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Deutsche Energie-Agentur (dena) – German Energy Agency
Division of Renewable Energy and Energy-efficient Mobility

Overview Report

Status and Perspectives for Renewable Energy Development in the UNECE Region

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Capacity Development for Climate Policy in Western Balkan, Central and Eastern Europe and Central Asia

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On behalf of:

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This paper was prepared within the context of the work of the Group of Experts on Renewable Energy (GERE) of the United Nations Economic Commission for Europe and an abstract of it will be provided for the discussion at the 7th International Forum on Energy for Sustainable Development, the International Conference on Renewable Energy, and the GERE annual session.

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Abbreviations

CAGR	Compound annual growth rate
CHP	Combined heat and power
CSP	Concentrated solar power
dena	Deutsche Energie-Agentur (engl.: German Energy Agency)
EBRD	European Bank for Reconstruction and Development
GDP	Gross domestic production
GHG	Greenhouse gas
GW	Gigawatt
HPP	Hydropower plant
IPP	Independent power producer
kWh	Kilowatt hour
LHP	Large hydropower
MW	Megawatt
OECD	Organisation for Economic Co-operation and Development
PPA	Power-Purchase-Agreement
PV	Photovoltaic(s)
RPS	Renewable portfolio standard
ST	Solar thermal
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe
USA	United States of America

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Executive Summary

The UNECE region, comprising 56 countries in the Northern hemisphere, is considered a promising region for the deployment of renewable energy technologies. In the region, the development stages of renewable energy deployment are very heterogeneous. The UNECE region includes some of the leading renewable energy markets but also countries with very low levels of renewable energy deployment. The costs of renewable energy technologies were decreasing over the last two decades which led to the emergence of new growth and future markets.

While several UNECE countries offer sound market conditions and an established infrastructure for further deployment of renewable energies, other UNECE still countries provide high potential for picking the ‘low hanging fruit’ within mostly fairly unexploited renewable energy markets.
In recent years UNECE member States have been characterised by increasing strategic planning in the area of renewable energy deployment, aiming at a transition within their national energy systems. However, in many UNECE countries the inherent potential for renewable energy deployment is inhibited by a number of challenges. Barriers such as an inadequate state of legal and regulatory framework, distorted pricing of energy commodities due to prevailing energy subsidies, a lack of market liberalisation, absence of public acceptance or poor knowledge about the application potential of renewable energy resources still hamper the uptake of renewable energy technologies in the UNECE region.

Within the given scope of encountered market barriers of renewable energy technologies the implementation of locally appropriate and tailored policy measures plays a vital role for renewable energy deployment in UNECE member States. This report aims at supporting the market uptake of renewable energies in the UNECE region by demonstrating the potential for renewable energy deployment and applicability of renewable energy promoting policy instruments for UNECE member States. With this objective, the report on one hand examines the current situation and challenges of renewable energy deployment in the UNECE region and on the other hand presents different policy options for the promotion of renewable energies, their current state of implementation and applicability in UNECE member States. The report draws from rich experience of renewable energy market development in several UNECE countries which is also analysed exemplary through case studies of Albania, France, Germany, Kazakhstan, Turkey, California/USA.

The report reveals that the UNECE region comprises a fairly developed renewable energy market with an installed renewable energy electricity capacity of 863 GW, accounting for almost half of the 1829 GW worldwide installed renewable energy electricity capacity. Hydro energy is identified as the most established renewable energy technology for electricity generation, making up 485 GW (379 GW corresponding to large hydro plants) of total renewable energy electricity capacity. Wind energy and PV represent the second and third largest renewable energy electricity markets with installed capacities of respectively 209 GW and 109 GW, however, both markets are identified as the most dynamically growing renewable energy electricity markets. Between 2011 and 2014 the wind energy market grew by a compound annual rate of 12% and the PV market by 24%.

On the policy level the report concludes that the majority of UNECE member States have adopted renewable energy promotion schemes, specifically 51 member States in the electricity sector and 43 member States in the heat sector. In the electricity sector the most widely established renewable energy promotion schemes are feed-in tariffs or premiums, tax reductions and investment incentives, with each type of these policy instruments being implemented 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 geothermal energy and energy from biogas or biomass.

The country-by-country market analysis of the presented case studies reveals that in four out of the six analysed UNECE member States (France, Germany, Turkey, California/USA) a general trend of increasing complexity of implemented renewable energy promotion policies can be observed. The primary policy objective of merely establishing and expanding renewable energy markets has evolved with the aim of achieving marked-based and cost-efficient renewable energy deployment. However, the trend of renewable energy promotion policies getting more complex is either not present or not yet observed in the two other thoroughly analysed UNECE member States (Albania and Kazakhstan), which are currently implementing primarily feed-in tariffs. The analysis of the case studies suggests that the choice and best applicability of policy instruments is linked to particular structural characteristics of national energy markets. This includes the degree of state regulation in the energy market, the extent of installed capacity and expansion targets of renewable energies, the share of installed capacity of highly fluctuating renewable energy sources such as wind energy and PV, which require extended grid balancing mechanisms and market expansion control, and the administrative capacities for implementing specific renewable energy promotion schemes.

In summary, the report concludes that no general blueprint can be applied for strengthening the uptake of renewable energy in the UNECE region due to major differences between the structures and stages of renewable deployment in the individual national energy systems. Nevertheless the report develops and presents a toolkit for policy makers which summarises major renewable energy promotion schemes, including their strengths and good practice examples, based on lessons learned from countries with higher renewable energy uptake. The policy toolkit can be applied to individual countries or on a regional level to support further renewable energy market development within the UNECE region. In the last chapter a recommendation for the future work of the UNECE Group of Experts on Renewable Energy (GERE) is presented.

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 work on sustainable energy is designed to improve access to affordable and clean energy for all and to help reduce greenhouse gas emissions and the carbon footprint of the energy sector in the region. It promotes international policy dialogue and cooperation among 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. The Group of Experts on Renewable Energy (GERE) has been set up to focus on activities that help significantly increase the uptake of renewable energies and to achieve the objective of access to energy for all in the UNECE region.

The UNECE region is considered to have great potential for renewable energy deployment. On the one hand it comprises established renewable energy markets within several UNECE countries, which offer a sound market environment and well-developed infrastructure for deploying renewable energies. On the other hand, other UNECE member States provide the opportunity of picking the "low hanging fruit" of fairly unexploited renewable energy markets. Nevertheless, the uptake of renewable energies in UNECE member States is partly hampered by a number of challenges, such as an inadequate state of legal and regulatory framework, distorted pricing of energy commodities owed to prevailing energy subsidies, a lack of market liberalisation, absence of public acceptance and/or sometimes little knowledge about the application potentials of renewable energy resources.

The following short report "Status and Perspectives for Renewable Energy Development within the UNECE region" has been commissioned to support the work of GERE as follow up research to the working document "Menu of efficient and economic technologies and policies to promote them in the UNECE region." The report aims at encouraging the uptake of renewable energies in the UNECE region by raising awareness on the status quo and the prevailing potential of renewable energy deployment in UNECE member States to support decision makers in meeting the encountered challenges. It provides information on policy options to support a transition towards a more sustainable energy supply in the UNECE region, which in turn contributes to achieving the UN Sustainable Development Goals and works for climate change adaption as well as mitigation through the reduction of greenhouse gas emissions.

The report is divided into five chapters. The first chapter gives an introduction into the theoretical background of renewable energy deployment, analysing its key dimensions, global trends and fields of application. Within the second chapter the status quo of renewable energy deployment and electricity pricing in the UNECE region is investigated. The third chapter presents an overview of major renewable energy promotion schemes or measures, examining their current implementation in both the electricity sector and heat sector for each UNECE member State. The fourth chapter comprises exemplary case studies of renewable energy deployment within six selected UNECE countries (Albania, France, Germany, Kazakhstan, Turkey and California/USA), giving insights into the individual national macroeconomic background, challenges and important steps for the uptake of renewable energies within each of the six selected UNECE member States. The last chapter summarises main findings and lessons learned through the report, concluding with a newly developed policy toolkit and recommendations for the future work of the UNECE GERE.

1. Setting the scene for the deployment of renewable energies

For the last few decades the international deployment of renewable energies has been politically encouraged in order to mitigate climate change and to increase environmental protection, security of energy supply as well as economic development. An increased share of renewable energies in national energy mixes helps to mitigate CO_2 emissions and offers opportunities for low-carbon economic growth. Electricity and heat generation from renewable energies is also beneficial for diversifying national energy mixes, which reduces national dependencies on fossil fuels and energy imports, leading to an increase in national energy supply security. Further, the establishment of renewable energy markets helps to stimulate the economy and employment as well as innovation, especially in rural areas and the agricultural sector.

In the following, the background and theoretical underpinning of renewable energy deployment is analysed by determining the corresponding key dimensions and factors, investigating the emergence of important global trends and defining fields of application for each renewable energy source.

1.1. Key dimensions and factors

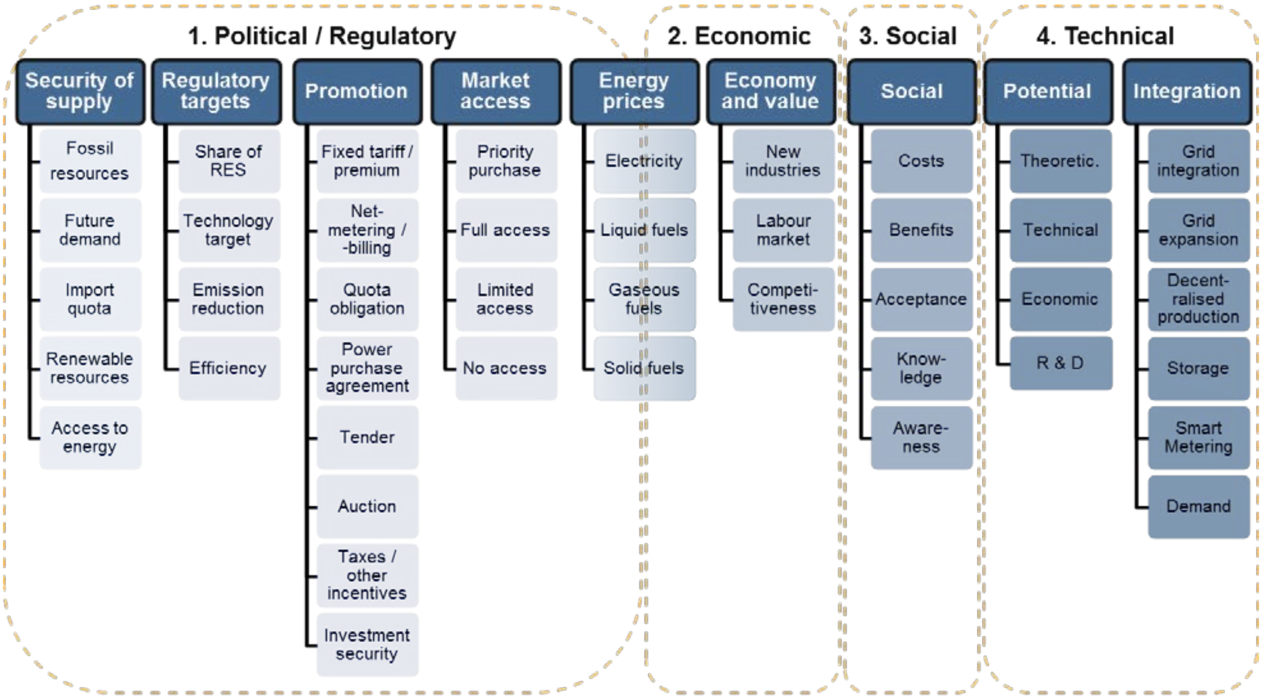
In terms of economic development, the prevalence of renewable energy technologies, underlying legal frameworks, and availability of natural resources, the UNECE is a heterogeneous region. The given heterogeneity in national energy markets poses a challenge for the application of universal policy solutions for the promotion of renewable energy deployment.

Promotion schemes and mechanisms can help to facilitate the introduction and uptake of renewable energies. 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.

The following chart (*Fig. 1*) provides an overview of important key dimensions (marked by dashed yellow lines) and the corresponding key factors (dark-blue boxes with black borders) for the market development of renewable energies on 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 and (4) technical.

Fig. 1: Key dimensions and important drivers for the market development of renewable energies



Political and regulatory dimension

On the political and regulatory level, the five major key factors of renewable energy deployment are energy supply security, regulatory targets of renewable energy, renewable energy promotion schemes, regulations of market access for renewable energy producers and the level of energy market prices. Security of supply is a prevailing motive in energy policies. Increasing renewable energy shares in national energy mixes is considered a potent strategy for enhancing national energy supply security, which is based on the entailed decreasing dependencies on limited fossil fuel reserves and increasing diversification of national energy mixes. The particular level and implemented type of renewable energy regulatory targets also strongly affect the development of renewable energies, since policy targets set the strategic direction of renewable energy promotion schemes. Renewable energy promotion schemes, in turn, can be considered as tools to achieve the respective renewable energy policy targets. The last two key factors, the prevailing regulation of market access for renewable energy producers and energy prices, also particularly the prevalence of energy price subsidies, are fundamental for the market entry and integration of renewable energies, since they influence the competitiveness of renewable energies within national energy markets.

Economic dimension

The national deployment of renewable energies is generally considered as economically favourable, since in-state value added, new industrial branches and employment are created. As key economic factors of renewable energy deployment electricity prices and energy market conditions need to be considered. The level and stability of electricity prices and sales revenues are decisive for the uptake of renewable energies. Low energy prices hamper the market entry of renewable energy technologies if no further promotion schemes are implemented to lift renewable energy prices above energy market prices in order to support the competitiveness of renewable energies against conventional energy sources. On the other hand, high energy prices might reduce the international competitiveness of local energy intensive industries.

Social dimension

In the social dimension of renewable energy deployment, the key factors are electricity costs, social acceptance, public knowledge and awareness of renewable energy deployment. The particular level of electricity costs constitutes a trade-off between energy affordability or social acceptance and the magnitude of renewable energy promotion, since promotion costs are usually passed through to energy consumer. Additionally, social acceptance for renewable energy deployment is highly dependent on the infrastructural planning of renewable energy expansion, particularly concerning 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 into the planning process of renewable energy expansion, for example through new business models like community-based renewable energy projects or natural resource management. Also, increasing knowledge about renewable energies is essential for the successful deployment of renewable energy as the application of relatively new technologies is highly dependent on a broad public awareness

Technical dimension

For a successful technical planning process, a country‘s renewable deployment potential and system integration requirements for renewable energies need to be analysed. An increasing renewable energy share within national energy mixes changes the entire existing energy system. Therefore the existing system needs to be adapted to the specific characteristics of electricity and heat generation from renewable energy technologies, particularly their fluctuating and decentralised feed-in. Measures to increase the system integration of renewable energies include the expansion of grid capacities, flexible power plant capacities, load management, demand side management and storage, the reduction of ‘must run’ capacities, as well as the implementation of local supply concepts. Regional cross-border integration can furthermore increase a system’s flexibility.

