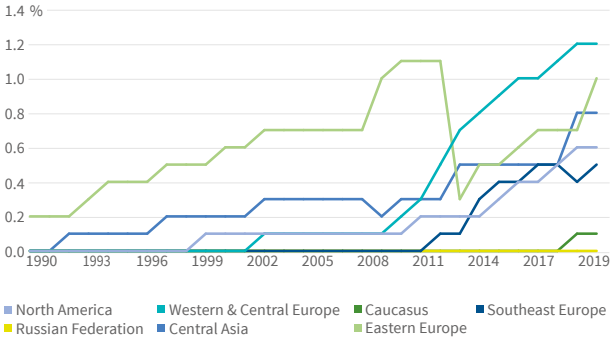


Figure 6: Development of solar energy in TFEC in UNECE regions from 1990 to 2019[16]

15 IEA, IRENA, UNSD, World Bank, WHO 2022

16 Illustration based on IEA, IRENA, UNSD, World Bank, WHO (2022). Countries are weighted within their region according to their total energy consumption (in TJ). The decline in share of solar in TFEC in Eastern Europe between 2011 and 2012 presumably results from a change in definition in primary data from the Israel Central Bureau of Statistics.

Deployment of renewable energy in the power sector

Figures 7 to 10 show the recent renewable energy development in the UNECE region by depicting the installed electricity capacities of the most relevant renewable energy technologies in the UNECE region (PV, wind energy, bioenergy and hydropower) and the corresponding compound annual growth rate (CAGR)[17].[18] While markets for other renewable energy technologies exist, they do not exhibit relevant deployment figures. The respective column size illustrates the growth of the cumulated PV, wind energy, bioenergy and hydropower capacities in GW between 2018 and 2021.

Cumulated solar power capacity (PV only)

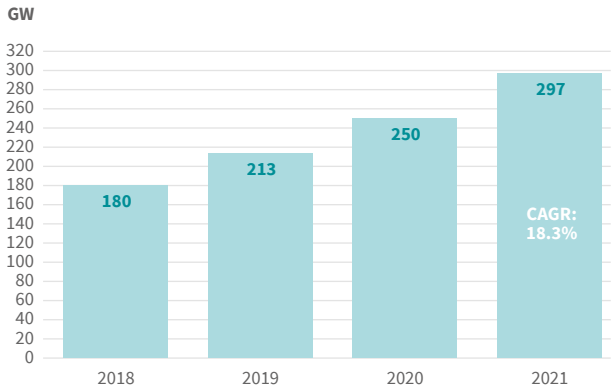


Figure 7: Recent PV development in the UNECE region[19]

Cumulated wind power capacity

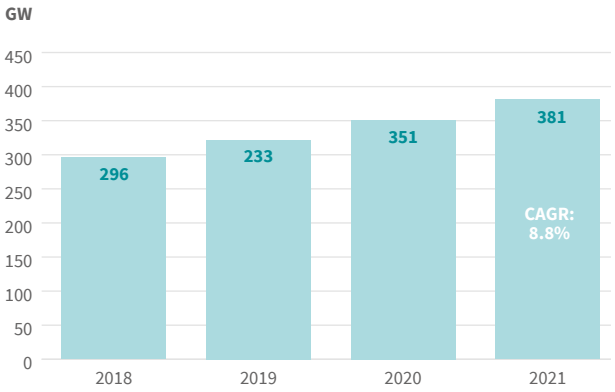


Figure 9: Recent wind energy development in the UNECE region[19]

Cumulated bioenergy electricity capacity

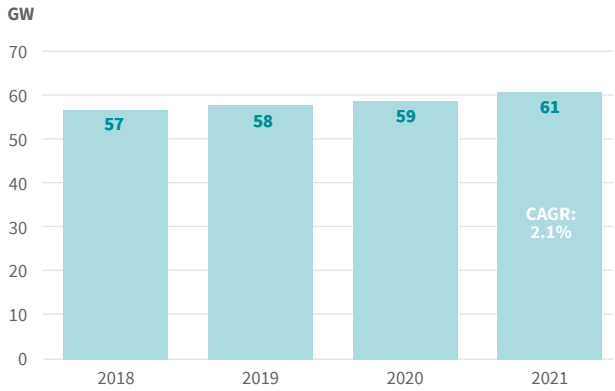


Figure 8: Recent bioenergy development in the UNECE region[19]

Cumulated hydropower capacity

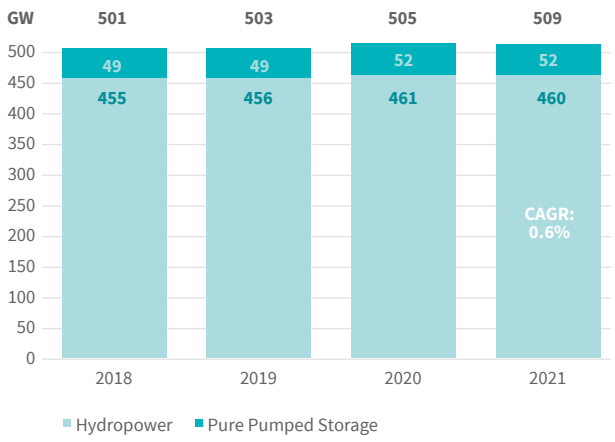


Figure 10: Recent hydropower development in the UNECE region[20]

17 The CAGR is the mean annual growth rate of an asset or investment (in this case, the growth of RE capacity) over a specific time period and is the result of the final or most recent value divided by the beginning value raised to an exponent of one divided by the number of years minus 1 and multiplied by 100 to convert into a percentage.

18 Wind energy includes onshore and offshore installations. Only countries for which data were available are included.

19 Illustration based on IRENA (2022).

20 Illustration based on IRENA (2022). Hydropower includes combinations of pumped storage hydro and hydropower (these so-called mixed plants generate electricity of both natural water inflow and water previously pumped uphill).

PV, wind energy, bioenergy and hydropower contributed 1,200 GW to a total of 1,211 GW of renewable electricity capacity installed in the UNECE region in 2021. Wind energy and PV have been the two most rapidly expanding renewable energy technologies since 2018.

Between 2018 and 2021, wind energy capacity increased from 296 GW to 381 GW, resulting in a compound annual growth of 8.8%. In the same period, the PV sector expanded even more rapidly from 180 GW to 297 GW, which equates to an annual growth of 18.3%.

In various countries, the modern use of biomass as a mean of generating electricity (as opposed to traditional uses such as burning timber) is either already established or new markets have recently begun to emerge in line with advancements in and availability of technology and improved bioenergy strategies and value chains. However, with 61 GW, bioenergy contributed the least to electricity generation capacity of the four examined technologies in 2021. The sector grew by a mean annual growth of 3.4%, from 57 GW in 2018 to 61 GW in 2021.

Throughout the UNECE region, hydropower capacity has grown less or even stagnated in recent years, resulting in capacity growth of only 0.6% annually. In some cases, as in the United States, the installed capacity even declined. Many UNECE countries are already using much of their economically exploitable hydropower potential, leading to less dynamic market growth and fewer new installations. In the majority of UNECE countries, run-of-river plants, reservoir plants and mixed hydro plants make up a significant proportion of installations, together accounting for 90% of installed hydropower capacity in the region. Only in a few countries, like Belgium, pumped storage hydro dominates the total hydropower capacity.

Status of renewable energy in the heating sector

In contrast to renewable energy in the electricity sector, deployment figures for renewable energy in the heating sector are far less granular. Globally, bioenergy is the main source for renewable heat.[21] Both globally and in the UNECE region, geothermal energy, solar thermal energy and concentrated solar power are less commonly used or established.

Despite the enormous theoretical potential, geothermal energy is only exploited in some UNECE countries (e.g. Iceland and the United States). Solar thermal energy, on the other hand, is a more established source of renewable heat. Israel, Switzerland, Türkiye and the United States have significant solar thermal markets and the technology is gaining importance in many other member states. Concentrated solar power plants for heat and/or power generation beyond the pilot or demonstration phase are only relevant in the United States and Spain. Although far more established and significant in some member states, the renewable heat sector in the UNECE region is far less developed than the sector for renewable electricity.

Why is renewable heat not as widely available as renewable electricity?

As established in section 1.2, energy for heating applications accounts for the majority of TFEC both globally and in the UNECE region. Strategies for decarbonizing heating systems that go beyond the application of traditional biomass should therefore be high on the agenda of policymakers.

However, as section 2.2 indicates, renewable heat is still lagging behind renewable electricity both in terms of technology deployment and general public awareness. There are two main reasons (in anticipation of section 3 Barriers and challenges to the uptake of renewable energy):

First and foremost, renewable heating applications still lack economic viability in most UNECE member states. Higher LCOH (Levelised cost of heating) as well as prevalent subsidies for fossil fuels diminish the competitiveness of renewable heat technologies.[22] However, as a result of the European energy crisis of 2021 and 2022, soaring fossil fuel prices are turning the economics in favour of renewables in the heating sector. Nevertheless, renewable heat technologies often face high upfront costs as well as investment risks, both of which impede their uptake in many regions. This is especially the case with geothermal heat, for instance.

Secondly, an effective renewable heat supply in densely populated areas also depends on availability of suitable infrastructure, namely district heating networks. If this infrastructure is not available, „plug-and-play"-solutions common in the electricity sector, such as high-efficiency appliances, are not possible. High upfront investment and ongoing maintenance is required in order to set up and run the required networks. In addition, building standards and energy efficiency regulations directly influence the viability of renewable heating solutions, adding to the complexity of their uptake and integration.

21 IEA 2022
22 IEA 2021

2.3 Dynamic Solar PV and Wind Energy Market Development

PV and wind energy markets have expanded dynamically between 2018 and 2021 in the UNECE region, with noticeably higher relative growth than other renewable energy sources. Given this significance and the actual and potential role that PV and wind energy has in meeting UNECE and global energy demand, this report analyses PV and wind energy deployment in greater detail.

Figures 11 and 12 display the recent development of PV and wind energy markets in the UNECE region at the member state level. The y-axis displays the compound annual growth rate (CAGR) of installed electricity capacities of PV (Figure 11) and wind energy (Figure 12) as an indicator for the growth of the respective national PV and wind energy markets between 2018 and 2021. The x-axis shows the market share of each technology as a percentage of total national electricity generation capacity in 2021, representing market penetration. The charts are divided into four quadrants representing different stages of market development (as introduced in Table 2).

	x-axis left half	**x-axis right half**
y-axis upper half	**Quadrant 2 – Emerging markets** below- median market share above- median growth rate	**Quadrant 1 – Thriving markets** above- median market share above- median growth rate
y-axis lower half	**Quadrant 3 – Underdeveloped markets** below- median market share below- median growth rate	**Quadrant 4 – Saturating markets** above- median market share below- median growth rate

Table 2: Description of the four quadrants: market share and growth rate

Member states that have an insignificant share of PV or wind assets in their power generation fleet and below-median CAGR are found in quadrant 3 (Q3). These markets may be qualified as **underdeveloped markets**.

When a member state has added renewable energy generation capacities rapidly but still has a below-median market penetration, it is found in Q2. Coming from a small fleet, extreme growth rates are easily attainable. As such, states with market shares below 1% were excluded from the graphs.[23] Nevertheless, countries in this quadrant indicate a dynamic market development, qualifying them as **emerging markets**.

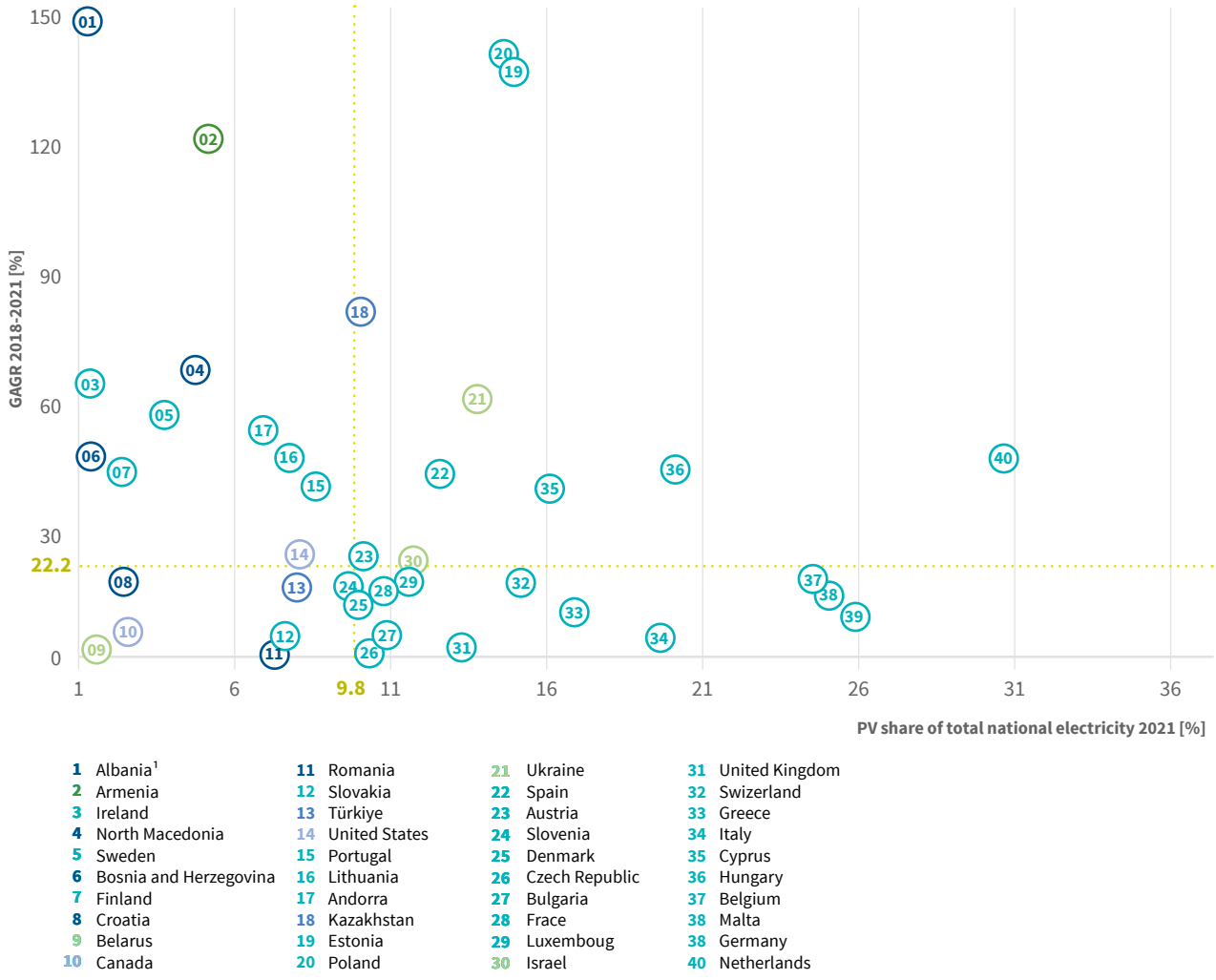
If a high CAGR prevails even if the technology's market share has reached an above-median level, member states appear in Q1. In these **thriving markets**, renewable capacity is added rapidly, expanding an already substantial generation fleet.

When the growth rate is below-median but a technology has an above-median market penetration, member states are displayed in Q4 with **saturating markets**. This is where established renewable energy markets are located.

Of course, this qualification of market status is relative to the other UNECE member states, and thus does not follow a definition that is constant over time. It also needs to be understood as a depiction of a point in time that does not reflect the fulfilment of renewable energy potential. Resource availability has not been considered in this analysis. Rather, the categorisation is a result of a member states recent market development.

23 Countries with PV market shares below 1% are: Azerbaijan, Georgia, Iceland, Kyrgyzstan, Latvia, Republic of Moldova, Montenegro, Norway, Russian Federation, Serbia, Tajikistan, Turkmenistan and Uzbekistan.
Countries with wind market shares below 1% are: Albania, Andorra, Armenia, Azerbaijan, Belarus, Georgia, Iceland, Israel, Kyrgyzstan, Malta, Russian Federation, Slovakia, Slovenia, Switzerland, Tajikistan, Turkmenistan and Uzbekistan.

