Report

Status and perspectives for renewable energy development in the UNECE region

Updated 2017 version with new findings and handbook on experiences for sustainable renewable energy policymaking in the UNECE region

Publishing information

Publisher
Deutsche Energie-Agentur GmbH (dena)
German Energy Agency
Chausseestrasse 128 a
10115 Berlin, Germany
Tel: +49 (0)30 66 777 - 0
Fax: +49 (0)30 66 777 - 699
E-mail: info@dena.de
Internet: www.dena.de

Lead authors
Oliver Frank, dena
Tibor Fischer, dena
Pia Dorfinger, dena
Laura Prawatky, dena
Yannik Simstich, dena
Marten Westphal, dena
Vassilios Triantafyllos, Revelle Group (Chapter 6)
Elisa Asmelash, Revelle Group (Chapter 6)

Additional authors and reviewers
UNECE: Stefanie Held, Gianluca Sambucini, Lisa Tinschert
Revelle Group: Emily Koulouvaris (Chapter 6)

This report is an updated and extended version of the 2016 study “Status and perspectives for renewable energy development in the UNECE region,” which was realised within the overarching GIZ program “Capacity development for climate policy in the Western Balkans, Central and Eastern Europe and Central Asia” in the framework of the International Climate Initiative (IKI).

This paper was prepared within the context of the Group of Experts on Renewable Energy (GERE) of the United Nations Economic Commission for Europe.

This work is co-published by dena and the United Nations (UNECE)

Date: 12/2017

Photo credits

©istockphoto.com/adamkaz©wagner-solar.com

Supported by:

Federal Ministry
for Economic Affairs
and Energy

on the basis of a decision
by the German Bundestag

Foreword

The 56 countries comprising the region of the United Nations Economic Commission for Europe (UNECE) are distinct and diverse. This is true not just of their languages, culture and economic development, but also and especially of their energy markets. When it comes to using renewable energy for heating and electricity generation, the potential is enormous in virtually all parts of the region. Nonetheless, the renewable energy environments in the countries display enormous differences in terms of market share, market progress, market structure and policy architecture.

Replacing conventional energy sources with renewable energy is a matter of sustainability. However, if we have learned one thing from the German energy transition, it is that the process is also a catalyst for profound technological, entrepreneurial and societal innovation. In recent years, Germany has provided many examples of how such a transition can work, and of what should be avoided. This holds true for all UNECE countries. Pooling, sharing and exchanging experiences, information and practical knowledge are crucial to consolidating and advancing the UNECE energy transition. The present report is a meaningful step on this path.

Andreas Kuhlmann
Chief Executive
German Energy Agency (dena)

Contents

Executive summary

The region of the United Nations Economic Commission for Europe (UNECE region) comprises 56 countries in Europe, North America and Asia, and is considered a promising region for deploying renewable energy technologies.

The UNECE region has a fairly developed renewable energy market. It had an installed renewable electricity capacity of 869 gigawatts (GW) in 2016. This accounted for almost half of the worldwide installed renewable electricity capacity (1,971 GW, excluding pumped hydro and mixed hydropower). Hydropower is the most established renewable energy technology for electricity generation, making up 412 GW (388 GW from large hydropower [LHP]) of total renewable electricity capacity. Wind energy and solar photovoltaics (PV) are the second and third largest renewable energy electricity markets, with installed capacities of 254 GW and 140 GW, respectively. These two markets are also growing the most dynamically. Between 2013 and 2016, the compound annual growth rate (CAGR) for the wind energy market was 7.6%, and 10.3% for the PV market.

At the policy level, the report concludes that most UNECE member states have adopted renewable energy promotion schemes – 49 member states have schemes in the electricity sector and 41 member states have them in the heat sector. In the electricity sector, the most widely established renewable energy promotion schemes are feed-in tariffs (FiTs) or premiums, tax reductions and investment incentives. Each of these policy instruments is in place in more than 40 UNECE member states. Promotion schemes within the heat sector are mostly used to encourage heat generation from solar thermal energy, followed by biogas/biomass and geothermal energy.

As the costs of renewable energy technologies have continuously declined over the last two decades, new growth and future markets have begun to emerge. Some countries in the UNECE region are now major market players. However, due to the region's diversity, renewable energy technologies are at different stages of development in different countries. Some only have very low levels of renewable energy deployment, despite the existing potential.

In recent years, UNECE member states have demonstrated increasing strategic planning in the area of renewable energy deployment, seeking to establish holistic and integrated national energy systems. However, in many UNECE countries, a number of challenges persist that are slowing market development. Barriers such as inadequate legal and regulatory frameworks, distorted pricing of energy commodities due to subsidies, a lack of market liberalisation, absence of public acceptance and poor knowledge about the application potential of renewable energy resources still hamper the uptake of relevant technologies. Locally appropriate and tailored policy measures are vital for renewable energy deployment. Although requirements for policy frameworks are unique because market conditions differ in each country, some approaches are nevertheless likely to result in successful implementation everywhere.

This report aims to support the market uptake of renewable energy by demonstrating its potential and applicability through selected policy instruments for UNECE member states. It examines the current situation and challenges facing renewable energy deployment across the region. It then presents different policy options for promoting renewable energy, their current state of implementation and their applicability.

With that in mind, the report seeks to provide insights into country-specific practices and experiences. Following a series of conversations about policy barriers and solutions, recommendations were developed to highlight commonly agreed recommendations and priorities for effectively implementing renewable energy

policies in the national energy markets. The report therefore gives policymakers a toolkit of selected renewable energy promotion schemes based on experiences from countries with higher renewable energy uptake. The policy toolkit can be applied to individual countries or at a regional level to help further develop the renewable energy market.

The report uses hands-on experience from renewable energy market development in three UNECE countries, and the results of two expert discussions held with regional energy experts during COP23 in November 2017. One of the main conclusions is that, besides political targets and accompanying policies, the actual form of policy implementation is crucial to successfully fostering renewable energy use in the electricity and heating sectors.

Overall, the report aims to provide useful information for more effective renewable energy policies that are predictable, consistent and steady in the long term, aligned with existing energy market structures, adjusted to the attributes of the defined key dimensions and factors of renewable energy deployment, and coordinated with other policies.

1 Introduction

The major aim of the United Nations Economic Commission for Europe (UNECE) is to promote pan-European economic integration among its 56 member states. The UNECE's work on sustainable energy is designed to improve access to affordable and clean energy for all, and to help reduce greenhouse gas (GHG) emissions and the carbon footprint of the regional energy sector. It promotes international policy dialogue and cooperation between governments, energy industries and other stakeholders. The focus is on energy efficiency, cleaner electricity production from fossil fuels, renewable energy, coal mine methane, natural gas, classification of energy and mineral reserves and resources, and energy security. UNECE set up the Group of Experts on Renewable Energy (GERE) to pursue activities that help increase the uptake of renewable energy and that achieve the objective of giving everyone in the UNECE region access to energy.

The UNECE region is considered to have great potential for renewable energy deployment. Some UNECE countries have developed renewable energy markets which offer a sound market environment and well-developed infrastructure for deploying renewable energy. Other countries can substantially increase their deployment of renewable energy in a fairly unexploited environment. Nevertheless, the uptake of renewable energy is hampered by a number of issues, such as inadequate standards and regulatory frameworks, distorted pricing of energy commodities due to existing energy subsidies, a lack of market liberalisation, absence of public acceptance and, sometimes, little knowledge about the application potential of renewable energy resources and their integration into existing fossil-fuel systems.

The following report is an update of the 2016 study "Status and perspectives for renewable energy development within the UNECE region".[1] Both reports were commissioned to support the GERE's work. The present report seeks to raise awareness of the status quo and the enormous potential of renewable energy in the region. It provides policymakers with information about how they can support the transition to a more sustainable energy supply in the UNECE region. In turn, this will help achieve the United Nations Sustainable Development Goals (SDGs) and will support climate change adaption and mitigation by reducing greenhouse gas emissions.

The report is divided into six chapters. The first and second chapters introduce the theoretical background of renewable energy development and deployment. They analyse the key dimensions, global trends and fields of application. The third chapter is dedicated to the status quo of renewable energy deployment and electricity pricing in the UNECE region. The fourth chapter presents an overview of major renewable energy promotion schemes and measures. It examines their current implementation in the electricity and heat sectors in each UNECE member state. The fifth chapter summarises the report's main findings and lessons learned, and concludes with a policy toolkit and recommendations for the GERE's future work. The last chapter focuses on crucial factors for successful energy transitions, and on how to implement policies successfully.

[1] Document available at: https://www.unece.org/fileadmin/DAM/energy/se/pdfs/gere/GERE_October_2016/Dena_Report_RE_2016.pdf

2 Setting the scene for deploying renewable energy

In the past, deploying renewable energy was politically encouraged in order to mitigate climate change and to enhance environmental protection, security of energy supply and economic development. Increasing the share of renewable energy in national energy mixes can help mitigate carbon emissions in the longer term, and can offer opportunities for low-carbon economic growth. Generating electricity and heat from renewable energy also helps to diversify national energy mixes and reduce dependencies on energy imports, which in turn increases a country's security of energy supply. Furthermore, establishing renewable energy markets helps to stimulate the economy, employment and innovation, especially in rural areas and the agricultural sector.

In the following, we analyse the background and theoretical underpinning of renewable energy deployment. We do this by determining the key dimensions and factors, investigating the emergence of important global trends and defining fields of application for each renewable energy source.

2.1 Key dimensions and factors

In terms of economic development, prevalence of renewable energy technologies, underlying legal frameworks and availability of natural resources, the UNECE is a heterogeneous region. This poses a challenge for applying universal policies for promoting renewable energy deployment.

Promotion schemes and mechanisms can help facilitate the introduction and uptake of renewable energy. However, underlying political, economic, technical and social key factors determine the initial situation of each energy market and have a strong influence on the future trajectory of each renewable energy technology and its field of application.

Figure 1 provides an overview of important key dimensions (dashed yellow lines) and the corresponding key factors (dark-blue boxes with black borders) for developing renewable energy markets at a national level. Major possible attributes and subcategories of each key factor are listed vertically (boxes with no borders).

The four key dimensions are (1) political/regulatory, (2) economic, (3) social, (4) technical.

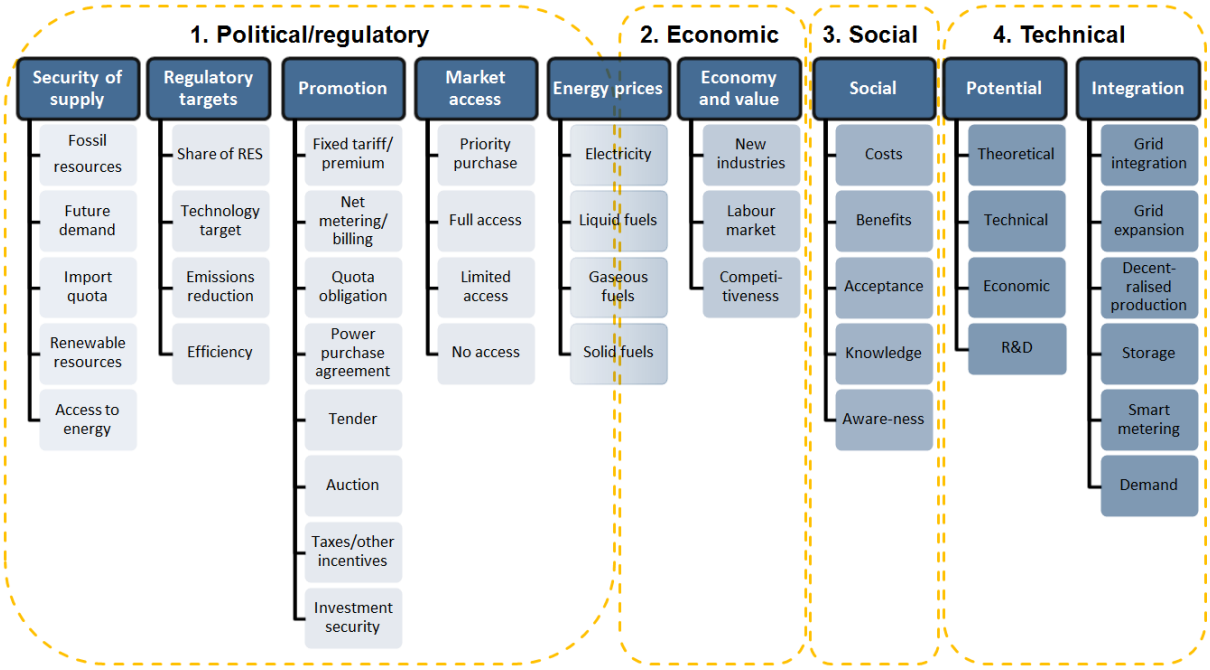


Figure 1 Key dimensions and important drivers for developing renewable energy markets

The political and regulatory dimension

At the political and regulatory level, the five key factors of renewable energy deployment are: security of energy supply; regulatory targets for renewable energy; renewable energy promotion schemes; market access regulations for renewable energy producers; and energy market prices. Security of supply is a major factor driving energy policies. Increasing the share of renewable energy in national energy mixes is seen as an effective way of enhancing national security of supply because it reduces dependency on limited fossil fuel reserves and results in a more diverse energy mix. The particular level and type of renewable energy regulatory targets also strongly affect the development of renewable energy, since policy targets set the strategic direction of renewable energy promotion schemes. These promotion schemes, in turn, can be considered as tools to achieve the respective renewable energy policy targets. The last two key factors – existing market access regulations for renewable energy producers, and energy prices, particularly the prevalence of energy price subsidies – are fundamental for the market entry and integration of renewable energy. This is because they influence the competitiveness of renewable energy within national energy markets.

The economic dimension

Deploying renewable energy is generally thought to economically benefit a country. This is because, from a macroeconomic perspective, it creates jobs and new branches of industry. As key economic factors in renewable energy deployment, it is important to consider electricity prices and energy market conditions. The level and stability of electricity prices and sales revenues are decisive for the uptake of renewable energy. Low energy prices make it harder for renewable energy technologies to enter the market if no further promotion schemes are used to lift renewable energy prices above energy market prices and thus make renewable energy more competitive than conventional energy sources. On the other hand, high energy prices might reduce the international competitiveness of local energy-intensive industries.

The social dimension

The key factors in the social dimension of renewable energy deployment are electricity costs, social acceptance, public knowledge and awareness of renewable energy deployment. Electricity costs reflect a trade-off between energy affordability or social acceptance and the magnitude of renewable energy promotion, since promotion costs are usually passed on to consumers. Additionally, social acceptance of renewable energy deployment is highly dependent on the infrastructural planning of renewable energy expansion, particularly in terms of the impact on local landscapes and natural habitats. Therefore, social acceptance can be encouraged by proper energy price monitoring and by including the public as relevant stakeholders in planning processes for renewable energy expansion. This can be done via, for example, new business models such as community-based renewable energy projects and natural resource management. Also, raising knowledge about renewable energy is essential for its successfully deployment, as the application of relatively new technologies depends heavily on broad public awareness.

The technical dimension

If technical planning processes are to be successful, a country's renewable deployment potential and system integration requirements for renewable energy need to be analysed. Increasing the share of renewable energy in the national energy mix will change the existing energy system as a whole. Therefore, the existing system must be adapted to the specific characteristics of electricity and heat generated by renewable energy technologies (particularly to their fluctuating and decentralised feed-in). Measures to increase the system integration of renewable energy include the following: expanding grid capacities; using flexible power plant capacities, load management, and demand-side management and storage; reducing "must-run" capacities; introducing local supply concepts. Regional cross-border integration can also make systems more flexible.

Major interdependencies exist between each of the defined key dimensions and factors. Policymakers should be aware of these interdependencies, since the attributes of individual key factors might interfere with new or existing renewable energy promotion schemes and measures, and might hinder efforts to further develop the market in renewable energy technologies. For example, introducing schemes to promote energy efficiency might be ineffective if electricity prices are low. Policymakers should understand the four key dimensions as fields of action in which barriers to renewable energy deployment can be identified and minimised by considering the key drivers for directly and indirectly promoting renewable energy.

In summary, no blueprint for successfully shaping stable frameworks for renewable energy deployment exists. Policies and mechanisms need to be applied in a differentiated manner that considers the national market conditions.

2.2 Global trends

In the early stages of global renewable energy deployment in the 1990s and 2000s, the main priority for policymakers was simply to expand renewable energy technologies. Since then, the political, regulatory, economic and technical framework for deploying renewable energy has evolved rapidly. It has followed some key global trends for more holistic and integrated policymaking within a green economy concept. Figure 2 gives an overview of when key trends emerged in the political, economic and technical spheres.

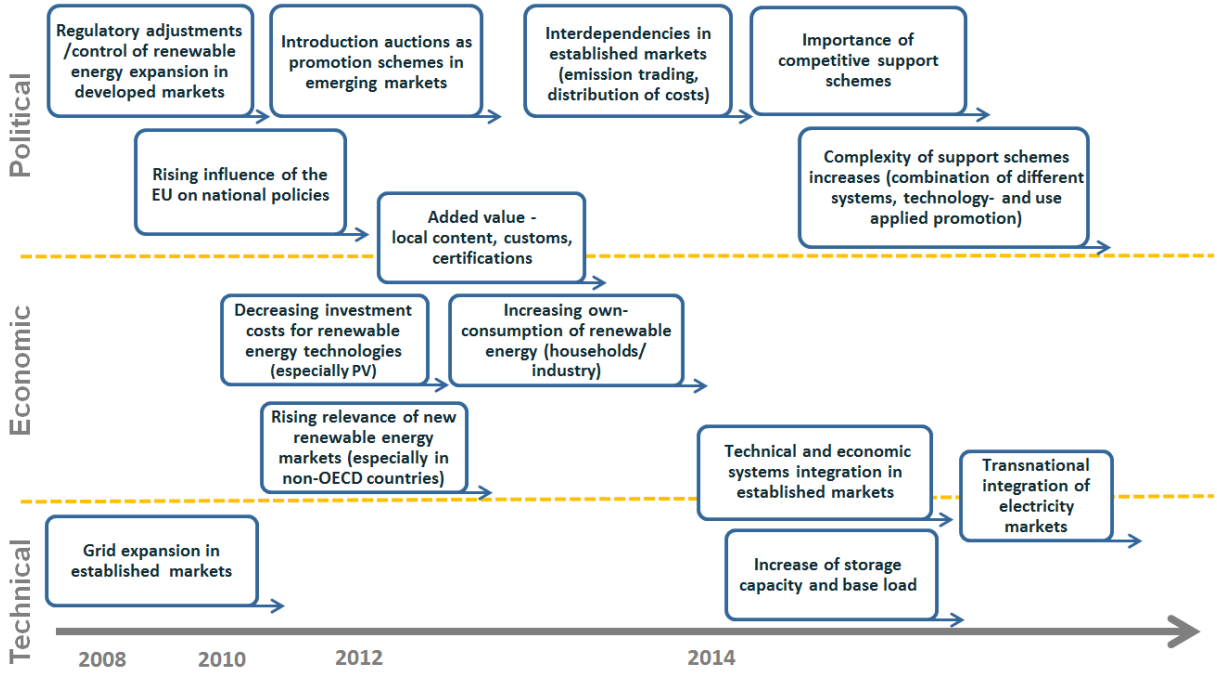


Figure 2 Emergence of important global trends in international renewable energy deployment

The first phase of global renewable energy deployment was characterised by minimal political monitoring and a strong focus on creating renewable energy markets using FiTs. Then, in 2008, the political and regulatory landscape of renewable energy deployment changed noticeably. Retroactive cuts on guaranteed FiTs and retroactive taxes were introduced to limit the further expansion of renewable energy in established markets such as Spain and the Czech Republic (PV). This was because FiTs had become too expensive and were raising procurement costs.