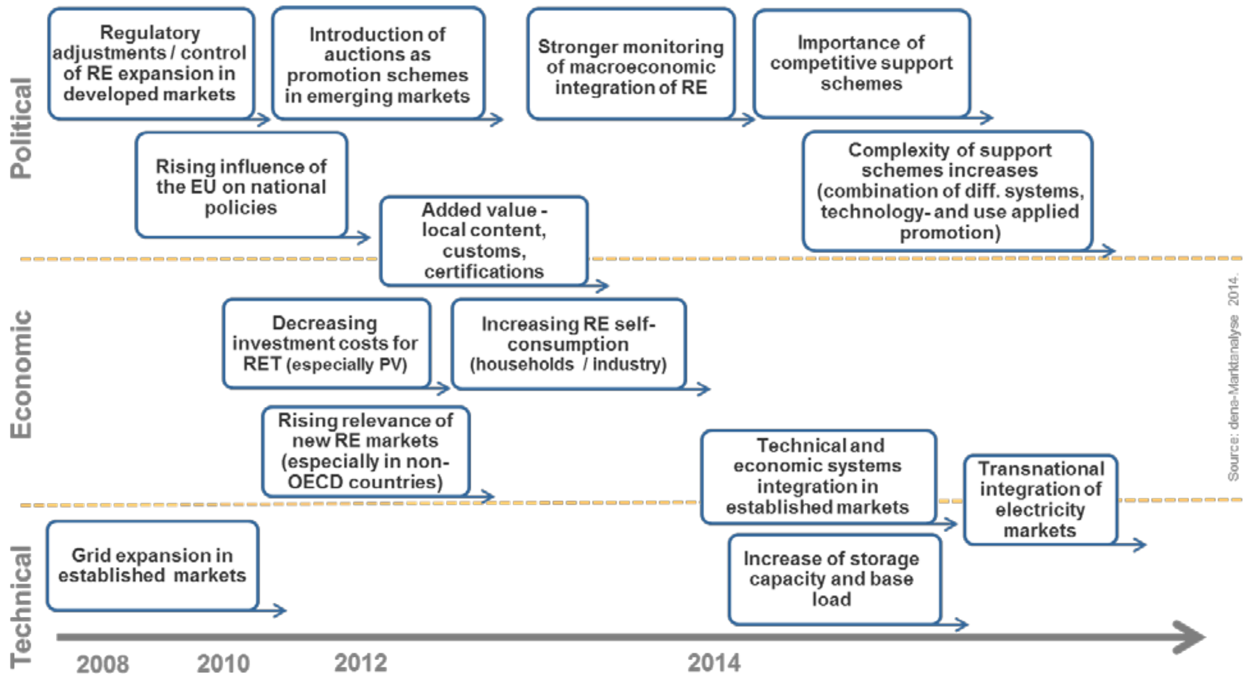
There are major interdependencies between each of the defined key dimensions and factors. Policy makers should be aware of these interdependencies, since the prevailing attributes of the individual key factors might be contrary to the effectiveness of newly or already implemented renewable energy promotion schemes or measures and might hinder further market development of renewable energy technologies. For example, the introduction of promotion schemes for energy efficiency might be ineffective if prices for electricity are low. Policy makers should understand the four key dimensions generally as fields of action, in which barriers for renewable energy deployment can be identified and minimised by considering the key drivers for the direct and indirect promotion of renewable energies.

In summary, no blueprint for a successful approach for shaping stable frameworks for renewable energy deployment exists. Policies and mechanisms need to be applied in a differentiated manner depending on the prevailing national market conditions.

1.2. Global trends

In the early stages of global renewable energy deployment in the 1990s and 2000s the mere expansion of renewable energy technologies had been set as the major renewable energy policy priority. Since then the political, regulatory, economic and technical framework for the deployment of renewable energies has been evolving rapidly, following some distinguishable global trends. The following chart (*Fig. 2*) gives an overview of the emergence of some important trends distinguishing between political, economic and technical level.

Fig. 2: Emergence of important global trends in international renewable energy deployment



After the first phase of global renewable energy deployment, which had been characterised by low political monitoring and a strong focus on the initial creation of renewable energy markets via feed-in tariff implementation, the year 2008 represented a clear break within the political and regulatory landscape of renewable energy deployment. Retroactive cuts on guaranteed feed-in tariffs or the retroactive implementation of taxes were put into effect to limit the further expansion of renewable energies in established markets, such as Spain or the Czech Republic (PV), as feed-in tariffs became too expensive and led to high procurement costs.

Since 2008, governments have been increasingly steering and controlling the deployment of renewable energies through the adoption of new legislation and policy scheme amendments.

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

On the political and regulatory level, an increasing influence of EU legislation on national energy policies led, for example, to the mandated obligatory development of National Renewable Energy Plans and EU verifications of national energy legislation, such as the review of the German feed-in-tariff system by the European Commission.

Due to continuous technological development, the investment costs for renewable energy technologies have been decreasing significantly over time, particularly for PV. In the private sector and industry sector, this led to an increased number of entities that generate electricity partly or entirely for their own use, referred to as autoproducers. This resulted in an uptake of new policies improving the integration of autoproducers into the infrastructural and regulatory system.

Furthermore, the decrease in technology costs led to the emergence of new renewable energy markets, especially in developing countries. Up until 2012, industrialised countries consistently contributed the majority of the worldwide investments in renewable energies. In 2012, this share declined to 52%. In the following years, developing and less developed countries invested more in renewable energies than industrialised countries, with respective shares of 75% in 2013 and 76% in 2014. As a result of the emergence of new renewable energy markets, auction schemes gained international importance as a renewable energy promotion scheme, being initially implemented mainly in emerging renewable energy markets in developing countries and now also often used in other countries as a competitive form of promoting renewable energies.

On the political/regulatory and economic level, local content rules and other local economy promoting market regulations have increasingly been set up in various countries, such as Brazil or Turkey, in order to establish new in-state value changes and to secure national value added in the renewable energy industry.

With the ongoing expansion and uptake of renewable energies, their macroeconomic integration grew more complex. Stronger monitoring of electricity pricing mechanisms, such as the electricity retail price formation, the distribution of renewable energy promotion costs and the influence of “greener” national energy mixes on CO_2 emission prices of emission trading schemes has become increasingly important.

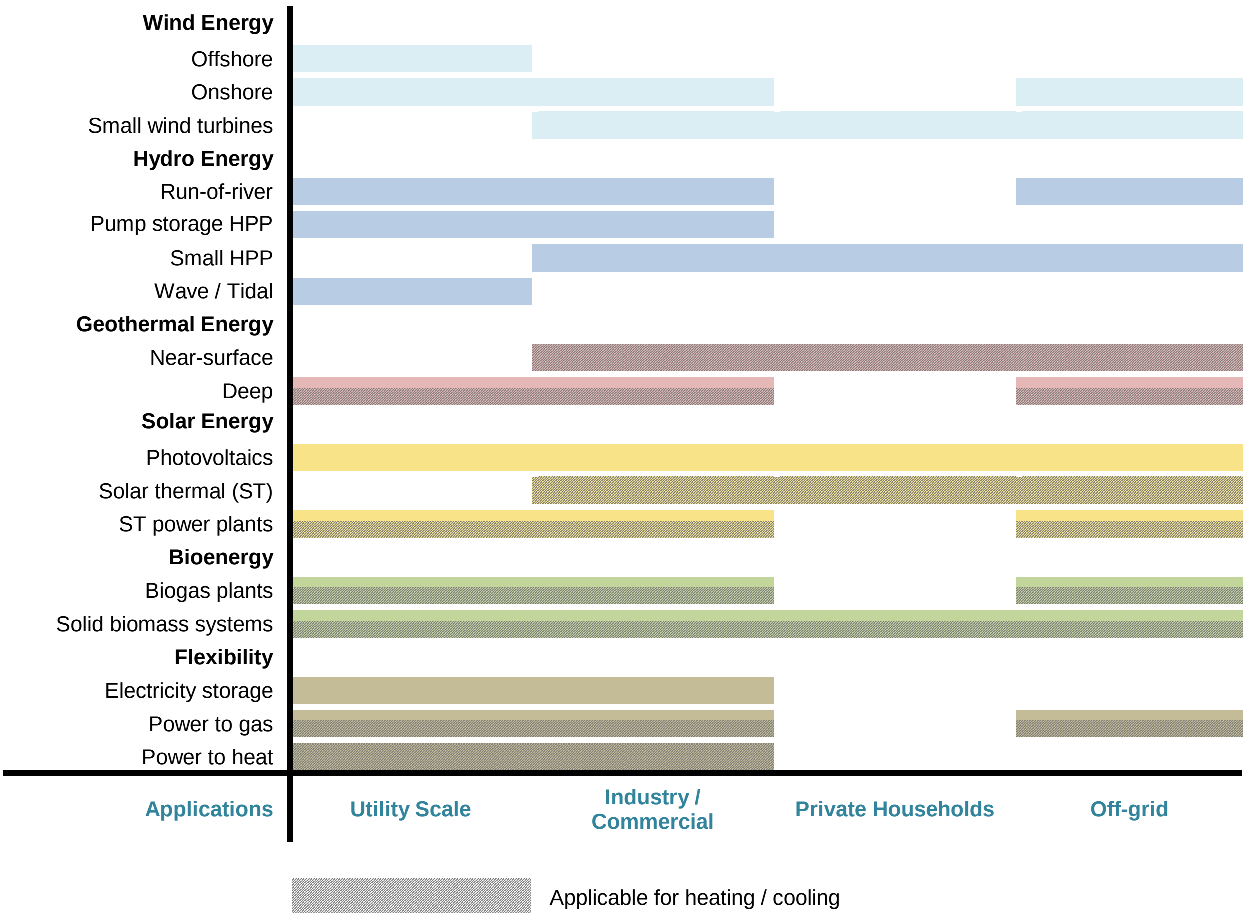
Besides the macroeconomic integration, the technical grid integration of renewable energies has evolved to a crucial aspect in established renewable energy markets. Fluctuating feed-in of renewable energy electricity has made grid balancing and enhancing the grid system’s flexibility new priorities. Fewer and more flexible baseload capacities, increased storage capacities, extended demand-side-management and load management, transnational electricity market coupling etc. have become essential for further renewable energy deployment.

On the political and regulatory level, the complexity of implemented renewable energy promotion schemes has increased. Promotion schemes have become more technology-specific and are combined to a stronger degree. A common trend from implementing purely expansion-oriented feed-in tariffs to introducing more competitive and market-based promotion schemes, such as auction schemes and feed-in premiums, can be observed. This has been particularly supported by the EU regulation mandating the introduction of auction schemes as principal renewable energy promotion schemes by 2017 in all EU countries.

1.3. Fields of application

Renewable energy sources can play an essential role in the future supply of power, heating and cooling. *Fig. 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. The fields of application (2) and (3) refer to autoproducers, which are businesses or private households generating electricity or heat wholly or partly for their own use as an activity which supports their primary activity.[1] Further *Fig. 3* illustrates whether a technology only provides power, heating / cooling, or both.

Fig. 3: Fields of application of renewable energy sources [2,3] (except renewable fuels)



1 OECD Energy Statistics Glossary

2 Biofuels are not included since they are not an original source of renewable energies but a particular processing stage of biomass.

3 Small scale wind turbines and hydro power plants have been evaluated separately in order to differentiate their fields of application from turbines and plants with high capacities.

The size of wind energy installations largely determines their field of application. Large offshore wind parks only operate on the utility scale, whereas small onshore wind turbines also provide energy 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, such as PV, which can provide electricity for vastly differing types of electricity demand, also particularly for off-grid electricity demand. Some technologies are limited to generating either electricity or heat, despite having a common energy source, for example in the case of solar thermal and photovoltaic installations. Other technologies are more versatile, such as biogas, and provide energy which can be used for both, heat and electricity generation.

In the deployment of various renewable energy technologies however, there still must be an accounting of GHG emissions. The special report of the IPCC on “Renewable Energy Sources and Climate Change Mitigation” assesses the total GHG emissions of one kilowatt hour electricity for each energy source by performing life cycle assessments. The findings of the study state that on average, renewable energy technologies generating electricity have significantly lower GHG emissions than fossil fuels, even those employing CCS. The array of renewable energy technologies has values falling on a spectrum of 4-46 g CO_{2eq}/kWh, whereas fossil fuels typically fall from 469-1,001 g CO_{2eq}/kWh. Next-generation biofuels in particular, possess the potential for higher degrees of mitigation by utilizing residue and waste products.

1.4. Conclusion

It has been revealed that the deployment of renewable energies is influenced by the impact of key factors from political and regulatory, economic, social and technical key dimensions. These key dimensions and corresponding key factors need to be seen as interrelated fields of actions, in order to define and introduce individual renewable energy promotion schemes and to minimise undesirable obstructions.

The analysis of the development of renewable energy deployment revealed that the emergence of some distinguishable global trends can be recognised. In the early stages of renewable energy deployment the promotion has been particularly concentrated on industrialised countries, with developing and less developed countries gaining in importance in the early 2010s and eventually contributing the majority of the worldwide investments in renewable energies in 2013 and subsequent years. A significant drop in investment costs over time, transnational technology transfer and the international emergence of renewable energy policy goals let to increasing renewable energy deployment also in developing countries. Additionally, the initial primary political objective of merely expanding renewable energies has evolved towards the aim of achieving a cost-efficient and steered deployment. In established renewable energy markets the complexity of promotion schemes has increased, with promotion schemes becoming more technology-specific and being combined to a stronger degree. Furthermore the need to adapt the existing grid and energy system infrastructure to the fluctuating and decentralised feed-in of renewable energies has emerged, requiring the expansion of grid capacities and more system integration via enhanced storage capacities, demand-side-management and more flexible power plants. Also, the integration of an increasing number of autoproducers and newly evolving business models has become a crucial issue. On the macroeconomic level the monitoring of electricity pricing mechanisms and the influence of renewable energy deployment on emission trading schemes has gained particular relevance.

Furthermore, it has been shown that each type of renewable energy source has a variety of possible fields of application, which can be mainly distinguished either into applications for electricity or heat generation and into utility scale applications, lower scale applications in the private or industry sector, or 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 systemic requirements in regard to the required infrastructure and promotion mechanisms.

When talking about renewable energies and the promotion of their deployment it is important to critically examine their contribution to climate change mitigation. The special report of the IPCC on “Renewable Energy Sources and Climate Change Mitigation” reveals that the electricity generation from renewable energies compared to the electricity generation from the combustion of fossil fuels does not only produce less GHG during the electricity generation process but also considering the entire life cycle assessment of one kilowatt hour of generated electricity.

2. Status quo of renewable energy deployment and electricity pricing in the UNECE region[4]

This chapter will provide a glance at the status quo of renewable energy deployment in the UNECE region. To a great extent, the research emphasis will lie 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. PV and wind energy will be analysed more thoroughly because they have been the most rapidly expanding technologies (in relative terms) in recent years, requiring particular political focus and regulatory intervention. Furthermore, electricity prices in the UNECE region will be analysed, since they have a strong influence on the potential and success of renewable energy expansion.

2.1. Development of renewable energies

During the last decade the worldwide expansion of renewable energies progressed rapidly. In 2014, the installed electricity capacity of renewable energy sources in the UNECE region amounted to about 863 GW, of which 380 GW corresponded to large hydropower plants[5] (LHP). The electricity capacity from renewable energies in the UNECE region accounted thereby for almost half of the 1829 GW installed renewable energy electricity capacity worldwide. Compared to an installed renewable energy electricity capacity of 470 GW in 2000, the UNECE market of renewable energies has grown annually on average by 4.4%, with LHP having only grown by 0.68%. When excluding LHP, renewable energy electricity capacities amounted to 125 GW in 2000 and have increased annually on average by 10.1%. Thus, renewable energies sources for generating electricity other than LHP have developed more expeditiously and dynamically over the last years and therefore contributed the bulk of newly installed capacities.

Across the UNECE region there are differing degrees of establishment and implementation of renewable energy technologies. While some renewable energy sources are exploited in many countries, others have yet to emerge. Hydropower is the most established source of renewable energy for electricity generation, being derived from both, large and small hydropower plants. About one third of all UNECE countries have well established hydropower markets. While hydro energy is used for electricity generation across the UNECE region, it is important to note that markets for wind energy, PV, solar thermal, geothermal, biogas and biomass power generation are almost exclusively established in UNECE countries that belong to the OECD.[6]

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4 Consideration and use of data from REN21 UNECE Renewable Energy Status Report 2015

5 Large hydropower plants include all installations with a capacity of 10 MW or larger, defined by the International Renewable Energy Agency - IRENA.

6 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)

There are significant amounts of national energy markets generating electricity from wind and PV as energy sources. Among countries with established onshore wind energy markets are Cyprus, Italy, Lithuania, Portugal and Spain. Significantly fewer countries have strong offshore wind markets, with the biggest being situated in Belgium, Denmark, Germany, the Netherlands, Sweden and the United Kingdom. While wind energy is more prevalent in Western European countries, PV markets have also emerged elsewhere, like Bulgaria, Romania, Slovakia, Slovenia and the Czech Republic. Both wind energy and PV energy markets are increasingly growing all across the UNECE region.