Recent development of PV markets in the UNECE region



1	Albania[1]	11	Romania	21	Ukraine	31	United Kingdom
2	Armenia	12	Slovakia	22	Spain	32	Swizerland
3	Ireland	13	Türkiye	23	Austria	33	Greece
4	North Macedonia	14	United States	24	Slovenia	34	Italy
5	Sweden	15	Portugal	25	Denmark	35	Cyprus
6	Bosnia and Herzegovina	16	Lithuania	26	Czech Republic	36	Hungary
7	Finland	17	Andorra	27	Bulgaria	37	Belgium
8	Croatia	18	Kazakhstan	28	Frace	38	Malta
9	Belarus	19	Estonia	29	Luxemboug	38	Germany
10	Canada	20	Poland	30	Israel	40	Netherlands

Figure 11: PV market growth in relation to PV's share of total electricity generation capacity in the UNECE region in 2021, concentrated solar power excluded, on- and off-grid applications included[24]

[1]Albania's actual CAGR is 196.6%. For illustrational reasons, y-axis is limited to 150%.

When observing PV deployment in the UNECE region (Figure 11), the median[25] market growth rate[26] between 2018 and 2021 reached 22.2%. The share of total electricity generation capacity remained relatively low, at 9.8%, especially considering that markets with a PV penetration of less than 1% have already been excluded.

Poland, Estonia, Ukraine, Hungary, Spain, Cyprus and the Netherlands show high growth rates with significant market penetration, therefore qualifying as **thriving PV markets**. For this analysis, comparing the solar PV market of Italy and Spain is particularly insightful as the countries have comparable economic strength and resource availability (solar irradiation). Achieving a CAGR of 42.0% despite an already high market penetration of 12.4%, Spain's solar market likely still has large untapped potential. Italy, on the other hand, is among the saturating markets in Q4 with a significantly higher market penetration of 18.6% but a low CAGR. Different approaches to renewable energy policy making might explain this difference in market development.

24 Illustration based on IRENA (2022).

25 The median separates the higher half from the lower half of a data set. That means in the case of the PV market 50% of the states have a lower market share than 9.8% and 50% have a higher share. The CAGR and Figure 12 work analogously. The median is used in case of statistical outliers like in this situation. That means very high and very low numbers. Therefore, the average can be biased. In the case of the PV market very high CAGR like Albania's raise the average and distort the correct assessment of the overall growth rates. The average would be 39.0% in contrast to the median at 22.2%.

26 Note that the CAGR in Figure 11 and 12 differs from the CAGR in Figure 7 and 8. In the latter, CAGR was taken from total GW numbers whereas in Figure 10 and 11 CAGR is calculated for every country individually and then the median CAGR is taken.

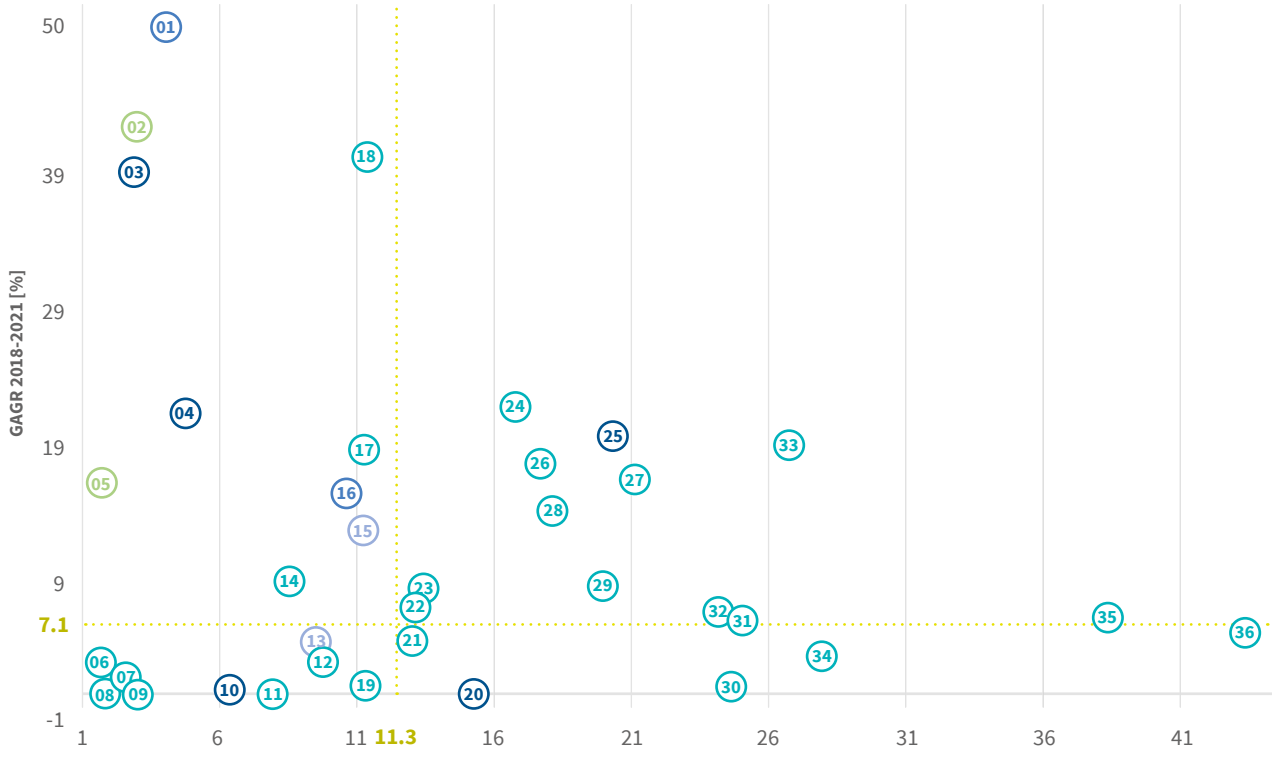
Despite only average growth and market penetration, Türkiye's PV market is noteworthy as well. Just as did Poland, Türkiye had less than 20 MW installed PV capacity at the end of 2013. In the meantime, both markets have grown substantially over the years with 7.7 GW installed capacity in Poland and 7.8 GW in Türkiye.

UNECE countries with **emerging PV markets** include Kazakhstan, Armenia, Albania, Portugal, North Macedonia, Ireland, Andorra, Bosnia and Herzegovina, Finland and Sweden. Considering resource availability (solar irradiation), it is unsurprising that countries in Northern Europe have relatively low PV market shares and are only recently beginning to take up this technology. Armenia, Albania, Bosnia and Herzegovina, North Macedonia and Kazakhstan, on the other hand, have only begun to tap into their abundant resources. Despite a mature market and high solar irradiation, Portugal still has high potential for substantial PV deployment.

Countries that are yet to deploy PV on a large scale include Türkiye, Slovakia, Slovenia, Romania, Denmark, Croatia, Canada and Belarus, finding themselves in Q3 as **underdeveloped PV markets**. Given their good climatic preconditions (solar irradiation) for PV deployment, Croatia, Romania and Türkiye are particularly noteworthy in this context, with the latter recently showing significant growth (as mentioned above).

The United Kingdom, Bulgaria, Czech Republic, France, Luxembourg, Israel, Greece, Italy, Belgium, Germany and Malta constitute the **saturating PV markets** in the UNECE region. All have high market penetration but relatively low market growth rates with Germany, Malta and Belgium showing the highest market shares in this quadrant between 24.4% and 25.7%.

Recent development of wind energy markets in the UNECE region



1	Kazakhstan[1]	11	Cyprus	21	Austria	31	Spain
2	Ukraine	12	Italy	22	Poland	32	United Kingdom
3	Bosnia and Herzegovina	13	Canada	23	France	33	Sweden
4	Serbia	14	Luxembourg	24	Netherlands	34	Germany
5	Republic of Moldova	15	United States	25	Croatia	35	Ireland
6	Czech Republic	16	Türkiye	26	Finland	36	Denmark
7	Lativa	17	Montenegro	27	Greece		
8	North Macedonia	18	Norway	28	Belgium		
9	Hungary	19	Estonia	29	Lithuania		
10	Bulgaria	20	Romania	30	Portugal		

Figure 12: Wind energy market growth in relation to wind energy's share of total electricity generation capacity in the UNECE region in 2021, on- and offshore included[24]

[1]Kazakhstan's actual CAGR is 112.8%. For illustrational reasons, y-axis is limited to 50%.

Looking at wind energy deployment in the UNECE region between 2018 and 2021 (figure 12), the median annual market growth rate was lower than that of PV (7.1% versus 22.2%). However, in 2021, wind power had a higher median market share in the UNECE region (11.3%) than PV (9.8%).

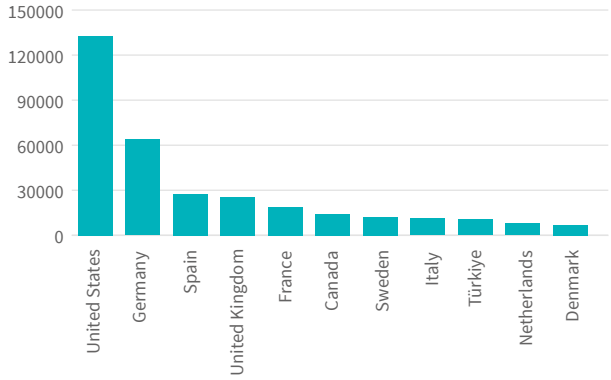
Belgium, Greece, Sweden, the Netherlands, Croatia, France, Lithuania, Norway as well as Finland show above-median growth rates in combination with above-median market shares. Within the UNECE region, these countries represent **thriving wind power markets**. Croatia is a particularly remarkable case, as it is the only non-Western and Central European country showing strong, above-median growth at a market penetration of 20.4%.

With 43.4%, Denmark has the highest market penetration of wind power, followed by Ireland with 38.3%, but its market grew slightly less between 2018 and 2021 (CAGR of 4.7% and 5.6%, respectively). As a result, it qualifies as a **saturating wind power market**, alongside Germany, Portugal, Spain, the United Kingdom, Romania, Poland and Austria.

On the other side of the spectrum, several UNECE member states qualify as **underdeveloped wind power markets** with below-median market shares and below-median growth rates. Italy, Canada, Czech Republic, North Macedonia, Bulgaria, Cyprus, Latvia, Estonia and Hungary fall into this category.

Countries with **emerging wind power markets** are beginning to tap into their wind resources with a below-median market share but above-median growth rate. Bosnia and Herzegovina, the Republic of Moldova, Serbia, Kazakhstan, Ukraine, Luxembourg, Montenegro, Türkiye and the United States belong to this group.

Installed PV electricity capacity in 2021 in MW



Installed Wind electricity capacity in 2021 in MW

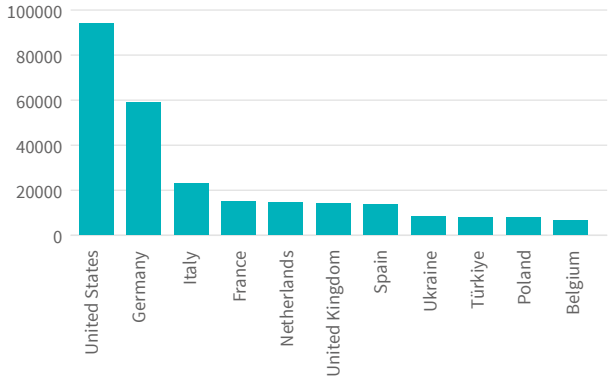


Figure 13: Installed PV and wind electricity capacity in UNECE countries[24]

Although useful for observing patterns and developments, growth rates and market shares do not provide information on total deployment figures. Figure 13 shows the ten UNECE member states with the largest installed PV and wind power capacities. Noteworthy is that all ten countries are in North America or Western and Central Europe with the exception of Türkiye (Central Asia). Not surprisingly, the United States leads on total deployment in both PV and wind power by a wide margin. This is due to obvious reasons such as country and market size and resource potential, but also due to less obvious reasons such as political support, competition from other resources, availability of local expertise and supply chains, and others. Generally, the differences within the UNECE region are extreme. 27 member states (out of 53 in total with available data) hold 99% of the entire PV capacity installed in the UNECE region. Similarly, 24 states cover 99% of the total installed wind power capacity.

03 Barriers and Challenges to the Uptake of Renewable Energy

As section 2 has demonstrated, renewable energy is gaining traction in the UNECE region. However, deployment figures are still not in line with the required speed to reach a carbon-neutral energy system by 2050 and achieve the global climate targets. Various barriers hinder the market penetration of renewable energy throughout the region.

This section provides an overview of barriers and challenges in terms of political strategy, economic viability, infrastructural capacity and public acceptance. Although not exhaustive, the following challenges represent major, overarching issues that need to be addressed early on and throughout the transition to a sustainable energy system based upon renewable energy.

3.1 Lack of Long-term Energy Sector Strategy

Transitioning from a fossil-dominated, conventional energy system to a renewable energy-based one is a task for decades, not years. As energy and the provision of energy services are essential for a country's society and economy, the transition to a sustainable, climate friendly energy system must be undertaken gradually, while maintaining a continuous balance of demand and supply at any given time. Major assets of the energy system and supporting infrastructure, including power plants and networks, need to be maintained, upgraded and enhanced, newly deployed or decommissioned. This all requires advanced planning and coordination and the establishment of a long-term, overarching energy sector strategy.

A comprehensive energy sector strategy sets out a vision for the sustainable supply of energy that meets expected demand with clear targets and timelines. This indicates a clear pathway forward and provides benchmarks that current and future political action can be checked against. A thorough assessment and understanding of the status quo and potential of the energy sector complements the vision. It is the prerequisite for successful regulatory interventions and requires the availability of reliable statistical data. With the vision and status quo in place, a country can then begin to develop strategies for the transition. This includes analysing and planning for required infrastructure and assets and their inherent interdependencies (e.g. generation additions and network connections). Building upon this, concrete policies can be drafted for the development of market structures that incentivize energy sector participants to act on achieving the vision and deploy the required technology.

Without such a comprehensive energy strategy, the use of resources and successful decision making and coordination amongst all relevant actors is less than optimal and thereby inefficient. Investment in necessary infrastructure is misguided, uncoordinated and lacking of long-term vision and planning. Private sector involvement is limited as the lack of a fundamental and clear message from the central authority and government lowers investor's confidence in the long-term viability of their investments. Subsequently, this leads to a lack of investment capital and higher interest rates, which in turn compromises the economic viability of projects (section 3.2) and timely development of the sector.

A comprehensive plan that aggregates energy sector data such as energy resource potentials, historical statistical trends and sophisticated forecasting, together with qualitative and quantitative information, into a clearly formulated and evidence-based development pathway is required as it allows for sound decision-making and sector development. Although energy sector planning and strategies will have to be adapted to new developments such as advances in technologies or geopolitical events, a certain degree of regulatory stability is required and crucial to maintain the confidence of all energy sector stakeholders and ensure market development and the achievement of energy sector and climate targets.