Since 2008, governments have been increasingly steering and controlling the deployment of renewable energy by adopting new legislation and amending policy schemes.

Simultaneously, at the technical level, expanding grid capacities gained more importance due to increasingly decentralised electricity generation and the fluctuating feed-in of renewable electricity, especially from wind energy and PV.

At the political and regulatory level, the increasing influence of EU legislation on national energy policies led, for instance, to the obligatory development of National Renewable Energy Plans. The EU also began checking national energy legislation, and the European Commission reviewed Germany's system of FiTs in this regard.

Due to continuous technological development, the investment costs for renewable energy technologies have been decreasing significantly, particularly for PV. In the private sector and in industry, this has increased the number of operators generating electricity partly or entirely for their own use ("autoproducers"). In turn, this led to new policies designed to better integrate autoproducers into the infrastructure and the regulatory system.

Declining technology costs also led to the emergence of new renewable energy markets, especially in developing countries. Up until 2014, industrialised countries consistently contributed the majority of worldwide investments in renewable energy. In 2015, developing countries invested more in renewable energy (excluding LHP) than their developed peers for the first time: $167 versus $145. Furthermore, investment in renewable energy has recently overtaken investment in conventional energy sources. In 2016, roughly $227 billion was invested in renewable energy plants (excluding LHP), with an additional $23 billion invested in large hydro installations. In contrast, investment in fossil and nuclear power plants only amounted to about $144 billion in 2016.[2] With the emergence of new renewable energy markets, auctions gained international importance as a way of promoting renewable energy. They were initially launched in emerging renewable energy markets in developing countries, but are now also often used in other countries as a competitive way of promoting renewable energy.

At the political/regulatory and economic level, local content rules and other local promotional market regulations have increasingly been introduced in various countries – such as Brazil and Turkey – in order to establish new domestic value chains and to secure national value-added in the renewable energy industry.

With the ongoing expansion and uptake of renewable energy, its macroeconomic integration has grown more complex. Closer monitoring of electricity pricing mechanisms – such as electricity retail pricing, the distribution of renewable energy promotion costs and the impact of "greener" national energy mixes on carbon prices in emissions trading schemes – has become increasingly important.

Besides macroeconomic integration, grid integration has become a crucial aspect in established renewable energy markets. The fluctuating feed-in of renewable electricity has created new priorities in the form of grid balancing and increased grid flexibility. Fewer and more flexible baseload capacities, increased storage capacities, extended demand-side management and load management, transnational electricity market coupling, etc., are now essential for further renewable energy deployment.

At the political and regulatory level, renewable energy promotion schemes have become more complex. They are now more technology-specific and more networked. We are seeing a common trend whereby purely expansion-oriented FiTs are giving way to more competitive and market-based promotion schemes, such as auctions and feed-in premiums. A major driver of this change is the EU regulation that requires all EU countries to introduce auctions as their main renewable energy promotion scheme by 2017.

[2] All investment data from the Global Trend in Renewable Energy 2017 report by the Frankfurt School-UNEP Centre.

2.3 Fields of application

Renewable energy sources can play an essential role in the future supply of electricity, heating and cooling. Figure 3 provides an overview of the various renewable energy technologies and their possible fields of application: (1) utility scale, (2) industry/commercial, (3) private households and (4) off-grid. Fields (2) and (3) refer to autoproducers – businesses and private households that generate electricity or heat wholly or partly for their own use, and in addition to their primary activity.[3] Figure 3 also shows whether a technology provides electricity, heating/cooling, or both.

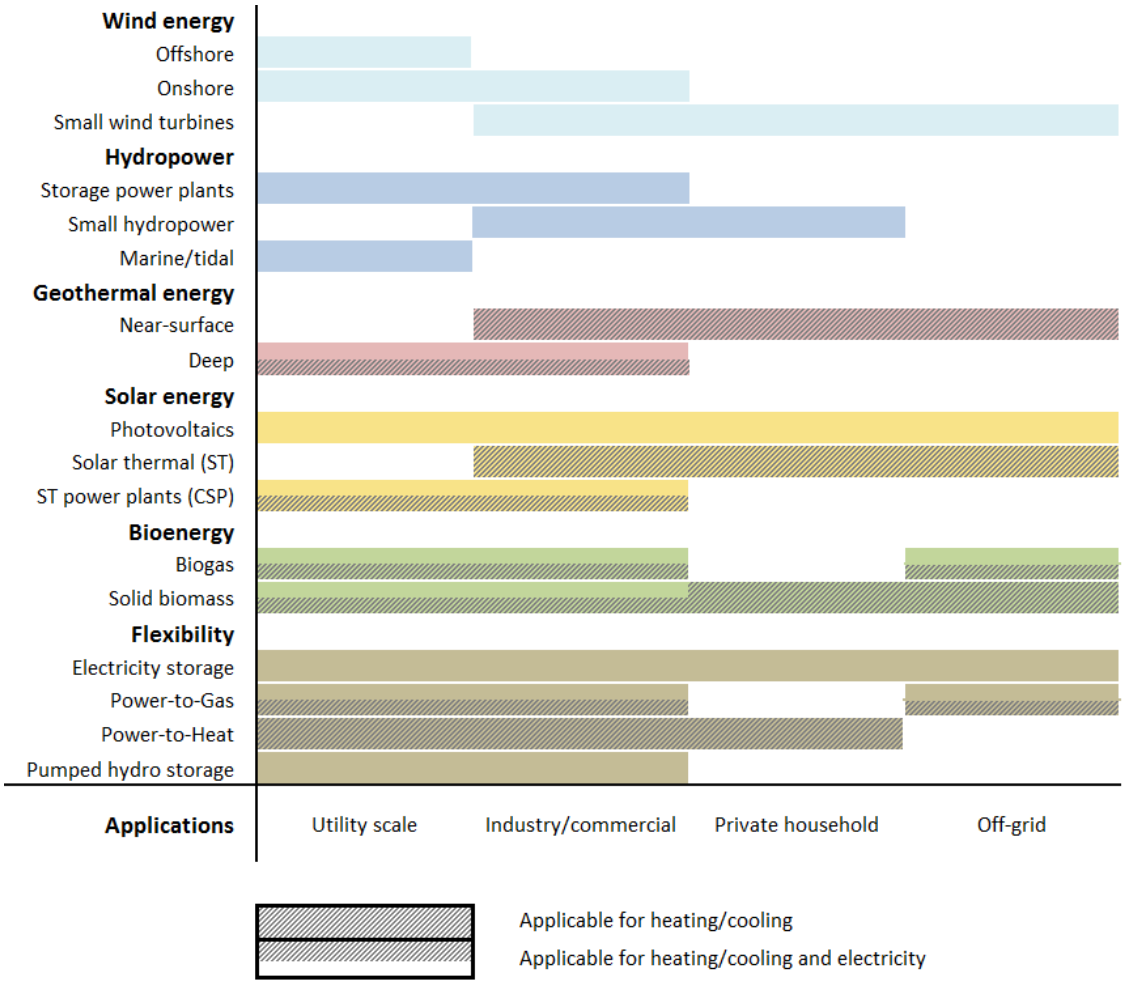


Figure 3 Fields of application of renewable energy sources [4] [5] (except renewable fuels)

The size of wind energy installations largely determines their field of application. Large offshore wind farms only operate on the utility scale, whereas small onshore farms or single onshore turbines also provide energy

[3] OECD Energy Statistics Glossary.

[4] Biofuels are not included since they are not an original source of renewable energy; they are processed biomass.

[5] Small-scale wind turbines and hydropower plants were evaluated separately in order to differentiate their fields of application from turbines and plants with high capacities.

for private households or small industrial consumers. While some technologies are only applicable in one or two areas, other technologies can cover a wide array of applications. This is true of PV, which can provide electricity for numerous types of electricity demand, and particularly for off-grid electricity demand. Some technologies are limited to generating either electricity or heat despite having a common energy source. This applies to solar thermal and photovoltaic installations. Other technologies, such as biogas, are more versatile and provide energy which can be used to generate both heat and electricity.

As far as the deployment of various renewable energy technologies is concerned, however, GHG emissions must also be accounted for. The special report by the Intergovernmental Panel on Climate Change (IPCC) on renewable energy sources and climate change mitigation uses life cycle assessments to work out the total GHG emissions for one kilowatt-hour (kWh) of electricity for each energy source. The findings show that, on average, renewable energy technologies for generating electricity have significantly lower GHG emissions than fossil fuels, even those employing carbon capture and storage (CCS). Renewable energy technologies produce between 4 and 46 g CO_{2eq}/kWh, whereas fossil fuels typically produce between 469 and 1,001 g CO_{2eq}/kWh. Next-generation biofuels also have the potential for higher degrees of mitigation, as they use residue and waste products.

2.4 Conclusion

Renewable energy deployment is influenced by key factors from the political, regulatory, economic, social and technical key dimensions. The dimensions and corresponding key factors should be seen as interrelated fields of action. This will make it possible to define and introduce individual renewable energy promotion schemes and to minimise undesirable obstacles.

In general, renewable energy markets have developed as follows: In the early stages of renewable energy development and deployment, promotion efforts were concentrated in industrialised countries. Developing and less developed countries gained importance in the early 2010s, and began contributing the majority of worldwide investments in renewable energy in 2015. A significant drop in investment costs over time, transnational technology transfer and the emergence of renewable energy policy goals promoted by an international community also led to increasing trends in developing countries.

Additionally, the initial primary political objective of merely expanding renewable energy has been replaced by the aim of achieving cost-efficient and managed deployment in an integrated, holistic manner. In established renewable energy markets, the complexity of promotion schemes has increased, with some becoming more technology-specific. There is now a need to adapt the existing grid and energy-system infrastructure to the fluctuating and decentralised feed-in from variable sources. In turn, this has created a need for more grid capacity and more system integration via enhanced storage capacities, demand-side management and more flexible power plants. The integration of an increasing number of autoproducers and newly evolving business models has become a crucial driver for acceleration. At the macroeconomic level, monitoring of electricity pricing mechanisms and the influence of renewable energy deployment on emissions trading schemes has gained particular relevance for the further development of renewable energy.

Each renewable energy source has a variety of possible fields of application: applications for generating electricity or heat, utility-scale applications, lower scale applications in the private sector and industry, and off-grid applications. When introducing a technology-specific renewable energy promotion scheme, the corresponding possible fields of application need to be taken into account in order to identify the system requirements with regard to infrastructure and promotion mechanisms.

It is important to critically examine how renewable energy contributes to climate change mitigation. The special report by the IPCC on renewable energy sources and climate change mitigation shows that generating electricity from renewable energy produces fewer GHG emissions than burning fossil fuels. However, existing evidence for the mitigation potential of renewable energy is mixed. For example, Germany is internationally known for its *Energiewende* (energy transition), which has so far mainly focused on increasing renewable energy use and energy efficiency in the electricity sector. In 2016, the share of renewable energy in the electricity mix reached 31.7%. However, GHG emissions remained stagnant at similar levels to the previous three years.[6] As a result, most recent analyses suggest that Germany will miss its 2020 goal of reducing emissions by 40% compared to 1990 levels. Estimates say that reductions will be in the range of 30-31% if no additional measures are implemented in the next three years.[7] This may change in the longer term, as more stringent regulations are put in place and the energy transition expands to include all energy sectors rather than just electricity. However, as of today, the immediate impact of renewable energy uptake on total GHG emissions may be less positive than suggested in theory.

[6] Agora Energiewende (2018): https://www.agora-energiewende.de/fileadmin/Projekte/2018/Jahresauswertung_2017/Agora_Jahresauswertung-2017.pdf
[7] Agora Energiewende (2017): Das Klimaschutzziel von -40 Prozent bis 2020: Wo landen wir ohne weitere Maßnahmen? https://www.agora-energiewende.de/fileadmin/Projekte/2015/Kohlekonsens/Agora_Analyse_Klimaschutzziel_2020_07092016.pdf

3 Status quo of renewable energy deployment and electricity pricing in the UNECE region[8]

This chapter provides an overview of the status quo of renewable energy deployment in the UNECE region. To a great extent, the research emphasis lies on the status quo of electricity generation from renewable energy sources, since the regional electricity sector has been the focus of most UNECE countries so far. We analyse PV and wind energy more thoroughly because they have been the most rapidly expanding technologies (in relative terms) in recent years, which has created a particular need for political focus and regulatory intervention.

The UNECE region spans Europe, North America and Asia, and is therefore very diverse. It comprises 56 countries and had a total population of 1.3 billion people in 2015. This represents 18% of the world's population[9] and most of the Northern Hemisphere's. As reported in the Global Tracking Framework: UNECE Progress in Sustainable Energy (UNECE Regional GTF),[10] the region is important in the global energy environment. In 2014, it accounted for 42% of global GDP,[11] 40% of the world's total primary energy supply (TPES)[12] and 34% of global carbon emissions from fossil fuel combustion.[13] The diversity of the region is visible in the history of its economic development and in the size, population density, national income, climate, and access to domestic energy sources of each country.[14]

Figure 4 Map of the UNECE region with 56 countries

[8] Consideration and use of data from REN21 UNECE Renewable Energy Status Report 2017.

[9] World Bank (2017c): World Development Indicators: http://data.worldbank.org/data-catalog/world-development-indicators (as of 13 April 2017).

[10] UNECE (2017): Global Tracking Framework: UNECE Progress in Sustainable Energy 2017.

[11] GDP, PPP (constant 2011 international USD).

[12] As defined by the International Energy Agency (IEA), total primary energy supply (TPES) (in terajoules [TJ]) is production plus net imports minus international marine and aviation bunkers plus/minus stock changes. *Data sources*: Energy balances from the IEA, supplemented by UN Statistical Division for countries not covered by the IEA.

[13] World Bank and International Energy Agency (2017a): Global Tracking Framework. Progress toward Sustainable Energy. http://gtf.esmap.org/

[14] For more information, please see UNECE (2017): Global Tracking Framework: UNECE Progress in Sustainable Energy 2017, page 8.

3.1 Development of renewable energy[15]

During the last decade, the worldwide expansion of renewable energy has progressed rapidly. In 2016, the installed electricity capacity of renewable energy sources in the UNECE region (without pumped storage and mixed plants) amounted to about 869 GW, of which 388 GW came from LHP[16]. The electricity capacity from renewable energy in the UNECE region therefore accounted for almost half of the 1,971 GW of renewable electricity capacity installed worldwide.[17] Thus, renewable energy sources for generating electricity (excluding LHP) have developed faster and more dynamically in recent years and have therefore contributed the bulk of newly installed capacities.

The UNECE Regional GTF Report provides insights into the status of renewable energy deployment in the UNECE region. It also measures progress made on achieving Goal 7.2 under SDG7 – which states, "By 2030, increase substantially the share of renewable energy in the global energy mix"[18] – by providing data on the share of renewable energy in total final energy consumption (TFEC). The 2017 report reveals that the UNECE region was the only UN region that consistently increased the share of renewable energy in the mix over the tracking period 2012-2014. In addition, growth has recently accelerated. The share of renewable energy in TFEC increased from 6% in 1990 to 11% in 2014, with growth happening fastest in Southeast Europe. The share of modern renewable energy in TFEC reached 11%, the second highest globally, as traditional biomass consumption is negligible in the region.[19] Figure 5 provides an overview of how the share of renewable energy developed in four UNECE sub-regions from 1990 to 2014.

[15] Data from IRENA Renewable Energy Capacity Statistics 2017.

[16] Large hydropower plants include all installations with a capacity of 10 MW or more, as defined by the International Renewable Energy Agency (IRENA).

[17] This report considers wind, solar, hydropower, bioenergy, geothermal and marine energy to be renewable energy sources. Pumped storage, mixed storage and hydropower plants are not counted.

[18] https://sustainabledevelopment.un.org/sdg7

[19] Within the GTF, renewable energy consumption includes "renewable energy consumption of all technology: hydro, biomass, wind, solar, liquid biofuels, biogas, geothermal, marine and renewable wastes". Modern renewable energy consumption is defined as "total renewable energy consumption minus traditional consumption/use of biomass. It covers all forms of renewable energy directly measured, including wind, hydro, solar, geothermal, marine, biogas, liquid biofuel, renewable energy waste, and modern biomass". Traditional renewable energy consumption is defined as "final consumption of traditional uses of biomass. Biomass uses are considered traditional when biomass is consumed in the residential sector in non-Organisation for Economic Co-operation and Development (OECD) countries. It includes the following categories in IEA statistics: primary solid biomass, charcoal and non-specified primary biomass and waste."

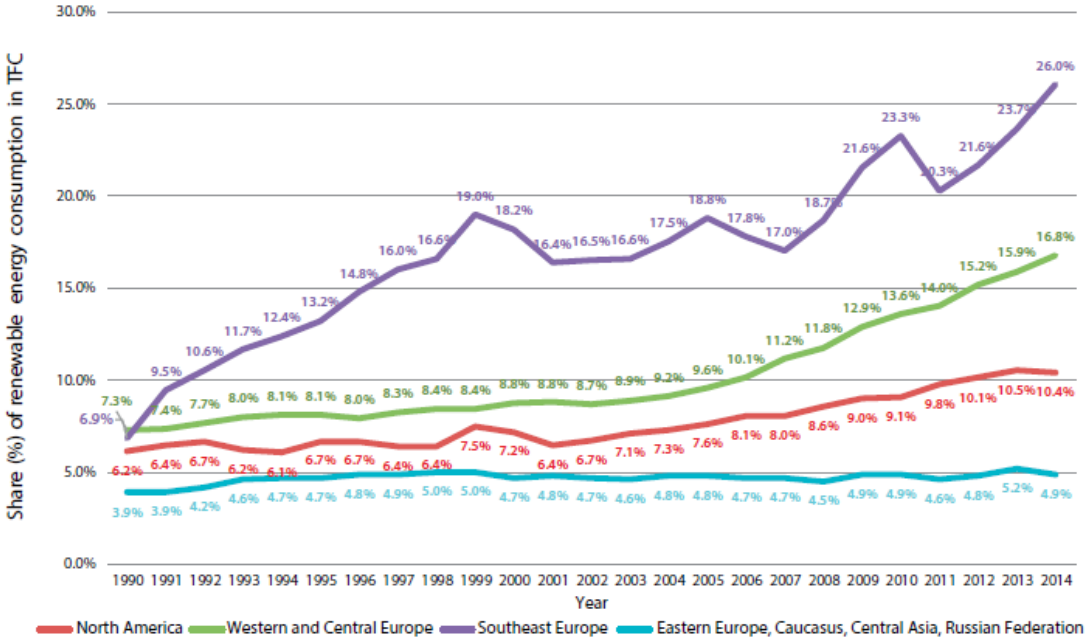


Figure 5 Growing renewable energy use in UNECE sub-regions. Source: As published in UNECE (2017)

Initially, the development of hydroelectric power underpinned a high rate of electricity access in the region. More recently, renewable energy development has mostly concerned large wind and solar farms, which reflects a central supply focus and falling production costs. Within renewable energy sources, the share of modern solid biofuels consumption was the highest in 2014 at 38%, followed by hydropower at 28%, and modern liquid biofuels at 14%. Between 2012 and 2014, wind and solar power production grew the fastest, reaching shares of 9.5% and 4.3%, respectively. Countries in the UNECE region differ in terms of the degree to which renewable energy technologies are established and in operation. While some renewable energy sources are used in many countries, others have yet to become popular. Hydropower is the most established source of renewable energy for electricity generation, and is used in both large and small plants. About one third of all UNECE countries have well-established hydropower markets. While hydropower is used for electricity generation across the UNECE region, it is important to note that markets for wind energy, PV, solar thermal energy, geothermal energy, biogas and biomass exist almost exclusively in UNECE countries that belong to the OECD.[20]

A significant number of national energy markets generate electricity from wind and PV. Countries with established onshore wind energy markets include Cyprus, Italy, Lithuania, Portugal and Spain. Far fewer countries have strong offshore wind markets, with the biggest being Belgium, Denmark, Germany, the Netherlands, Sweden and the United Kingdom. While wind energy is more prevalent in Western European countries, PV markets are more widely spread: Bulgaria, Romania, Slovakia, Slovenia and the Czech Republic all have established PV markets. The markets for both wind and PV are growing across the UNECE region.