The diagrams (*Fig. 4 - 7*) display the latest renewable energy development in the UNECE region. Depicted are the installed electricity capacities of PV, wind energy, bioenergy and hydropower, and the corresponding growth rates, measured by the compound average growth rate (CAGR).

Fig. 4: Recent PV development in the UNECE region[7]

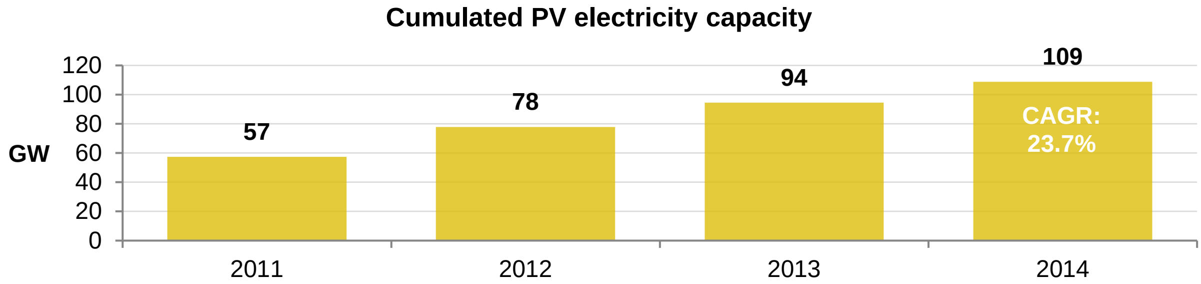


Fig. 5: Recent wind energy development in the UNECE region[7]

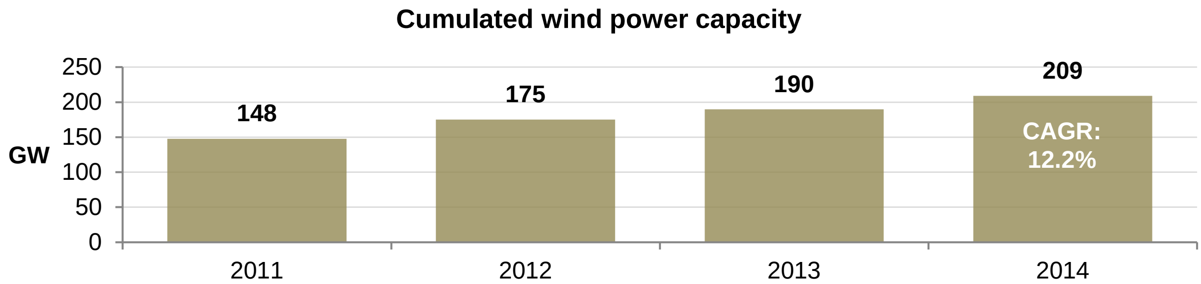
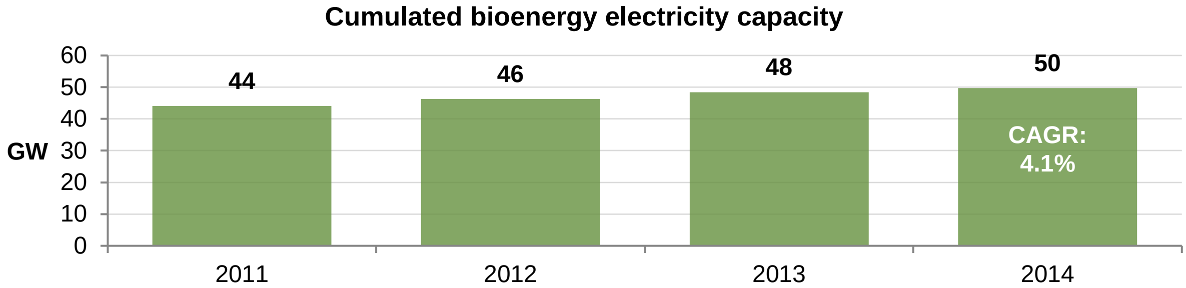
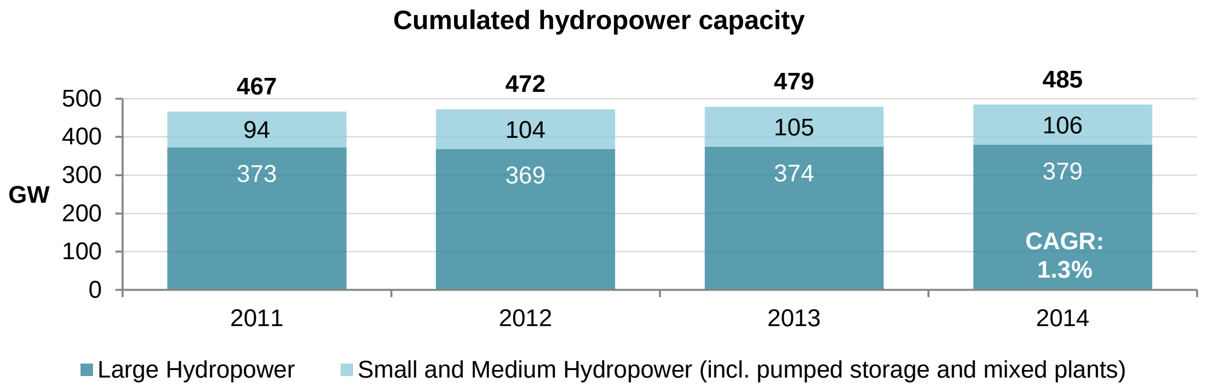


Fig. 6: Recent bioenergy development in the UNECE region[7]



[7] Fig. 4 - 7 – Data source: IRENA, Renewable Energy Capacity Statistics (2015). Wind energy includes onshore and offshore installations. Only countries for which data were available are included.

Fig. 7: Recent hydropower development in the UNECE region[7]



The size differences of the columns illustrate the growth of the cumulated PV, wind energy, bioenergy, and hydropower capacities in GW between 2011 and 2014. These four technologies are the most significant sources of renewable energy in the UNECE region, contributing 853 GW out of 863 GW installed renewable energy electricity capacity in 2014. The two most rapidly developing renewable energy technologies since 2011 are wind energy and PV.

The cumulative graphs show that recent developments of PV and wind energy differ notably from the growth rate of hydropower and bioenergy. From 2011 to 2014, wind energy capacity has increased annually on average by 12.2%, growing from 148 GW to 209 GW. In the same time period, the PV sector has prospered even more rapidly, with an annual growth rate of 23.7%, growing from 57 GW to 109 GW.

Hydropower capacity has grown less or stagnated in recent years, and at times even receded in UNECE member States. Many countries are already utilising much of their economically exploitable hydropower potential, which implicates a less dynamically growing market with fewer new installations. In the majority of UNECE countries, a significant portion of hydropower comes from LHP, making up between 70% and 100% of hydropower installed capacities. Few countries obtain the majority of their hydropower from small and medium sized plants, pumped storage and mixed plants. In Poland, the UK and Germany, however, LHP contributes only 12.5%, 28% and 31.9%, respectively, to the total hydropower capacity. Most notably, the LHP sector has hardly increased in size between 2011 and 2014; its capacities have grown by an average of 0.6% annually. Small and medium sized plants, pumped storage and mixed hydropower plants have increased by over 20 GW brought forth by an average annual growth rate of 4%. Overall, the hydropower sector has expanded annually on average by 1.3%.

In numerous countries the modern use of biomass (as opposed to the traditional use like burning wood) and biogas for electricity generation is either already established or new markets are recently evolving. However, bioenergy[8] had the smallest electricity generation capacity of the four technologies in the UNECE region amounting to 50 GW in 2014. The sector has grown annually on average by 4.1% from 44 GW to 50 GW between 2011 and 2014.

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[8] 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 described, PV, wind energy, bioenergy, and hydropower are the main renewable electricity sources. The markets of other renewable energy technologies are either not very developed or are mainly used for the generation of heat.

Main sources for renewable heat generation are geothermal, solar thermal, bioenergy as well as concentrated solar power. Albeit its potential, geothermal energy is exploited only in some UNECE countries. However, there are many countries with potential, and several countries in which markets for geothermal heat are emerging. Solar thermal, on the other hand, is a more established renewable source of heat. Countries, such as Israel, Switzerland, Turkey, and the United States, have significant solar thermal markets. In many other countries, this technology is gaining in importance. The modern use of bioenergy for heat generation is less common in the UNECE region. Concentrated solar power plants are only relevant in the United States and Spain due to site requirements with high solar radiation. Overall, the renewable heat sector of the UNECE region is not as developed as electricity generation from renewable energy sources despite a high potential in many member states.

2.2. Dynamic renewable energy markets for electricity: PV and wind energy

The markets of PV and wind energy can be determined as "dynamic" renewable energy markets for electricity, since their relative growth is noticeably higher compared to other renewable energy sources. Due to their vast expansion, requiring particular political focus and regulatory intervention, deployment of PV and wind energy is more thoroughly analysed in this report. 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 compound annual growth rate (CAGR) of installed electricity capacities of PV (*Fig. 9*)[9]and wind energy (*Fig. 10*) from 2011 until 2014 for each UNECE member State, as an indicator for the market growth of the respective national PV and wind energy markets. The x-axis reflects the market share of the particular renewable energy technology as a percentage of total national electricity generation capacity for each UNECE country in 2014. The bubble diameter represents the cumulative national installed electricity capacity of the respective renewable energy technology in 2014. Thus, the two graphs *Fig. 9* and *Fig. 10* display national wind energy and PV market growth rates set in relation to their level of national electricity market penetration in the individual UNECE member States. In order to cluster and analyse the countries, the graphs are divided into 4 quadrants (*Fig. 8*).

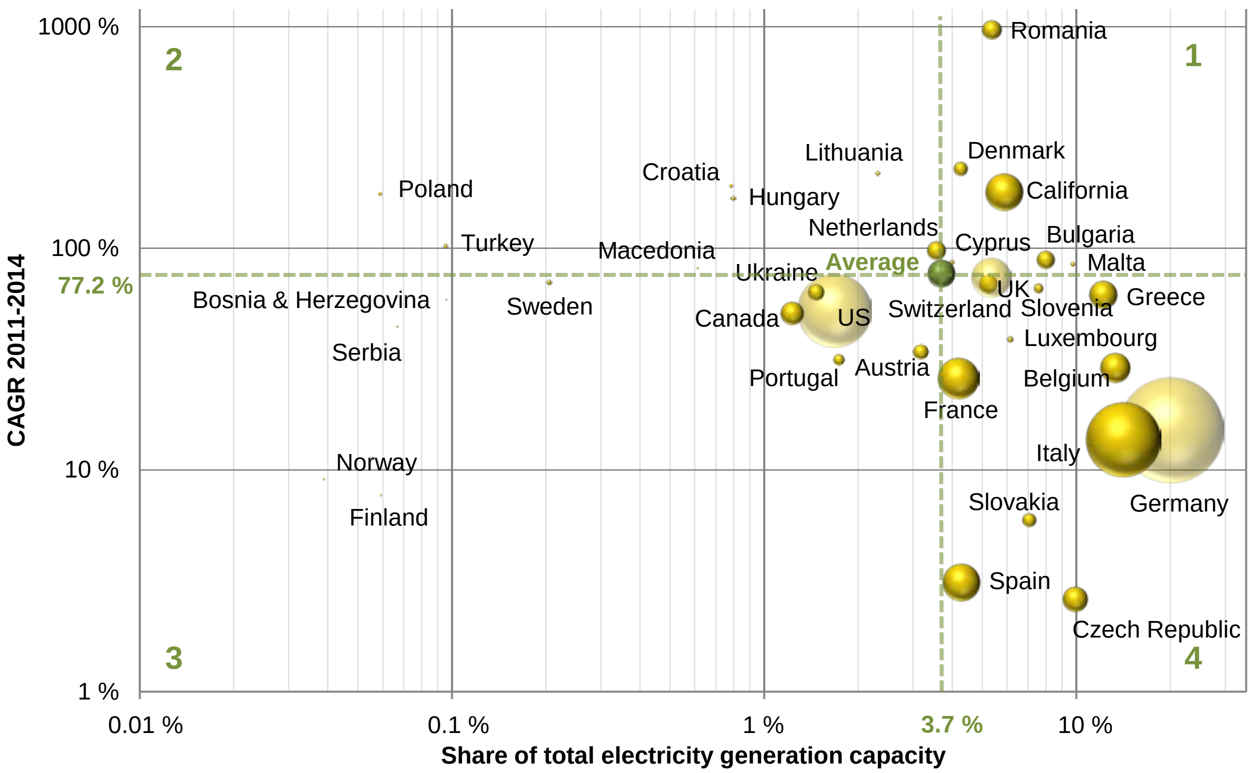
Fig. 8: Description of the four quadrants: market share and growth rate

Quadrant 2 below-average market share above-average growth rate	**Quadrant 1** above-average market share above-average growth rate
Quadrant 3 below-average market share below-average growth rate	**Quadrant 4** above-average market share below-average growth rate

[9] Fig. 9 and 10 – IRENA: Data for renewable energy capacities. EIA: Data for total electricity installed capacity 2012. Values for 2014 are estimates based on calculated trend projections. Only countries for which data were available are included. California is displayed for the purpose of the case study. However, averages were computed omitting California since it is already included in the data for the USA.

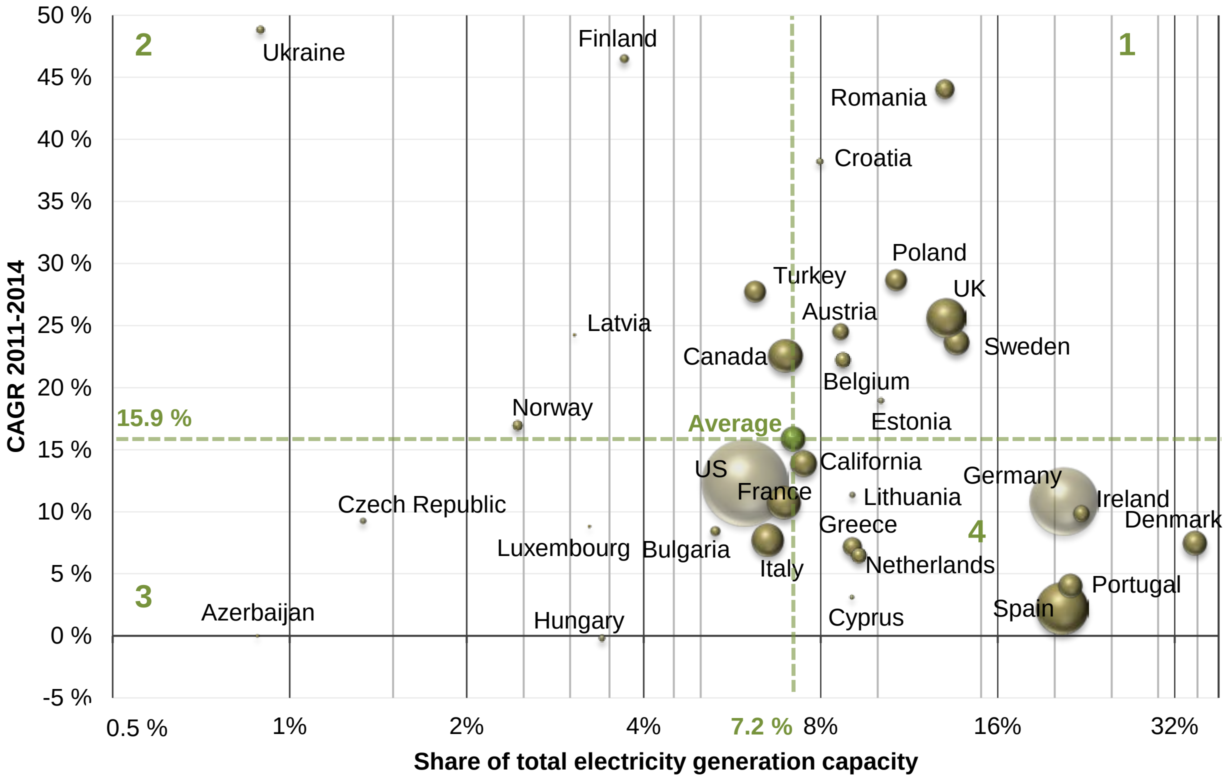
UNECE member States having no or low installed electricity capacities of the particular renewable energy technology, “start” in quadrant 3 (Q3). When their installed capacities start to increase, as new installations are added to the low initial capacity, UNECE member States “move” up to quadrant 2 (Q2). Regarding the recorded growth rates within Q2, it needs to be emphasised that high market growth rates values can be attained, since the initial starting values of installed electricity capacities of the particular renewable energy technology are low. Thus, market growth rates especially within Q2 need to be interpreted taking into consideration the initial values of installed capacities of the respective renewable energy technology. High growth rates can often be sustained in the short- to medium-term even if the market share of the renewable energy technology increases, which is the case of UNECE member States in quadrant 1 (Q1). When the growth rate of the particular renewable energy technology eventually slows down, countries “drop” to quadrant 4 (Q4), in which established markets of the respective renewable energy technology can be found. Since the quadrants are not definitive cut-off rules, established markets can also be found in Q3, when they have a large installed electricity capacity of a particular technology, whose market share, however, is small.