3.1.1 Policy Implementation: Long-term Energy Strategy

When designing renewable energy policies, the following guiding questions can support successful establishment and **implementation of a sector-wide long term energy strategy:**

- Does the government have a vision for and a clear commitment to renewable energy?
- Does a stable political framework exist?
- How does infrastructure ownership affect market access? Different policies can be considered depending on whether ownership is private or public.
- Is new infrastructure needed, or can existing infrastructure be upgraded or modernised?
- What existing regulations and political realities affect market access for renewable energy? Market access for renewable heat, for example, is influenced by factors such as building regulations, energy efficiency regulations and technical standards.
- Are permitting procedures clear and transparent, including the responsibilities of different public authorities? A 'one shop stop' approach for renewable energy projects is useful to reduce bureaucratic barriers and increase investors and project developers' confidence.
- Is there a clear enough understanding of energy demand and corresponding renewable generation? Energy mapping is important for accurately understanding electricity and heat consumption, and for connecting it with the highest possible share of renewable electricity and heat generation. In the case of heating, a certain amount might be covered by both renewable heat and excess heat from industry.
- What policy options are already being implemented or are available on a local level? The local level is key to achieving decarbonisation goals, and often has a high degree of policy effectiveness.
- What are neighbouring countries doing to increase their share of renewable energy? International cooperation between neighbouring UNECE countries can lead to a more sustainable electricity and heat supply as the countries often face similar challenges. Country clusters and collaborations can produce joint strategies and measures.
- Which ministries and public institutions on both national and provincial level need to be involved in the creation, implementation and monitoring of renewable energy support schemes that connect various sectors including environment and climate, transport, agriculture, and finance? What are their responsibilities?
- What role does innovation play in public procurement? When awarding concessions or public tenders, innovative approaches to and integration of renewable energy can play an important part in the selection criteria.

3.2 Lack of Economic Viability

As pointed out in section 2.1, the costs for renewable energy technologies have fallen dramatically over the last decade and subsequently economic viability for renewable energy projects has vastly improved. Despite these advances, renewable energy solutions are not yet sufficiently economically attractive to drive required levels of growth throughout the entire UNECE region.

A range of factors impede the economic viability of renewable energy projects. Lack of information or even misinformation, the relative immaturity of the sector and inexperience of relevant stakeholders (financial institutions, project developers, network operators, etc.) and limited access to investment capital and financial services all lead to higher perceived and actual costs for renewable energy projects. These factors are however not unique to the energy sector and often impact any innovative, nascent or developing technology.

Of particular and significant relevance to the economic viability of renewable energy investments is energy pricing, energy subsidies for conventional energy sources, and the means and methods by which costs of energy supply are socialised. Market-distorting subsidies (particularly for fossil fuels or electricity/heat), misaligned taxes and levies as well as instable revenue flows hamper the economic viability of renewable energy. This results in a lack of a level playing field for renewable energy technologies and hinders market development.

Furthermore in many UNECE countries, currency and political risks lead to high interest rates, compromised project bankability and, subsequently, the unavailability of investment capital.

3.2.1 Energy Pricing and Subsidies

As the main contributing factor by which generation assets, including renewable energy generators, earn revenues and recuperate investment costs, electricity prices are a crucial factor for the successful deployment of renewable energy - they directly influence the economic viability of renewable energy investments.

Electricity prices are generally composed of electricity generation and supply costs, network charges, as well as various taxes a nd levies such as sales, value-added taxes or renewable energy support levies. Electricity generation costs from all types of generating plants, both conventional and renewable, determine the electricity market price and, as the main component of electricity prices, they are decisive for the degree of economic viability of renewable energy generation.

Given the importance of energy access for quality of life and economic growth, and taking into account current socioeconomics, development goals and access to natural resources, governments strive and often struggle to find the best approach to energy and electricity pricing. Energy prices and costs for consumers, both

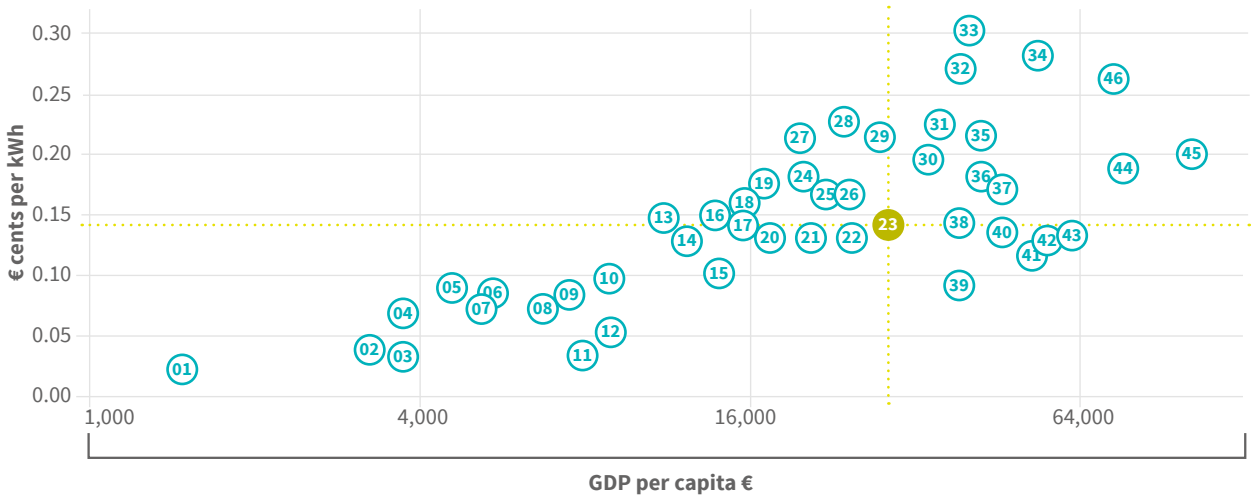
private households and businesses, often represent a considerable portion of household budgets or expenditures. As such, electricity pricing and the method by which costs for energy supply and energy infrastructure is socialised, has a direct effect on social acceptance of general and renewable energy policy, and the competitiveness of energy-intensive businesses and industries.

In order to enable access to energy to the most vulnerable and poor citizens, especially in developing nations, policy is often focussed on keeping energy prices as low as possible, even if actual energy supply costs are not covered. This type of subsidization is also quite common in countries with plentiful, indigenous natural resources. Low energy prices however, incentivise consumption and production of fossil-fuels, distort market signals and impede discovery of actual energy supply and consumption costs. In addition, subsidizing energy costs often strains government budgets, increases debt in developing economies and also negates climate mitigation efforts and tools such as emission trading or carbon taxes.

The existence of subsidies and the level of subsidisation is not always easy to identify. The most common method for measuring consumption subsidies; the price-gap approach compares average end-user prices with reference prices for the full cost of supply. A subsidy is present if the price an end-user pays is below the reference price for the full cost of supply. However, extensive data from international organisations, local governments and various organisations is required. Furthermore, costs of supply diverge greatly across the region and reference prices are based on international prices, thus making it difficult to accurately calculate the level of subsidisation.[27] Nonetheless, in the absence of all required data, electricity prices that do not align with global or regional averages imply that fossil-fuel subsidies are in place.

Throughout the UNECE region, approaches to energy pricing policy, subsidisation and the socialisation of renewable energy expansion costs are varied. In the absence of holistic data and information on direct and indirect subsidies, observing electricity prices can provide insight into the different energy pricing policies of member states.

As can be seen in Figure 14 and Figure 15, electricity prices between UNECE member states diverge greatly for both households (14) and for industrial consumers (15). In both figures, the y-axis displays the end-consumer electricity price in eurocents, including taxes and levies where data available, and relates it to the country's GDP per capita, shown on the x-axis. A positive correlation between the prices end consumers pay and the GDP per capita of the respective country can be observed; wealthier or more developed economies generally pay more for electricity. Noteworthy, most countries in Southeast Europe are among the countries with the cheapest electricity, ranging well below the average and comparable economies.

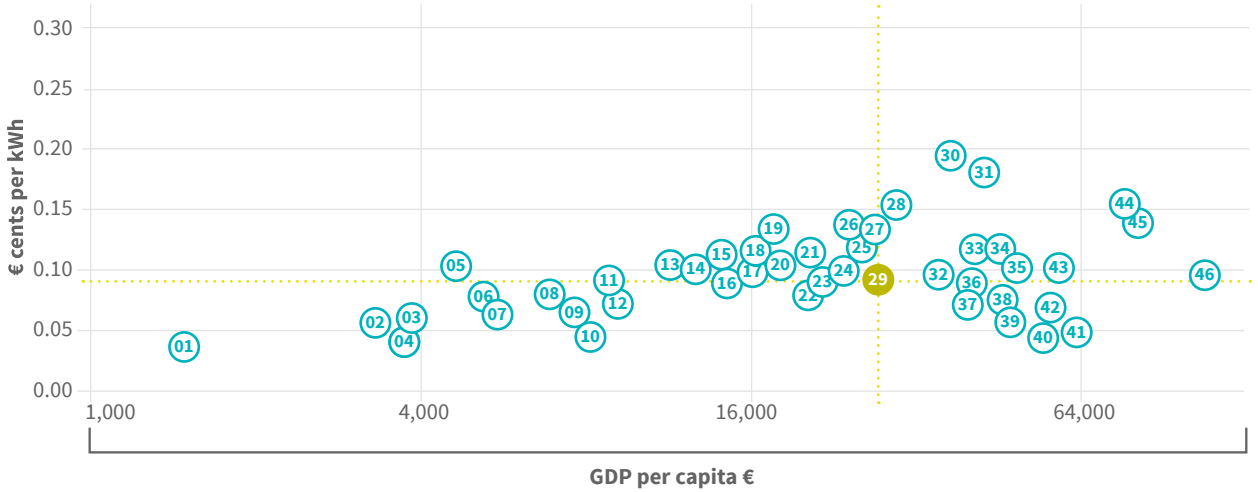


1	Uzbekistan	11	Kazakhstan	21	Estonia	31	United Kingdom	41	Iceland
2	Ukraine	12	Russian Federation	22	Malta	32	Belgium	42	United Strates
3	Azerbaijan	13	Romania	23	Average	33	Germany	43	Norway
4	Armenia	14	Croatia	24	Czech Republic	34	Denmark	44	Switzerland
5	Albania	15	Hungary	25	Slovenia	35	Austria	45	Luxembourg
6	Bosnia and Herzogovina	16	Poland	26	Cyprus	36	Finland	46	Ireland
7	North Macedonia	17	Latvia	27	Portugal	37	Sweden		
8	Serbia	18	Greece	28	Spain	38	Israel		
9	Türkiye	19	Slovakia	29	Italy	39	Canada		
10	Bulgaria	20	Lithuania	30	France	40	Netherlands		

Figure 14: UNECE electricity prices for private households in relation to GDP per capita in 2020[28]

27 IEA 2022

28 Illustration based on Eurostat (2021), GlobalPetrolPrices.com (2020), World Bank (2022). For detailed information about electricity prices see Figures 16 and 17.



1	Uzbekistan	11	Bulgaria	21	Portugal	31	Germany	41	Norway
2	Ukraine	12	Russian Federation	22	Czech Republic	32	France	42	Denmark
3	Armenia	13	Romania	23	Estonia	33	Belgium	43	United States
4	Azerbaijan	14	Croatia	24	Slovenia	34	Austria	44	Ireland
5	Albania	15	Poland	25	Spain	35	Netherlands	45	Switzerland
6	North Macedonia	16	Hungary	26	Cyprus	36	Israel	46	Luxembourg
7	Bosnia and Herzegovina	17	Latvia	27	Malta	37	Canada		
8	Serbia	18	Greece	28	Italy	38	Finland		
9	Türkiye	19	Slovakia	29	Average	39	Sweden		
10	Kazakhstan	20	Lithuania	30	United Kingdom	40	Iceland		

Figure 15: UNECE electricity prices for industrial consumers in relation to GDP per capita in 2020[28]

Figures 16 and 17 show the electricity prices in the UNECE region for household and industrial consumers respectively in descending order and display both the full price charged to the consumer and its split into generation costs as well as added taxes and levies (where data available). As both graphics show, electricity generation costs, including network costs, range between 0.10€/kWh and 0.15€/kWh in most UNECE member states. For member states in Southeast Europe and Central Asia, the overall electricity costs are well below 0.10€/kWh in total, giving further indication that electricity prices may be artificially low in these countries.

As can been seen in Figure 17, electricity prices for industrial consumers are generally lower than those for households in all member states across the region. As energy costs make up a large portion of business expenditures and directly effect international competitiveness of whole industries, business consumers enjoy greater subsidies and tax exemptions for energy.

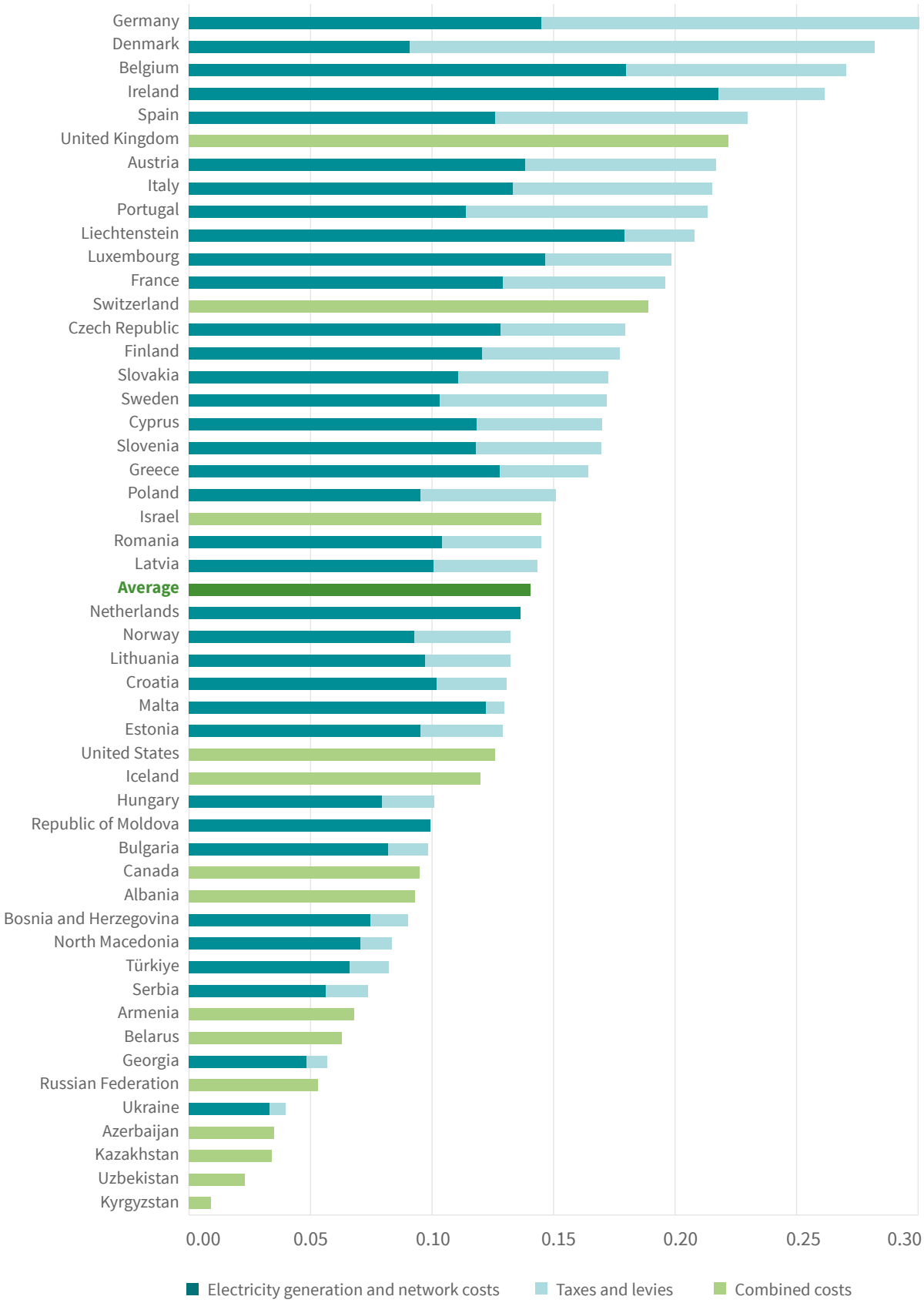


Figure 16: Composition of UNECE electricity prices for households in Eurocents/kWh in 2020[29]

29 Illustration based on Eurostat (2021), GlobalPetrolPrices.com (2020). All data for electricity prices are from 2020. For households, data are taken from an annual consumption range between 2,500 and 5,000 kWh. Taxes and levies include VAT and recoverable taxes. Defined by Eurostat. For single-coloured bars, no data were available for the different electricity price components. The prices for households are calculated using the average annual household electricity consumption per year. Defined by Globalpetrolprices.com. Prices between the two sources are not fully comparable due to different statistical approaches. It does not however distort the prices in a significant way which means the order in the figure still gives a true impression of the different electricity prices in the UNECE region.