[20] UNECE countries that are members of the OECD: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, Canada, United States of America (28).

UNECE countries that are not members of the OECD: Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Liechtenstein, Lithuania, FYR Macedonia, Malta, Republic of Moldova, Monaco, Montenegro, Romania, Russian Federation, San Marino, Serbia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan (28).

Figure 6 to Figure 9 show the most recent renewable energy development in the UNECE region.[21] They depict the installed electricity capacities of PV, wind energy, bioenergy and hydropower, and the corresponding compound annual growth rate (CAGR).

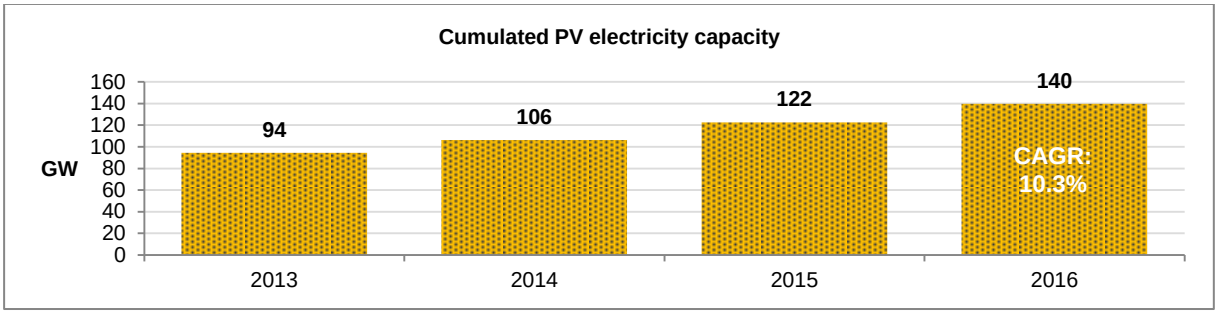


Figure 6 Recent PV development in the UNECE region

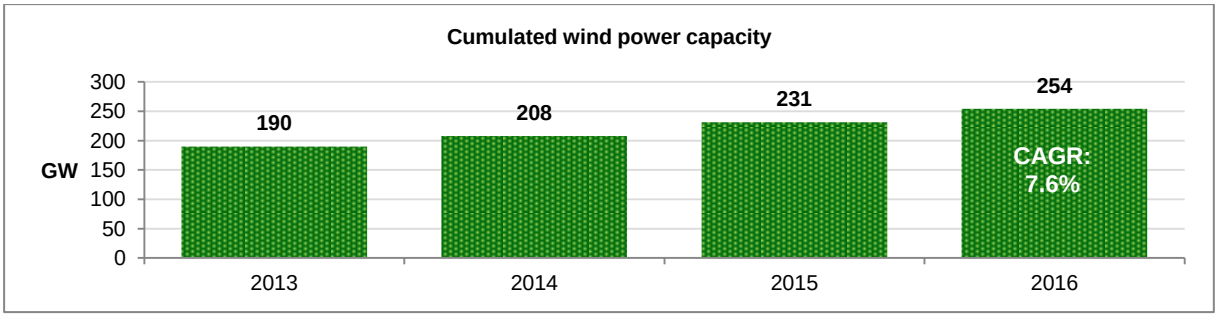


Figure 7 Recent wind energy development in the UNECE region

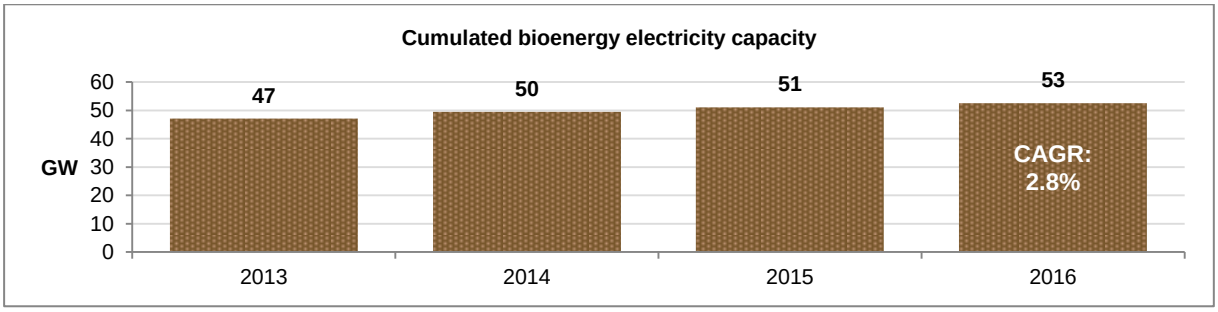


Figure 8 Recent bioenergy development in the UNECE region

[21] Data source: IRENA, Renewable Energy Capacity Statistics (2016). Wind energy includes onshore and offshore installations. Only countries for which data were available are included.

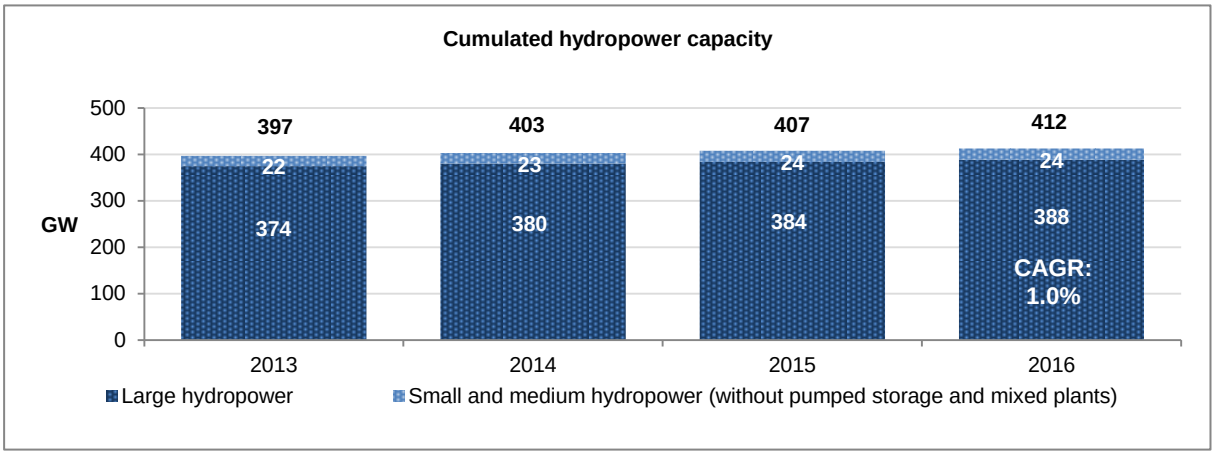


Figure 9 Recent hydropower development in the UNECE region

The size of the columns illustrates the growth of the cumulated PV, wind energy, bioenergy and hydropower capacities in GW between 2013 and 2016. These four technologies are the most significant sources of renewable energy in the UNECE region. They contributed 859 GW of the 869 GW of installed renewable electricity capacity in 2016. Wind energy and PV have been the two most rapidly expanding renewable energy technologies since 2013.

The cumulative graphs show that recent growth in PV and wind energy differs a great deal from the growth in hydropower and bioenergy. Between 2013 and 2016, wind energy capacity increased from 190 GW to 254 GW, which is an annual average of 7.6%. In the same period, the PV sector expanded even more rapidly – from 94 GW to 140 GW, which equates to annual growth of 10.3%.

Hydropower capacity has grown less or even stagnated in recent years. In some cases, it has declined. Many UNECE countries are already using much of their economically exploitable hydropower potential, which results in less dynamic market growth and fewer new installations. In the majority of UNECE countries, a significant portion of hydropower comes from LHP, which accounts for between 70% and 100% of installed hydropower capacity. A few countries obtain the majority of their hydropower from small and medium-sized plants, pumped storage and mixed plants. In Belgium, however, LHP contributes just 39% to total hydropower capacity. Most notably, the LHP sector has hardly grown between 2013 and 2016; its capacities have grown by an average of 0.9% annually. Small and medium-sized plants, pumped storage and mixed hydropower plants have increased by over 2 GW, thanks to an average annual growth rate of 1.7%. Overall, the hydropower sector has expanded by an annual average of 1.0%.

In numerous countries, the modern use of biomass (as opposed to traditional uses such as burning wood at home) and biogas to generate electricity is either already established or new markets have recently begun to emerge. However, bioenergy[22] had the smallest electricity generation capacity of the four technologies in the UNECE region: 54 GW in 2016. The sector grew by an annual average of 2.8%, from 47 GW in 2013 to 53 GW in 2016.

[22] 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.”

As explained above, PV, wind energy, bioenergy and hydropower are the main sources of renewable electricity. The markets for other renewable energy technologies are either underdeveloped or mainly focused on the generation of heat.

The main sources for renewable heat are geothermal energy, solar thermal energy, bioenergy and concentrated solar power. Despite its potential, geothermal energy is only exploited in some UNECE countries. However, many countries have good potential, and markets for geothermal heat are emerging in several others. Solar thermal energy, on the other hand, is a more established renewable heat source. Countries such as Israel, Switzerland, Turkey and the United States have significant solar thermal markets, and the technology is gaining importance in many others. The modern use of bioenergy to generate heat is less common in the UNECE region. Concentrated solar power plants are only relevant in the United States and Spain, due to the need for sites with high solar radiation. Overall, the renewable heat sector in the UNECE region is not as developed as the sector for renewable electricity – despite the high potential in many member states.

3.2 Dynamic renewable energy markets for electricity: Solar PV and wind energy

The PV and wind energy markets can be described as "dynamic" renewable energy markets for electricity, since their relative growth is noticeably higher than other renewable energy sources. Due to the vast expansion of these technologies, which requires special political focus and regulatory intervention, this report analyses PV and wind energy deployment particularly thoroughly. The two graphs below show the recent development of PV and wind energy markets in the UNECE region for each member state. The y-axis displays the CAGR of installed electricity capacities of PV (Figure 10) and wind energy (Figure 11)[23] between 2013 and 2016 as an indicator for the growth of the national PV and wind energy markets. The x-axis shows the market share of each technology as a percentage of total national electricity generation capacity in 2016. The diameter of the bubbles represents the cumulative national installed electricity capacity of the respective technology in 2014. Thus, Figure 10 and Figure 11 display national wind energy and PV market growth rates in relation to their level of national electricity market penetration in the UNECE member states. In order to cluster and analyse the countries, we divided the graphs into 4 quadrants (explained in Table 1).

	x-axis left half	**x-axis right half**
y-axis upper half	**Quadrant 2** below-average market share above-average growth rate	**Quadrant 1** above-average market share above-average growth rate
y-axis lower half	**Quadrant 3** below-average market share below-average growth rate	**Quadrant 4** above-average market share below-average growth rate

Table 1 Description of the four quadrants: market share and growth rate

[23] Data sources: IRENA: Data for renewable energy capacities. EIA: Data for total electricity installed capacity 2014. Values for 2016 are estimates based on calculated trend projections. Only countries for which data were available are included.

UNECE member states that have no or only very little installed PV or wind capacity start in quadrant 3 (Q3). When their installed capacities start to increase as new installations are added, the countries move up to Q2. Regarding the recorded growth rates within Q2, it should be noted that high market growth rates can be attained, since the initial installed PV or wind capacities are low. Thus, market growth rates (especially those in Q2) need to be interpreted in light of the initial installed capacities. High growth rates can often be sustained in the short to medium term even if the technology's market share increases – which is the case for UNECE member states in Q1. When the growth rate eventually slows down, countries drop to Q4, which is where the established PV and wind markets are located. Since the quadrants do not have definitive cut-offs, established markets can also be found in Q3 – if the country has a lot of wind or PV capacity but the market share is small.

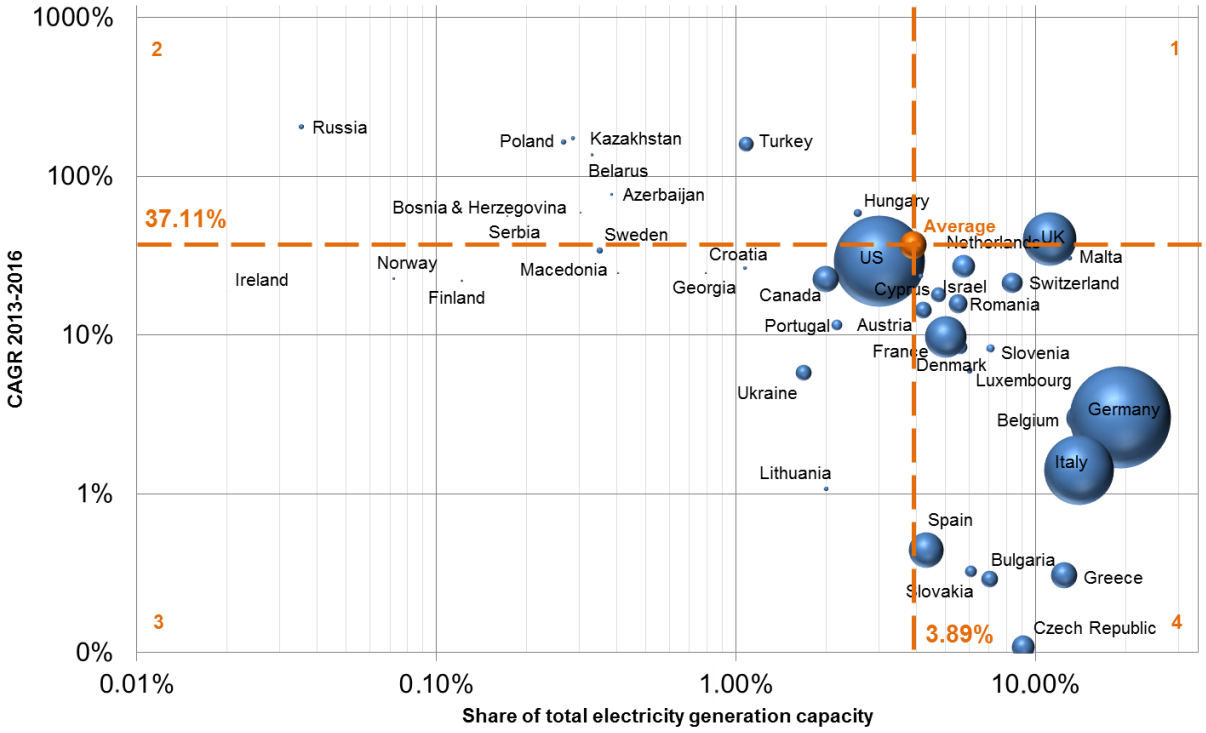


Figure 10 PV market growth in relation to PV's share of total electricity generation capacity in the UNECE region in 2016

Looking at PV deployment in the UNECE region, which is depicted in Figure 10, we see that the average market growth rate[24] between 2013 and 2016 was high, at 37.1%. However, the share of total electricity generation capacity stayed low, at 3.89%. Ireland, Finland and Norway have established their PV markets most recently. UNECE countries with still fairly unexploited PV markets but high market growth rates are Kazakhstan, Turkey, Russia and Poland. Q1 shows the most promising PV markets with high market shares and high market growth rates. These include the UK and, to a lesser extent, Malta. Established PV markets

[24] Note that the average CAGR in Figure 10 differs from the CAGR in Figure 6. The average for Figure 10 does not weight the countries' growth rates according to their overall PV capacity. Therefore, small markets like Romania with extremely high growth rates boost the average, as the larger market size of countries with lower growth rates is not accounted for. Hence, below-average growth rates are not synonymous with low growth rates. For wind energy, the difference between the CAGRs in Figure 11 and Figure 7 is due to the same reason.

with high market shares but relatively low market growth rates are Spain, the Czech Republic, Slovakia, Italy and Germany.

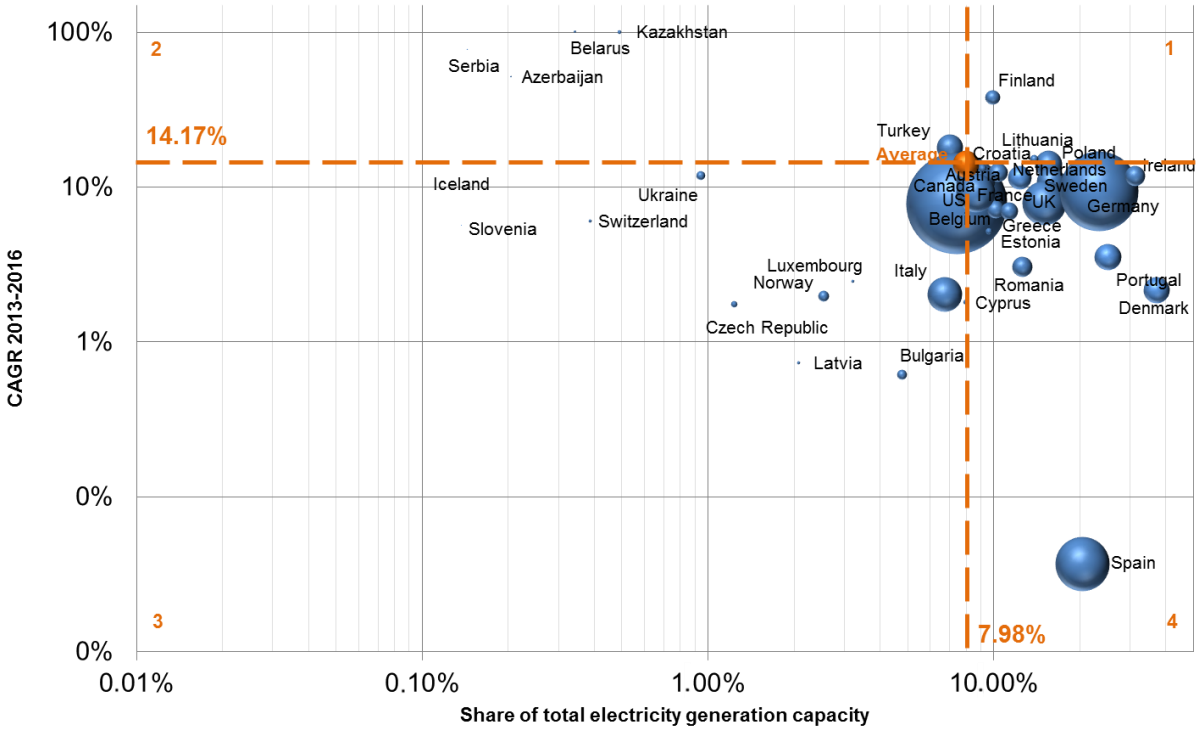


Figure 11 Wind energy market growth in relation to wind energy's share of total electricity generation capacity in the UNECE region in 2016

Looking at recent wind energy development in the UNECE region, which is displayed in Figure 11, we see that the average annual growth rate between 2013 and 2016 was lower than that of PV, amounting to 14.2%. However, the average UNECE market share of total electricity generation capacity in 2014 was higher for wind than PV, reaching almost 8%. UNECE member states where wind has a below-average market share and below-average market growth rates are Latvia, Slovenia and Luxemburg. UNECE member states with below-average wind energy market shares but strong growth rates are Azerbaijan, Serbia, Belarus and Kazakhstan. Poland and Finland are examples of UNECE member states where wind energy markets are already established with high market shares and high growth rates. Established wind energy markets with high market shares include Denmark, Germany, Ireland, Portugal and Spain.