Fig. 9: PV market growth in relation to the PV share of total electricity generation capacity in the UNECE region in 2014



Analysing the UNECE deployment of PV, which is depicted in *Fig. 9*, it can be noticed that the average market growth rate[10] between 2011 and 2014 has been high, amounting to 77.2%. At the same time, the share of total electricity generation capacity has stayed low, covering 3.7%. Bosnia and Herzegovina, Serbia, and Norway have been identified as UNECE member States that recently established their PV markets. UNECE countries with still fairly unexploited PV markets but high market growth rates are Poland, Turkey, Macedonia and Croatia. In Q1 the most promising PV markets with high market shares and high market growth rates are shown, including particularly Romania, Denmark and California, representing the USA. In contrast, established PV markets with high market shares but relatively low market growth rates are Spain, the Czech Republic, Slovakia, Italy and Germany.

Fig. 10: Wind energy market growth in relation to the wind energy share of total electricity generation capacity in the UNECE region in 2014



Looking at the recent wind energy development in the UNECE region displayed in *Fig. 10*, we can observe that the average annual growth rate between 2011 and 2014 has been lower than that of PV, amounting to 15.9%. However, it can also be noticed that the average UNECE wind energy market share of total electricity generation capacity in 2014 was higher than the PV market share, reaching 7.2%. UNECE member States with below-average market shares and

[10] Note that the average CAGR in Fig. 9 differs from the CAGR in Fig. 4. The average for Fig. 9 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 to low growth rates. For wind energy, the difference between the CAGRs in Fig. 10 and Fig. 5 is due to the same reason.

below-average market growth rates of wind energy capacities are Azerbaijan, Hungary, Czech Republic and Luxemburg. UNECE member States with below-average wind energy market shares but strong corresponding growth rates are Ukraine, Finland, Norway and Latvia. Romania, Croatia, Poland and UK are examples for UNECE member States, in which wind energy markets are already established with high market shares and high growth rates. Established wind energy markets, which have high market shares, are for example Spain, Portugal, Denmark, Ireland or Germany.

2.3. Electricity prices

Electricity prices are a crucial factor for the deployment of renewable energies, since they have a major influence on the economic viability of renewable energy generation and 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 an added share consisting of taxes and levies. Electricity generation costs from all types of electricity generating plants determine the electricity market price and are therefore decisive for the level of economic viability of renewable energy generation. UNECE member States with particular low electricity prices or subsidised electricity derived from conventional energy sources constitute a difficult starting position for the uptake of renewable energies, making the implementation of renewable energy promotion schemes even more important. However, the implementation of promotion schemes entails promotion costs, which are usually redistributed in form of taxes or levies and allocated on top of final consumer electricity prices. This leads to increasing or higher electricity prices, which in turn might result in a decrease of social acceptance for renewable energy deployment. At the same time, given high electricity prices, local energy-intensive industries might suffer competitive disadvantages and consider shifting their production sites abroad.

Hence, in the context of renewable energy deployment the level of electricity prices constitutes an important trade-off between the level of implemented renewable energy promotion schemes, social acceptance and the international competitiveness of local industries. Therefore a thorough consideration and monitoring of electricity price formation is necessary for the successful uptake of renewable energies.

Analysing UNECE electricity prices, a strong heterogeneity between UNECE member States can be recognised for both electricity prices for households (*Fig. 11*) and electricity prices for industrial consumers (*Fig 12*).[11] In both figures, the y-axis displays the end-consumer electricity price in €-cents, including taxes and levies, and sets it in relation to the respective country's GDP per capita, shown on the x-axis.

[11] For Fig. 11 and Fig. 12, all data for GDP per capita are from 2014, except Liechtenstein (2012), Luxembourg (2013), Malta (2013) and Switzerland (2013). Data sources: Eurostat, World Bank and others.
For Fig. 11 - 14, all electricity prices are from 2015, except Albania (2013), Armenia (2014), Azerbaijan (2013/2015), Canada (2012), Iceland (2014), Israel (2008), Kazakhstan (2011), Russia (2008/2012), Switzerland (2012), Ukraine (2012) and Uzbekistan (2013). Data sources: Eurostat and others.
Only countries for which data were available are included.

Fig. 11: UNECE electricity prices for private households in relation to GDP per capita in 2015

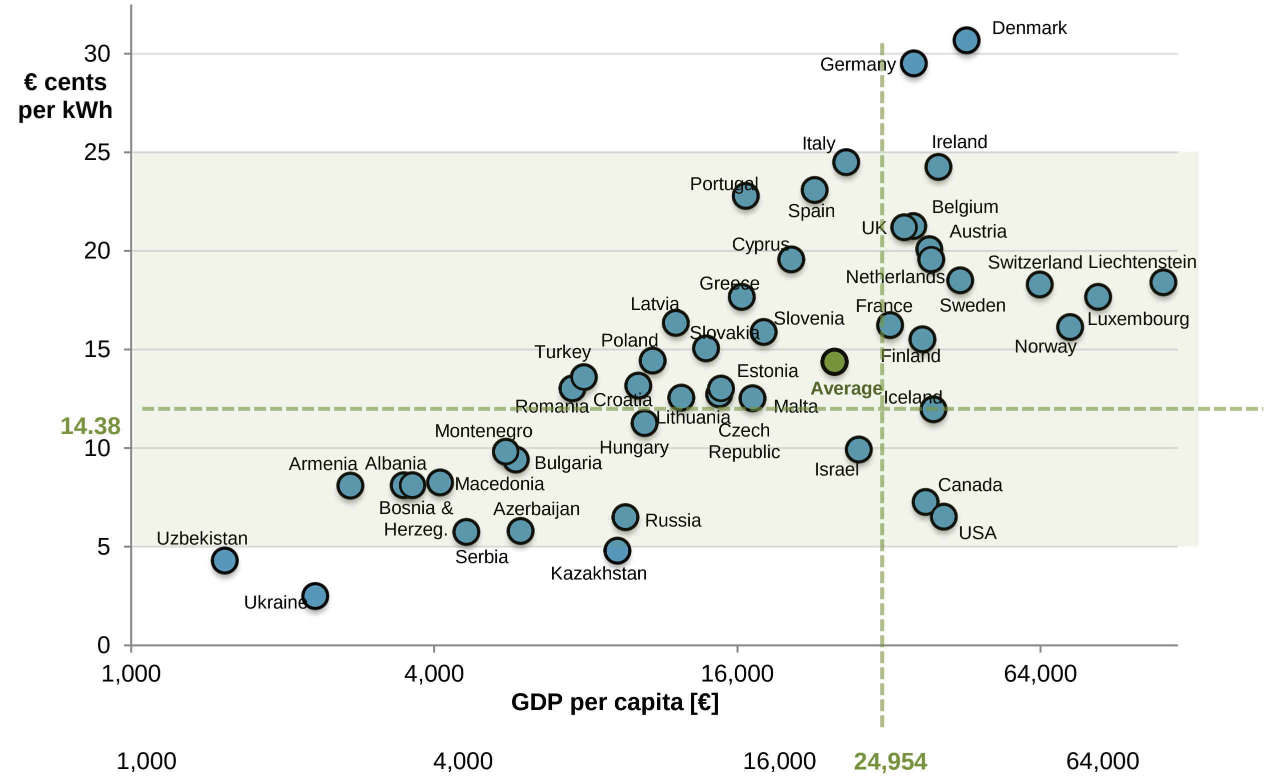
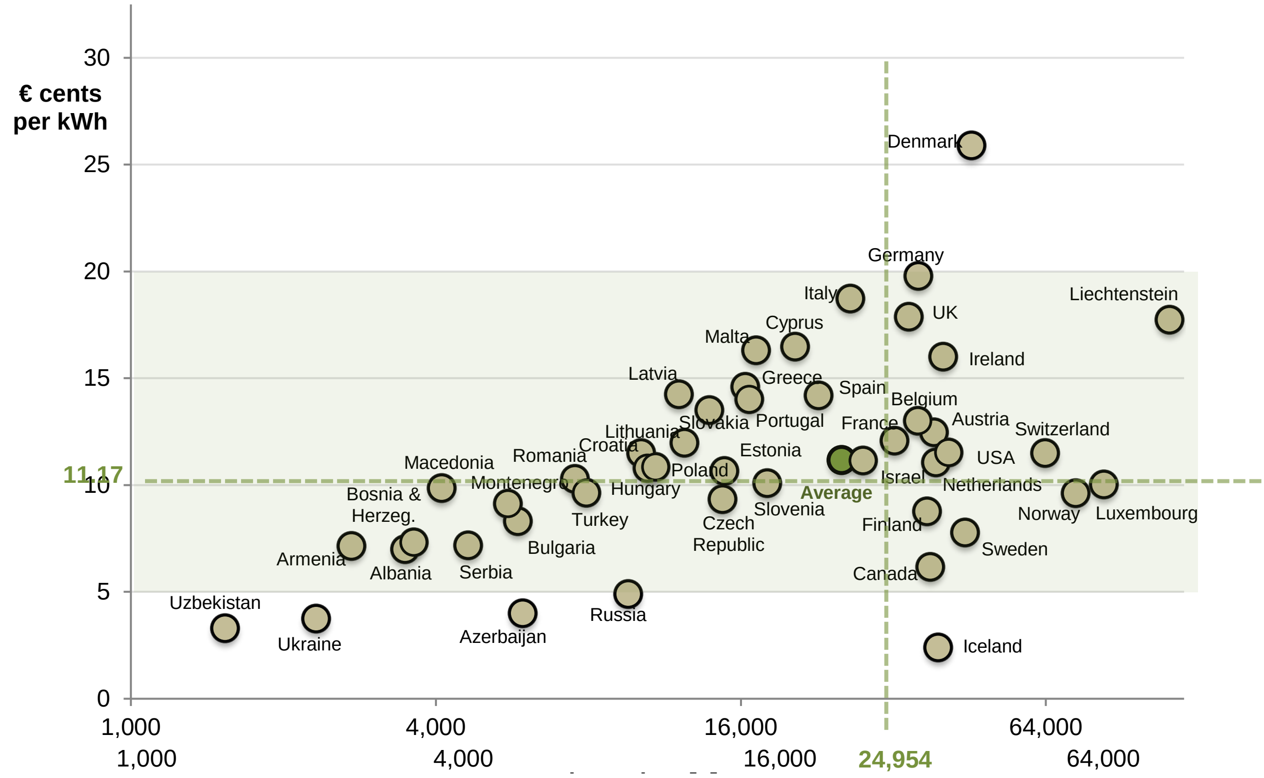


Fig. 12: UNECE electricity prices for industrial consumers in relation to GDP per capita in 2015

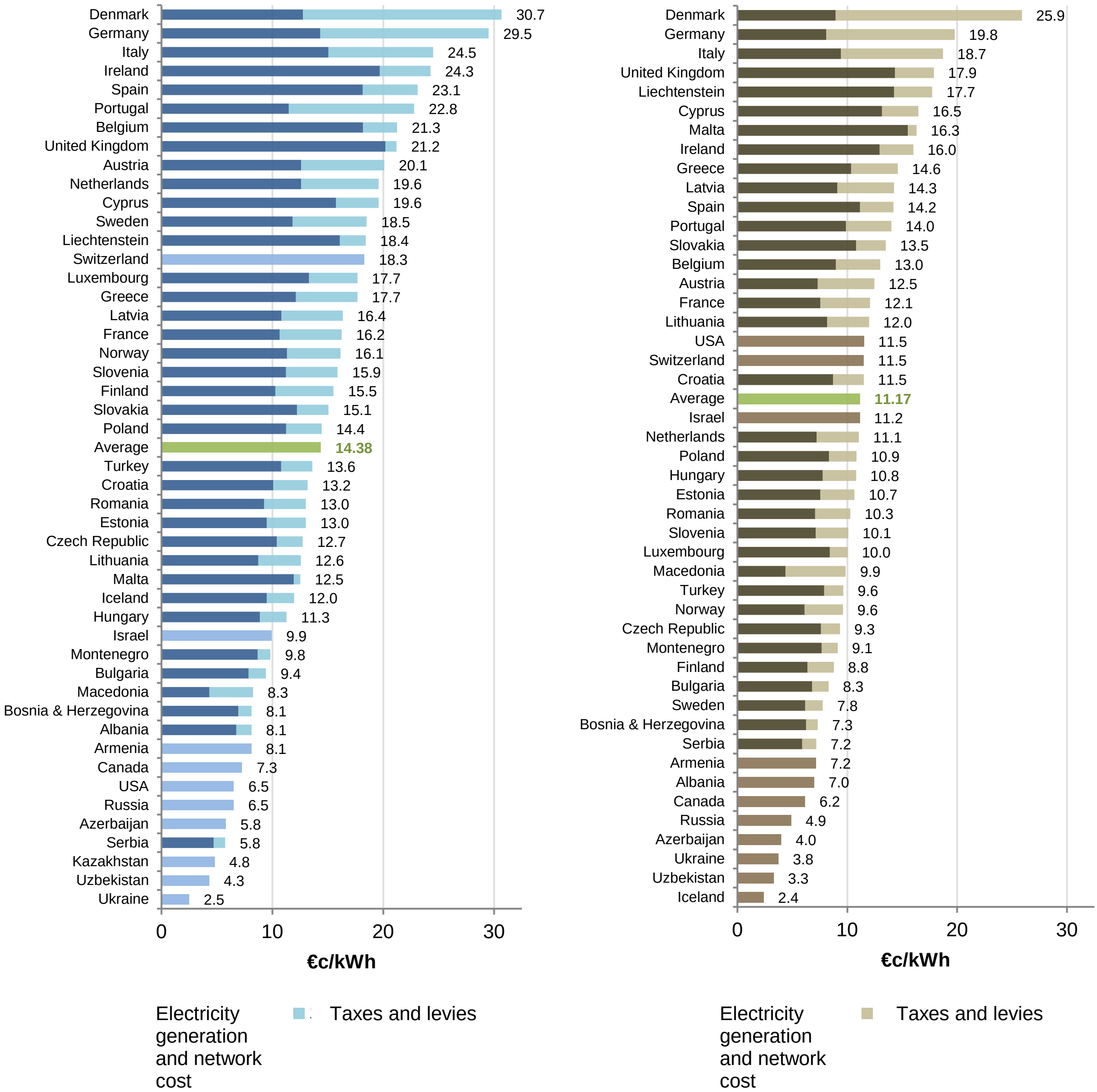


There here is a significant, positive correlation between the prices end-consumers pay and the GDP per capita of the respective country. While the significant positive correlation also exists for industrial consumers, it is not as strong.[12]

Noteworthy is the difference in electricity price levels for households, which are – with only few exceptions – evenly distributed in the range between five and 25 €-cents. This difference is less distinct in the industrial sector. Here, the majority of countries show electricity prices in the range of five and 20 €-cents.