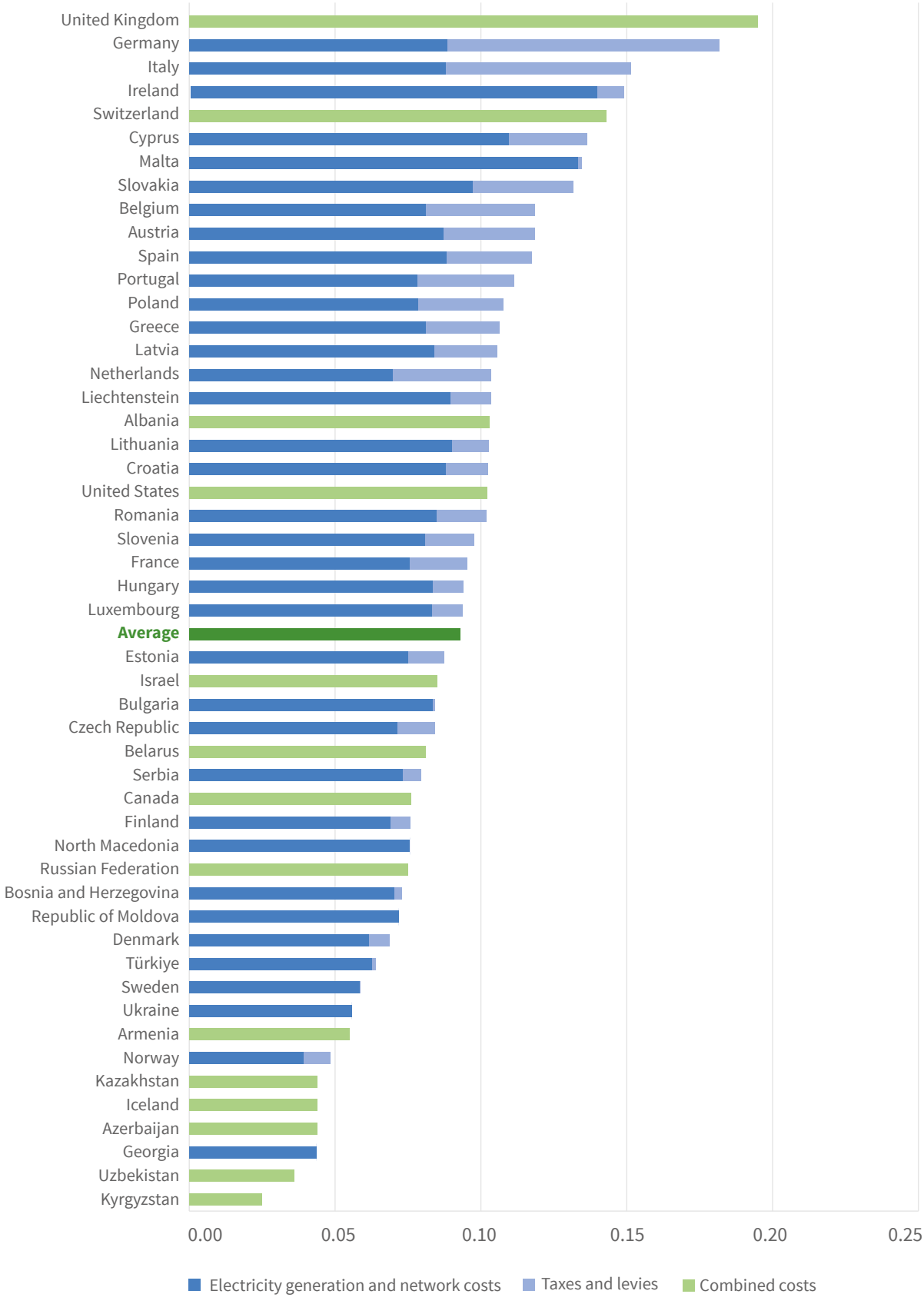


Figure 17: Composition of UNECE electricity prices for industry in Eurocents/kWh in 2020[30]

30 Illustration based on Eurostat (2021), GlobalPetrolPrices.com (2020). All data for electricity prices are from 2020. For industrial consumers, the range lies between 500 and 2,000 MWh. Taxes and levies include VAT and recoverable taxes. Defined by Eurostat. For single-coloured bars, no data were available for the different electricity price components. The prices for businesses are calculated using 1,000,000 kWh consumption per year. Defined by Globalpetrolprices.com. Prices between the two sources are not fully comparable due to different statistical approaches. It does not however distort the prices in a significant way which means the order in the figure still gives a true impression of the different electricity prices in the UNECE region.

UNECE member states with artificially low electricity prices or subsidised electricity prices from conventional energy sources present a difficult starting position for the uptake of renewable energy. In the absence of energy prices that reflect actual costs of supply, renewable energy expansion is stifled as renewable energy investments cannot be amortised and there is therefore little or no incentive for market entry.

In order to foster the market for renewables, existing fossil-fuel subsidies should be reviewed. In addition, renewable energy support policies and promotion schemes can be utilised to aid economic viability and create markets for renewable energy technologies. However, running these schemes entail promotion costs, which are frequently redistributed in the form of taxes or levies that increase final consumer electricity prices. This may lead to social acceptance issues for renewable energy deployment and impact the competitiveness of industries. To aid expansion costs and especially where extensive fossil fuel subsidies exist, the costs of renewable energy promotion schemes can be covered through a reduction of fossil fuel subsidies and reallocation of national budgets. Furthermore, as observed in Section 2 above, the costs of renewable energy are expected to further decline in the medium term and become more affordable in all UNECE member states across the region, making subsidisation less necessary and aligning actual costs with consumer prices.

In the context of renewable energy deployment, electricity pricing constitutes an important trade-off between implemented renewable energy promotion schemes, social acceptance and the international competitiveness of local industries. Therefore, extensive analysis and monitoring of electricity pricing and policy is necessary for the successful uptake of renewable energy.

On a global scale, it is clear that renewable energy is becoming a competitive edge for attracting new industries and services. For companies, it is a matter of making new location decisions dependent on the local availability of affordable and CO_2-free electricity or energy. Against this background, it is an important opportunity for governments to adapt the framework for renewable energy to make their economies fit for the future.

3.2.2 Policy Implementation: Improving Economic Viability of Renewable Energy

When designing renewable energy policies the following guiding questions can support successful strategies and policies in the field of **economic viability and financing**.

- What are the energy pricing aspects in the country? When considering the economic viability of renewable energy projects, it is important to review existing subsidies and market structures favouring fossil generation. Energy prices should reflect real costs, and include the negative environmental effects of generation, so that they can function as an incentive for renewable energy.
- Are financial support schemes necessary to help with the uptake of renewable energy? Depending on technology and policy objective, a range of different approaches is available (section 4.1)
- How easy is it to access financing and cover capital costs? These two aspects are crucial for the development of renewable energy projects. Local banks need to have the capacities and resources to finance renewable energy projects, especially in the face of high upfront costs.
- Are loans from development banks such as the EBRD or the World Bank available? Having access to these loans can help reduce financial costs, increase financial security and thereby make renewable energy projects feasible.
- Are (high) import taxes and custom duties imposed on renewable energy technologies and components? High levies and taxes have a significant impact on the viability of renewable energy projects in countries that must import most of the necessary equipment.
- What standards apply in the country? Having different standards in place may result in increased capital costs when entering new energy markets abroad.
- How much bureaucracy is involved in implementing renewable energy projects? The difficulty and time involved in processing and receiving permits and licenses influences the economic viability of projects.
- How stable is the local currency? Fluctuations and devaluations in local currencies are major challenges to the economic viability of renewable energy projects, especially if foreign investors are involved. This is because local currencies are often used to pay for the energy generated.

3.3 Lack of Infrastructural Capacity and Flexibility for Renewable Energy Integration

Another prevailing challenge in achieving a secure, stable and sustainable energy system is the successful integration of intermittent renewable energy resources into energy networks. In most UNECE member states, power grids still operate in the traditional way, meaning they deliver electricity from central sources of supply one-way to consumers. Integrating decentral renewables requires different grid operation methods, processes and technologies that enable bi-directional flows of electricity. In many countries, grid systems and equipment are not yet fit for this type of operation. In addition, renewable energy assets frequently connect to distribution rather than transmission grids, putting additional strain on these low-voltage networks. Although low levels of intermittent renewable energy resources can be received and accommodated by current networks, further expansion and integration of renewable sources with the most potential in most of the UNECE member states, namely solar and wind, require considerable network upgrades and more advanced operation methods.

In that respect, virtually all UNECE countries face the task of upgrading their power and heating networks to account for increased shares of intermittent renewable resources and changes in operation. In addition to necessary network upgrades, increasing system flexibility through demand side management or renewable flexible generation and storage can be utilised. Demand side management methods modify customer demand patterns through education or by incentivising customers (private, commercial and industrial) to shift their power demand requirements to either increase or reduce load, which helps prevent the curtailment of renewable energy and increases system stability.

Flexible renewable generation, such as pumped hydropower plants and battery storage systems can help to balance out fluctuations in the energy generated from renewable sources. Due to technical constraints, nuclear, coal and other fossil-fuelled power plants are mostly not capable of providing the necessary flexibility to provide dynamic grid stabilising services.

While the level of electrification is generally high and power networks are available and reach a large majority of the population in the UNECE region, district heating networks are far less common or expansive. In many countries, decentral heat generation prevails, leading to different challenges when integrating renewable energy. Existing networks and systems can be converted or adapted to utilise a range of renewable technologies such as heat pumps, biomass, biogas, geothermal energy, large-scale solar thermal heat plants with seasonal storage, and waste-to-energy plants. However, depending on the technology and existing infrastructure, a range of challenges may persist which require holistic solutions.

3.3.1 Policy Implementation: Developing Infrastructural Capacity and Flexibility for Renewable Energy Integration

When designing renewable energy policies the following guiding questions can support successful strategies and policies in the field of **infrastructural capacity and flexibility for renewable energy integration**.

- Is there an accurate monitoring system in place? Predicting and forecasting energy supply and demand helps to balance power grids and integrate intermittent renewable energy such as wind and solar.
- What standards are in place? Do they comply with international standards? Standards on matters such as integrating renewable energy into existing grids are important. They need to be properly designed and implemented, and should take account of different system requirements (grid codes, licensing procedures, etc.). Currently, standards vary from country to country, which hampers the cross-border use of renewable energy and excess heat. International standards can help improve cross-border energy use and thus make the overall energy supply system more efficient.
- Does the country already produce a large amount of renewable electricity? Technologies that link different energy sectors offer new possibilities for sustainably generating heating energy. Efficient biomass waste-to-energy plants make it possible to combine heat and electricity supplies while also solving waste disposal problems.
- What are the plans for increasing energy efficiency? It is important to look at the targets for energy efficiency when forecasting future heat demand, as an increase in efficiency will reduce demand.
- Do connections with neighbouring countries exist? Such connections can be beneficial when it comes to balancing the electricity grid and using natural resources efficiently on an international level.
- What laws and regulations govern land use? It is important to be able to assess the availability and quality of resources, but this has proven difficult in some UNECE countries (analysing geothermal potential is one example). Particularly in densely populated areas, renewable electricity and heat are competing for space and land use rights.
- Do heating networks exist? Especially in urban areas, heating networks can be the backbone of a low-carbon or zero-carbon heating supply. Hence, the existence of inefficient district heating networks, a lack of heating networks, or efforts to dismantle networks are obstacles to developing renewable heat. Plans for heating networks must consider both renewable and excess heat supply and demand, and future gains in efficiency. Many heating networks still work with very high temperatures from conventional heat generation. However,

renewable heat technologies and excess heat producers can supply heat via low-temperature heating networks.

- Does the country have sufficient expertise to operate renewable heat and excess heat supply systems? There are many possibilities in the UNECE region, such as using waste heat from oil refinery processes, geothermal heat and heat from bioenergy for industry, agriculture and public buildings.

3.4 Lack of Public Acceptance and Awareness

If renewable energy is to become an integral part of a country's energy system, then awareness, knowledge and capacities among all relevant stakeholders are vital. Given the different levels of deployment between countries with advanced renewable energy markets and those at an earlier stage of renewable development, mutual learning, knowledge transfer, capacity building and cooperation will be fundamental to help accelerate the uptake of renewables throughout the region.

Lack of awareness is one of the main obstacles to greater renewable deployment in many parts of the UNECE region, especially when the implementation of renewable energy technologies results in increased costs and electricity prices for consumers. The general population, businesses and even (local) governments are sometimes unaware of the potential and (economic) viability of renewable energy sources. This may result in a lack of public acceptance of renewable technologies – a situation that can be further aggravated by a relatively small number and low visibility of best-practice examples. Such local reference points, communicated via public programmes, for instance, play an important role in raising awareness. As mentioned above, a comprehensive energy sector strategy that is shared and communicated with all stakeholders, including the greater public, is essential to raise awareness and acceptance of the benefits of renewable energy.

Within the UNECE region, awareness about the advantages of renewable heat, for instance, is also clearly still lacking, while the disadvantages of a fossil heating supply (such as health risks, particularly from old, inefficient and polluting stoves) are frequently overlooked. Raising awareness about the opportunities and benefits of renewable energy is vital, though often quite difficult in practice.

3.4.1 Policy Implementation: Acceptance and Awareness Raising

When designing renewable energy policies the following guiding questions can support successful strategies and policies in the field of **acceptance and awareness raising**.

- Does the country have any flagship or demonstration projects in place? To increase awareness and encourage a positive social perception of energy from renewable sources, official commitments by public decision-makers and the existence of visible and symbolic flagship projects matter a great deal. Target groups include installers (especially in countries where basic knowledge is lacking), consultants such as energy auditors, final consumers, policymakers, public administrators, and opinion leaders in the media and civil society.
- Can individuals actively profit of renewable energy deployment? Prosumer schemes, investment opportunities for the public and favourable electricity procurement contracts for communities close to project sites can strongly improve public acceptance (see section 4)
- What myths and misperceptions exist around the functioning and effects of renewable energy? Awareness campaigns help in debunking myths and drawing attention to the importance and viability of renewable energy. Sound scientific studies and demonstration projects can also help reduce fears and concerns among the population.
- What is the level of public acceptance for renewable energy? Even if awareness for renewable energy is high, public acceptance for the deployment and promotion schemes may not be. Public sector institutions and individuals should take a leading role in promoting the benefits of renewable energy.
- What role can education play in creating social acceptance and public awareness? Which Technical and Vocational Education and Training curricular exist in the country that include renewable energy themes? Educating the population on renewable energy can be a crucial task. Education policies and information on environmental integrity and climate change are essential elements of a comprehensive awareness-raising strategy.
- Are any dialogue formats in place for exchanging ideas and good practices with other countries? Schemes that encourage dialogue between different countries raise own and foreign performance and allow each country to gain knowledge about efforts and progress elsewhere. A country with little renewable energy capacity might be more likely to set expansion targets, enact policies and launch programmes to foster renewable energy if other countries with similar needs and in comparable circumstances have already done so. Furthermore, exchanging information on what worked and what did not work could make it much easier to draw up effective policies.
- Is there any scope for tapping into international cooperation programmes? A wealth of international cooperations, collaborations and programmes exist that can be tapped into and used to increase knowledge and awareness about renewable energy. Exchange programmes, train-the-trainer programmes and other capacity-building schemes can be a major boost to sharing information, increasing knowledge and driving renewable energy deployment.
- How can national or local civil society organisations become partners to increase awareness about the benefits of renewable energy among the population?