3.3 Electricity prices

Electricity prices are a crucial factor for the deployment of renewable energy. They have a major influence on the economic viability of renewable energy generation and on social acceptance for renewable energy expansion, and are a competitive factor for local energy-intensive industries.

Electricity prices are composed of electricity generation costs and various taxes and levies. Electricity generation costs from all types of generating plants determine the electricity market price and are therefore decisive for the degree of economic viability of renewable energy generation. UNECE member states with particularly low electricity prices or subsidised electricity from conventional energy sources present a

difficult starting position for the uptake of renewable energy. This makes it all the more important that renewable energy promotion schemes are put in place. However, running these schemes entails promotion costs, which are usually redistributed in form of taxes or levies that increase final consumer electricity prices. This might lead to less social acceptance for renewable energy deployment. At the same time, high electricity prices mean that local energy-intensive industries might suffer competitive disadvantages and consider shifting their production sites abroad.

Hence, 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, thorough consideration and monitoring of electricity pricing is necessary for the successful uptake of renewable energy.

In terms of electricity prices, large differences exist between UNECE member states regarding electricity prices for households (Figure 12) and electricity prices for industrial consumers (Figure 13).[25] In both figures, the y-axis displays the end-consumer electricity price in eurocents, including taxes and levies, and relates it to the country's GDP per capita, shown on the x-axis.

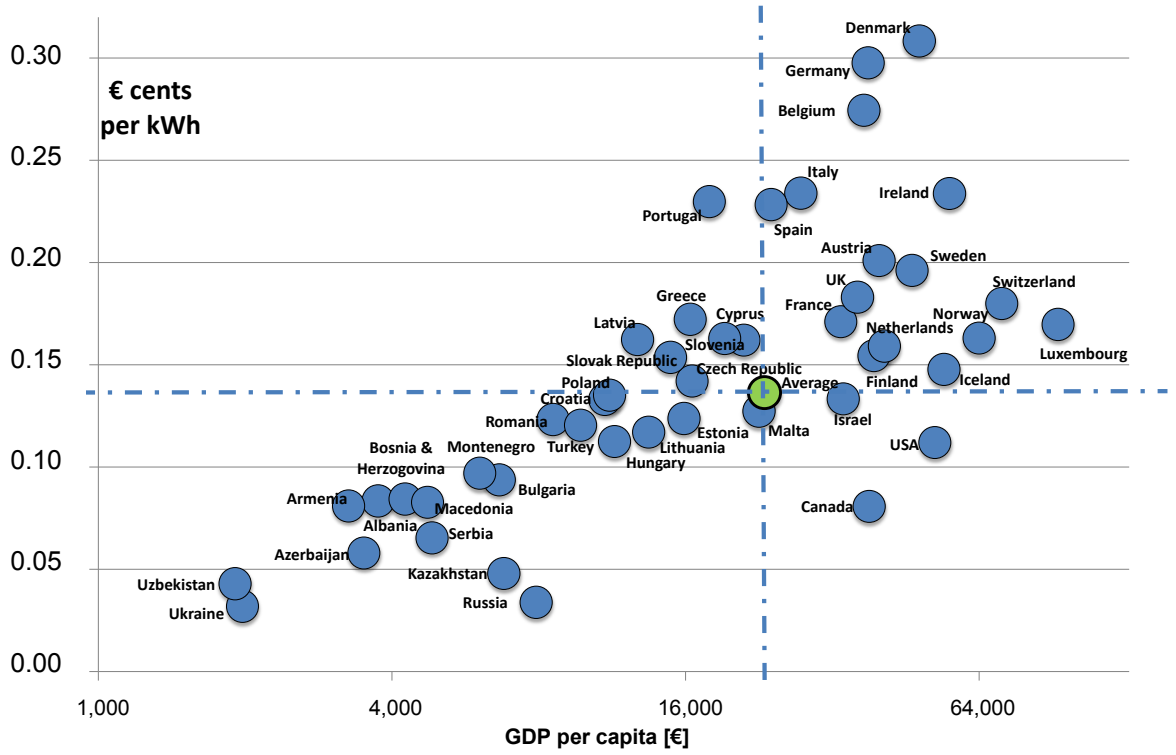


Figure 12 UNECE electricity prices for private households in relation to GDP per capita in 2016

[25] For Figure 12 and Figure 13, all data for GDP per capita are from 2016. Data sources: World Bank.

For Figure 10 to Figure 15, all electricity prices are from 2016, except Albania (2016/2013), Armenia (2014), Azerbaijan (2013), Belarus (2015), Canada (2017), Georgia (2015), Kazakhstan (2011), Kyrgyzstan (2015), Russia (2015), Ukraine (2016/2012), United States (2017), Uzbekistan (2013). Data sources: Eurostat and others.

Only countries for which data were available are included.

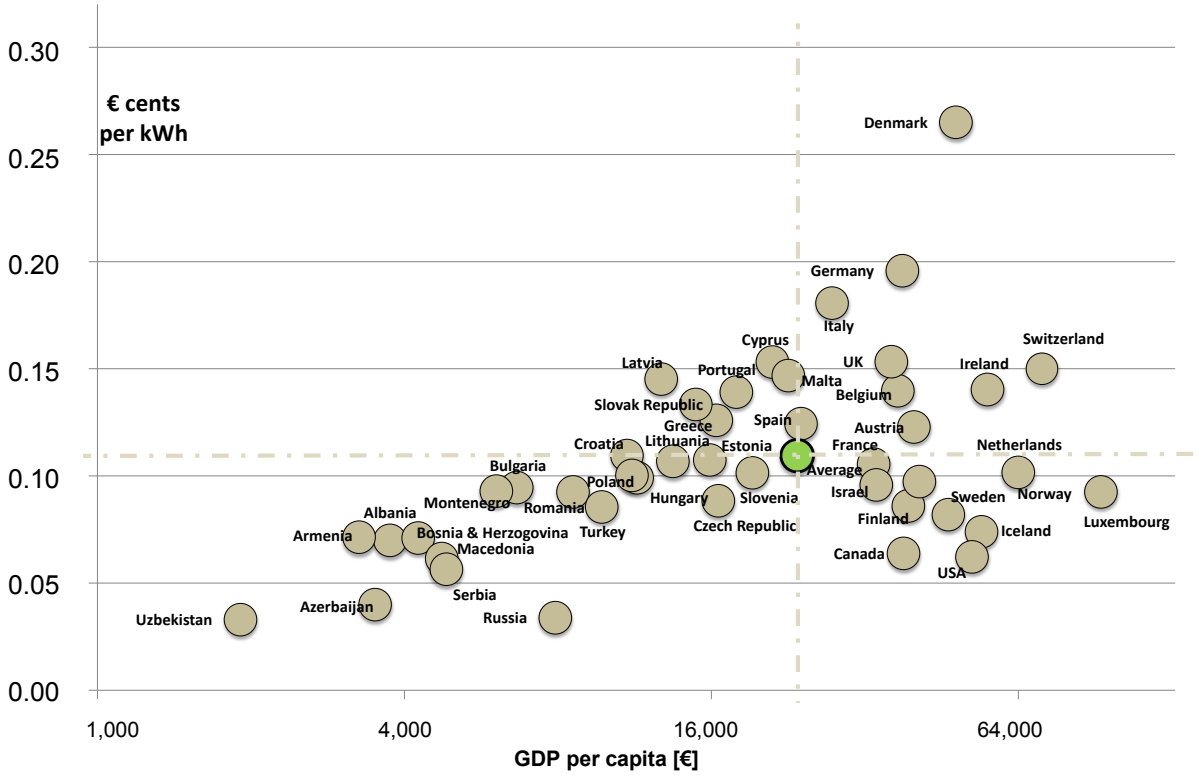


Figure 13 UNECE electricity prices for industrial consumers in relation to GDP per capita in 2016

Here we see a significant, positive correlation between the prices end consumers pay and the GDP per capita of the respective country. While the correlation also exists for industrial consumers, it is not as strong.[26]

The difference in electricity prices for households is noteworthy. With only a few exceptions, they are evenly distributed in the range between €0.05 and €0.25. This difference is less distinct in the industrial sector. Here, most countries have electricity prices in the range of €0.05 and €0.20.

All UNECE electricity prices for households and industrial consumers are displayed in Figure 14 and Figure 15.

The bars in Figure 14 and Figure 15 are arranged in descending order and display both the full price charged to the consumer and the share of taxes and levies.[27]

As discussed in the analysis of Figure 12 and Figure 13, UNECE household electricity prices show a much wider range. Also, it should be noted that in some countries, such as Denmark and Germany, taxes and levies make up more than half of the electricity price charged to consumers, while in others the taxes and levies are only a small fraction of the price. Lastly, electricity generation costs, including network costs, do not differ greatly across UNECE member states, with the exception of island countries, which consistently show higher electricity generation costs.

[26] The significance of the positive correlations was determined in one-sided t-tests with a 1% significance level.

[27] For Figure 14 and Figure 15, all data for electricity prices are from 2016. For households, data are taken from an annual **consumption range** between 2,500 and 5,000 kWh; for industrial consumers, the range lies between 500 and 2,000 MWh. Defined by Eurostat. For **single-coloured bars**, no data were available for the different electricity price components. **Taxes and levies** include VAT and recoverable taxes. Data sources: Eurostat and others.

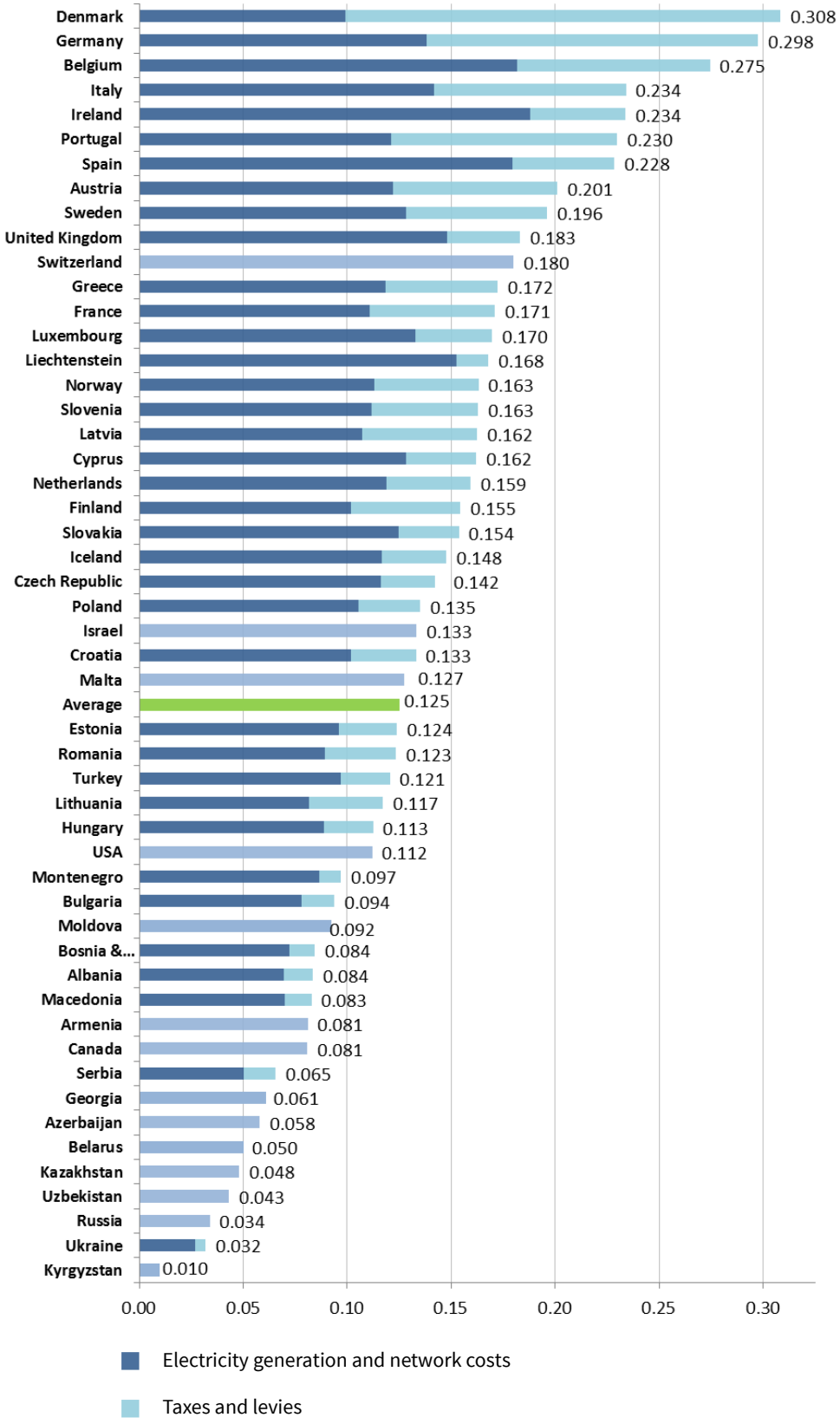


Figure 14 Composition of UNECE electricity prices for households in 2016

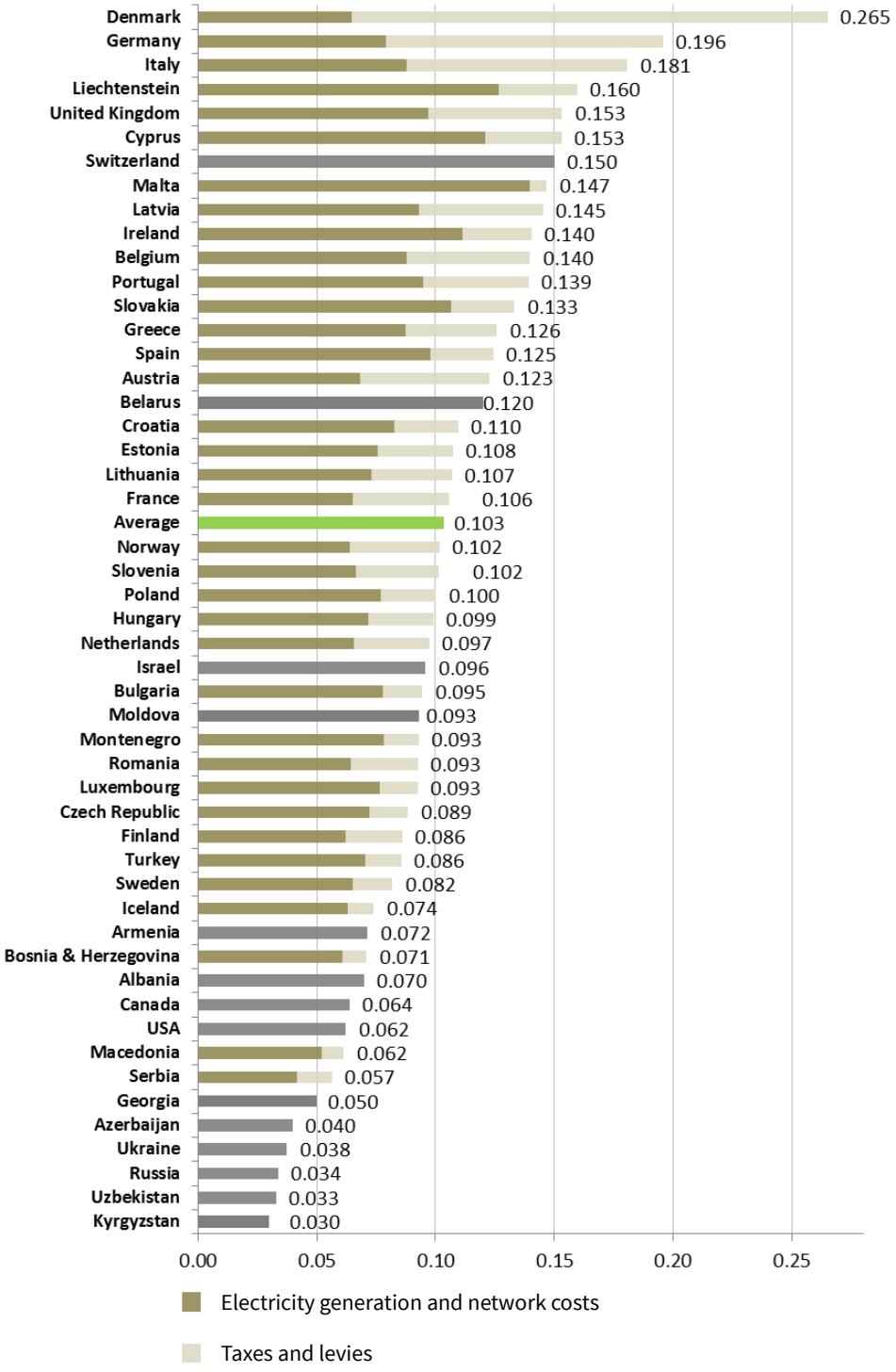


Figure 15 Composition of UNECE electricity prices for industry in 2016

Figure 16[28] shows the differences in average UNECE electricity prices between the private and industrial sectors. As we can see, industrial electricity prices in OECD and non-OECD countries in the UNECE region

[28] Only countries for which data were available are included.

diverge less than private-sector electricity prices in OECD and non-OECD countries. The similarity of electricity prices in the industrial sector – despite varying levels of GDP per capita in OECD and non-OECD countries – is due to the fact that national economies want to keep these prices low in order to increase their competitiveness as industrial locations.

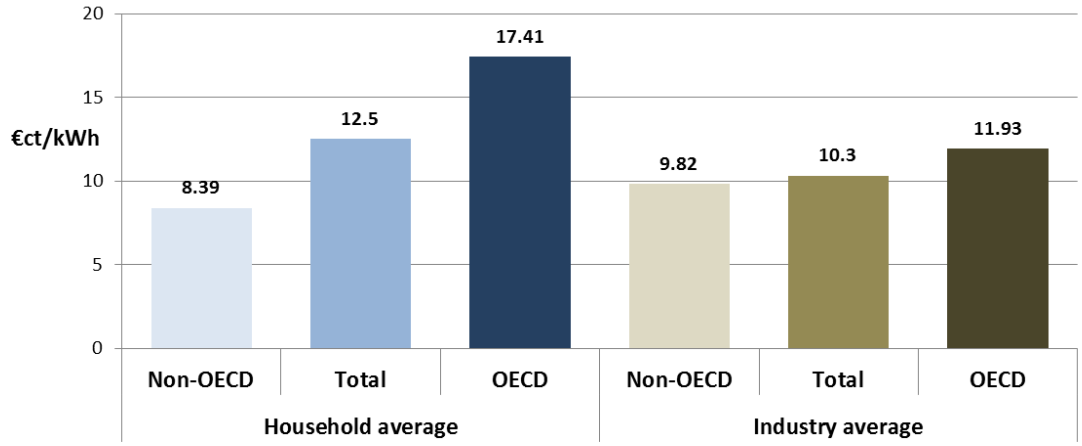


Figure 16 Average electricity prices for households and industry in 2016

Taxes included in electricity prices are usually refunded to companies. As the graph shows, average household electricity prices in non-OECD countries are relatively low, both compared to industrial prices in non-OECD countries and to household prices in OECD countries.

Taxes do have a strong influence on electricity pricing. In some countries, household electricity prices are even lower than electricity generation costs. As discussed above, when low and often subsidised electricity prices are combined with a lack of promotion schemes, it can hinder market uptake and integration of renewable energy technologies. This is because the technologies will be unable to compete with conventional electricity generation technologies on the energy market. Schemes such as FiTs, premiums, quota systems, auctions, and the reduction of fossil fuel subsidies can help to make renewable energy more competitive by lifting the renewable electricity sales price above the electricity market price.