All UNECE electricity prices for households and industrial consumers are displayed in *Fig. 13.*

Fig. 13: Composition of UNECE electricity prices for households (left) and industry (right) in 2015



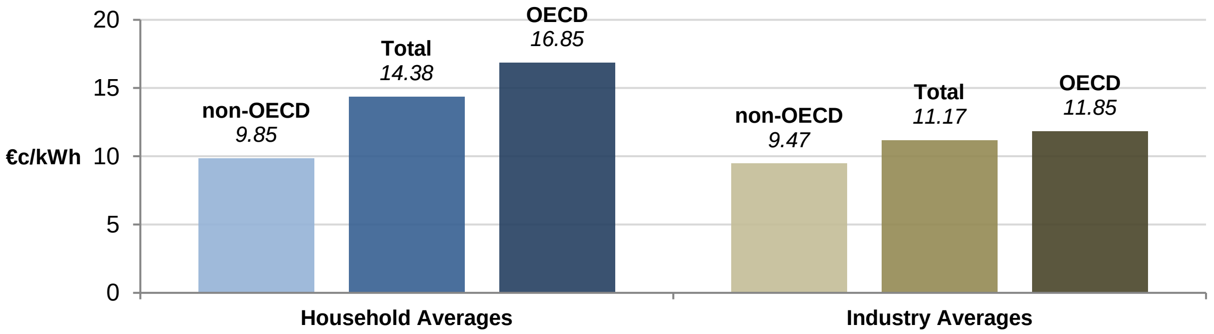
12 The significance of the positive correlations was determined in one sided t-tests at the 1% significance level.

The bars in *Fig. 13* – arranged in descending order – display both the full price charges to the consumer and the included particular share of taxes and levies.[13]

As discussed in the analysis of *Fig. 11 and Fig. 12*, UNECE household electricity prices show a much wider range. Also, it should be noted that while in some countries, such as Denmark and Germany, taxes and levies make up more than half of the electricity price charged to consumers, in other UNECE member States 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.

Fig. 14[14] shows the differences in average UNECE electricity prices between the private and industrial sector. Interestingly, the average UNECE electricity price for households drops to 12.79 €-cents when the national electricity prices are weighted by the population of the corresponding country. This represents the average electricity price that a citizen of the UNECE region pays. However, this drop change is mainly caused by Russia a
nd the USA, the two most populated countries in the UNECE region, which have very low electricity prices (6.5 €-cents). When taking into account the UNECE populations while omitting Russia and the USA, the average household electricity price increases to 16.58 €-cents. For industrial customers, there is no significant change in the average electricity price when the population is taken into account.

Fig. 14: Average UNECE electricity prices for households and industry



As we can observe, industrial electricity prices in OECD or non-OECD member states in the UNECE region show a smaller divergence than electricity prices in the OECD and non-OECD private sector. The similarity of electricity prices – despite varying levels of GDP per capita in OECD and non-OECD countries – in the industrial sector can be linked to the interest within national economies of strengthening locational competitive advantages by keeping industrial electricity prices low. Taxes included in electricity prices are usually refunded to companies.

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13 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.

14 Only countries for which data were available are included.

Taxes do have a strong influence on the formation of electricity prices. In some countries electricity prices for households are even lower than electricity generation costs. As discussed above, low, often subsidised electricity prices in combination with a lack of promotion schemes can hinder the market uptake and integration of renewable energy technologies, as renewable energy technologies will be unable to compete with conventional electricity generation technologies on the energy market. Here, promotion schemes such as feed-in tariffs or premiums, quota systems or auction schemes or the reduction of fossil fuel subsidies can help to make renewable energies more competitive, lifting the renewable energy electricity sales price above the electricity market price based on different mechanisms.

2.4. Conclusion

The status quo analysis shows that the renewable energy deployment in the UNECE region varies considerably across its member states. Electricity capacities from renewable energy sources have grown substantially since 2000. While the “dynamic” renewable energy technologies, wind energy and PV, are expanding at high rates, hydropower and bioenergy markets have had lower growth rates. Large hydropower plants contribute a great amount to the total installed renewable energy electricity capacity. Overall, the renewable electricity market is much more developed than the renewable heat sector in the UNECE region.

The analysis of UNECE electricity prices depicts that the price range is greater for households than for industrial consumers, which can be linked to the interest of national economies to strengthen locational advantages and attract further investment. While electricity generation costs, including network expenses, are comparatively homogenous across UNECE member States, a greater heterogeneity can be recognised between the UNECE national shares of electricity taxes and levies. 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 hinder the market entry of renewable energies. In this context direct or indirect subsidies of conventional energy sources should be minimised to support the deployment of renewable energies. Furthermore, the implementation of renewable energy promotion schemes can help to increase the competitiveness of renewable energies.

3. Renewable energy policies in the UNECE region

Renewable energy promotion schemes aim at facilitating the market entry, system integration and market growth of renewable energies. The respective success of each implemented promotion scheme depends on various factors. On the one hand, policies need to be predictable, consistent and steady in the long term in order to create stable market conditions and planning security for all stakeholders, such as plant operators, investors and end consumers (Swisher and Porter, 2006). On the other hand, the effectiveness of renewable energy policies strongly depends on their applicability within the prevailing energy market structure and the given attributes of the key dimensions and factors of renewable energy deployment, as described in chapter 1.1. Also, if several renewable energy promotion policies are combined their reciprocal impact needs to be considered in order to avoid mutual obstructions.

In the following first subsection, major renewable energy promotion schemes and measures for the electricity sector are presented and explained before their current status of implementation is analysed for each UNECE member State. Although the application of renewable energy promotion schemes and measures can be restricted to certain technologies, the evaluation of their current stage of implementation in the UNECE region will be analysed on an aggregated technological level to avoid excessive complexity. In the second subsection, the current state of renewable energy policy implementation in the heat sector is examined for each UNECE member State, distinguishing the existing promotion schemes by the promoted renewable heat source. Furthermore, the existence of promotion schemes for renewable energies in the UNECE building sector is investigated for each UNECE member State.

3.1. Promotion of renewable energies in the electricity sector

As revealed in the status quo analysis of the UNECE renewable energy deployment in chapter 2.1., the market of renewable energy electricity generation is rapidly growing in the UNECE region. This is strongly linked to the implementation of a wide range of renewable energy promotion schemes and measures in the UNECE electricity sector, which are listed and explained in *Fig. 15*. These major renewable energy promotion schemes and measures of the electricity sector can be broadly categorised into non-financial and financial support schemes.

Non-financial policy instruments support the deployment of renewable energies by facilitating their market entry and integration through the improvement of the given infrastructural framework conditions. These non-financial instruments comprise for example, officially communicated renewable energy electricity expansion goals, guaranteed grid access, priority feed-in, net metering or net billing etc. Guaranteed grid access entitles independent power producers (IPP) and autoproducers, such as private households or industrial entities, to grid access. The guaranteed grid access for power plants might be limited by a certain minimum or maximum capacity value. Priority feed-in builds upon guaranteed grid access and prescribes the mandatory purchase of renewable energy electricity by utilities. Net metering or net billing are billing mechanisms which credit renewable electricity generating entities for the net value between their supplied electricity fed into the grid and their demanded electricity. Produced electricity surpluses are thereby remunerated either as electricity credit counting towards future electricity demand (net metering) or as direct financial compensation at an agreed rate or tariff (net billing).

Financial support policy instruments promote renewable energy deployment by setting investment incentives for renewable energy technologies. They can be categorised into general financial support instruments and into support schemes, which are implemented to lift electricity sales prices for renewable energies above electricity market prices, in order to overcome the lacking competitiveness of renewable energies compared to conventional energy sources.

The first category of financial support schemes, referred to as general financial support instruments, comprises investment subsidies, credit grants, reduced rates of interest, tax credits or exemptions, governmental R&D expenditures, etc.

The second category of financial support schemes, which have been defined as electricity-price-related support schemes, can be subdivided into price-based, quantity-based or hybrid promotion schemes.

Feed-in tariffs or premiums are referred to as price-based promotion schemes, since they grant long term stable remuneration for the generation and feed-in of renewable energy electricity. The feed-in of renewable energy electricity is either remunerated with a fixed tariff (feed-in tariffs) or at the electricity market price, which is topped up by a varying market premium (feed-in premiums).

Quantity-based renewable energy promotion schemes are mainly quota systems. When implementing quota systems, such as renewable portfolio standards or renewable obligations, a certain renewable energy share of total electricity generation is mandated from national utilities. Quota systems are often combined with a trading system of certificates, which are referred to as green certificates or renewable energy certificates. These certificates are issued to electricity generating entities for each unit of generated renewable electricity and can be traded. The price for each certificate is determined by the market, based on the total amount of traded and supplied certificates and the demanded amount of certificates, which is highly influenced by the mandated renewable energy quota.

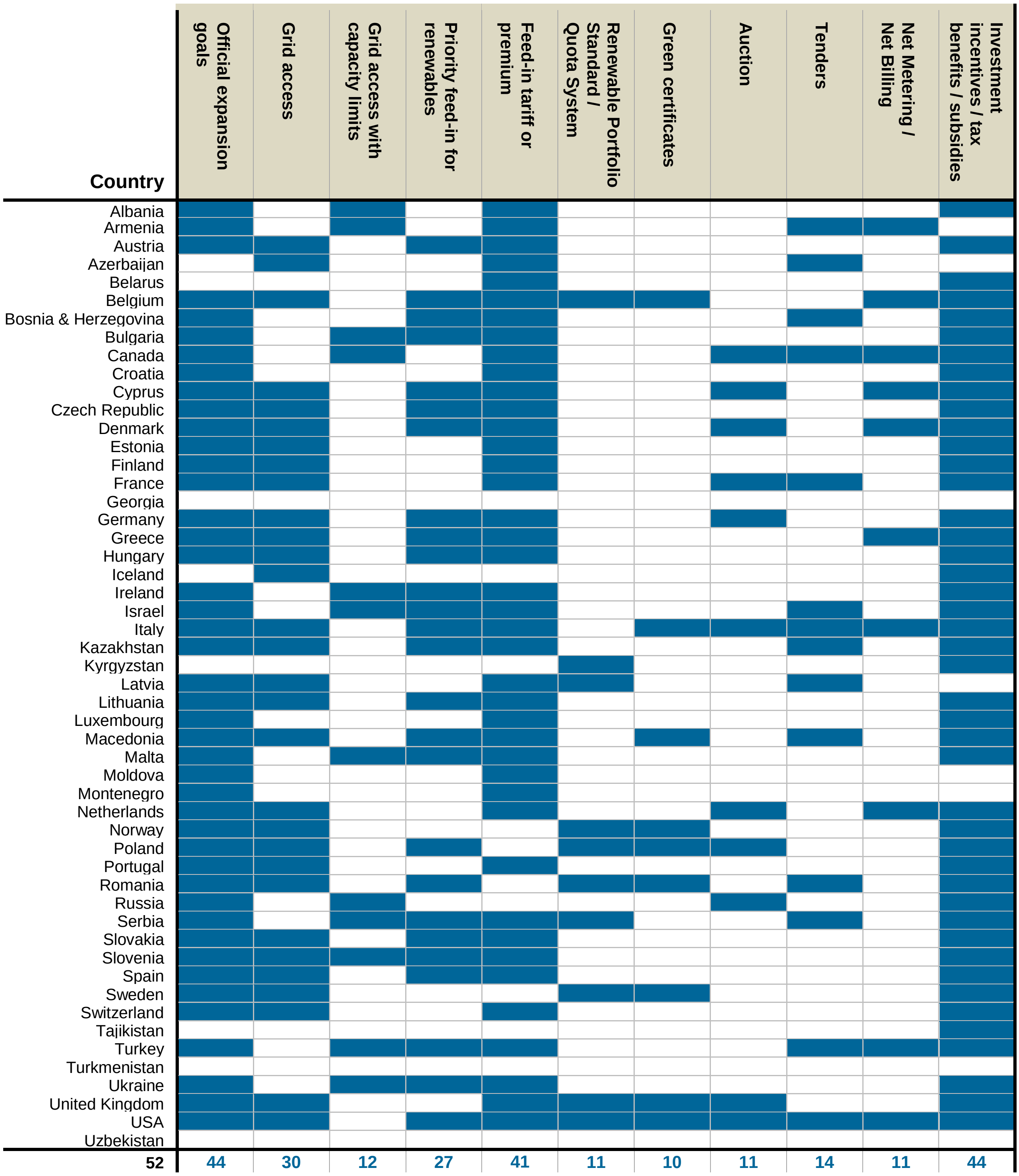
Auction schemes can be considered as hybrid renewable energy promotion schemes, since they include elements of both price-based and quantity-based promotion schemes. In the context of renewable electricity projects, auctions are public bidding processes, in which long term contracts are awarded for the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

Fig. 15: Renewable energy promotion schemes and measures in the electricity sector

Promotion Scheme	Description
Expansion goal	Definition and official communication of (technology-specific) binding or non-binding expansion goals.
Grid access / Grid access with capacity limits	Guaranteed grid access for independent power producers or autoproducers possibly restricted by capacity limits.
Priority feed-in	Prescribes the mandatory purchase of renewable energy electricity by utilities.
Net Metering / Net Billing	Billing mechanisms, in which renewable electricity generating entities are credited for the net value between their supplied electricity fed into the grid and their demanded electricity. Produced electricity surpluses can be remunerated as electricity credit counting towards future electricity demand (net metering) or as direct financial compensation at an agreed rate or tariff (net billing).
Feed-in tariff or premium	Remuneration for the feed-in of renewable energy electricity. The feed-in of renewable energy electricity is either remunerated with fixed tariffs (feed-in tariffs) or at electricity market prices topped up with an adjusting market premium (feed-in premiums).
Quota system (renewable portfolio standards, renewable obligations)	Obligatory renewable energy share of energy electricity supply or demand, mandated from utilities. Quota systems are often combined with a trading system of certificates, which are referred to as 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 generated and supplied renewable energy electricity.
Auctions	Public bidding process, which awards long term electricity purchase contracts for an agreed amount of produced renewable electricity or for the electricity output from a certain auctioned quantity of renewable electricity capacity. Long-term contracts are awarded exclusively according to price-based criteria.
Tender	Multi-criteria auctions.
Other financial incentives	Investment subsidies, credit grants, reduced rates of interest, tax credits or exemptions, governmental R&D expenditures etc.

The current stage of promotion scheme implementation for renewable energies in the electricity sector is depicted in *Fig. 16*, which reveals that UNECE member States do not only have expansion goals in place but have implemented various promotion schemes and measures to support the market entry, integration and growth of renewable energies.

Fig. 16: Renewable energy promotion schemes and measures in the electricity sector of UNECE member States



Out of 52 analysed UNECE member States[15], 44 have official, to a certain extent technology-specific, renewable energy expansion goals. While in 30 UNECE countries utilities, IPPS and lower scale autoproducers in the industrial and private sector have unlimited grid access, twelve countries restrict their guaranteed grid access by capacity limits. Priority feed-in is set up in 27 UNECE countries.

While 41 UNECE member States promote renewable energy deployment via price-based feed-in tariffs or premiums, only eleven UNECE member States impose quantity-based obligatory renewable energy electricity shares within a quota system. Seven UNECE member States have introduced tradable green or renewable energy certificates alongside their quota system and four UNECE member States have implemented a trading scheme of green or renewable energy certificates without establishing a quota system. Auctions are increasingly used as a renewable energy promotion scheme. They are deployed in eleven national energy markets, while tendering is even used in 14 countries.

Net metering or net billing is deployed in eleven UNECE member States. Tax reductions and other investment incentives for renewable energies often play a complementary role to other measures and are used in 44 UNECE member States.