04 Renewable Energy Policymaking in the UNECE Region

4.1 General Introduction to Renewable Energy Policymaking

Renewable energy promotion schemes and support policies aim to facilitate market entry, system integration and market growth of renewable energy by addressing barriers and challenges as identified in Chapter 3. While some policies and measures may be focussed and aim to address specific challenges, such as expansion targets or rebates for specific technologies to improve economic viability, other policies may be more broad and address multiple challenges, such as targets or quotas for the uptake and consumption of renewable energy system wide. Table 3 summarises the most common renewable energy support policies and measures and the main challenges and barriers they aim to address.

Promotion Scheme	Description	Primary Focus
Official Targets for Renewables	Defines and officially communicates binding or non-binding targets and goals for the expansion and use of renewable energy. Targets may be technology or sector specific.	Energy sector strategy, economic viability, acceptance
Guarenteed / Priority Access	Providing all technical and regulatory requirements are met, network operators are required to guarantee and prioritise grid connection and access to new renewable installations.	Economic viability, integration
Priority Dispatch	Priority dispatch is guaranteed for renewable generators whereby grid operators are obligated to prioritise the feed-in and dispatch of renewable electricity from renewable generators ahead of conventional generators.	Economic viability, integration
Net Metering / Net Billing	Net billing and net metering mechanisms promote self-consumption of distributed generation. Renewable electricity system owners are credited for the net value between the electricity they feed into the grid and electricity they use. Electricity surpluses can be remunerated as credit for future electricity demand (net metering) or as direct financial compensation at an agreed rate or tariff (net billing).	Economic viability, acceptance
Feed-in Tariff (FiTs) or Feed-in Premium (FiPs)	Administratively set pricing instrument that remunerates producers for feeding renewable electricity into the grid. The feed-in of electricity is either remunerated with a fixed tariff (FiTs) or at market prices supplemented with a variable market premium (feed-in premium).	Economic viability
Quotas & Obligations (renewable portfolio standards, renewable obligations)	Quotas and Obligations set and define the minimum share of renewable energy required in the energy mix of power utilities and electricity and fuel providers. Quota systems are often combined with trading systems that use green certificates or renewable energy certificates. Such quotas may also apply to large consumers.	Energy sector strategy, economic viability
Tradable Renewable Energy Certificates (REC)	RECs are tradable, non-tangible commodities that represent a unit of generated renewable energy from an eligible generator, which are often used in combination with quota systems. The certificates are issued for each unit of renewable electricity (usually MWh) that is generated and supplied.	Economic viability
Auctions / Tenders	A renewable energy auction is a competitive process for the procurement of renewable electricity generation, whereby project developers compete for long-term supply contracts based primarily on the lowest price of energy provision. Auctions can be designed to promote transparent procurement and competitive prices, in addition to other system and policy specific goals, such as system flexibility or the development of local industries and expertise.	Energy sector strategy, economic viability, integration
Other Financial Incentives	Financial or fiscal incentives such as credit grants, lower interest rates, tax credits or exemptions, and soft loans are designed to improve access to capital, reduce financing costs and otherwise reduce upfront costs of renewable energy systems and efficiency measures or processes. Typical examples include subsidies for electric vehicles or tax-exemptions for equipment used in large scale renewable energy projects.	Economic viability

Table 3: Renewable energy promotion schemes and measures in the electricity sector

The success of each scheme depends on various factors. On the one hand, policies need to be predictable, consistent and steady over the long term in order to create stable market conditions and planning security for all stakeholders, including plant operators, investors and end consumers.[31] On the other hand, the effectiveness of renewable energy policies strongly depends on their applicability within the existing energy market structure. Also, as multiple renewable energy promotion policies often run in parallel, their combined effect needs to be considered and monitored in order to avoid any undesirable effects such as excessive cross-subsidisation or technological lock-in.

The following subsections 4.2 and 4.3 examine the current state of renewable energy policy implementation in the electricity and heat sector in the UNECE region.

4.2 Policies Promoting Renewable Electricity in the UNECE Region

As shown in section 2.2, market shares of renewable electricity generation capacity grew rapidly in several UNECE member states in the past years. This is a result of the successful introduction of regulation and support for renewable energy. Figure 18 shows the current stage of implementation for the renewable energy promotion schemes in the electricity sector. Only two out of 52 analysed countries – Turkmenistan and Iceland - have no policies specifically promoting the use of renewables.[32] All other member states have a variety of policies in place that support market entry, integration and growth of renewable energy. It should be noted though, that the figure only provides a quantitative analysis as there is no statement about the quality of the policies implemented.

Country	Official Targets for Renewables	Guaranteed / Priority Access	Priority Dispatch	Net Metering / Net Billing	Feed-in Tariff or Premium	Renewable Portfolio Standard / Quota System	Tradable REC	Tendering / Auctions	Other Financial Incentives
Albania	✓	✓	✓	✓	✓	✓	✓	✓	✓
Armenia	✓	✓	✓	✓	✓	✗	✗	✓	✓
Austria	✓	✗	✓	✓	✓	✗	✓	✗	✓
Azerbaijan	✓	✗	✗	✗	✗	✗	✗	✗	✓
Belarus	✓	✓	✗	✗	✓	✓	✗	✗	✓
Belgium	✓	✓	✓	✓	✗	✓	✓	✓	✓
Bosnia and Herzegovina	✓	✓	✓	✗	✓	✗	✗	✓	✗
Bulgaria	✓	✓	✓	✗	✓	✗	✗	✗	✓
Canada	✓	✓	✓	✓	✓	✓	✓	✓	✓
Croatia	✓	✗	✓	✗	✓	✗	✗	✓	✓
Cyprus	✓	✓	✓	✓	✓	✗	✗	✓	✓
Czech Republic	✓	✓	✓	✗	✓	✗	✓	✗	✓
Denmark	✓	✓	✓	✓	✓	✗	✓	✓	✓
Estonia	✓	✗	✗	✗	✓	✗	✗	✓	✓
Finland	✓	✓	✓	✗	✓	✗	✓	✓	✓
France	✓	✓	✗	✗	✓	✗	✓	✓	✓
Georgia	✗	✗	✗	✗	✗	✗	✗	✗	✓
Germany	✓	✓	✓	✗	✓	✗	✓	✓	✓
Greece	✓	✗	✓	✓	✓	✓	✓	✓	✓
Hungary	✓	✓	✗	✓	✓	✗	✗	✓	✓
Iceland	✗	✗	✗	✗	✗	✗	✗	✗	✗
Ireland	✓	✓	✓	✗	✓	✗	✓	✓	✓
Israel	✓	✓	✓	✓	✓	✓	✗	✓	✓
Italy	✓	✓	✓	✓	✓	✗	✗	✓	✓
Kazakhstan	✓	✓	✓	✗	✓	✗	✓	✓	✓
Kyrgyzstan	✗	✗	✗	✗	✗	✓	✗	✗	✓
Latvia	✓	✗	✗	✓	✓	✗	✗	✓	✓

31 Swisher and Porter 2006
32 Andorra, Liechtenstein, San Marino and Monaco were excluded of the assessment due to a lack of data.

Country	Official Targets for Renew-ables	Guaran-teed / Priority Access	Priority Dispatch	Net Metering / Net Billing	Feed-in Tariff or Premium	Renewable Portfolio Standard / Quota System	Tradable REC	Tendering / Auctions	Other Financial Incentives
Lithuania	✓	✓	✓	✓	✓	✓	✗	✓	✓
Luxembourg	✓	✗	✗	✗	✓	✗	✗	✓	✓
Malta	✗	✓	✓	✓	✓	✗	✗	✓	✓
Republic of Moldova	✗	n/a	n/a	✓	✓	✗	✗	✓	✓
Montenegro	✓	✓	✓	✗	✓	✗	✗	✓	✓
Netherlands	✓	✗	✓	✓	✓	✗	✓	✓	✓
North Macedonia	✓	✓	✓	✗	✓	✗	✗	✗	✓
Norway	✓	✓	✓	✗	✗	✓	✓	✓	✓
Poland	✓	✗	✗	✗	✓	✓	✓	✓	✓
Portugal	✓	✓	✓	✗	✗	✓	✓	✓	✓
Romania	✓	✓	✓	✓	✗	✓	✓	✗	✓
Russian Federation	✓	✓	✓	✗	✓	✗	✗	✓	✓
Serbia	✓	✓	✓	✗	✓	✗	✗	✗	✓
Slovakia	✓	✓	✓	✗	✓	✗	✓	✗	✓
Slovenia	✓	✓	✓	✓	✗	✗	✓	✓	✓
Spain	✓	✓	✓	✓	✗	✗	✗	✓	✓
Sweden	✓	✗	✓	✗	✗	✓	✓	✗	✓
Switzerland	✓	✓	✓	✗	✓	✗	✓	✗	✓
Tajikistan	✓	✓	✗	✗	✓	✗	✗	✗	✓
Türkiye	✓	✓	✓	✓	✓	✗	✗	✓	✓
Turkmenistan	✗	✗	✗	✗	✗	✗	✗	✗	✗
Ukraine	✓	✓	✓	✓	✓	✗	✗	✗	✓
United Kingdom	✓	✓	✓	✗	✓	✓	✓	✓	✓
United States	✓	✗	✗	✓	✓	✓	✓	✓	✓
Uzbekistan	✓	✗	✗	✗	✗	✗	✗	✓	✓

Figure 18: Renewable energy promotion schemes and measures in the electricity sector in UNECE member states[33]

Out of the 52 analysed countries, 46 have official, and to a certain extent, technology-specific renewable energy expansion goals. Guaranteed or prioritised grid access exists in 35 countries while projects receive priority dispatch in 36 countries. In 31 countries both policies are implemented whereas in nine countries, only one of the two policies are in place. Out of 15 countries which have implemented quotas or obligations, only Poland, Kyrgyzstan and the United States have neither guaranteed / prioritised access to grid nor priority dispatch. In summary, 43 countries have at least one of the three policies - prioritised grid access, priority dispatch and/or quotas/obligations - installed. Twenty-two UNECE member states have policies for net metering or net billing. Feed-in-tariffs or –premiums are in place in 39 countries.

Eleven countries have introduced tradable renewable energy certificates alongside their quota system, while 12 have introduced certificates trading without establishing a quota system. Auctions are increasingly used to determine the market value of renewable energy and have been introduced in 35 national energy markets.

Finally, a large majority – besides Iceland, Turkmenistan and Bosnia and Herzegovina - use tax reductions and other financial (investment) incentives to promote renewable energy in the electricity sector. In combination with official expansion goals, both policies are implemented in 45 countries.

33 Illustration based on Energy Sector Management Assistance Program 2020; REN21 2021; RES LEGAL Europe 2019; Energy Community 2021; Climate Change Laws of the World database, Grantham Research Institute on Climate Change and the Environment and Sabin Center for Climate Change Law n.d.; European Commission n.d.; Koper et al. 2020

4.3 Policies Promoting Renewable Heat in the UNECE Region

Figure 20 gives an overview of UNECE countries that have introduced policy and regulatory measures as well as financial support schemes for promoting renewable energy in the heat market. The first column indicates whether the country generally has policy and/or regulatory measures promoting renewables in the heat market independent of financial support. It covers policies and laws encouraging the deployment of renewables, e.g. laws that demand solar thermal heating installations on the roof of new buildings. The second column indicates whether at least one financial support scheme is in place, and the three remaining columns show which renewable heat technologies are specifically supported.

Support may take the form of subsidies, low interest loans, tax regulations or a combination thereof. Support funds do not necessarily have to be from the member state governments but could also be from foreign sources, e.g. the EBRD. The schemes implemented are of permanent nature, meaning at least several years. One-time or pilot projects do not qualify as promotion schemes. Promotion by the state only for public facilities are not considered.

Policies and support schemes can be available for either private households or companies. It should be noted, that the figure gives an impression about the number of member states with promotions schemes in the UNECE region but does not say anything about the quality thereof. This has several implications. First, some countries have already established renewable heating at a large scale and therefore do not directly or specifically promote it anymore. Israel, for example, where solar thermal heating has been obligatory for new buildings since 1980, was one of the first countries to introduce such policies. Second, promoting all technologies does not necessarily mean better support for renewable heating. The aforementioned policy lead to 85% of Israeli households using solar thermal heating, indicating that focussing on only one technology can be successful. Furthermore, geographical circumstances need to be considered. Understandably, countries in the southern hemisphere focus on solar thermal whereas it is not as common in northern countries.

Having this in mind, out of 52 analysed UNECE countries, 34 promote renewable heating technology at the political and financial level. Six countries promote either one or the other. In the vast majority of cases, if financial support is given, countries promote all three technologies. Heat from solar thermal energy receives support in 35 member states, directly followed by biogas/biomass, which is promoted in 34 member states. Geothermal energy and heat pumps are supported in 33 member states.

A comparison of existing promotion schemes for renewable heat and renewable electricity generation reveals that governments currently mainly focus on promoting renewable energy in the electricity sector. Renewable heat is still a policymaking niche despite the great potential for renewable heat in the UNECE region (see info box in section 2.2). Given that all member states are situated in the Northern Hemisphere, there is high demand for heating applications.

Country	Policies and / or Regulatory Measures (independent of financial schemes)	Financial Support Scheme(s) in Place	Biogas / Biomass	Solar Thermal	Geothermal / Heat Pumps
Albania	✗	✗	✗	✗	✗
Armenia	✓	✗	✗	✗	✗
Austria	✓	✓	✓	✓	✓
Azerbaijan	✗	✗	✗	✗	✗
Belarus	✗	✗	✗	✗	✗
Belgium	✓	✓	✓	✓	✓
Bosnia and Herzegovina	✓	✗	✗	✗	✗
Bulgaria	✓	✓	✓	✓	✓
Canada	✓	✓	✓	✓	✓
Croatia	✓	✓	✓	✓	✓
Cyprus	✓	✓	✓	✓	✓
Czech Republic	✓	✓	✓	✓	✓
Denmark	✓	✓	✓	✓	✓
Estonia	✓	✓	✓	✓	✓
Finland	✓	✓	✓	✓	✓
France	✓	✓	✓	✓	✓
Georgia	n/a	✗	✗	✗	✗

Country	Policies and / or Regulatory Measures (independent of financial schemes)	Financial Support Scheme(s) in Place	Biogas / Biomass	Solar Thermal	Geothermal / Heat Pumps
Germany	✓	✓	✓	✓	✓
Greece	✓	✓	✓	✓	✓
Hungary	✓	✓	✓	✓	✓
Iceland	✓	✗	✗	✗	✗
Ireland	✓	✓	✓	✓	✓
Israel	✓	✗	✗	✗	✗
Italy	✓	✓	✓	✓	✓
Kazakhstan	✗	✓	✗	✗	✗
Kyrgyzstan	✗	✗	✗	✗	✗
Latvia	✓	✓	✓	✗	✗
Lithuania	✓	✓	✓	✓	✓
Luxembourg	✓	✓	✓	✓	✓
Malta	✓	✓	✗	✓	✓
Republic of Moldova	n/a	✗	✗	✗	✗
Montenegro	✗	✓	✓	✓	✗
Netherlands	✓	✓	✓	✓	✓
North Macedonia	✗	✓	n/a	✓	n/a
Norway	✓	✓	✓	✓	✓
Poland	✓	✓	✓	✓	✓
Portugal	✓	✓	✓	✓	✓
Romania	✓	✓	✓	✓	✓
Russian Federation	✗	✗	✗	✗	✗
Serbia	✓	✓	✓	✓	✓
Slovakia	✓	✓	✓	✓	✓
Slovenia	✓	✓	✓	✓	✓
Spain	✓	✓	✓	✓	✓
Sweden	✓	✓	✓	✓	✓
Switzerland	✓	✓	✓	✓	✓
Tajikistan	✓	✗	✗	✗	✗
Türkiye	✗	✗	✗	✗	✗
Turkmenistan	✗	✗	✗	✗	✗
Ukraine	✓	✓	✓	✓	✓
United Kingdom	✓	✓	✓	✓	✓
United States	✓	✓	✓	✓	✓
Uzbekistan	✓	✗	✗	✗	✗

Figure 19: Renewable energy promotion schemes and measures in the heat sector in UNECE member states[34]

34 Illustration based on Energy Sector Management Assistance Program 2020; REN21 2021; RES LEGAL Europe 2019; Energy Community 2021; European Commission n.d.; enerCEE n.d.; National Research Council Canada n.d.; Environmental Protection and Energy Efficiency Fund n.d.; United Nations Environment Programme 2015; Theocharidou & Associates LLC 2020; State Environmental Fund of the Czech Republic 2021; IEA 2019; solarthermalworld.com 2017; IRENA 2019b; IEA 2017b; solarthermalworld.com 2021; Balkan Green Energy News 2021; Instituto para la Diversificacion y Ahorro de la Energia 2021; IEA 2017a; N.C. Clean Energy Technology Center n.d.; Energie Zukunft Schweiz AG n.d.; Swissolar n.d.; Bundesamt für Energie 2020

05 Policy Implementation in Progress: Renewable Energy Hard Talks

For policy and policy implementation to be successful, it is important to understand the current and future potential challenges and available solutions, as well as the goals to be achieved.