3.4 Investment in renewable energy

As the UNECE Regional GTF Report noted, most investments in renewable energy in the UNECE region occurred in Western Europe and North America as a result of strong price support and policies such as FiTs, auctions and tax incentives.

An analysis of renewable energy investments in 17 UNECE countries, including the Caucasus, Central Asia, the Russian Federation, and Southeast and Eastern Europe,[29] is provided in the UNECE Renewable Energy Status Report 2017, which was produced by REN21 and UNECE.[30] The report reveals that despite having a total population of 300 million, the 17 countries received only a fraction – 0.2% – of global investment in renewable energy in 2015. This was down from 0.5% in 2014. Investment in renewable energy in these

[29] List of countries considered in the report:
[30] UNECE and REN21 (2017): UNECE Renewable Energy Status Report 2017. https://www.unece.org/energywelcome/areas-of-work/renewable-energy/unece-renewable-energy-status-report.html

countries totalled $400 million in 2015, a notable decline from $700 million in 2014. Figure 17 gives an overview of total investments in renewable energy in five sub-regions of the UNECE region between 2004 and 2015.

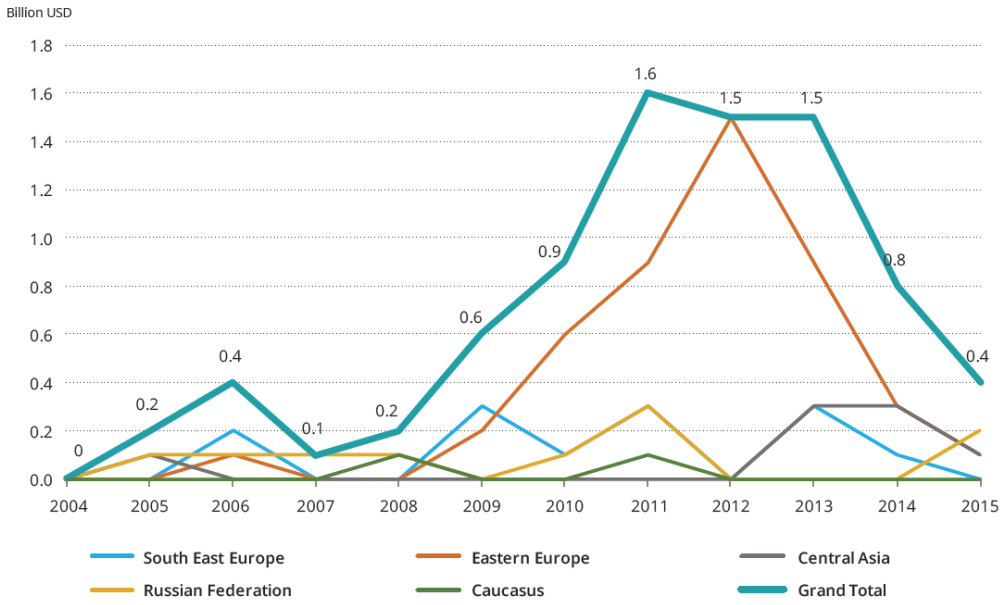


Figure 17 Investment in renewable energy in selected sub-regions of the UNECE region. Source: As published in UNECE et al. (2017)

Only Kazakhstan, the Russian Federation and Ukraine saw new investment in renewable energy in 2015. In comparison, global investment in renewable power and fuels (excluding LHP above 50 MW) grew to $285.9 billion in 2015. This was also the first year that renewable energy investment in developing countries ($156 billion) outweighed that in developed countries ($130 billion). None of the top ten countries worldwide included a UNECE country, and none of the 17 selected UNECE countries surpassed the $500 million mark per annum. Figure 18 presents the cumulative investments for the period 2004 to 2015 in 12 selected countries from the eastern part of the UNECE region. The leading country is Ukraine with $4 billion, followed by the Russian Federation with $1 billion and Kazakhstan with $600 million.

The report further shows that, excluding the Russian Federation, investment across the 17 countries continues to be driven by international donors and development banks, mainly in the form of debt financing or grants. Similar to the World Bank, the European Bank for Reconstruction and Development (EBRD) has a mandate for all 17 countries. With more than $1.8 billion, it provided most renewable energy financing in the region between 2010 and 2016. The second largest lender is the Asian Development Bank (ADB), which provided $753.4 million in renewable energy projects in its mandated countries of the Caucasus and Central Asia. Next is the World Bank, which provided $152 million. Important lenders for countries in Southeast Europe include the European Commission, the Council of Europe Development Bank (CEB), the EBRD, the European Investment Bank (EIB), the German development bank KfW, and the World Bank.

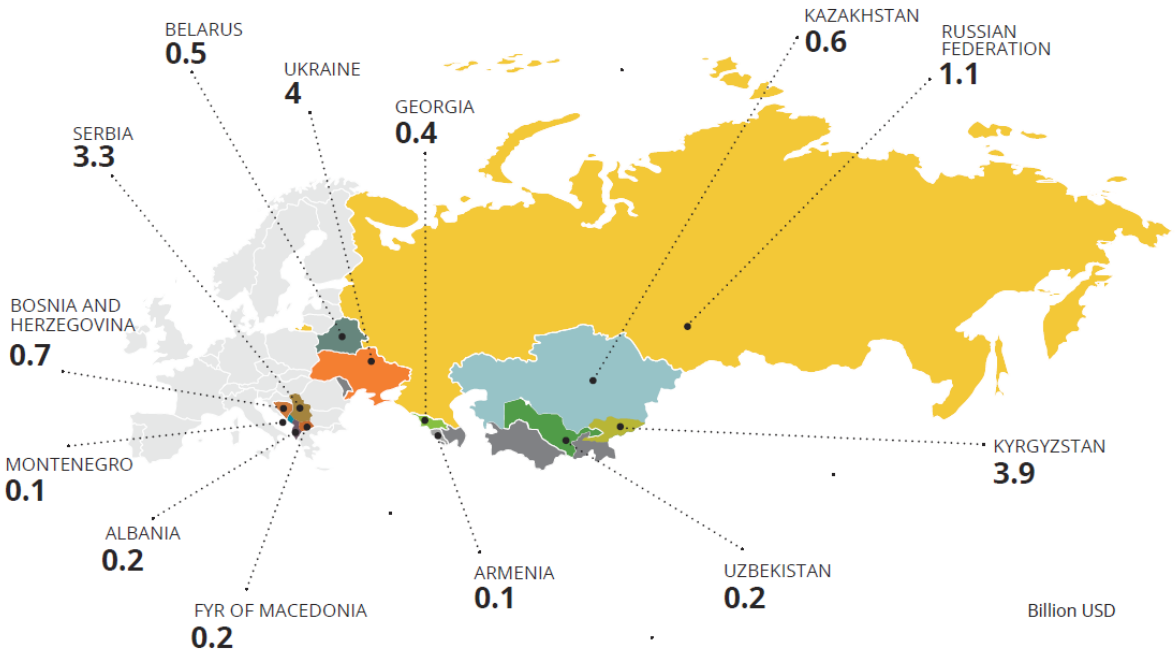


Figure 18 Cumulative investment in renewable energy in selected countries of the UNECE region from 2004 to 2015. Source: As published in UNECE et al. (2017)

3.5 Conclusion

The status quo analysis shows that renewable energy deployment in the UNECE region varies considerably across the member states. Electricity capacities from renewable energy sources have grown substantially for more than a decade. While the “dynamic” renewable energy technologies – wind energy and PV – are expanding a great deal, hydropower and bioenergy markets have had lower growth rates. LHP makes a large contribution to the total installed renewable electricity capacity. Overall, the renewable electricity market is much more developed than the renewable heat sector in the UNECE region.

In terms of investments, the eastern UNECE region in particular lags behind global developments and has even seen a decline in renewable energy investments over the past two or three years. It is clear that barriers to investment continue to exist – however, examples of past investments as well as government plans to attract more investors suggest the potential for future growth. The analysis of UNECE electricity prices shows that the price range is greater for households than for industrial consumers. This is because national economies want to increase their competitiveness as industrial locations and attract further investment. While electricity generation costs, including network expenses, are comparatively homogenous across UNECE member states, national shares of electricity taxes and levies are more diverse across the region. The shares of taxes and levies, which are included in the total electricity price, range from close to zero to almost two thirds. Very low electricity prices are an obstacle to market entry for renewable energy. In this context, direct or indirect subsidies for conventional energy sources should be minimised to support the deployment of renewable energy. Furthermore, introducing renewable energy promotion schemes can help make renewable energy more competitive.

Overall, the conclusion of the UNECE GTF Regional Report indicates that the current rate of progress is not sufficient to achieve the 2030 goal of a renewable energy share in TFEC of 36%. This applies both globally and to the UNECE region. In addition, the report argues that assessing progress to achieve higher shares of renewable energy should go beyond focusing on one single indicator and include other indicators such as capacity installations, the share of renewable energy in total primary energy supply (TPES) and investments in renewable energy (as presented in Chapters 3.3 and 3.4).

4 Renewable energy policies in the UNECE region

Renewable energy promotion schemes aim to facilitate market entry, system integration and market growth of renewable energy. 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 – such as 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 and on the attributes of the key dimensions and factors of renewable energy deployment, as described in Chapter 2.1. Also, if several renewable energy promotion policies are combined, their reciprocal impact needs to be considered so that they do not obstruct each other.

In the first subsection below, we present and explain major renewable energy promotion schemes and measures for the electricity sector. We then analyse their current stage of implementation in each UNECE member state. Although renewable energy promotion schemes and measures can be restricted to certain technologies, we assess their current stage of implementation on an aggregated technological level, so as to avoid excessive complexity. In the second subsection, we examine the current state of renewable energy policy implementation in the heat sector for each member state. We separate the existing promotion schemes according to the respective renewable heat source. Finally, we examine schemes for promoting renewable energy in the UNECE building sector for each member state.

4.1 Promotion of renewable energy in the electricity sector

As shown in Chapter 3.1, the market for renewable electricity generation is rapidly growing in the UNECE region. This is strongly linked to the introduction of a wide range of renewable energy promotion schemes and measures in the UNECE electricity sector, which are listed and explained in Table 2. These major renewable energy promotion schemes and measures in the electricity sector can be broadly categorised into non-financial and financial schemes.

Non-financial schemes encourage the deployment of renewable energy by improving the necessary infrastructure so that market entry and integration become easier. Examples of non-financial instruments include officially communicated renewable electricity expansion goals, guaranteed grid access, priority feed-in, net metering and net billing. Guaranteed grid access entitles independent power producers (IPPs) and autoproducers, such as private households and industrial entities, to grid access. Guaranteed grid access for power plants might be limited by a certain minimum or maximum capacity. Priority feed-in schemes build on guaranteed grid access and require utilities to purchase renewable electricity. Net metering and net billing are billing mechanisms which credit renewable electricity producers for the net value between the electricity they feed into the grid and the electricity they use. Electricity surpluses are remunerated either as credit for future electricity demand (net metering) or as direct financial compensation at an agreed rate or tariff (net billing).

Financial schemes promote renewable energy deployment by creating investment incentives for renewable energy technologies. Some are general financial support instruments, while others are designed to raise the

[31] Swisher, Randall and Porter, Kevin (2006): Renewable Policy Lessons from the US: The Need for Consistent and Stable Policies, In: Mallon, K. (ed.) Renewable Energy Policy and Politics: A Handbook for Decision-making, Earthscan, UK.

sales price of renewable electricity above market prices in order to help renewable energy compete with conventional energy sources.

General financial support instruments include investment subsidies, credit grants, lower interest rates, tax credits or exemptions, and government R&D spending.

Schemes to raise renewable electricity prices can be subdivided into price-based, quantity-based and hybrid promotion schemes.

FiTs or premiums are price-based promotion schemes because they grant long-term, stable remuneration for generating renewable electricity and feeding it into the grid. The feed-in is either remunerated with a fixed tariff (FiTs) or at the electricity market price, which is topped up by a variable market premium (feed-in premiums).

Quantity-based promotion schemes are mainly quota systems, such as renewable portfolio standards and renewable obligations. They require national utilities to maintain a certain share of renewable energy in total electricity generation. Quota systems are often combined with trading systems for green certificates or renewable energy certificates. These certificates are issued to electricity producers for each unit of renewable electricity generated, and can be traded. Certificate prices are determined by the market, based on the total number of traded and supplied certificates and on the demand for certificates, which is highly influenced by the renewable energy quota.

Auctions can be considered as hybrid schemes, since they include elements of both price-based and quantity-based promotion schemes. In the context of renewable electricity projects, auctions are public bidding processes in which long-term contracts are awarded for the purchase of renewable electricity. These contracts are called power purchase agreements (PPAs) and are awarded either for an agreed amount of renewable electricity or for the electricity output of an auctioned amount of installed renewable electricity capacity. Auctions provide stable remuneration for renewable electricity generation, something which is also guaranteed by price-based promotion schemes. Auctions allow legislators to control the expansion of installed renewable electricity capacities, which is also the case with quantity-based promotion schemes. In auctions, the long-term contracts are awarded exclusively on the basis of price criteria, such as lowest electricity generation costs. Tendering procedures, by contrast, award long-term contracts on the basis of various factors, which is why they are referred to as multi-criteria auctions.

Promotion scheme	Description
Expansion goal	Defines and officially communicates (technology-specific) binding or non-binding expansion goals.
Grid access / Grid access with capacity limits	Guarantees grid access for IPPs or autoproducers, possibly restricted by capacity limits.
Priority feed-in	Requires utilities to purchase renewable electricity.
Net metering / Net billing	Billing mechanisms that credit renewable electricity producers 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).
Feed-in tariff (FiTs) or premiums	Remunerates producers for feeding renewable electricity into the grid. The feed-in is either remunerated with fixed tariffs (FiTs) or at electricity market prices topped up with a variable market premium (feed-in premiums).
Quota system (renewable portfolio standards, renewable obligations)	Requires utilities to maintain a certain share of renewable energy in electricity supply or demand. Quota systems are often combined with trading systems that use green certificates or renewable energy certificates.
Green certificates / Renewable energy certificates	Tradable certificates, which are often used in combination with quota systems. The certificates are issued for each unit of renewable electricity that is generated and supplied.
Auctions	Require utilities to purchase renewable electricity.
Tenders	Multi-criteria auctions
Other financial incentives	Investment subsidies, credit grants, lower interest rates, tax credits or exemptions, government R&D spending, etc.

Table 2 Renewable energy promotion schemes and measures in the electricity sector

Figure 19 shows the current stage of implementation for the renewable energy promotion schemes in the electricity sector. It shows that, as well as having expansion goals in place, the UNECE member states have also introduced various promotion schemes and measures to support the market entry, integration and growth of renewable energy.

Country	Official expansion goals	Grid access	Grid access with capacity limits	Priority feed-in for renewable energy	Feed-in tariff or premium	Renewable portfolio standard / quota system	Green certificates	Auctions	Tenders	Net metering / net billing	Investment incentives / tax benefits / subsidies
Albania	■		■		■				■		■
Armenia	■		■		■				■	■	
Austria	■	■		■	■						■
Azerbaijan		■			■				■		
Belarus		■			■	■			■		■
Belgium	■	■		■	■	■	■			■	■
Bosnia & Herzegovina	■	■		■	■				■		■
Bulgaria	■		■		■						■
Canada	■		■		■	■		■	■	■	■
Croatia	■		■		■				■		■
Cyprus	■	■		■	■			■		■	■
Czech Republic	■	■		■	■						■
Denmark	■	■		■	■			■		■	■
Estonia	■	■			■						■
Finland	■	■			■						■
France	■	■			■			■	■		■

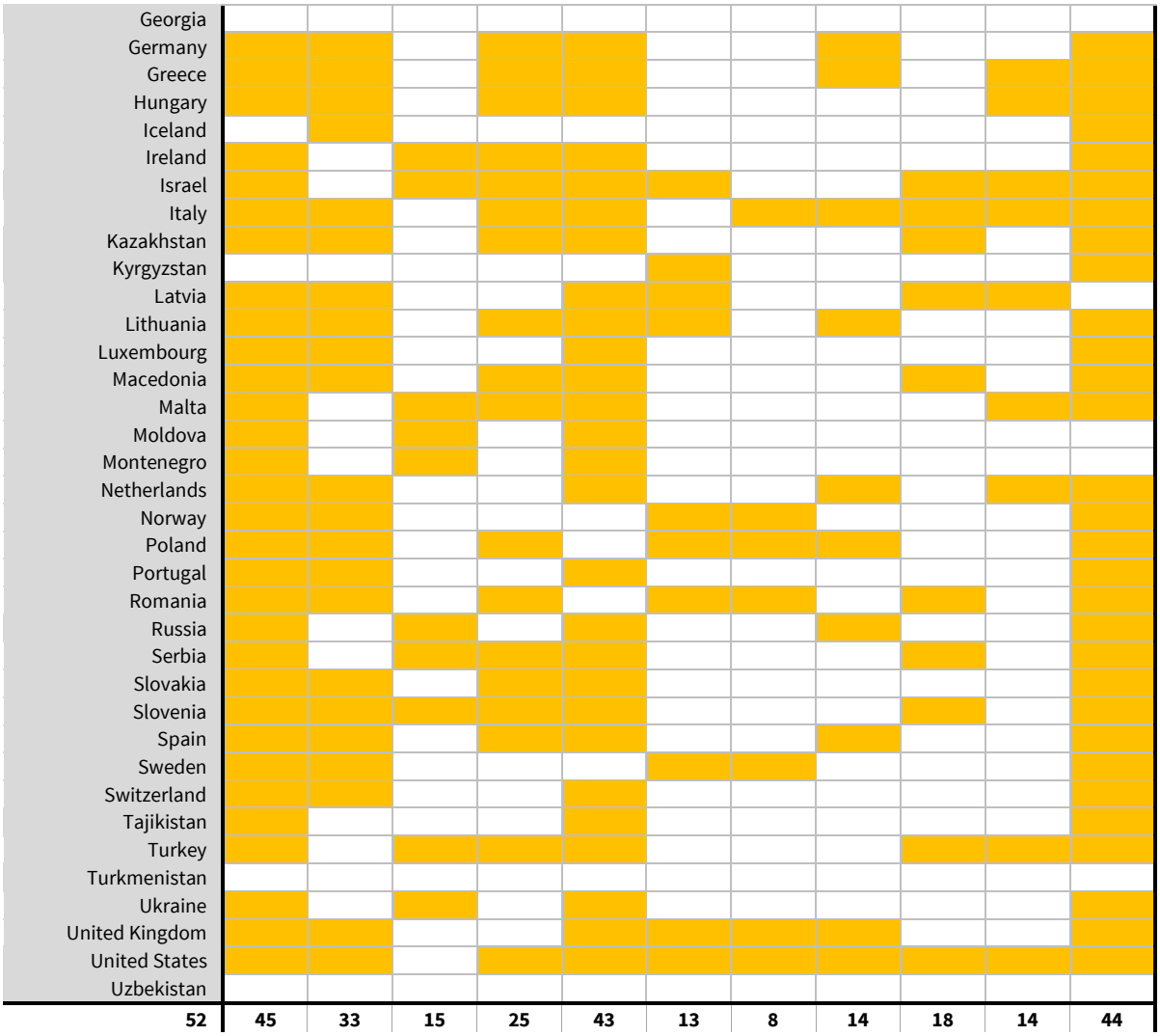


Figure 19 Renewable energy promotion schemes and measures in the electricity sector in UNECE member states

Out of 52 analysed countries,[32] 45 have official – and to a certain extent technology-specific – renewable energy expansion goals. Thirty-three UNECE countries give utilities, IPPS and smaller-scale autoproducers in the industrial and private sector unlimited grid access, while 15 countries restrict guaranteed grid access by capacity limits. Priority feed-in exists in 25 UNECE countries.