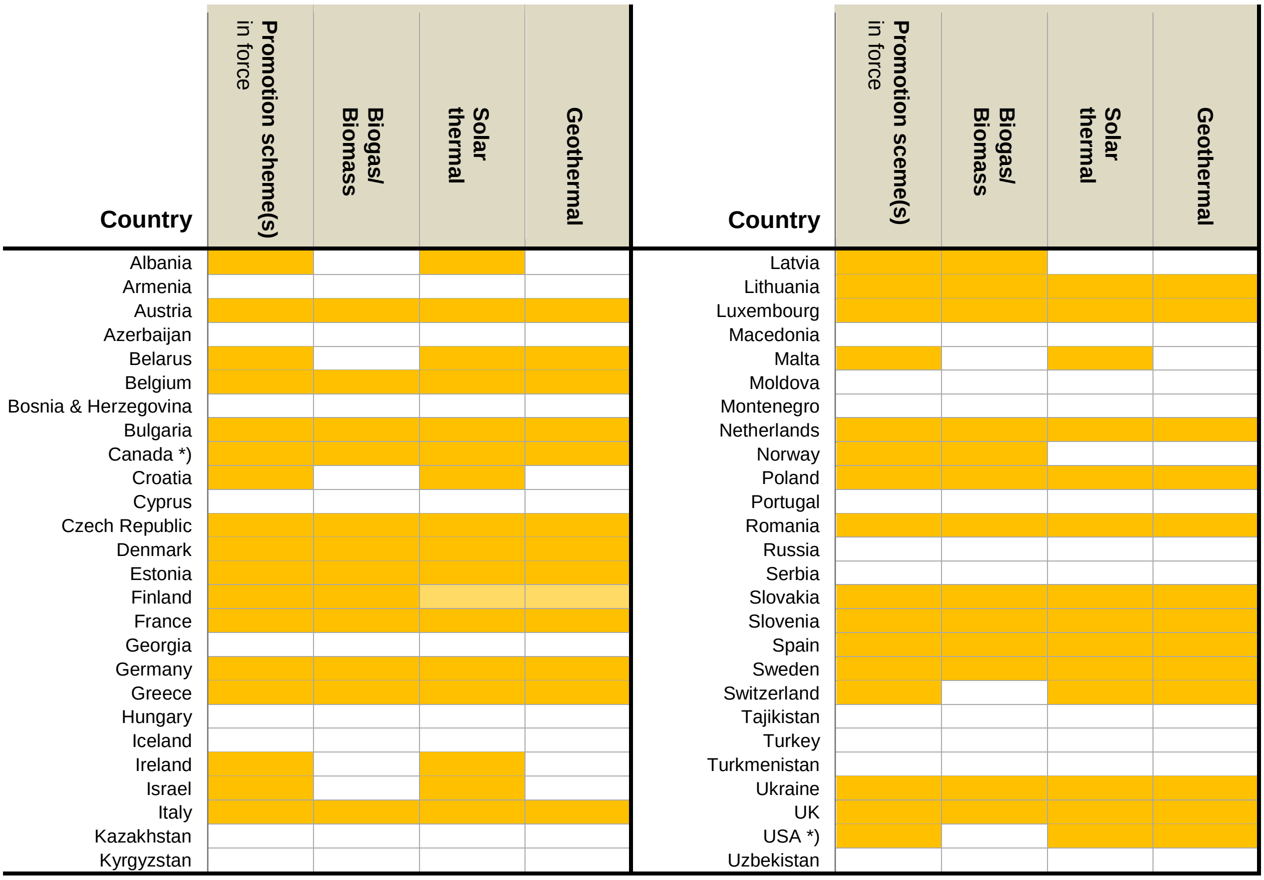
3.2. Promotion of renewable energies in the heat sector

Fig. 17 gives an overview of the UNECE countries that have policy schemes and measures in force for promoting renewable energies in the heat market, mostly through subsidies, low-interest loans, tax regulations, or a combination of these instruments. While the first column indicates whether or not there is at least one promotion scheme in place, the remaining columns describe which renewable heat technologies are promoted in the respective country. Out of 52 analysed UNECE countries, 33 (almost two thirds) promote at least one technology. However, the majority of countries with promotion schemes in place support all three technologies, i.e. biogas/biomass, solar thermal and geothermal energy. Overall, heat from solar thermal energy is promoted the most.

In *Fig. 18* legal requirements and promotion schemes for the use of renewable energy technologies in the building sector are displayed. Certain UNECE member States promote renewable energies in the building sector through financial incentives; others have established legal requirements for the use of renewable energies and some countries do both. Almost half of the UNECE countries have already implemented renewable energy promotion schemes in the building sector, while eleven countries are still developing suitable renewable energy promotion schemes and 18 are even not yet planning to promote renewable energies in the building sector.

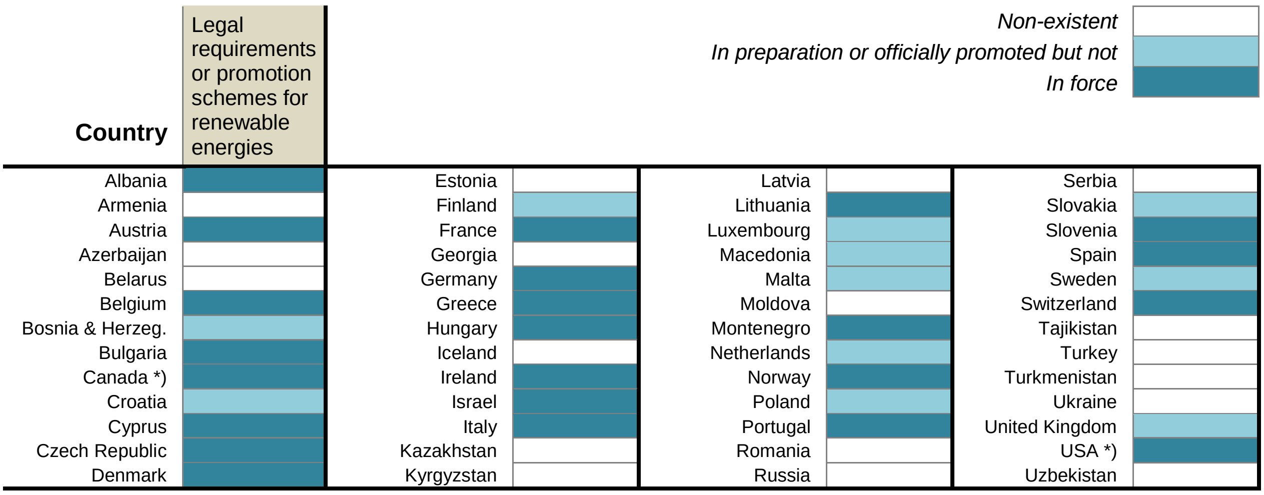
[15] Andorra, Liechtenstein, San Marino und Monaco have not been included due to a lack of data.

Fig. 17: Renewable energy promotion schemes and measures in the heat sector of UNECE member States



*) Schemes are not always based on federal promotions, different support schemes on state or provincial level
Sources:: RES Legal, IEA, solarthermalworld.org and others

Fig. 18: Renewable energy promotion schemes and measures in the building sector of UNECE member States



*) Schemes not always based on federal promotions, different support schemes on state or provincial level, Sources: BuildUp.eu and others

A comparison between the existing implemented promotion schemes for renewable heat and renewable electricity generation reveals that, until today, governments mainly focus on the renewable energy promotion in the power sector. Renewable heat is still a niche of policy making despite the great potential, particularly in the UNECE region, since its member states are geographically situated in the Northern hemisphere, which is why their energy markets also possess larger heat markets than countries in warmer regions.

3.3. Conclusion

The analysis reveals that the large majority of the 52 analysed UNECE member States have not only officially set renewable energy expansion goals, but also implemented a wide range of renewable energy promotion schemes and measures in the electricity and heat sector to achieve these goals. The integration of renewable energies within the electricity sector has thereby received greater political emphasis, which is indicated by 51 UNECE member States having adopted renewable energy promotion schemes or measures in the electricity sector, as opposed to 43 UNECE member States in the heat sector.

The most widely adopted policy instruments in the electricity sector are feed-in tariffs or feed-in premiums, tax reductions and investment incentives, with each type of these policy instruments being implemented in more than 40 UNECE member States. In the heat sector the most strongly supported renewable energy source is solar thermal energy, followed by geothermal energy and energy derived from biogas or biomass. These renewable energy heat sources are respectively promoted by 31, 26 and 25 UNECE member States. In the building sector the integration of renewable energy sources is promoted almost by half of the UNECE countries, while eleven UNECE member States are currently still developing renewable energy promotion schemes or measures and 18 UNECE member States have no promotion scheme or measure in place or planned.

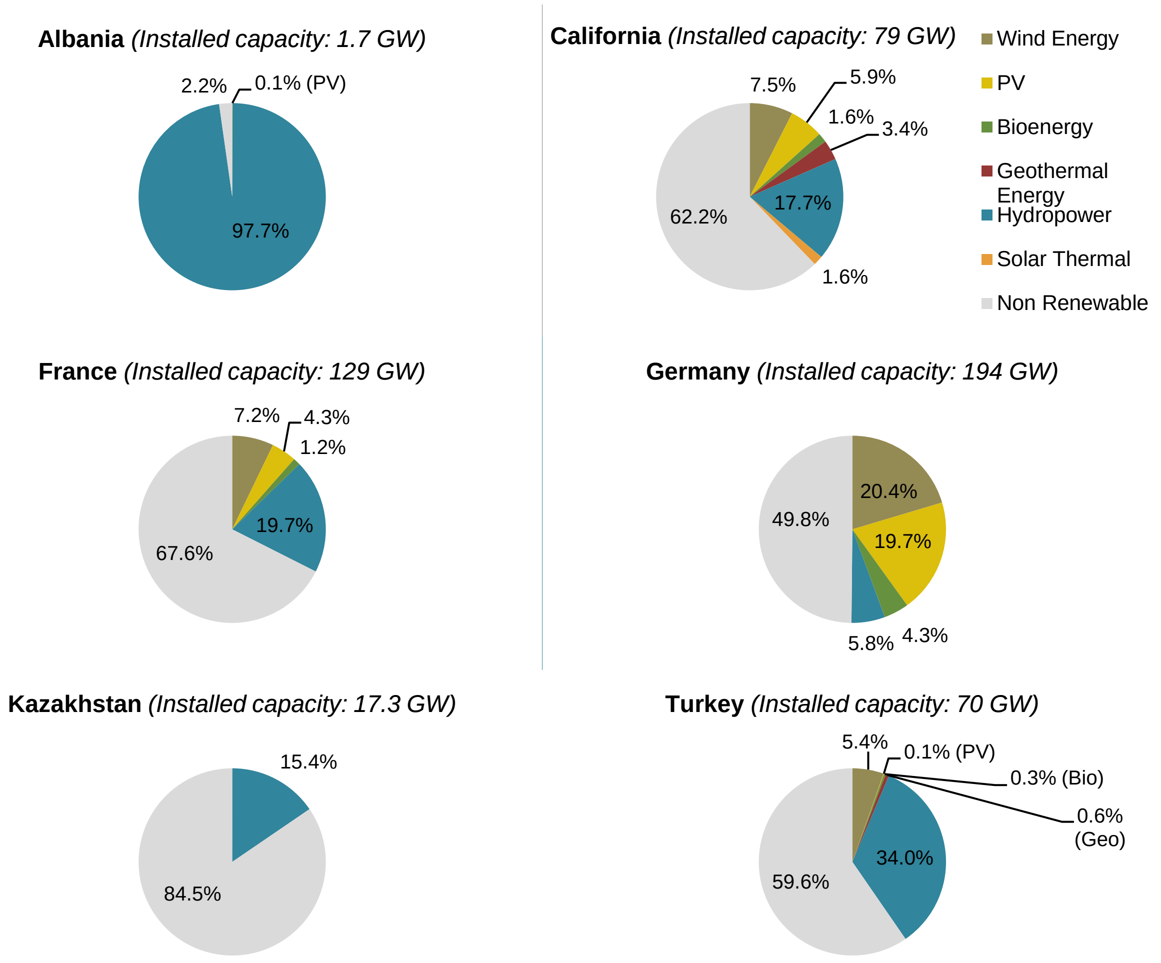
Although the revealed status quo of renewable energy policy implementation in the UNECE region seems to be at an advanced level, it needs to be emphasised that the mere implementation of renewable energy promotion schemes and measures does not necessarily lead to an uptake and integration of renewable energies in the UNECE electricity and heat sector. In order to be effective, renewable energy policies need to be predictable, consistent and steady in the long term, aligned to the prevailing energy market structure, adjusted to the attributes of the defined key dimensions and factors of renewable energy deployment and coordinated with other implemented policies.

4. Case studies: Renewable energy within national energy markets

The case studies comprise the following countries: (1) Albania, (2) France, (3) Germany, (4) Kazakhstan, (5) Turkey and (6) the United States, through the example of California. These countries have been chosen to cover different geographical areas and to show a variety of aspects influencing renewable energy uptake, i.e. degree of market liberalisation, prevailing energy markets, availability of natural resources and different policy approaches. First, the status quo, overall energy profile, current use of renewable energies and targets are analysed. Subsequently, key pillars and important regulatory steps of the last decade are described. Finally, each case study will conclude with the country's current challenges and provide an outlook for the coming years. After presenting individual case studies, initial lessons learnt and conclusions for the larger UNECE region are drawn.

For the selected case study countries, the pie charts in *Fig. 19* display the particular shares of the different types of installed electricity capacities in 2014.[16]

Fig. 19: Composition of electricity capacities per energy source of the case study countries in 2014



[16] Renewable energy shares, source: IRENA. Capacities are from country-specific sources, except Albania and Kazakhstan, for which the 2014 capacities are based on trend estimation from previous years (EIA).

Note that in most countries, with the exception of Albania, non-renewable energy sources constitute the majority of installed electricity capacity. However, even in countries like Germany with high installed capacities, it is important to keep in mind that, on average, renewable energy sources have much lower full load hours. Thus, high shares in electricity capacity do not translate into the same share in electricity generation.

4.1. Case Study Albania

Macroeconomic background

In the 1990s and early 2000s Albania experienced GDP growth rates of up to 7.3% (as achieved in 2005). Since 2011 the country has had a steady rate of around 2% of economic growth. The European Bank for Reconstruction and Development (EBRD) estimates the economy to have grown by 2.3% in 2015 and expects a growth rate of 3.3% in 2016. As tax revenues have stayed below expectations, the government has to cope with severe budget constraints and might fail to reach the targets agreed under an IMF programme. The EBRD sees improved efforts to “reduce informality in the economy”, which should yield positive returns in the future.

In 2012 Albania’s primary energy consumption amounted to 30.8 TWh. In 2014, the country produced 21.8 TWh in primary energy, making the country dependent on energy imports for about 30% of their primary energy needs. Out of the 21.8 TWh primary energy production, 7.2 TWh have been derived from renewable energy sources. Albania has oil deposits, but coal and petroleum products have to be imported to a large extent. Electricity generation relies almost entirely on hydropower. However, in 2015 only 30 - 35% of available hydropower capacities were used as the technical potential is not yet fully exploited. Additionally, there is large potential for wind power and solid biomass. The solar energy sector has seen private investment in mini and small scale solar thermal applications with increasing collector surfaces.

Total gross electricity generation amounted to 4.7 TWh in 2014. The full dependency on hydropower for electricity generation makes Albania’s domestic electricity supply subject to hydrological conditions. For instance in 2010, positive circumstances resulted in a strong surplus of electricity, whereas in 2011 a drought forced Albania to use imports to meet electricity demand. This cycle occurs regularly.

Key pillars and important steps

In 2013, Albania adopted a Renewable Energy Law, aimed at making better use of its renewable energy resources. The implementation of the law is currently delayed, but a National Renewable Energy Action Plan (NREAP) based on the requirements of the EU Renewable Energy Directive was adopted in January 2016. The NREAP was not yet submitted to the Energy Community Secretariat at time of drafting (February 2016). In April 2015, a Power Sector Law was adopted in order to comply with the third EU Energy Market package.

The focus on hydropower is mirrored in the existing support schemes for renewable energy sources. The only renewable energy technology currently supported by a feed-in tariff – the main support instrument – is small scale hydropower in the plant categories with capacities of up to 15 MW. The tariffs are based on the electricity import prices of the previous year. Theoretically, other renewable energy technologies are also eligible for a feed-in tariff, but no specific tariffs have been implemented yet. Regarding grid connection of renewable energy installations, the grid operator is required to connect every energy-generating plant to the system, but there is no priority for renewable energy plants.

In line with the EU's initiative to establish an electricity transmission corridor from Bulgaria to Italy, the EBRD announced plans in December 2015 to finance the first electricity interconnector between Macedonia and Albania, in addition to the existing interconnectors from Albania to Montenegro and Kosovo. A second interconnector to Kosovo is also planned. The goal is to be able to import more electricity from abroad in periods of little precipitation and export electricity surpluses when river levels are high. This will support energy security in Albania and should help to reduce power outages, which are more frequent in Albania than in the other Southeast European countries.