Dialogue with all stakeholders is important to better understand the many aspects for consideration. Stakeholder workshops, discussion and continuous communication is essential for sound policy making. To aid this process in the UNECE region, a series of stakeholder workshops, so-called Renewable energy "Hard Talks" were held as part of the UNECE RE-Uptake Project in 2021 and 2022. Renewable Energy Hard Talks were held with four different UNECE member countries: Albania, Georgia, Serbia and the Republic of Moldova.

5.1 Concept of the Hard Talks

Hard Talks in brief

The "Hard Talk" is a discussion format on current topics of renewable energy held with relevant stakeholders of the participating member states of the United Nations Economic Commission for Europe (UNECE) and organized by the UNECE secretariat and partner organizations.

The goal of the Hard Talk is to identify the best methods for realizing the potential of renewable energy by identifying key barriers that block private sector investment, as well as creating a well-functioning and stable system for the development of renewable energy.

The multi-stakeholder dialogues are organized by the UNECE in collaboration with host countries, local partners and international organizations such as the European Union, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), REN21 (Renewable Energy Policy Network for the 21st Century), and dena (German Energy Agency).

Hard Talks involve all interested government agencies, parliament, private investors, energy producers and consumers, financial and research institutions, NGOs, and international organizations. Key players in the field of energy discuss key issues, determine priorities and offer concrete policy recommendations to overcome political, legal, regulatory, and technical barriers and to access the untapped potential of renewable energy.

They aim to:

- Investigate barriers that hinder the full unfolding of renewable energy potential in the host country.
- Facilitate the exchange between political decision makers, project developers, investors and technology providers and thus between the public and private sector.
- Highlight and prioritise solutions to improve the investment climate for renewable energy and to foster discussion on what the UNECE can provide with similar initiatives.

Each of the four countries in focus for the UNECE RE-Uptake Project 2021 exhibit vastly different energy systems, from available natural resources and energy mix, to market structure and stage of energy transition. Despite the many differences, common themes and issues and their corresponding solutions are evident in each of the four host countries, demonstrating that main influencing factors to pave the way for renewable energy uptake are fundamentally the same, even if different policy frameworks apply. Moreover, the discussions in all four Hard Talks have proven that the experience and good practices associated with addressing those common, largely identical influencing factors are transferable from one country to another. Therein lays the added value of the Hard Talks: mobilising both international and regional experience to address local challenges and drive sustainable reform.

5.2 Hard Talk Process

As with any dialogue and open discussion format, cooperation with and involvement of relevant stakeholders is essential. For the Renewable Energy Hard Talks, the initial

identification and then collaboration with host partner organisations, such as ministries and energy agencies, ensures that topics of interest and relevance can be discussed and defined, and the relevant stakeholders identified and involved in the process.

The identification of known challenges and potential solutions together with host partner organisations prior to the event is central to an effective discussion and practical dialogue. Before the event, a review of the renewable energy situation in the host country is undertaken with the view to identify issues which hinder the uptake of renewable energy sources. Ideally, recommendations and possible solutions based on international experience and good practices that address the focus topics and identified challenges are formulated and shared with the Hard Talk participants prior to the event.

During the event, specific guests and all participants are invited to provide input and their perspectives on the identified challenges and recommendations and further share additional information on other challenges, solutions or ideas. The identified challenges, solutions and discussion are then brought together to produce a discussion and recommendation paper that details the main issues and recommendations. This is then shared for review and finalised with input from the Hard Talk participants and organising team. The final document is then published and shared with all interested parties to serve as a basis for further discussion and work on the topics and challenges therein.

Note that the country analysis, identified challenges and proposed recommendations are made at the approximate time of each Hard Talk and may not reflect the most recent country developments.

5.3 RE Hard Talk with Albania: Uptake, Integration and Harmonisation of Renewables in Albania

Within the context of the UNECE RE-Uptake 2021 project, the first of four UNECE Renewable Energy Hard Talks was held with Albania remotely on the 6th and 7th of July 2021. Key issues, challenges, solutions and recommendations regarding **network integration, renewable policy support and bankability of renewable projects** were discussed and refined.

With more than 130 participants over two days, the Hard Talk featured presentations, interventions and discussion from a wide variety of Albanian and international energy sector stakeholders, including: the Ministry of Infrastructure and Energy (MIE) Albania, National Agency of Natural Resources (AKBN - Agjencia Kombëtare e Burimeve Natyrore), Albanian Power Corporation (KESH - Korporata Elektroenergjitike Shqiptare), Energy Regulatory Authority Albania (ERE), Transmission System Operator (OST), Electricity Distribution System Operator (OSHEE), United States Agency for International Development (USAID), International Renewable Energy Agency (IRENA), European Bank for Reconstruction and Development (EBRD), German Federal Ministry for Economic Affairs and Energy (BMWi), Deutsche Industrie- und Handelsvereinigung (DIHA) Albania, Statkraft, Uniper, Voltalia, and others.

The Hard Talk is intended to speed up existing processes to further progress renewable energy deployment, diversification and security of supply and the development of an attractive market for renewable energy in Albania. The Hard Talk focussed on the following main topics and leading questions:

- Network Integration: What needs to be done to integrate and harmonise renewables within the network?
- RE Support: How can current support mechanisms for renewable energy deployment be strengthened and improved?
- Project Development: How can bankability of project ideas and proposals be improved?

5.3.1 Country Introduction

Albania has one of the largest shares of renewable energy in its energy mix in South-East Europe but is also a net energy importer and thus heavily reliant on imports. The renewable energy share in Albania is predominantly hydropower of which accounts for 95% of all generating capacity, with the remaining divided between solar (1%) and crude oil (4%) as of 2021. The heavy reliance on hydropower also means that renewable generation is sensitive to rain-fall, which has seen considerable annual variations and a steady decline in recent years. This is likely to further decline with the effects of climate change. In addition to hydropower resources, Albania also has abundant solar and wind resources, which are almost entirely untapped. In order to improve the energy security and climate resilience and to meet growing energy demand, it is imperative that Albania accelerates the transition to those abundant, available and local, renewable energy sources.

5.3.2 Challenges and Recommendations

Main Issue / Challenge	Description	Recommendations
Renewable Energy Zoning	Planning and economic resource analysis for solar and wind is lacking, thus hindering policy development and the setting of realistic targets, appropriate sizing of solar and wind auctions, and least-cost power system planning.	■ RE zones should be developed in accordance with analysis of resource potential, grid access and ability to receive renewable inflows, geographic and environmental aspects, proximity to demand, etc. ■ RE zoning could also consider an integrated approach to renewable energy development together with land use for Agriculture, especially when considering large-scale photovoltaic (PV) plants.
Comprehensive energy master plan	The current National Energy Sector Strategy 2030, National Renewable Energy Action Plan 2018-2020, and the Gas Master Plan serve to guide Albania's energy sector. A holistic, least-cost plan that aggregates sub-sectoral plans is lacking.	■ A comprehensive plan that aggregates energy sector data such as renewable energy zoning, energy resource potentials and historical statistical trends, together with qualitative and quantitative information, into a clearly formulated and evidence-based development pathway will allow for sound decision-making and sector development.
Strengthening of the distribution network	Power generation from renewable energy sources fluctuates and is naturally variable. This requires more advanced and modern network infrastructure and operation that can handle bidirectional energy flows and changing supply profiles. Particularly in high-demand urban areas, the Albanian distribution grid lacks sufficient capacity and dynamic operation to handle variable electricity injection. This severely hampers the successful integration of renewable energy sources in the country.	■ Refurbishment of the distribution grid around main load centres of Tirana and Durres. ■ Further expansion of the HV and MV grid, including interconnection capacities. ■ Planning and upgrading for an active grid that can handle bidirectional flows is required and should include equipment for safety of data. ■ Flexibility studies could be carried out to support the planning. ■ Monitoring of RE generation and input is required. ■ Improving energy parameters, technical loses and voltage levels. ■ Implementation of new technologies such as GIS, SCADA, HPPS monitoring should be considered.
RE requirements and Balance Responsibilities	The current law regarding Balance Responsibility is not clear and thus requires refinement.	■ Improved forecasting. ■ Limits or threshold capacity may be required to avoid too severe a reduction of gross income for balancing parties.
Strengthening support mechanisms for renewable energy	Fiscal incentives and policies such as feed-in-tariffs (FiT) or premiums (FiP) and tax reductions comprise the main supporting mechanisms to attract investments in renewables. The current support mechanisms and associated processes in Albania could be revised and improved.	■ Value-added tax (VAT) reduction on all equipment and machinery required for renewable energy technologies. ■ FiT methodology improvement to adhere to the Albanian market, not based on the Hungarian power exchange (HUPEX). ■ Large consumers are currently exempt from paying levies. Renewable energy obligation should be extended to all consumers, not just those connected to the distribution grid. ■ The current methodology for the Net-Metering scheme is unclear and therefore requires revision: • Adapt the net-metering scheme to enable all prosumers to benefit. • Create a breakdown of different obligations for different types of network users such as IPP or autoproducers / prosumers in the National Renewable Energy Action Plan (NREAP).

		■ Simplification and streamlining of permitting and approval processes for generation of renewables and grid connection: • Shortening of period for giving permissions. • Limit number of third parties. • Current maintenance requirements are too onerous and should be revised. ■ The model for the Contract for Difference (CfD) system is not yet approved and should be finalized. ■ There is a lack of legislation addressing heating and cooling in buildings, e.g. no minimum requirements for renewables. As a first step, clear targets should be set together with sufficient planning. ■ Intensifying of use of renewable in end use sectors – Transport Sector: • Incentivise electro mobility use (through rebates, tax incentives, etc.). • Increase number of charging points. ■ Development of demand side management.
Establishing a dedicated renewable energy agency	A dedicated renewable energy agency could inform the coordinated development of renewables in line with national and international targets and obligations, including the timely development of new infrastructure, human resources and legislation with a view to meeting future energy demands in a sustainable and least-cost development pathway.	■ A dedicated renewable energy agency not considered by all as a priority as current efforts and initiatives should focus on implementation.
Facilitating financing of bankable project proposals	Many renewable project proposals for FiT or during auction bidding rounds are not approved and labelled as "unbankable". Sufficient documentation on technical and pre-feasibility assessments is often lacking of the necessary information independently from the quality of the project proposal.	■ Available resources and best practices should be observed, utilised and maintained by the private sector and public institutions. ■ Standardisation of documentation based on best practices. ■ Development of financial instruments, decarbonisation policies. ■ Strict monitoring, project compliance and standards and safeguards will help reduce perceived project risk. ■ Policy commitment, including RE targets, auction schedules, clear and creditable institutional arrangements and a robust legislative and contractual framework is required. ■ Auction design could be improved and should include: details on location, volume, technology, eligibility and selection criteria; promotion of project delivery; support provision; fair risk allocation; and off-taker arrangements.
Raising public awareness on the benefits of renewable energy	There is a current lack of knowledge of incentives and support. Awareness raising and the provision of information on the available renewable energy options, incentives and support programs can advance the perspectives of energy consumers and consequently renewable energy uptake.	■ In addition to private promotional efforts, government supported and initiated awareness-raising efforts and strategies can provide necessary information and confidence for greater adoption.
Enhancing institutional capacities and local human resources	Dedicated renewable energy training and education at vocational, tertiary and technical levels is lacking. Such investment and nurturing of human resources and expertise is required to maximise and ensure the development of local economies.	■ Educational programmes. including education in schools for RE is required and should be pursued. ■ The introduction of renewable energy training programmes and a focus on specific areas such as PV should be prioritised in order to realise benefits as soon as possible. ■ There should be a focus on the development of skills required for PV installation and energy auditors.

5.4 RE Hard Talk with Georgia: Building Support for Renewable Energy Investments in Georgia

The Renewable Energy Hard Talk dedicated to Georgia was held virtually on the 12th and 13th of October 2021 and focused on **building support for investments in renewable energy in Georgia**.

With 75 participants across the two days, the Hard Talk featured presentations, perspectives and highly interactive discussions amongst all participants. Participants represented all major stakeholder groups and various geographies, including: the Ministry of Economy and Sustainable Development of Georgia (MoESD), Parliament of Georgia, Ministry of Finance of Georgia, Ministry of Environmental Protection and Agriculture, Georgian Energy Exchange (GENEX), National Statistics Office of Georgia (GEOSTAT), Georgian Energy Development Fund (GEDF), United States Agency for International Development (USAID), European Bank for Reconstruction and Development (EBRD), Asian Development Bank (ADB), World Experience for Georgia, ISET Policy Institute, United Nations Industrial Development Organisation (UNIDO), Georgian Renewable Energy Development Association (GREDA), Green Alternative, Energy Efficiency Centre (EEC), Tbilisi Transport Company, Helios Energy, Infinity Energy LLC, among others.

The Hard Talk focused on ways to increase support and attractiveness for investments in RE in Georgia, by looking into the policy landscape, market structure and public support for the sector. The aim was to (1) mobilise stakeholders (local and external) to discuss concrete actions and increase their individual and collective impact, and (2) provide recommendations to actors in and outside Georgia, which could help bolster investment in RE. For this, key bottlenecks, drivers to change, solutions and recommendations were explored.

5.4.1 Country Introduction

Georgia's energy mix is based on hydropower, biofuels and waste as well as fossil fuel imports (natural gas, oil, and coal). The energy sector is heavily dependent on imported natural gas, which is the dominant energy source used in Georgia, followed by oil. The country has significant hydro potential and is among the top countries in the world by water resource per capita, while currently only 20-22% of this potential is utilised. There is also a lot of untapped potential from wind, solar, geothermal and biomass resources.

Georgia has made substantial progress towards the liberalisation of the electricity and gas markets, improvements in cross-border infrastructure and regional trade, as well as the transition to a low carbon energy future in the past decade. Although the country's energy security has been improving with the domestic hydro generation, the supply-demand gap keeps growing due to increasing electricity demand and relatively limited local RE production. In 2019, high imports were needed to meet domestic demand for electricity generation even in the summer. Attracting more investments is needed to reduce dependency on imports by creating an enabling environment for RE.

Although considerable private investments in hydropower plants have been realised, the investment climate needs further improvement by creating a stable regulatory regime and establishing clear RE targets by technology. Streamlining secondary legislation would enable the energy market to function efficiently, gradually moving out of a state-heavy energy sector. Clear price signals, along with transparent and competitive market rules would further encourage investments in renewable energy. Strong local opposition has also been a barrier against the completion of ongoing RE projects in the country. Enhancing investments in RE will, therefore, require improvements in policy mechanisms, market structures, along with the public attitudes towards and support of RE.