While 43 countries promote renewable energy deployment via FiTs or premiums, only 13 impose obligatory renewable electricity shares via a quota system. Eight countries have introduced tradable green or renewable energy certificates alongside their quota system, while six have introduced certificates trading without establishing a quota system. Auctions are increasingly used to promote renewable energy. They are deployed in 14 national energy markets, and tendering is used in 18 countries.

Net metering or net billing is deployed in 14 UNECE member states. Tax reductions and other investment incentives often complement other measures, and are used in 44 countries.

[32] We excluded Andorra, Liechtenstein, San Marino and Monaco due to a lack of data.

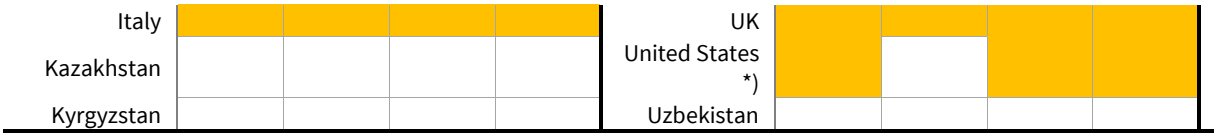
4.2 Promotion of renewable energy in the heat sector

Figure 20 gives an overview of the UNECE countries that have introduced policy schemes and measures for promoting renewable energy in the heat market. These are mostly subsidies, low-interest loans, tax regulations or a combination thereof. The first column indicates whether or not at least one promotion scheme is in place, and the remaining columns show which renewable heat technologies are promoted. Out of 52 analysed UNECE countries, 41 (more than two thirds) promote at least one technology. Most countries with promotion schemes in place support all three technologies: biogas/biomass, solar thermal energy and geothermal energy. Overall, heat from solar thermal energy receives the most support.

Figure 21 shows the legal requirements and promotion schemes for using renewable energy technologies in the building sector. Some countries promote renewable energy in the building sector through financial incentives, others have established legal requirements for using renewable energy, and some countries do both. More than half of the countries are already running promotion schemes in the building sector, eight countries are still developing suitable schemes, and ten are not yet planning to promote renewable energy in the building sector.

Country	Promotion scheme(s) in place	Biogas/ biomass	Solar thermal	Geothermal
Albania	■		■	
Armenia				
Austria	■	■	■	■
Azerbaijan				
Belarus	■		■	■
Belgium	■	■	■	■
Bosnia & Herzegovina				
Bulgaria	■	■	■	■
Canada *)	■	■	■	■
Croatia	■			
Cyprus	■	■	■	■
Czech Republic	■	■	■	■
Denmark	■	■	■	■
Estonia	■	■	■	■
Finland	■	■	■	■
France	■	■	■	■
Georgia				
Germany	■	■	■	■
Greece	■	■	■	■
Hungary	■			
Iceland				
Ireland	■		■	
Israel	■		■	

Country	Promotion scheme(s) in place	Biogas/ biomass	Solar thermal	Geothermal
Latvia	■	■		
Lithuania	■	■	■	■
Luxembourg	■	■	■	■
Macedonia	■	■	■	
Malta	■		■	
Moldova	■			
Montenegro	■	■	■	
Netherlands	■	■	■	■
Norway	■	■		
Poland	■	■	■	■
Portugal	■		■	
Romania	■	■		■
Russia				
Serbia	■	■		
Slovakia	■	■	■	■
Slovenia	■	■	■	■
Spain	■	■	■	■
Sweden	■	■	■	■
Switzerland	■		■	■
Tajikistan				
Turkey	■		■	■
Turkmenistan				
Ukraine	■	■	■	■



*) Schemes are not always at the federal level; different support schemes exist at the state or provincial level.
Sources: RES Legal, IEA, solarthermalworld.org and others.

Figure 20 Renewable energy promotion schemes and measures in the heat sector in UNECE member states

Non-existent
In preparation or officially promoted but not yet statutory
In place

Country	Policy	Country	Policy	Country	Policy	Country	Policy
Albania		Estonia		Latvia		Serbia	
Armenia		Finland		Lithuania		Slovakia	
Austria		France		Luxembourg		Slovenia	
Azerbaijan		Georgia		Macedonia		Spain	
Belarus		Germany		Malta		Sweden	
Belgium		Greece		Moldova		Switzerland	
Bosnia & Herzeg.		Hungary		Montenegro		Tajikistan	
Bulgaria		Iceland		Netherlands		Turkey	
Canada *)		Ireland		Norway		Turkmenistan	
Croatia		Israel		Poland		Ukraine	
Cyprus		Italy		Portugal		United Kingdom	
Czech Republic		Kazakhstan		Romania		United States *)	
Denmark		Kyrgyzstan		Russia		Uzbekistan	

*) Schemes are not always at the federal level; different support schemes exist at state or provincial level. Sources: BuildUp.eu and others.

Figure 21 Legal requirements or promotion schemes for renewable energy in the building sector in UNECE 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. This is despite its great potential, which is particularly high in the UNECE region because the member states are situated in the Northern Hemisphere. This is also why they have larger heat markets than countries in warmer regions.

4.3 Conclusion

Most of the 52 UNECE countries analysed have officially set renewable energy expansion goals and have introduced a wide range of promotion schemes and measures in the electricity and heat sectors to achieve these goals. Integrating renewable energy in the electricity sector has thereby received greater political emphasis. This is reflected in the fact that 49 UNECE member states have adopted renewable energy promotion schemes or measures in the electricity sector, while 41 countries have done so for the heat sector.

The most widely adopted policy instruments in the electricity sector are FiTs or feed-in premiums, tax reductions and investment incentives. These policy instruments are implemented in 43 or 44 UNECE member states. In the heat sector, solar thermal energy receives the most support, followed by biogas/biomass and geothermal energy. These renewable heat sources are promoted by 35, 29 and 28 UNECE member states, respectively. In the building sector, two thirds of the countries are promoting the integration of renewable

energy. Meanwhile, eight are still developing schemes or measures, and ten have no promotion schemes or measures in place or planned.

Although the implementation of renewable energy policies in the UNECE region seems to be at an advanced level, simply introducing promotion schemes and measures does not necessarily improve the uptake and integration of renewable energy in the electricity and heat sectors. In order to be effective, renewable energy policies need to be predictable, consistent and steady in the long term. They also have to be aligned with the existing energy market structure, adjusted to the attributes of the defined key dimensions and factors of renewable energy deployment, and coordinated with other existing policies.

5 Policy options for promoting renewable energy

In view of the GERE objectives of promoting the uptake of renewable energy, improving access to affordable energy sources and increasing energy efficiency, this report analyses the status of and perspectives for renewable energy development in the UNECE region. We began by describing the background of renewable energy deployment, identified key dimensions and factors, and examined global trends and fields of application. We then explored the current status of renewable energy deployment and the corresponding growth of renewable energy markets in the UNECE region. In addition, we described all the major promotion schemes and their stage of implementation in the electricity and heat sectors for each member state.

Table 3**Fehler! Verweisquelle konnte nicht gefunden werden.** is based on the results of the report and aimed at policymakers. The toolbox describes all the major renewable energy promotion schemes and measures, notes their impact dimension, highlights their particular strengths and primary effects, and gives examples of countries that have shown good practice in each case. Policymakers can use elements from the toolbox as a basis for making decisions about implementing promotion schemes. Examples of good practice are especially useful as references if policymakers need more detailed information about implementing particular promotion schemes. However, this toolbox does not provide a template for decision-making or for developing and implementing policies. For information on how to implement policies, please see Chapter 6.

Promotion schemes and measures	Impact dimension	Description	Strengths / primary effects	Good practice
Official targets for renewable energy	Political	Defines and officially communicates (technology-specific) binding or non-binding expansion goals.	Planning security	**EU countries, United States (state level)**
Market access / grid access	Political/regulatory	Guarantees grid access for IPPs or autoproducers, possibly restricted by capacity limits.	Market integration	**Chile**
Net metering / net billing	Political/regulatory	Billing mechanisms that credit producers for the net value between the renewable electricity they feed into the grid and the electricity they use. Electricity surpluses are remunerated as credit for future electricity demand (net metering) or as direct financial compensation at an agreed rate or tariff (net billing).	Market integration	**Australia, United States (state level), Turkey**
Priority feed-in and feed-in tariffs or premiums	Political/regulatory	Priority feed-in requires utilities to purchase renewable electricity. Feed-in tariffs or premiums grant long-	Financial support, market integration, investment and planning	**Germany, Italy**

		term, stable remuneration for the feed-in of renewable electricity, either via fixed tariffs (FiTs) or at electricity market prices topped up by a variable market premium (feed-in premium).	security, investor diversity	
Green certificates, renewable energy certificates	Political/regulatory	Tradable certificates, which are often used in combination with quota systems. The certificates are issued for each unit of renewable electricity generated and supplied.	Market integration	**Sweden, Norway**
Quota system	Political/regulatory	Requires utilities to maintain a certain share of renewable energy in electricity supply or demand.	Financial support, market integration, expansion control, cost-effectiveness, promotion of innovation	**United States (state level), India (state level)**
Auctions	Political/regulatory	Public bidding processes which award long-term electricity purchase contracts for an agreed amount of produced renewable electricity or for the electricity output from a certain amount of renewable electricity capacity. Long-term contracts are awarded on the basis of price criteria.	Financial support, investment security, market integration, expansion control, cost-effectiveness, promotion of innovation	**Brazil, Uruguay, India**
Tenders	Political/regulatory	Multi-criteria auctions	Financial support, investment security, market integration, expansion control, cost-effectiveness, promotion of innovation	**Kenya, Japan**
Renewable heating obligations	Political/regulatory	Requires building owners to ensure a minimum share of heating from renewable energy sources or CHP plants.	Financial support, market integration, expansion control.	**Denmark, Germany**
Other investment incentives	Political/regulatory	Investment subsidies, credit grants, lower interest rates, tax credits or exemptions, government R&D spending, etc.	Financial support, promotion of innovation	**United States (federal and state level), Germany, France**

Table 3 Policy toolbox: Political and regulatory promotion schemes and measures

The following table gives an overview of major fields of action and measures which, while not usually directly linked to policies promoting renewable energy, are nevertheless crucial to their further development.

Fields of action and measures	Impact dimension	Description	Strengths / primary effects	Good practice
Renewable energy system integration	Technical	National Integrates renewable energy into the energy system by expanding grid capacities and making the power system more flexible. A flexible power system can be achieved by replacing "must-run" capacity with flexible power plants, by expanding load management, demand-side management and storage capacity, and by developing local supply concepts.	Grid balancing, security of electricity supply	**California (obligation for utilities)**
	Political/regulatory, technical	International Makes the power system even more flexible via cross-border technical and economic integration of electricity markets (market coupling).		**EU**
Public educational work	Social	Introduces measures to raise public knowledge and awareness of renewable energy deployment.	Public knowledge and awareness of renewable energy	**IRENA**
Public participation	Political/regulatory, social	Increases public participation by including relevant stakeholders and introducing new business models.	Social acceptance	**Denmark**
Research and development	Political, economic	Research and development can be promoted through financial support and by creating a favourable institutional framework, e.g. via a patent system.	Innovation, technology transfer	**United States**

Table 4 Further fields of action and measures

6 Making the energy transition work: Evidence from successful policy implementation

As discussed in Chapter 2, successfully establishing renewable energy technologies depends heavily on a variety of key drivers.

Even if policy measures to foster renewable energy are in place, they do not necessarily and automatically lead to renewable energy investments. Adverse effects and obstacles indirectly linked to the political and regulatory framework of energy markets may have a negative impact on project realisation. If we are looking at renewable energy policies as instruments to increase the share of clean technologies in energy markets, we must understand how to successfully implement these policies. This chapter will therefore begin by examining barriers that could hinder effective policy implementation, and will then provide good-practice examples of how to overcome these obstacles.

Two expert meetings organised in Germany during COP23 in November 2017 focused on the successful implementation of renewable energy policies in the electricity sectors and heating markets of countries within the United Nations Economic Commission for Europe (UNECE countries). The main idea was to identify constraints that hinder the successful implementation of policies, and to share experiences on overcoming these barriers. The discussions were arranged around four main topics derived from the more general dimension of Figure 1 in Chapter 2.1.

The key factors influencing the success of renewable energy policies at the implementation level can be grouped as follows:

1. Political framework and market regulation
2. Infrastructure capacity and technical feasibility
3. Economic viability and financing
4. Acceptance and awareness raising

In addition to the general **policy implementation pathways** that emerged from the expert meetings held during COP23, this chapter also describes the detailed outcomes of three national UNECE Hard Talks, which were held in 2016 and 2017 in Georgia, Ukraine, and Azerbaijan. The following subsections present an analysis of each factor, the specific barriers associated with it and the recommendations derived from the Hard Talks.

Overall, this chapter aims to demonstrate the importance of a well-implemented renewable energy framework.

Hard Talks in brief

A Hard Talk is a specific multistakeholder policy dialogue event format organised by the United Nations Economic Commission for Europe (UNECE), in cooperation with host countries, local counterparts and other partners - e.g. the Renewable Energy Policy Network for the 21st Century (REN21), the German Energy Agency (dena) and Revelle Group sprl- which has been already implemented in three countries (Georgia, Ukraine and Azerbaijan). Hard Talks are adapted to the specifications and requirements of each host country.

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.
- Point out prioritised solutions to improve the investment climate for renewable energy and to foster discussion to what the UNECE can provide with similar initiatives.

At the heart of the Hard Talk format is the Discussion Paper, a “problem/solution” format document, which facilitates a 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 could potentially interfere with uptake of renewable energy sources and, particularly, with private sector investment in renewable energy. Subsequently, recommendations are formulated, based on international experience and good practices that could contribute in de-blocking private investment by addressing the issues identified. The first version of this Discussion Paper is introduced at the first-day to expert-level participants of the Hard Talk event, with the purpose of focusing the discussions. The outcomes of the first-day discussions are incorporated into an updated Discussion Paper, adding participants’ perspectives and viewpoints, and the revised, second version of the Discussion Paper is presented to the participating decision-makers during the second day of the event. The decision-makers have the chance to offer insights on the second version of the Discussion Paper. The Discussion paper is then finalised with the comments offered during the second day of the event and is disseminated in its final form (Recommendation Paper) to the events participants and other stakeholders for further action.

Experience with this unique policy dialogue format is drawn from the three countries that have hosted them: Georgia, Ukraine, and Azerbaijan. The common denominator of the Hard Talk experience is that, despite the many differences in the three host countries, common themes have arisen that prove that the main influencing factors to path the way for renewable energy uptake are fundamentally identical even if different policy frameworks apply. Moreover, the discussions in all three Hard Talks have proven that the experience and good practices associated with addressing those common, largely identical influencing factors are easily transferable from one country to another. Therein lays the added value of the Hard Talks: mobilising international experience to address domestic issues.

6.1 Political framework and market regulation

In any given country, the political framework and market regulation governing the energy sector influence the uptake of renewable energy. If governments are to develop a comprehensive renewable energy strategy, they need a vision, clear political commitment and regulations tailored to the market structure, market organisation and infrastructure.

Issues concerning the political framework and market regulation are the most important when it comes to unlocking investments in renewable energy systems. This is because they provide investors with basic confidence that enables them to eventually raise the necessary capital for their projects. A comprehensive and reliable set of laws and regulations for renewable energy creates a healthy environment for developing projects, which can reassure investors and consequently attract new investments. In this regard, having a good sense of the status and potential of the renewable energy industry (this includes having access to reliable statistical data) could offer a solid foundation for regulatory interventions and ensure that reality and policymaking are better aligned.

Once a country has set its renewable energy targets and formulated the corresponding strategies and policies, it must, crucially, guarantee stability and planning security. Unexpected changes in policies for promoting renewable energy production – e.g. partial suspension of green certificates and the (retroactive) removal of feed-in tariffs – have compromised renewable energy deployment in UNECE countries in the past (i.e. Spain or the Czech Republic).

In terms of designing and implementing relevant policies for renewable electricity and heat, different factors and prerequisites need to be considered. In general, obstacles exist in the areas of bureaucracy, processing times, permit procedures and their transparency, and market design. Policies need to take into account that renewable energy are deployed and integrated into existing infrastructure that is very often fully amortised and based on conventional electricity and heat generation. Furthermore, UNECE countries faces different situations and conditions depending on their individual energy market, renewable energy potential, and access to resources.

In general, renewable heat deployment in the UNECE region is still lagging behind that of renewable electricity. To a certain extent, this is due to the absence of robust heating policies and a lack of guidance and management in the sector. The type of policies that can drive the renewable heat sector forward will depend on existing regulations – for example, whether households are allowed or required to be connected to a district heating network instead of getting connected to the natural gas grid.

Policy implementation pathways:

When designing renewable energy policies, the following guiding questions can support successful strategies and policies in the field of **political framework and market regulation**:

- 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 role does innovation play in public tenders? When awarding concessions or public tenders, innovative approaches to and integration of clean energy can play an important part in the selection criteria.
- 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 is useful to reduce bureaucratic barriers and increase investors and project developers' confidence.
- What are the ownership structures in the buildings sector? Different policies will apply when the share of renewable energy is increased in a rental property market with few homeowners.
- 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?

Outcomes from the Hard Talks: Ukraine

Threats to the country's energy security have urged the Government of Ukraine to create a comprehensive set of regulations and laws as well as tangible targets to support renewable energy development.

The desire to promote renewable energy as an alternative to fossil fuel contributed in making radical changes to Ukraine's regulatory environment. The Ukrainian example also exemplifies the value of the Hard Talk format as a tool to focus and encourage implementation of renewable energy measures. Indeed, many of the solutions proposed during the Hard Talk event held in Kiev in December 2016 have already been implemented.

The issues associated with the Ukrainian power purchase agreement PPA at the time of the Hard Talk in 2016 revolved around three aspects: PPA signing, PPA duration and PPA template. PPAs are essentially long-term offtake agreements executed with a creditworthy offtaker to enable repayment of debt by providing an adequate and predictable revenue stream. International practice guarantee that PPAs are signed before major investments in infrastructure are made, which gives the financiers enough confidence to deploy the needed capital. Moreover, PPAs should be able to guarantee a certain duration of guaranteed offtake to make projects bankable (i.e. remove both volume and price risk for the produced power). Procedures for the PPAs in Ukraine were not in line with international practices, as they increased and exposed both project developer and investors to additional risks. The issues identified at the time of the Hard Talk, and the corresponding recommendations, were:

	Issues	**Recommendations**
PPA Timing and Feed-in tariffs (FiT)	PPA is signed only after construction and commission of a project	Adoption of the new draft Electricity Market Law establishing the signing of the PPA before construction of any facility
	Green tariffs (FiT) are secured and received only after construction and commission of a project	Regarding FiTs, the following should be considered: ▪ Locked-in terms should be withdrawn after a period of time that would be adequate for construction and commissioning ▪ Possibility to change dynamically to reflect changes in market- i.e. reduction of installation costs, number of pending applications, etc. ▪ A mechanism to monitor market and system conditions and periodically adapt the FiT for new plants should be set in place ▪ Grandfathering provisions for existing agreements explicit in Law and changes should only apply to future licenses
PPA Duration	Current PPA is signed for only one year with the state-owned enterprise 'Energorynok' and producers are obliged to re-sign annually.	▪ The Draft Electricity Market Law provides for an extension of agreements falling under the "Green Tariff" regime until 1 January 2030. ▪ This approach, insofar as it takes under consideration the depreciation of the asset, addresses the respective barrier and should be adopted during the

	Issues	Recommendations
		Second Reading.
PPA Template	The current PPA does not reflect international standards and does not provide proper protection clauses for the investor.	Revision of PPA template on the basis of international standards of legal certainty, transparency and legal equality: ▪ Extension of the FiT duration (amendment is already foreseen in the Draft Electricity Market Law– see A.2). ▪ Guaranteed offtake for the lifetime of the project, with regards to volume ▪ Address change-in-law risks with regards to FiT, exchange rate mechanisms etc. ▪ Provisions for curtailment compensation ▪ International arbitration in third country

Table 5 Issues and recommendations discussed at Hard Talk Ukraine regarding the political framework and market regulation

It is indicative of the value of the Hard Talk format that all three of those issues identified in December 2016 have already been addressed by the Ukrainian legislators and many of the adopted solutions are in tandem with the proposals mentioned above. Indeed, a conditional PPA can now be signed at the early phases of the project, it has a duration until 1 January 2030 and the revised template is largely in line with bankability requirements and international standards.