Challenges and outlook

Hydropower will continue to be the leading technology for electricity generation in Albania in the mid and long term. Plans for new generation capacities focus on a mix of small and large hydro power plants, complemented to a smaller extent by electricity from wind, solar and biomass. The draft of the NREAP includes ambitious goals for these technologies, but a history of 400 concessions for new hydropower plants since 2007, of which only 70 were realised until 2014, shows that the implementation of these goals poses challenges.

Transmission losses, which were as high as 35.5% of final energy consumption in the electricity sector in 2013, represent another difficulty. Announced improvements in the domestic transmission and distribution network might help to reduce the transmission losses.

The Albanian government is not only looking at renewable energy sources for the development of the energy sector. For November 2016, a natural gas master plan is announced, which is intended to analyse the given technical, legal, regulatory, economic and social framework for introducing a gas market. In this context, Albania started negotiations with companies regarding the exploitation of oil and gas at seven onshore and offshore blocks.

The start of the construction work on the Trans-Adriatic gas Pipeline (TAP), which aims at transporting Caspian gas to Europe, is scheduled for construction from 2016 onwards. TAP would give Albania new importance as a gas transit country.

4.2. Case Study France

Macroeconomic background

France is one of the biggest countries and member of the core group of industrial leaders in the UNECE. The country is poor in energy resources and the energy system is highly dominated by nuclear energy, currently accounting for approximately 75% of electricity production.

France’s total primary energy consumption amounted to 1,790 TWh in 2012, of which electricity consumption accounted for 490 TWh. In 2012, France generated a total electricity amount of 540 TWh. The electricity use per capita was 7,283 kWh. In 2014, renewable energies contributed 18% to the total electricity generation in France. The largest proportion came from hydro energy with 13%, followed by wind energy with 3%, PV with 1% and further sources accounting for 1%. In March 2015, France had an installed wind capacity of 9,482 MW and an installed PV capacity of 5,860 MW. Geothermal energy contributes a smaller share to the renewable energy mix. In the future, France wants to further develop marine energy.

In 2013, 18.3% of France’s primary heat consumption was covered by renewable heat. In 2014, France generated 128 TWh of renewable heat. Bioenergy accounts for 66% of French renewable heat generation. The main share comes from wood combustion. Further, biodiesel and heat pumps contribute respectively 11% and 7%, while agricultural waste and biogas have very marginal shares. Especially during the winter season, nuclear power plants cannot deliver sufficient electricity for French households, due to the additional use of primarily electric heating systems.

France is striving to achieve a long-term transformation and diversification of its energy mix. The French government is interested in stimulating green growth and increasing the share of renewable energies, not only for climate protection reasons. The government also sees strong potential for economic growth by promoting green industry development, especially renewable energy industries. Therefore, the government defined an extensive energy transition law, which came into force in August 2015, addressing energy efficiency, climate protection and renewable energy topics.

Key pillars and important steps

In its National Renewable Energy Action Plan (NREAP), France has defined a list of renewable energy targets for 2020. Firstly, the share of renewables has to reach 23% of final energy consumption. Further, 10.5% of transport energy should come from renewable sources. Regarding renewable energy installations, 25 GW of installed wind capacity, including 6 GW of offshore wind should be reached by 2020. For PV, a capacity target of 5.4 GW by 2020 has been defined. Finally, 32% of energy consumption for heating and cooling should be derived from renewables by 2020.

Furthermore, in 2015, France passed the French Energy Transition Law, with which the French Government wishes to position France as one of the leading environmental players worldwide. The law is expected to boost employment, creating around 100,000 green-growth jobs.

The 66 articles of the Energy Transition Law reflect France's desired transformation of its energy system. GHG emissions are to be reduced by 40% until 2030. In this context, the law sets a sharp increase in the French carbon tax, which is currently at 14.50 €/t and will be quadrupled, reaching 58€/t in 2020. Furthermore, strong energy saving targets are defined. They stipulate to reduce final energy consumption by 20% until 2030 and by 50% until 2050. Additionally, the share of renewables in the country's final energy consumption shall reach 32% by 2030. This means a further raise from the NREAP's target set for 2020 at 23%. Furthermore, fossil energy sources should be reduced by 30% until 2030, in comparison to 2012. This implies that the nuclear share in the electricity mix shall be reduced from 75% today to 50% in 2025. Also, the law sets a specific cap at 63.2 GW for nuclear capacity. This implies a building stop for new reactors with no replacement of those nuclear power plants that are shut down.

The law also foresees supportive actions for energy efficiency and electro mobility, such as interest-free loans for private building renovation and subsidies for switching from old diesel to new electric cars. The total volume allocated for this support by the government is 10 billion €.

Challenges and outlook

The Energy Transition Law will facilitate the development of onshore wind, biogas and small hydropower production by streamlining the authorisation process. The envisaged concentrated authorisation process ("permis unique") will apply to wind, biogas and hydro power plants. The French renewable energy output had previously been blocked by a complex administrative system, uncertain legal framework and numerous legal challenges by anti-renewable public protests, specifically against wind farms.

Under the new administrative system, legal challenges will be allowed only in the two months, instead of six months after the granting of an authorisation. Further, the law states that renewable energy installations of up to 3 kWh must receive grid access within two months after signing the grid-access demand, provided that no new grid development is needed for the connection. For most big renewable energy plants, grid access must be granted within a maximum of 18 months. Projects, where grid access authorisation processes are delayed beyond the set time span, will be compensated monetarily.

The law also paves the way for a new subsidy system, which is to be applied by 2016 for bigger renewable energy plants of renewable energy technologies, such as PV and wind. The new subsidy system shall be in line with the European Union Directive, which mandates a gradual transformation of national promotion scheme systems moving away from plain feed-in tariff system guaranteeing fixed renewable energy electricity retail prices to market-based renewable energy promotion systems. Therefore the new subsidy system replaces feed-in tariffs by feed-in premiums. Instead of guaranteeing a fixed tariff as remuneration for each generated and supplied unit of renewable energy, the renewable energy units are compensated at market prices, which are topped up by a renewable energy market premium.

The introduction of a market premium aims at setting an incentive for renewable energy producers to produce at times when the feed-in of renewable energies is low and the wholesale power prices therefore high and carry out maintenance during off-peak times, helping to balance the grid.

Further, the Energy Transition Law defines regulations for the transition period from the old to the new renewable energy promotion system. The law also sets the framework for citizen- or community-based financing of renewable energy projects. It supports the offering of project shares of project development companies or cooperatives to local citizens or municipalities as project financing method. Also, the Energy Transition Law outlines the development of a nation-wide biomass strategy, which is implemented to increase the use of biomass combustion and combined heat and power (CHP) plants in the private, commercial and industrial sector. Lastly, the law contains a target of building 1,500 additional agricultural biogas plants within the next three years.

4.3. Case Study Germany

Macroeconomic background

In 2014, Germany's primary energy consumption amounted to 3,646 TWh, which was covered by 1,108 TWh (30,4%) in-state energy generation and 2,538 TWh (69,6%) energy imports. This composition reveals that Germany heavily relies on energy imports. In terms of energy sources, mineral oil products contributed the largest share of energy consumption, amounting to 33.8%. The remaining energy consumption was covered by energy generation from natural gas (21%), hard coal (12.7%), soft coal (11.9%), nuclear energy (7.5%), other sources (0.5%) and renewable energy sources (12.6%). Looking exclusively at in-state energy generation, soft coal contributed the major share of energy generation in Germany in 2014, making up 40.5%, while the share of renewable energy sources amounted to 10.1%. Examining the sources and import-export balances of electricity generation in Germany, it can be noted, that Germany has a noticeable renewable energy share of total electricity generation amounting to 30% in 2015, which totals 647 TWh (estimate). In 2015, Germany was able to create and export an electricity surplus of 83 TWh, while importing only 33 TWh.

In 2013, Germany, as Europe's largest economy, has achieved a reduction in greenhouse gas emissions of 22.6%. Overall, Germany has set targets for renewable energies expansion and energy efficiency enhancement as well as greenhouse gas emission reductions (*Fig. 20*).

Fig. 20: Environmental policy targets of Germany

Objective	Status 2014	Target 2020	Target 2050
Share of renewable energy in gross final energy consumption	12.6%	**18%**	**60%**
Share of renewable energy in electricity consumption	27.7%	**35%**	**-**
Renewable energies as a proportion of heat consumption	9.1% (2013)	**14%**	**-**

Energy efficiency: reduction in primary energy consumption	- 8.9%	**- 20%**	**-**
Reduction in greenhouse gas emissions	- 22.6% (2013)	**- 40%**	**- 80-95%**

Efforts to increase the share of renewable energy sources in the power sector are currently well on track. In 2014, renewables became Germany’s most important source for electricity generation for the first time. The renewable energy share of total heat consumption slightly dropped in 2013 to 9.1%. However, in absolute figures the heat consumption covered by heat generation from renewable sources increased to 134.4 TWh in 2013. The share of renewable energy in the energy consumption within the transport sector amounted to 5.5% in 2013.

Key pillars and important steps

In 2011 the key pillars for the German energy transition were determined by the German Bundestag. Germany’s energy policy is guided by three main objectives: energy security, affordable energy prices, and attaining an energy supply that is environmentally compatible. The German government is striving for the market and system integration of renewable energies as well as an increasing energy efficiency, which makes renewable energies and energy efficiency the two main pillars of the German energy transition. For renewable energies, the key legislations are the Renewable Energy Sources Act and the Renewable Energy Heat Act. Key legislations promoting energy efficiency are the Energy Saving Ordinance and the Heating Cost Ordinance. These legislations are also aimed at putting conditions in place to ensure that energy remains affordable for consumers.

To foster climate protection and increase energy efficiency, the Climate Action Programme 2020 and the National Action Plan for Energy Efficiency (NAPE) were adopted by the German government in December 2014. The measures of the NAPE include introducing competitive tendering for energy efficiency projects, increasing the amount of funding available for building refurbishment and introducing federal- and state-funded tax incentives for energy efficiency-improving building renovations. Another measure of the NAPE is the energy-efficiency strategy for buildings (ESG), which has been released at the end of 2015.

Germany is currently working on an electricity market reform towards the so called electricity market 2.0. The electricity market reform will be implemented to adapt the energy system to higher renewable energy shares and to guarantee energy supply security at the lowest possible cost. Additionally, in 2014 amendments to the Renewable Energy Sources Act (EEG) brought four essential changes to Germany’s electricity market:

1) So called corridors, setting upper limits for the expansion of electricity generation capacities of renewable energies, have been defined to better forecast and monitor the future development of renewable energy.
2) To limit promotion costs for further renewable energy capacity expansions, priority was given to wind and solar energy capacity expansion, since they are considered low-cost renewable energy technologies.

3) Through mandatory direct selling of renewable energy electricity from plants with capacities of more than 100 kW, renewable energy electricity is aimed toward a better integration into the electricity market. This implies that operators of large plants are responsible for forecasting demand and have to sell their electricity directly in the electricity market.
4) Partial extension of the renewable energy surcharge to electricity produced and self-consumed. At the same time, changes to the special compensation arrangements for businesses shall ensure that electricity-intensive industries will continue to be able to produce competitively.

In order to ensure security of energy supply, capacity reserves are going to be established in Germany. Several lignite power station units will be shifted into a capacity reserve and then closed down after four years. At the same time this will add to the reduction in greenhouse gas emissions, for which Germany is not only focusing on the electricity sector, but also on the heat sector. A reform of the CHP Act in late 2015 states that cogeneration of heat and power will contribute to significant CO_2 reductions, which will mainly result from substituting existing coal-fired CHP installations with gas-fired CHP and from a moderate funding for new CHP installations. More emission reductions will be attained via the implementation of energy efficiency measures in the building sector, in municipalities, in industries and the railway sector.

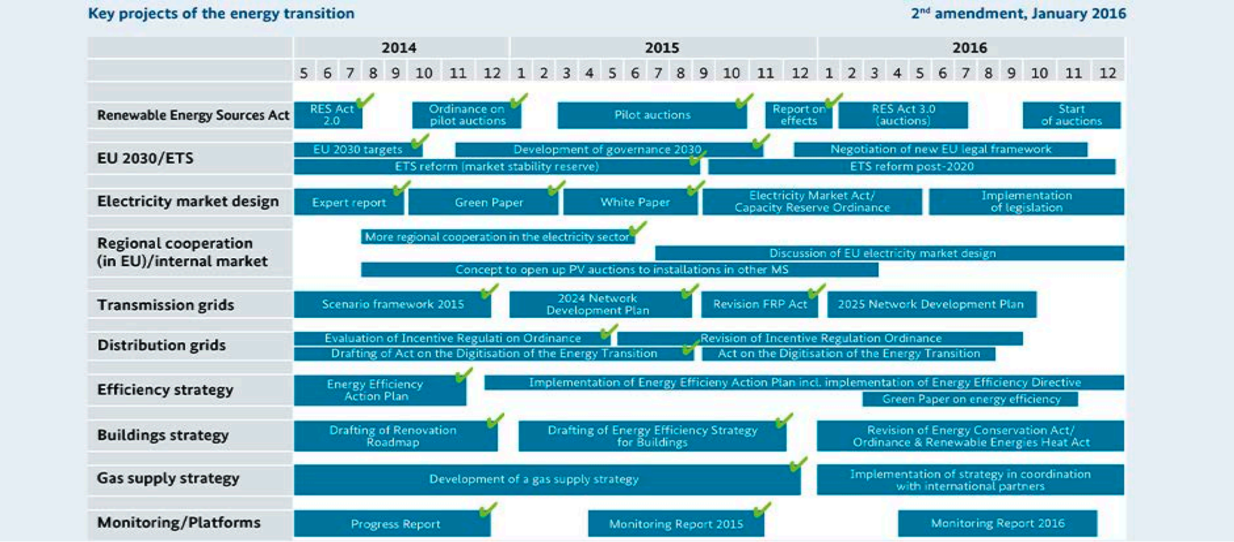
Challenges and outlook

The EEG has stimulated Germany's renewable energy development for more than ten years. The country is now looking at integrating a rising share of renewable energies into its electricity grid, but also at the economic and technical integration of its energy markets. The entire power system needs to become more flexible and integrate demand side management solutions, storage solutions and flexible thermal power plants. In terms of grid expansion, Germany is currently investing in the installation of underground cables (as opposed to overhead powerlines) to be able to transport renewable electricity generated in the northern part of the country to the power demand centres in the south of Germany. When looking at energy efficiency, the "Energy of the Future" (*Fig. 21*) progress report states that Germany will not be able to reach its 2020 target of reducing primary energy consumption by 20% if no further measures will be implemented. Thus, increasing energy efficiency is a major challenge in Germany. To ensure the realisation of Germany's energy transition the government has set a clear timetable.

Future tasks in 2016 are:

- Foster climate protection: ETS Reform post-2020 (EU carbon-trade)
- Increase Energy Efficiency / Renewable Heat: Energy Saving Ordinance / Renewable Energies Heat Act 2016
- Grid Expansion: Network Development planning until 2025
- EU: Economical and technical integration of energy markets: market-coupling, gas-market strategy and also the legal framework in perspective of 2030.

Fig. 21: Energy of the future: An overall strategy for the energy transition (BMWi 2016)



4.4. Case Study Kazakhstan

Macroeconomic background

Kazakhstan, which is rich in oil and gas resources, is the world's ninth largest country. Even though Kazakhstan is rich in fossil fuel resources, it is still struggling to meet electricity demand in certain regions due to a lack of power stations and missing grid infrastructure. The South of Kazakhstan is especially dependent on electricity imports from Kyrgyzstan and Russia. In 2014, the country generated 93.9 TWh of electricity and had to import 0.64 TWh. In the same year electricity consumption amounted to 91.6 TWh (including transmission losses). Furthermore, Kazakhstan exports energy due to supply and demand fluctuations, as well as a lack of modern-day national boundaries of the Soviet-era grid.