5.4.2 Challenges and Recommendations

An extensive list of challenges and potential solutions/recommendations discussed during the Hard Talk, can be found below. The main takeaways include:

- Establish a **long-term policy strategy**, setting longer-term (technology specific) RE targets that will provide clear signals to investors.
- Improve existing and introduce new **RE support schemes**. There is a need for flexible, technology-based support mechanisms, with the ability to accommodate dynamic changes in the market.
- Provide **stable and transparent market rules**. With the market reform underway, a transitional action plan that supports investors, as the pricing mechanism becomes clearer, would increase investors' confidence.
- Develop a tactical, long-term **communication strategy** involving various stakeholder groups to overcome social opposition. Promote communication campaigns and social engagement in RE project implementation.
- Intensify **capacity building activities** through the development of local education programs. Update existing curricula to introduce students to the new technologies and skills required and encourage the collaboration between universities and industry.
- Convene **regular multi-stakeholder discussions** to advance the renewable energy agenda in Georgia.

Main Issue / Challenge	Description	Recommendations
Lack of network capacity	■ Grid limitations for RE integration, lack of reserve capacity.	■ Flexibility options, including energy storage (such as pumped-storage power stations (SPPS) and battery storage), dispatchable generation, interconnections, demand-side management, and other innovative technologies for better integration of variable RE sources can be promoted. ■ Retrofitting of and constructing power grids play an important role for better RE integration. ■ Accelerate the roll out of smart meters and smart, digital technologies.
Uncertainty regarding market reform	■ Slow energy market reform, causing uncertainty with investors (policy, social issues, market prices). ■ Low electricity prices and missing transparent price mechanism in market PPAs. Marginal price bidding (consideration of fixed and finance costs). ■ Extra fees (GENEX fee, BM fee, guarantees, imbalances, additional staff costs) are expected increase the financial burden that generators would have to pay. ■ Low participation in balancing and ancillary services market (market concentration related to major HPPs).	■ Accelerate the adoption of electricity market rules, offer more transparency to market participants and investors on the market design, and provide the stability and visibility necessary to attract investments. ■ Monitor the implementation of the new electricity market and make transparent improvements. ■ The market transitional period impacts the decisions of investors; to this end, there should be a transitional action plan that supports investors, as the pricing mechanism becomes clearer. ■ Preserve the Regulator's independence and authority to effectively regulate the market and create competitive rules.
RE support mechanisms need strengthening	■ Feed-in premium (FiP) offers 1.5 USc/KWh on top of the market price, but there is a limit to 5.5 USc/KWh, which is quite low considering the high procurement (mostly imports), construction and infrastructure installation costs. ■ Furthermore, the support scheme does not apply during the summer months. (Although over 16 HPP projects have benefited off this scheme). ■ No incentives for the private sector towards energy saving strategies or approaches.	■ The FiP scheme could be expanded to apply also to summer months, as hydro and solar plants produce more electricity during the summer period. Furthermore, the mechanism should provide some guarantee (through a minimum floor price) to the investor at least during the first 10 years. ■ Introduce a Contract for Difference (CfD) mechanism to enable generators to stabilise their revenues at a pre-agreed level for the duration of the contract. ■ Develop transitory support schemes (e.g., temporary (3-4 years) tariff guarantee) and plans for market stability during transition to the new market model.
Societal opposition - lack of information and trust	■ 43 suspended RE projects currently, due to public opposition and prevailing misinformation. Resulted in stopping investments of USD 3.8 billion, corresponding to a total capacity of 2,000 MW and approximately 20,000 jobs. ■ Lack of public awareness about RE and co-benefits, neither about the risks of inaction (environmental impacts, on quality of life, including disruption to the ecosystems, landscape deterioration, etc.). ■ Disinformation exists for existing RE projects (e.g., perception that HPP construction will lead to the flooding and destruction of karst caves and that a potential dam break will flood Kutaisi city and another 17 municipalities of western Georgia). ■ There is a lack of trust and communication between parties (policymakers, the public, industry, and investors). ■ Lack of citizen involvement in project development (renewable communities, benefits sharing). Misconception in the private sector about investments profitability and the benefits, costs and policies that can support them.	■ Develop a strategic long-term communication plan and campaigns (on myth-busting, co-benefits, etc.) to overcome the lack of social acceptance - through knowledge exchange, communities of practice, and raise awareness among all stakeholder groups. Experts and non-experts should be involved in the process. ■ Involve public figures (not necessarily technical) as RE “ambassadors” in the country. ■ It is important to involve citizens, as well as other relevant stakeholders from the planning phase of the project development all the way through its implementation. Investors could carry out site visits to communicate with locals before the implementation of the project (potentially organise a kick-of-meeting with locals). ■ Introduce legislation for developers to carry out societal engagement prior to project implementation. Currently, social impacts are only part of the environmental impacts assessment. Strategies that developers could consider, depending on the development phase of the project, include regular exchange with relevant sector agencies, and environmental associations, assignment of a direct and reliable public relations officer, communications agency, etc. ■ Sharing benefits directly with the local population of the impacted area, along with communication of the environmental benefits achieved through the project are likely to result in lower social opposition.

Lack of adequate policy support	■ Lack of long-term energy strategy. While RE law exists, secondary legislation is missing. ■ Lack of subsidies, tax incentives, loan assistance for renewables, while fossil fuels are highly subsidised. ■ Market entry barriers for solar, wind, and other renewable resources as they need to compete with wealthier industries that benefit from existing infrastructure, expertise and policy.	■ There is a need for a long-term vision and strategic planning for the RE deployment. Set ambitious RE targets, consistent with the long-term national energy strategy and action plans to increase investors' confidence on Government's commitment and attract additional capital. ■ Develop strategic documents at regional level for energy planning in a more decentralised way. ■ There is a need for assurances especially during the transition period and coordinated action with the Ministry of Finance to mitigate investors' concerns by proper planning and a clear vision on the country's priorities. ■ Encourage RE investments beyond electricity (into renewables-based district heating/cooling; clean transport, etc.). District energy systems could be included in the national energy action plans. ■ Government should end subsidies for fossil fuels and encourage replacement of gas boilers with more efficient ones. Planning of the heating and cooling sector should consider the availability of local resources (such as geothermal, solar, but also waste heat could be considered). ■ The energy policy actions need to be more consistent with the policy objectives (e.g., eliminate distortions putting renewables at a disadvantage).
High investment costs	■ High upfront investment cost for some RE technologies. ■ RE technologies are imported in Georgian market, further increasing the cost. ■ As opposed to investment costs, electricity prices are low.	■ Provision of incentives should take into consideration the high prices of the technologies. Currently, materials, know-how, and technology are all imported. ■ Consider attaching local-content requirements to RE subsidies; however, need to consider how this will affect the project costs.
Lack of access to capital	■ High interest rates with banks. ■ Lack of access to micro-financing, poor business development skills by RE system suppliers/developers.	■ Introduce programs to increase awareness and expertise of local financial institutions for RE opportunities. ■ Establish micro-financing schemes and increase access to capital.
Project implementation challenges	■ Reliance on outdated historical data for the planning and financial modelling of RE projects. Because of many issues such as climate change, these historical data may not be valid and the predictions may change, creating a big gap. ■ Weather forecasts are not so accurate in Georgia, and this creates hurdles in the reliable hourly projection of generation. Without reliable forecast, investors are unable to project day/night hourly prices and account for imbalances. ■ Lack of capacity developing full CBA for each project.	■ Bureaucracy of the state agencies has been reduced and is more accessible now; however, there is need for more transparency in the project development processes. ■ Accurate resource assessment is necessary. Enhance quality and availability of energy resource data and transparency regarding assumptions. ■ Introduce policy to cater for differences in the estimation of investors' finances at a later stage due to unpredictable meteorological challenges. ■ Proper treatment/allowance should be provided in the formulation of rules for Electricity Market Reforms to account for challenges in weather forecasting.
Lack of local capacity / human resources	■ With the new market reforms, new skill sets will be required. There is currently a lack of skills for supporting services (e.g., in forecasting, pricing for the next day), not only technicians and engineers, but other specialists, too, such as economists. ■ Lack of spare parts and adequate skills to repair/service the equipment leads to equipment failure. This together with low reliability in a technology lowers customer confidence in some RE technologies and hinders their adoption. ■ The Ministry of Economy and Sustainable Development is under-staffed.	■ Intensify capacity building activities through the development of local education programs and incentivise exchange programs for local promising students. ■ Update existing curricula in local universities and develop new programs that introduce students to the new technologies and skills required. ■ Encourage the connection/collaboration between the universities and industry and promote an industry-oriented focus to research/academic programmes. ■ Provide support to companies that focus on the use of local resources and incentivise local production of machinery, spare parts, etc. ■ Capacity building should also take place at a legislative and project level. It is important to have competent people in policy and project development. ■ Need for more human resources in the Ministry of Economy and Sustainable Development.

5.5 RE Hard Talk with the Republic of Serbia: Renewables in Serbia: The Path Ahead, Net Metering and Auctions

The UNECE Renewable Energy Hard Talk dedicated to Serbia was held remotely on the 16th and 17th of November 2021. The Hard Talk **Renewables in Serbia: The Path Ahead, Net Metering and Auctions** focussed on renewable energy support mechanisms in Serbia with a specific focus on the recent net metering scheme and the upcoming renewable energy auctions. The event was made possible through close coordination with the Ministry of Mining and Energy of Serbia.

The two-day Hard Talk featured presentations, interventions and discussion from a wide variety of Serbian and international energy sector stakeholders. More than 80 participants joined from various institutions including: Ministry of Mining and Energy of Serbia, the United Nations, E3 Analytics, Guidehouse, KfW Belgrade, AHK Serbia, EBRD, GIZ, Balkan Green Energy News CWP Global, CMS Belgrade, MT Komex, Elicio NV and others.

Key issues, challenges, solutions and recommendations regarding **renewable energy support schemes (incl. the net-metering scheme recently developed) as well as renewable energy auctions** were discussed and refined. The Hard Talk focussed on the following main topics and leading questions:

- RE Support: How can current support mechanisms for renewable energy deployment be strengthened and improved?
- RE Support: What is the role of net metering in the deployment of renewable energy in Serbia?
- RE Auctions: What are the opportunities and challenges for renewable energy auctions in Serbia?
- RE Auctions: How can international best practice and experience be utilised in the development of renewable energy auctions in Serbia?

5.5.1 Country Introduction

Fossil fuels dominate Serbia's energy mix with 87% of the total primary energy supply (TPES) being supplied with fossil fuels in 2017. Only 13% of TPES is covered by renewable energy (RE) sources, mainly in the electricity sector where RE contribute 37% to the total generation capacity (as of 2019). Hydropower makes up 45% of RE capacity and bioenergy 54%. The growth of RE from 2016 to 2017 has already more than doubled than in the previous five years. Growth in 2016 to 2017 was 12.2% in comparison to 2012 to 2017 with 5.6%. Through the development of the largest wind park in region, it is clear that Serbia also intends to diversify the RE mix. However, the development of new RE sources remain in a stagnant state, especially in the PV sector, leading to a miss of RE targets. Rising energy demand also outpaced RE expansion, thus further contributing to missed RE targets.

To further progress towards the green transition and environmental protection, the Law on the Use of Renewable Energy Sources was enacted at the beginning of 2021. In addition to existing feed-in-tariffs (FiTs), new market premiums, RE auctions and new regulations for prosumers, including a net metering scheme aim to drastically increase the uptake of renewables. The new net metering scheme was recently launched in September 2021, including a 50% rebate on the installation costs of new rooftop PV systems. The first round of auctions in Serbia are to be held in December 2021, followed by a three-year schedule, which is to be revealed in February 2022.

5.5.2 Challenges and Recommendations

Main Issue / Challenge	Description	Recommendations
Strategic planning of renewable energy deployment and alignment with climate targets	Planning and economic resource analysis for solar and wind is lacking. This hinders policy development and the setting of realistic targets, least-cost power system planning, and the ability to develop and implement appropriate support mechanisms.	■ A comprehensive plan that aggregates energy sector data such as renewable energy zoning, energy resource potentials and historical statistical trends, together with qualitative and quantitative information, into a clearly formulated and evidence-based development pathway will allow for sound decision-making and sector development. Energy Action Plans should also be developed at a municipal level. ■ RE zones should be developed in accordance with analysis of resource potential, grid access and ability to receive renewable inflows, geographic and environmental aspects, proximity to demand, etc. ■ The national integrated energy and climate plan (NECP) should be finalised as soon as possible.
Strengthening support mechanisms for renewable energy	Fiscal incentives and policies such as feed-in-tariffs (FiT) or premiums (FiP) and tax reductions comprise the main supporting mechanisms to attract investments in renewables. The new net metering scheme was recently launched in September 2021, including a 50% rebate on the installation costs of new rooftop PV systems up to 6kW in a first round offer. Given the relative immaturity of the market and recent adoption of said measures, increased adoption requires a change of mindset from local experts and industry. To aid adoption, current support mechanisms and associated processes could be revised and improved.	■ Administrative simplification for approval and licensing of renewable energy projects is required. • Create a "One-stop-shop" for renewable energy project approval and licensing to enable streamlined deployment of projects. ■ Advanced Net-Metering schemes could be explored and prepared for implementation, including third-party ownership and financing, rooftop leases and PPAs (power purchase agreements) and 'virtual net metering' for energy communities. ■ Lack of clear procedure for remuneration of surplus energy reduces bankability of prosumer projects. • Energy pay factoring in the average market price of that year could be a workable solution. ■ Currently rolled out solar PV equipment is not always future-proof. • Inverter standards and requirements for smart equipment should be introduced from an early time to ensure equipment is compatible with future technologies.
Lack of qualified personnel for the renewable energy industry	Skilled workers will be required throughout the emerging renewable energy industry in Serbia. This includes technicians and engineers but also managers and economists. Dedicated renewable energy training and education at vocational, tertiary and technical levels is lacking. Such investment and nurturing of human resources and expertise are required to maximise and ensure the development of local economies.	■ A comprehensive power system plan should be established to match future grid reinforcements and extensions with the planned deployment of RE capacities in order to ensure more efficient system integration. ■ Market-based support mechanisms coupled to the day-ahead market price should be introduced to increase market integration: • Variable premiums (one-way or two-way contract for difference (CfD) provide higher planning certainty for investors and offer a lower risk premium than fixed premium. • Fixed premiums could also be considered and are less complex and easier to understand and implement early on. There is however exposure to long-term electricity price volatility. ■ A fixed premium could be initially introduced and transition to a variable/sliding premium as the wholesale market develops and capacities increase.

Balancing responsibility	The responsibility for system balancing, including balancing costs as a result of increasingly intermittent generation from higher shares of renewable energy and subsequent deviations in planned from actual production volumes remains unclear and the respective bylaws are yet to be finalised.	■ A liquid intra-day market is a precondition for full balancing responsibility however an intermediate solution of 'partial responsibility' through a cap or fixed imbalance price/ penalty-free production deviation could be considered. ■ The decree regulating balancing responsibility for renewable energy producers should be finalised and published as soon as possible.
Cost competitiveness of projects with older or outdated technology	Due to the lengthy process from announcement of auction, bids, awarding of bids and finally project realisation, projects permitted with old technology, in particular older wind turbine models, may have difficulty competing with the levelised cost of electricy (LCoE) of new projects in development.	■ In the case of wind projects, the turbine selection should be moved to a later stage in the planning/permitting process to allow up-to-date equipment to be deployed at the time of construction. This will ensure that the most competitive technology options can be considered throughout implementation from the initial winning of the auction, approval and awarding of capacity right up until construction.

5.6 RE Hard Talk with the Republic of Moldova: Renewables, Resilience and Flexibility Options in the Republic of Moldova

The UNECE Renewable Energy Hard Talk with the Republic of Moldova took place in Chisinau, Moldova on June 14, 2022. **The exclusive event dealt with the integration of renewable energy with a focus on resilience and flexibility options in the energy system of the Republic of Moldova.**

The event was organized by the UNECE project team together with the host- and partner organisation the Ministry of Infrastructure and Regional Development of the Republic of Moldova.