Outcomes from the Hard Talks: Georgia

With a view to guarantee security of supply, to rely less on imported electricity in the winter months (whereas it is a net electricity exporter in the summer months), and to diversify its energy mix, Georgia has started examining the substantial potential for renewable sources such as wind, solar, biomass, and geothermal. Up to the point in time when the Hard Talk was held (December 2016), the government has been mainly focusing towards hydropower production, making other generation sources still lag far behind in terms of cost-effectiveness.

Held at the same time that Georgia's accession to the Energy Community Treaty was announced, the Tbilisi Hard Talk was the first event of its type focusing on discussions between all involved stakeholders (including the Ministries of Energy, of Finance and of Agriculture) a comprehensive legislative and regulatory framework for renewable energy. There was no national renewable energy strategy in place, with specific, quantified and feasible targets for renewable energy for 2020 and beyond, nor a support scheme for renewable energy generation.

Tariffs in Georgia were calculated on a case-by-case basis and did not apply horizontally, which makes the tariffs system lacking clarity in its methodology and monitoring in its calculation.

Recommendations from the Hard Talk discussions highlighted the following:

	Issues	Recommendations
Feed-in tariffs	▪ Unclear methodology for tariffs calculation and monitoring ▪ Determination of tariffs on a case-by-case basis ▪ Non-horizontal application of tariffs	Transparent and fair methodologies for renewable energy sources (RES) electricity purchase price (tariff) calculations should be adopted which will facilitate project bankability and subsequent financing

Table 6 Issues and recommendations discussed at Hard Talk Georgia regarding the political framework and market regulation

The Hard Talk discussions highlighted the need to undertake three key actions:

1. Embracing an integrated approach to renewable energy development:

   The country is endowed with a huge potential for hydropower production, which currently accounts for more than 80% of Georgia's generating capacity and between 75% and 90% of power generation. However, the country's dependence on hydropower means that the reliability of supply is threatened in the winter months when power demand is high and hydropower capacity is reduced due to depleted storage in reservoirs. In this context, taking an integrated approach to renewable energy development, which encompasses all available sources, complementing each other rather than competing, has the potential to strengthen energy security. Activities such as modelling and developing energy scenarios, as well as implementing systems of tracking the progress of renewable energy development (through data collection and capacity building) could help in looking at the country's broader energy picture and formulating strategies that take into account all renewable energy possibilities.

2. Carrying out multi-stakeholder consultation:

   This should be seen as part of a continuous dialogue and ensuring appropriately participatory processes capturing inputs of all key stakeholders (i.e. Ministry of Energy, Georgian National Energy and Water Supply Regulatory Commission- GNERC, TSO/DSO, private developers and international donor and financial institutions). These consultations/processes should be seen in the context of an ongoing dialogue between relevant actors on how responsibilities can best be shared to ensure the development and success of a national energy strategy.

3. Formulating a comprehensive national strategy for renewable energy development

   This includes two elements. First, the adoption of a legislation on renewable energy sources, which also includes the design of a National Renewable Energy Action Plan (NREAP) according to Energy Community ascendancy obligations and the finalisation of the National Energy Efficiency Action Plan (NEEAP). Second, a comprehensive support scheme, with specific long term targets aiming for 2020 and 2030, which would include defined support measures for specific renewable energy sources by technology and relevant provisions.

At present, the NEEAP has been finalised and will be implemented by January 2019. Yet, the legal framework in Georgia still does not include a special law for renewable energy and the NEEAP has yet to be developed. Similarly, the country still lacks specific targets for renewable energy in the electricity, heating and cooling

and transport sectors. However, it is expected that with the adoption of the NEEAP, the remaining legal measures and regulations will follow and will be designed and implemented by mid-2019. Moreover, Georgia's accession to the Energy Community Treaty is foreseen to catalyse even more changes. The Protocol on the Accession of Georgia to the Energy Community Treaty was signed on 14 October 2016, during the 14th Energy Community Ministerial Council (weeks before the Tbilisi Hard Talk) and the accession agreement was ratified by the Georgian Parliament on April 24, 2017. Therefore, more developments in this field (such as a single legislative act on renewable energy and further approximation with E.U. acquis by introducing a regime that is compliant with the requirements of Renewable Energy Directive 2009/28/EC) are considered to be in the pipeline.

Outcomes from the Hard Talks: Azerbaijan

In 2016, the country adopted the 'Strategic Roadmap for Public Utilities', which outlines the key milestones and targets to be achieved covering the short, medium and long-term horizon. However, concrete and well-structured actions are still lacking in the current strategy, indicating a clear need for more detailed planning on its formulation and implementation. Moreover, most of the existing tasks under the 'State Programme on Use of Alternative and Renewable Energy Sources in the Republic of Azerbaijan' have been completed and therefore an update is needed.

Similarly, the renewable energy sector is mainly regulated by four different laws, each of them containing sub-clauses, all covering the interest of the entire sector, but still having gaps. In this context, the revision of the current legislation and preparation of a comprehensive and unified primary and secondary law would speed up the process of renewable energy deployment in the country.

Renewable energy generation also lacks both a comprehensive support scheme, as well as a transparent support mechanism, which makes investors reluctant to be involved even in pre-screened, viable projects.

The tariff calculation methodology for renewable energy in Azerbaijan is not yet clearly defined. This is a key barrier to renewable energy developments because in order to attract private investors, renewable energy tariffs should have a clearly defined structure. Recommendations from the Hard Talk discussions highlighted the following:

	Issues	**Recommendations**
Feed-in tariffs	Unclear definition of tariff calculation methodology	▪ Transparent and fair methodologies for RES electricity purchase price (tariff) calculations should be adopted which will facilitate project bankability and subsequent financing ▪ Request donor-funded technical assistance for developing a computation methodology ▪ Incorporate and reflect added benefits from renewable energy (health, environmental, Natural Gas savings, added value etc.).

Table 7 Issues and recommendations discussed at Hard Talk Azerbaijan regarding the political framework and market regulation

The existing model of the Power Purchase Agreement (PPA) does not comply and is not done according to international standards. In this regard, the main recommendation from the Hard Talk was that a standard PPA template accommodating specific requirements of different technologies should be prepared and made available.

This was the situation in October 2017, when the Baku Hard Talk was held, and the discussions highlighted that efforts should channelled towards four key actions:

1. Preparation of a study on renewable energy development options

   The study should aim at providing an overview of renewable energy potentials in the country and ultimately help to define and meet targets, taking into account the advantageous synergies between gas and renewable energy for power generation.

2. Formulation of a comprehensive National Renewable Energy Action Plan (NREAP)

   The NREAP should be based on the above-mentioned study. It should address mid and long-term targets, with a clear vision regarding the involvement of the private sector and should include a revised and updated version of the 'State Programme on the Use of Alternative and Renewable Energy Sources in the Republic of Azerbaijan'.

3. Development of a sound, unified and transparent legal instrument

   The instrument should clearly and efficiently regulate renewable energy. It should also include the drafting and implementation of a new "Law on Energy from Renewable Resources", that not only incorporates current good practices but also properly responds to the needs and realities of Azerbaijan.

4. Development of a support scheme for renewable energy sources

   The scheme should primarily include an update of existing laws as well as proposed new laws that will regulate the area of renewable energy, energy efficiency and the environment as a whole. It should also target renewable energy sources producers through the establishment of a special fund for renewable energy sources, which could be funded with additional export revenues of natural gas saved by the use of renewable energy sources and support their payments.

6.2 Economic viability and financing

The economic viability of renewable energy projects has improved vastly over the last few years and has led to a substantial increase in renewable energy installed capacity in the UNECE region. This is primarily the result of reductions in technology and capital costs in UNECE countries with stable renewable energy promotion policies and currencies. However, as pointed out in the REN21 UNECE Renewable Energy Status Report 2017, renewable energy investments recently declined despite untapped potential in many UNECE countries, in particular in the Caucasus, Central Asia, the Russian Federation, and South East and Eastern Europe.

Certain factors can reduce the economic viability of renewable energy projects. These include fossil fuel subsidies, a lack of stable revenues from renewable energy supply, difficulties in accessing investment or financing options, and high investment costs – particularly if the equipment and components for the renewable energy system have to be imported into countries with high customs duties and import taxes. In the context of successfully implementing strategies and policies, it is important to note that local fossil fuel

prices in some UNECE countries do not reflect the real cost of the fuels and generation. As a result, fossil fuel subsidies do not just distort competition between energy generation from fossil fuels and renewable energy sources; they also put a strain on national budgets.

With regard to a country's investment climate, a credible counterparty for the offtake agreement is needed to ensure project bankability. In the absence of such a counterparty (e.g. a wealthy public, a state-owned entity or an industrial offtaker), some form of insurance must be used to mitigate any risk.

Policy implementation pathways:

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 look at externalities such as pollution in energy retail and related health impacts. 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.
- 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 on offer? Having access to these loans can help reduce financial costs, increase financial security and thereby make renewable energy projects feasible.
- What are the balancing costs of renewable energy? Balancing costs relate to the costs of integrating renewable energy into the grid. The limited predictability of renewable energy means that operational reserves must be maintained in order to respond to forecasting errors and ensure secure system operation. Allocating and deploying these reserves costs money. If balancing costs are applied, project financiers require visibility and predictability in terms of operating expenses during the power plant's lifetime. Investors will have to mitigate potential variations in costs according to the cost item in question.
- 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 increases 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. The longer it takes, the higher the upfront costs.
- How stable is the local currency? Fluctuations and devaluations in local currencies are major challenges to the economic viability of renewable energy projects. This is because local currencies are often used to pay for the energy generated.

Outcomes from the Hard Talks: Ukraine

Economic and viability issues in Ukraine were mostly related to project financing, investment climate/country risk and balancing costs. Project financing in Ukraine was not easily accessed at reasonable rates. Ukraine was still experiencing a difficult climate for investments and still has a high country risk. Private investors in renewable energy sources in Ukraine were exposed to a relatively high level of counterparty risk given the fragile state of the Ukrainian economy (credit rating CCC). Additionally, it still is difficult for investors to find to insurance against counterparty risk. For example, it has been understood that the Multilateral Investment Guarantee Agency is providing political insurance for projects in Ukraine only to a limited extent, while private insurance is very expensive and sometimes not available.

Ukraine's Fitch Rating has remained at B- and no significant credit enhancement tools have been introduced. Discussions for a Green Fund are still active and spearheaded by the State Agency on Energy Efficiency and Energy Saving of Ukraine. The Green Fund is a financing institution, focussing on providing initial financing for renewable energy projects and thus foreseen to facilitate investment. Ukraine recently introduced a similar Energy Efficiency Fund in 2017 and the option to mobilize its funds for projects dealing both with energy efficiency and renewable energy (such as replacing obsolete district heating gas-fired boilers that have significant losses with biomass or CHP) is also being examined. The Kiev Hard Talk findings were:

	Issues	**Recommendations**
Project financing	Ukrainian banks offer: ▪ Loans with high interest rates (up to 24%) ▪ Corporate financing only and use credit lines of the international banks, such as the EBRD and the European Investment Bank. A 100% guarantee is the only requirement for the recipient of a loan	Improvement of project financing conditions and access to financing from local banks through: ▪ Development of a special-purpose fund for RES ▪ Introduce a financing programme of renewable energy projects on reasonable terms and conditions (including a grant scheme to reduce project development costs for developers). ▪ Examine possibility to include some RES projects under the Energy Efficiency Fund – e.g. retrofitting district heating with biomass / CHP ▪ Address financial management and budgeting rules in district heating companies and municipalities in order to encourage their role in attracting private investors at local level.
Investment risk	▪ Ukrainian economy still fragile although Fitch Ratings were upgraded in November 2016 upgraded from 'CCC' to 'B-'	Introduce new forms of credit enhancement through: ▪ Bilateral or multilateral agencies ▪ Export Credit Agencies

	Issues	Recommendations
Investment risk	▪ Insurance is too expensive or not available	▪ Sovereign guarantee ▪ Government-funded account ▪ Replacement of state offtake counterparty with more creditworthy customers
Balancing cost	▪ Balancing costs are foreseen to be borne by RES producers under the draft Electricity Market Law.	Balancing costs should take into consideration: ▪ Need for increased capacity in forecasting and modelling methodologies and tools ▪ Need for certain market maturity and market-specific conditions ▪ Need to evaluate RES penetration and impact on the market. ▪ Balancing Costs should be revisited after a more comprehensive analysis

Table 8 Issues and recommendations discussed at Hard Talk Ukraine regarding economic viability and financing

The New Electricity Market Law was adopted by the Ukrainian Parliament in April 2017 and became effective on 11th June 2017 (6 months after the Hard Talk). However, certain provisions, including those related to the balancing markets, day-ahead market and other market sub-segments, will be enacted later and should become operational from July 1st 2019.

Outcomes from the Hard Talks: Azerbaijan

An interesting perspective offered in the Baku Hard Talk is the option to finance a FiT-based support scheme for renewable energy sources with the profits made from exporting gas (the price of which, as a scarce resource, will continue to increase) that would otherwise have been used to fuel the domestic needs that will be covered by renewable energy (with dropping installation costs and zero fuel costs). This option shows that even for countries with abundant and cheap fossil fuels, renewable energy can make sense from a financial standpoint. Another aspect of economic and viability issues with renewable energy sources in Azerbaijan is bankability.

With regards to bankability, Hard Talk discussions highlighted the following:

	Issues	Recommendations
Bankability	Bankability hindered by the high interest rates and high securities requirements from local banks	Involvement of donors and international financial institutions into the process can potentially reduce risks and build capacity for local banks to provide funding for renewable energy projects

Table 9 Issues and recommendations discussed at Hard Talk Azerbaijan regarding economic viability and financing

6.3 Infrastructural capacity and technical feasibility

One of the biggest challenges in achieving a secure, stable and sustainable energy system is how to integrate large amounts of fluctuating renewable energy into the heating and power grids. While this is one of the key barriers to a more extensive and rapid deployment of renewable energy, technological innovations in generation, trade, distribution and flexibility have been developed to tackle the challenge.

One of the tasks facing virtually all UNECE countries involves updating and investing in their heating and power networks. In addition, when expanding the share of renewable energy in electricity generation, flexible power systems, such as hydropower plants, and storage systems are needed to balance out fluctuations in the energy generated by PV and wind. Nuclear, coal and other fossil fuel plants may not be capable of providing the necessary flexible supply response.

Other flexibility options include demand side management, where customers (private, commercial and industrial) are incentivised to adapt their power consumption to available power generation.

Various technical challenges also apply to integrating renewable energy technologies into heating supply systems: Large-scale heat generation from solar, biomass and geothermal energy needs access to heating networks, and small-scale heat generation technologies have to be integrated into existing and new building heating systems. Governmental and regional support influences the planning and development of new district heating networks. It also affects the conversion of existing networks based on biomass, biogas, geothermal energy, large-scale solar thermal heat plants with seasonal storage, and waste-to-energy plants.

One of the differences to electricity in terms of market access is that it is harder to feed excess heat or heat from a renewable source into an existing network. From a technical perspective, many more factors need to be taken into account (temperature, content, water quality, etc.) than with electricity.

Again, standards and higher efficiency on the demand side are crucial to the success of renewable heat supply – as are properly designed grid codes and straightforward licensing procedures. With this in mind, some countries have already begun simplifying matters by adopting a “one-stop-shop” approach.

Why is renewable heat lagging behind renewable electricity?

Heat accounts for 50% of global final energy consumption. This figure is even higher in the UNECE region, where heat accounts for 70% of final energy consumption. Renewable heat therefore has huge potential to help decarbonise the energy sector, especially in the Northern Hemisphere.

Nevertheless, the deployment of renewable heat technologies is still lagging behind renewable electricity. Several factors are responsible for the different development and deployment pathways. Two of the main factors for the slow uptake of renewable heat are the comparatively high subsidies for gas and oil, and a lack of incentives and subsidies for renewable heat. While fossil fuel prices often do not reflect real costs, renewable heat technologies also face high upfront costs (this is the case with geothermal heat, for instance), unfavourable pricing and tariffs, and few or no incentive schemes and programmes. Capital costs are even higher for renewable heat than for renewable electricity.

Heat supply also depends on access to (capital-intensive) infrastructure such as heating networks where ownership structures can hinder the supply of renewable heat. Building regulations, energy efficiency regulations and different standards for the fuel and the technologies add to the complexity of the renewable heat sector. Furthermore gas networks directly combete with networks for district heating. The often much easier “plug-and-play” situation that can be found in the electricity sector does not apply to the heating sector.

Policy implementation pathways:

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

- Is there an accurate forecasting system in place? Predicting energy supply and demand helps to balance power grids and integrate variable renewable energy such as wind and solar.
- What standards are in place, and 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 heating networks exist in any areas? 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. An example: 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.
- 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.
- How complex and lengthy are planning procedures? Complex permit applications and planning procedures can have a big impact on renewable energy development. The longer and more complicated they are, the more they hinder a successful and rapid expansion of renewable energy.

Outcomes from the Hard Talks: Ukraine

Infrastructural capacity and technical feasibility issues in Ukraine are mostly related to grid connection, land zoning and permitting.

Investors in Ukraine faced bureaucratic barriers in order to secure grid connection in a timely manner and with reasonable connection terms. Additionally the procedures for re-zoning of land for renewable energy sources are very complicated and time consuming, while investors need transparency and consistency in land usage and zoning rules. Permitting is another important issue, related in particular to non-transparent, un-predictable and variable procedures as well as to the fact that legal deadlines are not well enforced against public actors.

In order to create a favourable environment for investors, Hard Talk discussions suggested the following:

	Issues	**Recommendations**
Grid connection	▪ Grid connection is cumbersome. Investors currently face significant bureaucracy. Negotiations, approvals, official mailing, are lengthy and significantly delay the time needed to complete a project ▪ Lack of transparency on connection points and available capacities.	▪ Provide guarantees that grid connection will be provided on time ▪ Be transparent on: o Technical specifications o Connection points o Available capacities ▪ Streamline administrative procedure ▪ Ensure closer cooperation between grid operator and regulator to better coordinate administrative & technical processes
Re-zoning of land	Land re-zoning procedures for RES are complicated and time consuming	▪ Adoption of the Draft Law 2529a from 08.26.2015 "On Amendments to Certain Legislative Acts of Ukraine about simplification procedures on land allocation and/or power generation facilities from renewable energy and/or biofuels" ▪ Allowing for the construction of power and heat generation facilities from renewable energy/ biofuels without changing the utilisation purpose of land.
Permitting	▪ Non-transparent, un-predictable and variable permitting procedures ▪ Legal deadlines are not enforced	▪ Introduction of one-stop-shop for RES developers, preferably with online capabilities to shorten duration of permitting procedures and reduce their number ▪ Permitting procedure could be done by an independent central agency which oversees the permitting procedure, ensures transparency and impartiality and has the administrative obligation to reply within a few months ▪ Introduction of a small fee per application could

	Issues	Recommendations
		help to finance the process.