More than 50 participants joined the Hard Talk, which featured presentations, interventions and discussion from selected Moldavian and international energy sector stakeholders, including: the Ministry of Infrastructure and Regional Development of the Republic of Moldova, the National Energy Regulatory Agency, Moldelectrica, CET Nord, Premier Energy Moldova, RED Nord, the Energy Community Moldova, World Bank, USAID, European Business Association, Energy Efficiency Agency, Termoelectrica, American Chamber of Commerce Moldova, and others.

Key issues, challenges, solutions and recommendations regarding the **successful expansion and integration of renewables, including resilience and flexibility options** were discussed. The main topics and leading questions addressed in the Hard Talk with the Republic of Moldova were:

- What flexibility options are available to increase system security and resiliency in Moldova?
- What actions need to be taken in the short to medium term to sufficiently plan for greater shares of variable renewable energy?

5.6.1 Country Introduction

The energy system of the republic of Moldova features low levels of indigenous, natural resources and production and thus has a heavy reliance on energy imports; more than 70% of primary energy supply, including natural gas, petroleum and electricity is imported, mainly from the Russian Federation via Ukraine. The share of electricity in final energy consumption is also low at approximately 15% as of 2019, illustrating the low level of electrification and heavy reliance on gas imports and generation. Electricity is predominantly generated by the large gas-fired power plant in the breakaway region of Transnistria or imported from the Ukraine. Domestic electricity production includes the Cotesti hydro power plant, several large cogeneration plants in Chisinau and Balti and a negligible number of small renewable energy systems.

Albeit largely untapped, the Republic of Moldova features great potential for renewable energy, including wind, solar and bioenergy resources. In addition to the clear benefit of increased energy security and diversification of supply, the expansion of renewable energy sources offers a range of benefits including increased employment and improved health, and a reduction of emissions and associated negative climate impacts from fossil fuel use.

Given the recent global developments, it is clear that greater energy independence and diversification of supply, especially in the immediate region, should be of primary concern for the Republic of Moldova and its neighbours.

To enable the successful integration of renewable energy sources, both variable and dispatchable, a reliable energy system and power network is essential. The power network of the Republic of Moldova is however outdated, demand fluctuates greatly and the interconnector capacity is low. The potential for grid stabilization measures made available through the ENTSO-E synchronization in March 2022 are therefore severely inhibited and cannot be leveraged. In addition to current issues, energy system stakeholders are concerned that the increase of variable energy resources such as wind and solar will exacerbate current grid operation issues and lead to additional balancing problems and costs.

5.6.2 Challenges and Recommendations

Main Issue / Challenge	Description	Recommendations
Increasing and ensuring enough flexibility sources to account for increased shares of variable renewables	Due to a lack of domestic resources and generation assets, the energy system of the Republic of Moldova lacks system flexibility options and relies almost exclusively on Ukraine for system balancing. As the share or variable renewable energy sources increases, so too will the need to flexibility options.	■ A comprehensive power system plan should be finalised as soon as possible and align future grid reinforcements and extensions with the planned deployment of renewable energy capacities in order to ensure efficient system integration. ■ Development of standards and guidelines for relevant actors: generators and plant operations, network operators, etc. ■ Implementation of intelligent equipment and systems for effective management of renewable energy systems. ■ Establishment and maintenance of a database of renewable energy systems for analysis, planning and forecasting. ■ The responsibility for system balancing, including balancing costs as a result of increasingly intermittent generation from higher shares of renewable energy and subsequent deviations in planned from actual production volumes remains unclear and the respective bylaws are yet to be finalised. Clear rules and responsibility for balancing need to be finalised and applied as soon as possible. ■ Stakeholder training should be developed and implemented, including: network codes (ENTSO-E), system operator requirements, market rules, best practices, technical solutions, etc. ■ As a short-term measure, battery energy storage systems (BESS) could be integrated to provide frequency control services and allow for accurate real-time balancing. ■ In the medium to long-term further increase of storage, either BESS or possibly pumped-storage hydro power plants could enable higher shares of renewable energy system (RES) integration and mitigate spilled energy and the need for curtailment.
Consider the role that bioenergy can have in contributing to system flexibility and energy independence	In addition to providing renewable energy for heating and electricity, bioenergy can provide short-term flexibility to help stabilize the electricity grid with both positive and negative ancillary services and provide long-term flexibility through storage and transportation of biomass-based energy. The current promotion and support of bioenergy projects, in particular biogas plants, is insufficient to incentivize further investment and market development.	■ The role of Bioenergy in contributing to system flexibility and integration of other RES should be further explored and exploited. ■ A bioenergy strategy that promotes the use of biomass, further develops biomass trade and communication across the relevant supply chains and increases the role of bioenergy in the energy sector should be developed. ▪ This strategy should build upon the work in biomass previously undertaken by UNDP and partners from 2011-2018 and ensure sustainable development of bioenergy resources taking into account the low level of forestation in the country. ■ Promotion of Bioenergy technologies, including biogas plants should consider additional benefits such as flexible ancillary services (flexibility premiums) to ensure sufficient incentives for investments and market development.
Network losses	The majority of RES in the Republic of Moldova are connected to the distribution network. Long-distance transport of electrical energy produced by renewable energy systems through distribution networks of medium voltage generate significant energy losses.	■ Sophisticated modeling and tracking tools should be developed and optimised, such as interactive maps with load curve graphs for various geographical areas. ■ RES could be paired with BESS to enable greater flexibility and optimal dispatch.

Maintenance of renewable energy systems and system equipment	Given the immaturity of the renewable energy sector, processes, supply chains and standards are not yet sufficiently established for the proper operation, servicing and maintenance of renewable energy systems and equipment, thus creating even more uncertainty for successful network integration and operation.	■ Complete technical regulatory framework with minimum requirements for operation of electrical equipment and renewable energy systems. ■ Complete regulation on maintenance procedures. Maintenance of installations should be carried out by properly certified, specialised personnel. ■ Periodic assessment of RES systems, including technical and performance tests and standards. ■ Scheduled maintenance should be planned and coordinated between relevant parties. ■ Development of interaction agreements between stakeholders and involved parties: OEM suppliers, operators, service providers, etc.
Network access for renewable energy systems	The number of valid requests for RES connection to the electricity network are far greater than those that are actually issued and connected despite capacities being available. Quotas are often reserved but not actually used.	■ Remove barriers for market participants - connection requests should be based on liability and guarantees. ■ Identify solutions that would allow the maximum quotas for renewable capacity approved by the Government to be reallocated to other technologies if quotas are not met. ■ Increase the maximum capacity for Net Metering – the process to amend the capacity limit should be initiated and completed as soon as possible.
Review methodology for setting and communicating tariffs for RES	Previously set tariffs have been insufficient in driving investments and the methodology by which they were determined have been criticised, as well as how relevant stakeholders were involved and informed.	■ The method for calculating tariffs and other mechanisms should be made transparent and all relevant actors should be consulted. ■ When determining tariffs for different RES, additional factors and aspects should be considered by the regulator when calculating and adjusting tariffs. For example, additional benefits beyond energy such as flexibility, security of supply, fostering the establishment of local industry, and other intangible benefits should be considered. ■ Tariffs should be reviewed to allow for adjustments or other mechanisms to better account for inflation, exchange rate movements, other effects such as lack of required resources, e.g. biomass resources.
Increasing attractiveness for renewable energy investments and project development	The current regulation and secondary legislation on the promotion of RES is yet to successfully create an attractive regulatory framework and market for private investments.	■ Dedicated policies to increase investor interest should be explored and implemented (e.g. reduced import duties for RES). ■ A bankable Power Purchase Agreement (PPA) should be developed, including guarantees and predictability for involved stakeholders, such as: offtake obligation, balancing obligations and costs, clear rules on liability for non-compliance, instruments to ensure payment security, rules on the transfer of obligations in the event of a new central supplier, and specified duration terms, amongst others. ■ Rules for the designation of long-term central supplier should be established. ■ Protection against changes in the law after the implementation of support schemes is required. ■ Clear and transparent rules for renewable energy auctions, including transparent auction design and implementation with the involvement of the energy community should be prioritised. ■ Focus state support programs to areas of activity with potential to produce raw material (biomass) for non-variable, flexible technologies, such as biogas CHP plants. ■ Optimisation of net metering mechanism (change of calculation period, shift to net billing). ■ Increase the maximum capacity for Net Metering – the process to amend the capacity limit should be initiated and completed as soon as possible.

Difficulties in finding funding sources and financial services	The financial and banking sector in the Republic of Moldova is comparatively small and has less experience and limited expertise with capital-intensive renewable energy projects. The relative immaturity and limited understanding results and higher perceived risk associated with renewable energy projects, ultimately leading to higher financing costs and unattractive lending arrangements.	■ Enhance and standardize required finance and project document to promote clarity, understanding and transparency. ■ Diversify funding programs for RES projects and facilitating access to the financial market. ■ Improve bankability of projects including the establishment of a bankable PPA.
Lack of qualified energy sector experts and specialists	There is a lack of qualified specialists on the labor market. Skilled workers will be required throughout the emerging renewable energy industry in the Republic of Moldova. This includes technicians and engineers but also managers and economists. Dedicated renewable energy training and education at vocational, tertiary and technical levels is lacking. Such investment and nurturing of human resources and expertise are required to maximise and ensure the development of local economies.	■ Capacity building: investors, design engineers, installers, other supporting staff. ■ Update existing curricula in local universities and develop new programs that introduce students to the new technologies and skills required. ■ Encourage the connection/collaboration between the universities and industry and promote an industry-oriented focus to research/academic programs. ■ The introduction of renewable energy training programs and a focus on specific areas such as PV should be prioritised in order to realise benefits as soon as possible.
Bureaucratic hurdles and misalignment between relevant authorities	Requirements to obtain building permits and other required project documents are far too onerous, require coordination with and approval by multiple bodies resulting in lengthy project development timelines, and thus, need to be streamlined.	■ Establish a central body or authority 'one-stop-shop' to streamline the process for approval and licensing of RES project development. ■ Optimise and standardise project documentation to promote clarity, understanding and transparency.
Strategic planning of renewable energy deployment and alignment with climate targets	Planning and economic resource analysis for solar and wind is lacking. This hinders policy development and the setting of realistic targets, least-cost power system planning, and the ability to develop and implement appropriate support mechanisms.	■ A comprehensive plan that aggregates energy sector data such as renewable energy zoning, energy resource potentials and historical statistical trends, together with qualitative and quantitative information, into a clearly formulated and evidence-based development pathway will allow for sound decision-making and sector development. Energy Action Plans should also be developed at a municipal level. ■ RE zones should be developed in accordance with analysis of resource potential, grid access and ability to receive renewable inflows, geographic and environmental aspects, proximity to demand, etc.

06 Conclusion

This report provides an insight into the status quo of renewable energy deployment and policymaking in the UNECE region. As the analysis has shown, several key motivations drive the uptake of renewable energy: In addition to mitigation of climate change and regional pollution and the reconstruction of future-proof economies after the Covid-19 pandemic, improvements in the security and affordability of energy supply and energy independence are high on the political agenda in many member states. Countries throughout the region are at very different stages of renewable energy uptake and highly diverse in terms of their approaches to renewable energy deployment. The analysis of the share of renewables in TFEC conducted for this report shed light on the status of renewable energy deployment in the UNECE sub-regions: Since the start of the new millennium, the use of renewable energy grew the steadiest in Western and Central Europe. North America and Eastern Europe had slower, but also steady growth. In Southeast Europe renewable energy use in contrast, was subject to more fluctuations but increased most dynamically overall. In Central Asia, the Caucasus and the Russian Federation, the share of renewables in TFEC stagnated or even declined in the years leading up to 2019.

Bioenergy and hydropower remain the dominant sources of renewable energy in the UNECE region. However, both show either slower growth (bioenergy) or stagnation (hydropower) in their contribution to the energy mix for the region. Wind energy and solar energy, on the other hand, have significantly gained importance for the energy mix of various states. In fact, renewable energy use in the power sector, mainly from wind and solar, has developed more dynamically than any other source of energy in recent years. Particularly Western and Central Europe, North America and Southeast Europe have increased their use of renewable electricity from wind and PV power plants. Despite the enormous potential and the importance of the heating sector as the main energy application in the region, renewable energy is not as widely adopted in the heating sector as in the power sector.

The uptake of renewable energy, including both renewable electricity and renewable heating solutions, face similar, overarching barriers and challenges: First, a vision, a clear political commitment and a roadmap outlying the pathway to a new energy system are prerequisites for successful and sustainable deployment of renewable energy. Many countries in the UNECE region have not yet produced or adopted a comprehensive renewable energy strategy. This hampers the confidence of potential investors and energy sector stakeholders, neglects essential, overarching system planning and ultimately hinders energy system development. Second, the economic viability of renewable energy projects, foremost in the power sector, has improved vastly over the last decade but has not yet been effectively realised throughout the UNECE region. Despite the competitiveness of renewables, renewable energy projects are not yet economically attractive in all countries in the UNECE region. In particular, market-distorting subsidies, misaligned taxes and levies as well as instable revenue flows hamper the economic viability of renewable energy generators. Third, a lack of infrastructural flexibility has been found to be a prevalent barrier for successful integration of intermittent renewable energy. Fourth, a lack of awareness of the benefits of renewable energy and a lack of energy sector expertise and capacity is still far spread across the UNECE region.

As the analysis in this report has shown, nearly all UNECE member states introduced legislation to tackle the main barriers of renewable expansion. National deployment targets and financial incentives are among the most widely used measures to provide the sector with an overarching energy sector strategy and address a lack of economic viability. Renewable heat is promoted in fewer member states than renewable power generation, revealing that governments currently mainly focus on the power sector for renewable energy deployment.

Given the variety in renewable energy deployment status and approaches to policymaking, there is great potential for knowledge transfer and mutual learning among UNECE member states. The four Hard Talks held in the framework of the UNECE Re-Uptake project with Albania, Georgia, Serbia and the Republic of Moldova facilitated such regional exchange and sharing of international best practice and experience. Although very diverse in terms of energy supply and demand, common themes and challenges were identified in each of the Hard Talks, including: a lack of energy system planning, immature or inadequate market structures and a lack of awareness and expertise of renewable energy.

All in all, this report as well as the conducted Hard Talks aid current and future development on the uptake of renewable energy by presenting the status of renewable energy uptake in the region – never have the conditions been more favourable for realising the potential of renewable energy in reducing emissions and achieving climate neutral energy supply and ensuring affordable and secure energy provision throughout the UNECE region.

Figures

Tables

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Abbreviations and Acronyms

ADB	Asian Development Bank
BMWK	German Federal Ministry for Economic Affairs and Climate Action
CAGR	Compound annual growth rate
CEB	Council of Europe Development Bank
CHP	Combined heat and power
COP23	23rd Conference of the Parties
CO2eq	Carbon dioxide equivalent
CSP	Concentrated solar power
dena	German Energy Agency
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
EU	European Union
FiT	Feed-in tariff
GDP	Gross domestic product
GDP, PPP	GDP at purchasing power parity
GERE	Group of Experts on Renewable Energy
GHG	Greenhouse gas
GTF	Global Tracking Framework
GW	Gigawatt
IEA	International Energy Agency
IKI	International Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent power producer
IRENA	International Renewable Energy Agency
KfW	Kreditanstalt für Wiederaufbau
kWh	Kilowatt-hour
LHP	Large hydropower
MW	Megawatt
NEEAP	National Energy Efficiency Action Plan
NREAP	National Renewable Energy Action Plan
OECD	Organisation for Economic Co-operation and Development
PPA	Power purchase agreement
PV	Photovoltaic(s)
RES	Renewable energy sources
REN21	Renewable Energy Policy Network for the 21st Century
SDG	Sustainable Development Goal
ST	Solar thermal
TFEC	Total final energy consumption
TJ	Terajoule
TPES	Total primary energy supply
UK	United Kingdom
UN	United Nations
UNECE	United Nations Economic Commission for Europe