Table 10 Issues and recommendations discussed at Hard Talk Ukraine regarding infrastructural capacity and technical feasibility

Although changes in the last year focused more on the first influencing factor (new Electricity Market Law, new PPA template, discussions on the Green Tariff), on the ground reports indicate that there has been some progress in making the grid connection process less cumbersome and time consuming. The permitting process is currently being scrutinised as well, in line with the requirements of the new legal environment.

Outcomes from the Hard Talks: Georgia

Grid connection and grid code in Georgia display a threefold problem. Firstly, the country lacks definite and pre-established technical standards for connection terms (including connection method), leading to lack of transparency and possibility of abuse (e.g. imposition of inefficient technical requirements). Secondly, there is no regulation of grid access for renewable energy sources. Finally, there are still technical issues related to the physical access to grid (long waiting times, lack of transparency), the incomplete distribution network unbundling and the insufficient support of distributed generation.

Economic and viability issues in Georgia are mostly related to permitting, namely to the fact that there are too many actors involved in the process and that there is a lack of a comprehensive mapping of permitting processes before the project take-off.

Key issues and recommendations of the Tbilisi Hard Talk include:

	Issues	Recommendations
Grid connection	▪ Lack definite and pre-established technical standards for connection terms ▪ Lack of regulation of RES grid access ▪ Technical issues related to: ▪ Physical access to grid ▪ Incomplete distribution network unbundling ▪ Insufficient support of distributed generation	The grid capabilities for integrating RES should be re-examined after taking into account latest international good practice of integrating renewable energy
Permitting	▪ Too many actors involved ▪ Lack of comprehensive mapping of permits and processes before project take-off.	Simplification of the permitting process

Table 11 Issues and recommendations discussed at Hard Talk Georgia regarding infrastructural capacity and technical feasibility

Outcomes from the Hard Talks: Azerbaijan

Both Grid connections and grid codes in Azerbaijan are not in line with international standards, procedures are not well regulated and connection is not cost-efficient. In addition, there is a lack of experience and knowhow on behalf of the grid operator on how to develop technical solutions to accept renewable energy integration into the grid.

Possible identified actions concerning grid connection and permitting include:

	Issues	**Recommendations**
Grid connection	▪ Non-compliance and non-regulation of grid connections and codes with international standards ▪ Lack of technical capacity and knowledge to integrate renewable energy into the grid	▪ Introduction of an updated Grid Code, with the support of donors. ▪ Provision of information on connection points and on available capacities to interested parties. ▪ Clear definition and adoption of technical standards (including type of connection method) for the integration of renewable energy sources into the grid ▪ Integration (where available) of renewable resource mapping for technologies into grid expansion ▪ Increase know-how of grid operator through exchanges of good practices and cost-efficient solutions to renewable grid integration and connection.
Permitting	Procedure in the field is not easily accessible for foreign investors	Production of a clear, concise and practical Guide for investors describing the project development process. This will make the environment more accessible and understandable to foreign investment actors.

Table 12 Issues and recommendations discussed at Hard Talk Azerbaijan regarding infrastructural capacity and technical feasibility

6.4 Acceptance and awareness rising

If renewable energy are 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, the potential for mutual learning, knowledge transfer and capacity building is enormous.

A lack of awareness is one of the main obstacles to greater renewable deployment in many parts of the UNECE region. The general population, businesses and even (local) governments are sometimes unaware of the importance and viability of renewable energy sources. This may result in a lack of public acceptance of renewable technologies and energy efficiency measures – a situation that can be further aggravated by the relatively small number and low visibility of best-practice examples. Such reference points, communicated via public programmes, for instance, could play an important role in raising awareness.

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

Policy implementation pathways:

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

- 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 existance 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.
- What myths and misperceptions exist around the functioning and effects of renewable energy? Awareness campaigns can be a big help in debunking myths and drawing attention to the importance and viability of renewable power. 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 acceptance can be increased by linking renewable energy projects to a high-ranking figure or a public personality. This can potentially lead to more public coverage, increase the visibility of the projects and improve the public's perception of them. In addition, the public sector can effectively show what is possible: Public funds could be used for renewable energy and energy efficiency projects (e.g., solar thermal, PV, heat pumps) in schools, kindergartens, hospitals and sports facilities.

- 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 each country's awareness of its own performance and allows it 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 successfully taken that path. 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?

Outcomes from the Hard Talks: Ukraine

There is a high public awareness of the seriousness and importance of Ukraine's energy security threat and developing renewable energy sources is seen as the country's only road to energy independence from gas imports from Russia. Energy independence has become a matter of national security in Ukraine, which explains the country's progress and commitments towards a clean energy transition.

Technical information about Ukraine's renewable energy potential and project pipeline is only available to a limited extend of considered unreliable unless carried out by a reputable international firm. Such information is also very costly to obtain.

	Issues	**Recommendations**
Technical information	Limited and unreliable technical information on the country's renewable energy potential and project pipeline	The preparation of a comprehensive assessment of Ukraine's renewable energy potential by region/city through the production of a renewable energy Atlas would be highly welcomed as it could provide data-driven basis for renewable energy project development. International Donors and International Financing Institutions have been identified as instrumental in assessing this highly technical field by providing their technical assistance, building capacity, as well as financing comprehensive mapping.

Table 13 Issues and recommendations discussed at Hard Talk Ukraine regarding acceptance and awareness raising

Donor support remains active in Ukraine through various programs, focusing mainly on technical assistance and capacity building. However, since the Hard Talk in December 2016, no comprehensive assessment of renewable energy potential has been carried out yet.

Outcomes from the Hard Talks: Georgia

The lack of awareness on renewable energy in Georgia is pervasive and widespread amongst consumers, end-users and local residents. In addition, the country experiences social and political resistance related to renewable energy ("Not In My Backyard" concerns by special interest groups). Moreover, there is the deeply held impression, even by institutional actors, that large hydro is a viable alternative to renewable energy sources like wind, solar and small hydro, and that no need for diversification exists.

Similarly, there is a significant lack of renewable energy technical knowledge and capacity, particularly outside the capital- Tbilisi and technical information about non-hydro renewable energy potential and project pipeline is limited and costly to obtain.

To address these issues, the Hard Talk discussions highlighted the following:

	Issues	**Recommendations**
Awareness and capacity	▪ Lack of awareness on renewable energy amongst consumers, end-users and local residents ▪ Lack of renewable energy technical knowledge and capacity	▪ Undertake public outreach and awareness raising activities for RES. Information exchange activities and trainings should be outlined, formulated and implemented as part of renewable energy development strategy. ▪ Increase technical capacity through a number of activities, such as: Technical education programmes, courses and degrees; Advanced learning on RES for trained professionals; Establishment of knowledge validation and certification programmes Universities ▪ Undertake comprehensive assessment of non-hydro renewable energy potential by region/city through the production of a renewable energy Atlas in sectors not already available, to provide data-driven basis for project development. In parallel, transposing the experience and lessons gained from hydro project development to non-hydro renewable energy could speed their development.

Table 14 Issues and recommendations discussed at Hard Talk Georgia regarding acceptance and awareness raising

Less than a year since the Tbilisi Hard Talk event was held, the Energy Community Secretariat organised under the auspices of the EU4Energy Governance Project[33] a similar event called the "High-level Policy Talks on the electricity market of Georgia", held on November 9, 2017. These events and all follow-up activities, represented by constant dialogue, are seen as an established and successful tool to raise awareness and build capacity in the country.

Outcomes from the Hard Talks: Azerbaijan

Discussions have highlighted that Azerbaijan's public sector enterprises lack technical knowledge and capacity in new renewable energy technologies and methods.

To address these issues, the Hard Talk discussions highlighted the following:

	Issues	Recommendations
Technical knowledge and capacity	▪ Lack of technical knowledge and capacity in new RES technologies and methods.	▪ Strengthening of domestic technical capacity through: ▪ Technical education programmes, courses and degrees ▪ Advanced learning on RES for trained professionals ▪ Establishment of knowledge validation and certification programmes

Table 15 Issues and recommendations discussed at Hard Talk Azerbaijan regarding acceptance and awareness raising

6.5 Conclusion

The discussions held and experience gained during the three Hard Talks and two expert meetings show that, besides political targets and accompanying policies, the actual form of policy implementation is crucial to successfully fostering renewable energy use in the electricity and heating sectors.

In addition to focusing on directly promoting renewable energy, strategies should also consider the different aspects that might result in the non-realisation of renewable energy projects. To implement policies effectively, policymakers must take account of the various drivers and obstacles discussed in the four key factors set out in this chapter.

The market conditions for renewable heat appear to be more challenging than those for renewable electricity. Policymakers should be aware of the specific challenges that renewable energy face in the heating sector.

Expert meetings and talks of the kind held in Ukraine, Georgia and Azerbaijan create scope for identifying constraints and sharing examples of good practice in renewable energy development. Multistakeholder-based dialogue can help to develop a common view and accelerate the deployment of renewable energy.

[33] EU4Energy Governance Project: https://www.energy-community.org/regionalinitiatives/EU4Energy.html

7 Conclusion

When looking at how renewable energy deployment has developed internationally, we can identify a number of distinct global trends. Renewable energy promotion schemes dominated the early stages of global deployment, especially in developed and emerging UNECE markets. Over time, investment costs for renewable energy technologies have dropped, while transnational technology transfer and the international dissemination of renewable energy policy goals have increased. In turn, this has increased the uptake of renewable energy, particularly in developing UNECE countries. In established renewable energy markets, policies that initially aimed to expand renewable energy have evolved to become policies that pursue cost-efficient and managed renewable energy deployment. The complexity of promotion schemes has also increased, as has the need to adapt energy system infrastructures to the highly fluctuating and decentralised feed-in of renewable energy. Furthermore, the regulatory integration of renewable energy autoproducers and newly evolving business models has gained importance. On the macroeconomic level, it is now crucial to monitor how renewable energy deployment affects pricing mechanisms, such as those that determine electricity/energy prices and carbon prices within emission trading schemes.

Overall, the uptake of renewable energy has progressed well so far, although major differences in renewable energy expansion exist between UNECE member states (see Chapter 3, regarding shares of total generation capacity). With an installed renewable electricity capacity of 869 GW, the UNECE region accounts for almost half of the 1,971 GW installed worldwide. Hydropower is the most established renewable energy technology for generating electricity, making up 412 GW (388 GW from LHP) of total renewable electricity capacity. Electricity capacities from renewable energy sources have grown substantially in the UNECE region over the last few years. This is largely due to the rapid expansion of wind energy and PV, which have high growth rates in several UNECE countries such as Ukraine and Kazakhstan (wind energy), and Russia and Turkey (PV). Although the wind and PV markets are growing the most dynamically of all renewable electricity markets in the UNECE region (with a compound annual growth rate of 7.6% and 10.3%, respectively, between 2011 and 2014) they are only the second and third largest markets overall (with installed capacities of 254 GW and 140 GW, respectively).

Electricity prices play a crucial role in efforts to shift energy markets towards more renewable energy. This is because the prices have a major influence on social acceptance for renewable energy deployment. Electricity prices are considered a decisive competitive factor for energy-intensive industries, they strongly affect the economic viability of renewable energy technologies, and they determine the effectiveness of renewable energy promotion schemes. If a country has particularly low electricity prices, it can hamper the uptake of renewable energy, since low prices reduce the economic viability of renewable energy technologies, especially when they face tough competition from conventional energy sources. Introducing effective schemes for promoting energy efficiency might also prove difficult because low prices reduce the incentive to save energy. Therefore, electricity pricing must be thoroughly considered and monitored to ensure a successful uptake of renewable energy.

Against this backdrop, we determined the electricity prices and split them into electricity generation and network costs, and into shares of taxes and levies for each UNECE member state. Our comparison of the prices showed that electricity prices and the shares of taxes and levies vary considerably from country to country. We found a significant correlation between electricity prices and GDP per capita in both the private and the industrial sector.

Our report finds that most UNECE member states have already adopted renewable energy promotion schemes: 49 member states have schemes in the electricity sector, and 41 have schemes in the heat sector. In the electricity sector, the most widely established promotion schemes are FiTs or feed-in premiums, tax reductions, and investment incentives. These policy instruments are in place in more than 40 UNECE member states. In the heat sector, most schemes aim to encourage heat generation from solar thermal energy, followed by biogas/biomass and geothermal energy. In the building sector, roughly two thirds of the UNECE countries have promotion schemes in place, and eight countries are currently developing renewable energy promotion schemes or measures. So far, the electricity sector has received more political attention as a field of application for renewable energy than the heat sector. It is important to note that renewable energy promotion schemes do not automatically translate into a substantial expansion of renewable energy in a given country. This can be seen in our analysis of renewable energy market development in the UNECE member states (see Chapter 3). Many promotion schemes are in place across the region, but ultimately the uptake of renewable energy depends much more on market access and the effective implementation of the schemes than on their simple existence.

Chapter 5 briefly outlines the major renewable energy promotion schemes and measures, and notes their particular strengths and primary effects. Chapter 2 showed that policies must be applied in a differentiated manner depending on the prevailing national market conditions. As the results of the expert meetings and Hard Talks in Chapter 6 show, the approach to and details of policy architecture and implementation are vital for successfully boosting renewable energy deployment. In order to design effective policies and ensure swift implementation, opportunities and barriers associated with the four key types of factor identified – political framework, economic viability, infrastructure, and social acceptance and awareness – must be addressed and taken into account. Another issue to be kept in mind during implementation is that the market conditions for renewable heat in the UNECE region appear to be more challenging than those for electricity. While formulating an effective and functioning policy framework seems to require specific and tailored approaches in different countries, implementation seems to depend on a set of good practices that are almost universally applicable and likely to be successful. Multi-stakeholder forums, such as the Hard Talks that contributed to this report, can be excellent opportunities for shaping a common view of market structures, frameworks, challenges and drivers, and for boosting renewable development in a given country.

Figures

Tables

Bibliography

Analytical Center for the Government of the Russian Federation (2015): Russian Energy – 2015.

CER – Center for Economic Research (2012): "Green" Buildings in Uzbekistan: Technologies, Legal framework and Incentives, http://www.cer.uz/upload/iblock/b5d/green%20buildings%20in%20uzbekistan.pdf, accessed on 15.02.2016.

CIF – Climate Investment Fund (2014): Information about the Kyrgyz Republic for participation in the Scaling-Up Renewable Energy Program for Low Income Countries (SREP), https://www-cif.climateinvestmentfunds.org/sites/default/files/meeting-documents/kyrgyzrep_eoi_0.pdf, accessed on 15.02.2016.

dena-Factsheet: Albania (2014), Armenia (2014), Ukraine (2014).

dena-Marktanalyse (2014): Status und Perspektiven für die weltweite Entwicklung erneuerbarer Energien.

dena-Länderprofile: Azerbaijan (2013), Kazakhstan (2012), Tajikistan (2014), Uzbekistan (2013).

Database of State Incentives for Renewables & Efficiency (2016): http://www.dsireusa.org/, accessed on 15.02.2016.

Deutsch-Israelische Industrie- und Handelskammer (2017): Factsheet Israel.

EIA – Energy Information Administration (2016): Average Price of Electricity to Ultimate Customers by End-Use Sector, https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a accessed 13.12.17.

EIA – Energy Information Administration (2016): Electricity Data, http://www.eia.gov/electricity/data/browser/, accessed on 06.12.2017.

Energocredit (2016): Renewable Energy in Armenia, http://www.energocredit.am/en/renewable-energy, accessed on 12.02.2016.

Energy Charter Secretariat (2013): In-Depth Review of the Energy Efficiency Policy of the Republic of Belarus, http://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-Belarus_2013_en.pdf, accessed on 16.12.2015.

Energy Community (2017): Implementation, https://www.energy-community.org/ accessed 14.11.2017.

enviacon international/ adelphi- Länderprofile: Belarus (2015), Georgia (2015), Kyrgyzstan (2015), Switzerland (2016).

EUROSTAT (2017): Energy Database, http://ec.europa.eu/eurostat/web/energy/data/database, accessed on 03.11.2017.

EUROSTAT (2017): Electricity Price Statistics, http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_price_statistics, accessed on 18.01.2018

Global Solar Thermal Energy Council (2016): http://www.solarthermalworld.org/, accessed on 11.02.2016.

Hydro Quebec (2017): Comparison of Electricity Prices in Major North American Cities 2017.

IEA – International Energy Agency (2017): Policies and Measures, http://www.iea.org/policiesandmeasures/renewableenergy/, accessed on 02.11.2017.

Intelligent Energy Europe (2017): The European portal for energy efficiency in buildings, http://www.buildup.eu/en, accessed on 02.12.2017.

International Hydropower Association (2016): Profile Georgia, https://www.hydropower.org/country-profiles/georgia accessed 6.12.2017

IPCC (2011): Renewable Energy Sources and Climate Change Mitigation. Special Report of the Intergovernmental Panel on Climate Change, http://www.ipcc.ch/report/srren/, accessed on 15.07.2016.

IRENA (2017): Renewable Energy Capacity Statistics.

IRENA (2015): REmap 2030 Renewable Energy Prospects for Ukraine, https://www.irena.org/remap/IRENA_REmap_Ukraine_paper_2015.pdf, accessed on 18.01.2016.

Natural Resources Canada, Office of Energy Efficiency (2016): Directory of Energy Efficiency and Alternative Energy Programs in Canada, http://www.nrcan.gc.ca/energy/efficiency, accessed on 15.02.2016.

Office of Energy Efficiency & Renewable Energy (2016): http://energy.gov/eere/office-energy-efficiency-renewable-energy, accessed on 15.02.2016.

REN21 (2017): Global Status Report 2017.

UNECE and REN21 (2017): UNECE Renewable Energy Status Report 2017.

Renewable Market Watch (2014): Kazakhstan Solar and Wind Power Markets 2014, Development Opportunities, http://renewablemarketwatch.com/news-analysis/121-kazakhstan-solar-and-wind-power-markets-2014-development-opportunities, accessed on 18.01.2016.

RES Legal (2017): Support Schemes, http://www.res-legal.eu/compare-support-schemes/, accessed on 13.12.2017.

Riwatt Solar Co.,Ltd (2015): Solar Water Heaters in Montenegro, http://riwatt.com/news/Domestic-Hot-Water-and-Heating-News-Italy.html, accessed on 17.02.2016.

UKEEP – Ukraine Energy Efficiency Programme (2015): http://www.ukeep.org/en/ukeep-for-enterprises/eligibility-criteria.html, accessed 16.12.2015.

UNECE (2017): Global Tracking Framework: UNECE Progress in Sustainable Energy (2017).

World Bank (2017): Data GDP per capita, http://data.worldbank.org/indicator/NY.GDP.PCAP.CD, accessed on 08.11.2017.

Swisher, Randall and Porter, Kevin (2006): Renewable Policy Lessons from the US: The Need for Consistent and Stable Policies, In: Mallon, K. (ed.) Renewable Energy Policy and Politics: A Handbook for Decision-making, Earthscan, UK

Abbreviations and Acronyms

ADB	Asian Development Bank
BMWi	German Federal Ministry for Economic Affairs and Energy
CAGR	Compound annual growth rate
CEB	Council of Europe Development Bank
CCS	Carbon capture and storage
CHP	Combined heat and power
COP23	23rd Conference of the Parties
CO_{2eq}	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

Art.-No.: 9234

www.dena.de

dena
German Energy Agency