Most of Kazakhstan's heat supply is generated through combined heat and power plants (CHP). Altogether there are 40 CHP plants in the country, with 80% of the heat supply being based on coal. Kazakhstan's heat network is 12,000 km long, of which almost 30% urgently needs modernisation. Currently, transmission losses in the heat network reach almost 40%. Not only the network, but also the CHP plants themselves need to be modernised. They are operating 17.1 GW below their potential capacity due to wear, tear and abrasion.

Kazakhstan is a member of the Energy Charter, a regional treaty which originated in the Soviet Union and Eastern Europe in the 1990's, covering commercial energy activities between members including trade, transit, energy efficiency and investments. Furthermore, Kazakhstan is a member of INOGATE, the Interstate Oil and Gas Transportation to Europe programme.

Kazakhstan has a huge natural potential for the deployment of renewable energies. However, its renewable energy sector is still very small. As of mid 2015, Kazakhstan had a total installed renewable energy capacity of 227 MW, excluding LHP. PV and wind energy contributed respectively 55 GW and 53 GW and small hydropower plants made up the remaining 119 MW.

Key pillars and important steps

In June 2013, Kazakhstan published a presidential edict “On the Concept of the Transition of the Republic of Kazakhstan to a Green Economy”. The aim is to develop a “green economy”, which entails a substantial change in the country’s economy. The country’s economic wealth and the people’s living standard should be raised while minimising negative impacts on the environment and on natural resources. In this edict, a renewable energy target of a 3% share of solar and wind energy in energy production by 2020 has been set. This share increases to 30% in 2030 and 50% in 2050. The edict is based on the 2009 “Law on Promoting the Use of RES” and includes some important amendments. In order to reach the set renewable energy targets, Kazakhstan introduced a guaranteed feed-in tariff valid for 15 years of generation and supply of renewable energy electricity. Furthermore, renewable energy producers are exempt from paying for the transmission of the electricity they produce and grid operators (electricity as well as heat) have to offtake any renewable energy generated. Feed-in tariffs have been set at 22.68 KZT/kWh (ca. 0.07 €/kWh) for wind energy, 34.61 KZT/kWh (ca. 0.11 €/kWh) for PV, 16.71 KZT/kWh (ca. 0.05 €/kWh) for small hydro power and 32.23 KZT/kWh (ca. 0.10 €/kWh) for biogas.

In order to promote small scale off-grid renewable energy applications, the government has set up a financial support programme that covers 50% of the installation costs for renewable energy systems smaller than 5 kWh. Furthermore, Kazakhstan wants to establish an in-state renewable energy and aims at setting up a full PV supply chain by 2028.

Challenges and outlook

In August 2014, Kazakhstan restructured its ministries and set up a new Energy Ministry, which is in charge of implementing the renewable energy strategy. However, with a current renewable energy share of only 0.62%, excluding LHP, renewables are still facing several obstacles in Kazakhstan. Due to the absence of renewable energy projects and lack of experience in implementing them, as well as missing reliable data on the given natural potential, there is a substantial deficit in know-how and information among businesses and the population. The lack of pilot projects, know-how and information in turn, poses challenges to achieve social acceptance and the uptake of further renewable energy projects.

The missing information, project implementation experience and bankability of renewable energy projects, as well as the uncertainty in the long-term development of tariffs leads to additional difficulties, particularly in financing renewable energy projects. Furthermore, there are no technical norms or quality control systems for the use of renewable energy.

With the “Green Bridge” Partnership Programme and in view of EXPO 2017 “Future Energy”, Kazakhstan has set a first important step towards the uptake of renewable energies. However, due to a lack of information, know-how on renewable energy deployment and the missing institutional stability, the goal of reaching 30% renewables by 2030 remains ambitious.

4.5. Case Study Turkey

Macroeconomic background

Turkey is the 17th largest economy in the world and the 6th largest in Europe. The country's fast growing economy and population is leading to increased energy consumption, while at the same time fossil power generation is stagnating. Turkey is heavily dependant on imported fossil resources, which has placed the topic of a secure energy supply at the top of the government's agenda. In order to reduce its level of energy dependency, Turkey is now looking at promoting alternative energy solutions and developing sustainable energy models.

In 2013, 71% of Turkey's power generation was based on fossil fuels, 25% on hydro power and 4% on other renewable energy sources. By 2023, the government plans to meet 30% of the country's electricity needs, as well as 10% of the requirements for the transportation sector, using renewable energy sources.

Out of renewable energies, Turkey currently mainly uses hydroelectric power followed by biomass, which is used for heat generation. Geothermal, wind and solar energy have played marginal roles so far. However, with its Renewable Energy Action Plan the Turkish government has initiated a forward-looking energy policy to increase the share of renewable energies to meet rising energy demands and support high economic growth rates.

Turkey's total primary energy consumption in 2012 was 1,346 TWh, of which electricity consumption accounted for 195 TWh. In 2012, Turkey generated in total 228 TWh of electricity. In-state electricity generation exceeds national electricity consumption. However, due to grid losses no electricity is exported. Turkey is among the countries with the highest energy intensity in Europe. The share of renewable energy in the total electricity generated in Turkey was 4% in 2013. The largest share came from hydropower with 85%, followed by wind energy with 10% and geothermal with 1%. PV and other sources are still playing a minor role in Turkey's electricity generation.

Turkey is among the global top five countries in terms of renewable heat generation from geothermal sources. In 2014, Turkey added an estimated 107 MW of geothermal generating capacity and is using 20.6 TWh of geothermal heat. With an installed capacity of 224 MW in 2014, biomass is playing an important role in Turkey's heat generation. Biogas is currently not part of the country's renewable energy plan.

At the end of 2015, Turkey had about 4.7 GW of wind energy capacity installed. Installed PV capacity amounted to 248 MW, which is still an insignificant share of gross electricity generation.

Key pillars and important steps

With the assistance of the EBRD, Turkey's Ministry of Energy and Natural Resources has developed a set of renewable energy targets in its Renewable Energy Action Plan. The objective is to bring Turkey's energy strategy in line with the European Union's 2009 Renewables Directive. For 2023, the following renewable energy capacity targets for electricity generation (Fig. 22) have been set.

Fig. 22: Turkey's renewable energy capacity targets for 2023

Renewable energy technology	**Target 2023:** *Installed capacity (GW)*	**Status quo 2014:** *Installed capacity (GW)*
Hydro	34	23.6
Wind	20	3.8
Geothermal	1	0.4
PV	5	0.06
Biomass	1	0.2

By 2023, renewable energy is expected to generate approximately 159 TWh. The target for energy from renewables in gross final energy consumption in 2023 is 20%.
The Turkish Renewable Energy Action Plan is based on several strategic energy guidelines provided by different ministries:

- Electricity Energy Market and Security of Supply Paper
- Climate Change Action Plan 2011-2033
- Energy Efficiency Strategy Paper 2012-2023
- The Republic of Turkey Ministry of Energy and Natural Resources Strategic Plan 2010-2014

Turkey's first law concerning renewable energy was passed in 2005, the "Law on Utilization of Renewable Energy Sources for the Purpose of Generating Electrical Energy" (Renewables Energy Law, REL, Law No. 5346). However, investment and deployment of renewable energy remained limited due to a lack of secondary legislation and relatively low feed-in tariffs. In a next step in 2010, the Renewable Energy Law amendment introduced higher feed-in tariffs and other monetary and non-monetary incentives. This led to an increase in renewable energy uptake and attracted both local and international investors.

According to a new regulation which came into force at the end of 2013, unlicensed PV systems producing up to 1 MW of electricity are entitled to sell surplus electricity to the grid at the prices according to the regular feed-in tariff (net-metering / net-billing). This surplus energy is purchased by supplier companies for 10 years.

Since 2012, Turkey has put various investment incentives in place including, among others, VAT exemptions, customs duty exemption, tax deduction and land allocation. The different incentive plans, depending on the actions undertaken, can be applied to renewable energy facilities, R&D initiatives, development of equipment and the manufacturing of component parts for renewable energy plants.

The feed-in tariff is applicable for 10 years. Each year the investor can choose between the feed-in tariff and direct sales in the power market. Additionally, an incentive to promote the use of local equipment has been introduced. Operators of renewable energy plants can obtain higher remunerations as well as the feed-in tariff, if their plant uses electrical and mechanical equipment that was entirely or partly produced in Turkey.

Private sector actors are driving renewable energy deployment forward in Turkey as well. The proportion of private electricity generated has grown substantially, from 10% in 1996 to 62% in 2013. This was due to the creation of a legal framework for private sector electricity generation, initially on the basis of BO (Build-Operate), BOT (Build-Operate-Transfer) and TOR (Transfer of Operational Rights) models. Independent Power Producer (IPP) models were subsequently introduced. Private sector interest has been motivated by the guaranteed purchase of electricity. An additional incentive has been set for operators of renewable energy plants under 1 MWp. These operators do not need an operator’s licence and also do not have to register as a business. However, operators must lodge an informal application with the local grid operator, submit documents and specify the plant’s site.

Renewable energy plants over 1 MWp, in particular solar PV, are subject to a competitive process, which is decided by means of tendering. Since 2013, Turkey has held several tendering rounds for 600 MW of solar PV.

Challenges and outlook

In January 2015, Turkey has released the 2015-2019 Strategic Plan which is the second step in reaching the national energy target of 30% by 2030. Turkey aims even more at fostering private sector investment by increasing the number of renewable energy licensed projects and increasing electricity grid connections for wind power plants. Renewable energy zones are stated in the plan and financial support for innovation and technology research in the field of renewable energies are presented. However, in order to guarantee grid access and to allow for increasing volumes of renewable energies, in particular wind energy, to be efficiently and smoothly integrated into Turkey’s grid, more technical and administrative measures are needed. Furthermore, the level and structure of feed-in tariffs as well as financing models are currently being assessed to identify factors that are slowing down the implementation of renewable energies.

4.6. Case Study California, USA

Macroeconomic background

The United States of America (USA) is the country with the second highest energy consumption in the world. In recent years the country has also become the world’s leading producer of oil and gas, reducing its dependency on foreign oil and gas. The US electricity consumption has been consistent over the last ten years and has even slightly declined due to changes in the economic structure and implemented policies to promote energy efficiency. The national composition of energy supply is shifting from mainly petroleum and coal towards increasing charges of natural gas and renewable energies. However, with 90% in 2014 the vast majority of the US primary energy production was still based on fossil fuels.

The development of renewable energies varies strongly across the United States. This is due to the different levels of policy making in the country. There are federal policies regulating the deployment and support of renewable energies. However, much of the energy supply in the US is coordinated on a state and regional level. Therefore policies on the state, regional and even local level have a strong impact on the national development as well. On the federal level the production tax credit (PTC) and investment tax credit (ITC) are the two main financial instruments and support systems for renewable energy in the power sector. On the state level, the Renewable Portfolio Standard (RPS) is one of the main support systems. One of the states that has been at the forefront of supporting renewable energies is California.

California is the largest economy in the US and the world's eight largest. The state accounts for almost 8% of the national electricity demand. By having set ambitious renewable energy targets, California is by now one of the leading states in the US in terms of renewable energy capacity. In 2013, 19% of California's electricity was generated by renewable energies. The biggest share in fossil fuel power generation was natural gas with 60%. As of October 2015, California had an in-state renewable energy operating capacity of 31.7 GW (see *Fig. 23*). The majority of the installed renewable electricity capacity comes from LHP with 10 GW, PV with 8.7 GW and wind energy with 6 GW.

Fig. 23: Renewable energy capacities in California

Renewable energy technology	Installed capacity (GW)
Large hydropower	10
Solar PV	8.7
Wind	6
Geothermal	2.7
Small hydro	1.6
Biomass	1.4
Solar thermal	1.3

Key pillars and important steps

California is one of the states in the US with the highest renewable energy targets set in their RPS. California's RPS initially started in 2002 with a target of 20% of the retail sales of electric utilities coming from renewable sources. This target was later increased to 50% of retail sales from renewables by 2030. In addition to these renewable energy targets California has also passed a mandate to its three investor-owned utilities to collectively procure 1,325 MW of energy storage by 2020. Each utility's share must include a certain amount of storage at the transmission and distribution level and a certain amount must be customer-sited.

California has seen a big increase in the share of renewables energies due to its various renewable energy policies that have been in place since the 1990s. Apart from the RPS, California has a set of various renewable energy policies in place. In 1996, California established a net-metering law, which has been amended several times since. The net-metering scheme applies to all utilities and includes solar-electric systems, wind energy, biogas and biomass. There is a cap of 1 MW for most systems and up to 5 MW for university or local government systems. Net-metering also includes net excess generation, which is credited to consumer's next electricity bill at retail rates. Furthermore, virtual net-metering is allowed for multi-tenant properties. Other state incentives in California include the self-generation incentive programme, which also applies to energy storage. Within this programme wind, waste heat, energy storage, biogas, CHP and fuel cell systems receive rebates based on the system size.

California also used to have a feed-in tariff which was replaced by the Renewable Market Adjustment Tariff (ReMAT) in 2013. Other state initiatives include the California Solar Initiative (CSI), New Solar Homes Partnership (NSHP) and the California FIRST PACE Financing where property owners are allowed to finance the installation of energy and water improvements on their buildings and pay the amount back through property taxes.

Challenges and outlook

The newly adopted RPS target of 50% of retail sales from renewables by 2030 is part of the SB 350 climate bill that promotes greater deployment of renewable energy technologies up to 2030 and an increase in energy efficiency in buildings. In 2011, California's new Governor set clean energy goals as part of a plan to rebuild the state's economy. He set the overall goal of adding 20 GW of renewable energy generation by 2020. This should include 8 GW of large-scale renewables (meaning > 20 MW) and 12 GW of distributed generation. California furthermore has a target of 3 GW of self-generation solar systems.

The United States in general, and also California, is facing the challenge of integrating large amounts of renewable energies into a grid infrastructure that is in need of expansion and modernisation. Storage is therefore playing a vital part in California's future renewable energy plans and the state has taken some first policy steps to increase storage capacity (energy storage mandate). Another challenge is that policy making and implementation in the US takes place at several levels: federal, state, regional and local including different agencies. In order to keep the share of renewable energies increasing, policies must be consistent, predictable and long-term on all three levels.

4.7. Conclusion

Examples of experiences in promoting renewable energies can help to identify a wide range of possible courses of action. Looking at the six country case studies from different UNECE member States shows that there is no blueprint for an ideal set of renewable energy policy options that will guarantee a strong increase in renewable energy deployment. The examples of the six case studies show that each analysed UNECE country has a different set of policies in place in order to increase the uptake of renewable energies and drive their deployment forward.

In the case studies of national energy markets having low renewable energy deployment rates, like Kazakhstan, or markets with virtually no renewable energy capacity other than hydropower, like Albania, feed-in tariffs have been identified as main renewable energy support scheme. Within the four case studies, which analyse the more established or diverse national renewable energy markets in France, Germany, Turkey and California/USA, more complex renewable energy promoting policies have been found. Here a general trend of policy objectives, evolving from mere renewable energy expansion to the aim of achieving a cost-efficient and market based renewable energy deployment, has been identified. In these established or diverse renewable energy markets it is crucial to follow holistic policy approaches to support the uptake of renewable energies, considering also particularly the energy system infrastructure and technical integration of high shares of fluctuating energy supply.

Defining and implementing renewable energy policies in any given country is a continuous process that is influenced by the energy market, as well as regional and political factors. The analysis of case studies suggests that it is vital to create a stable political, legal and financial framework and to have a clear commitment towards the expansion of renewable energies in order to ensure their uptake. Another important prerequisite determining which policies are being implemented is the national energy market structure. The level of market liberalisation, state regulation, installed capacity and expansion targets of renewable energies and also particularly the share of installed capacity of highly fluctuating renewable energy sources, such as wind and PV, influence the set and effectiveness of policies applied in each country.

5. Policy options to promote renewable energies

In view of the UNECE GERE objective of promoting the uptake of renewable energies, improving the access to affordable energy sources and increasing energy efficiency, this report analyses the status and perspectives for renewable energy development in the UNECE region. Within this scope, first, the given background of renewable energy deployment has been outlined, identifying key dimensions and factors, the emergence of global trends and fields of application. Second, the current status quo of renewable energy deployment and the corresponding growth of renewable energy markets in the UNECE have been examined. Furthermore, all major promotion schemes have been described and the status of their implementation in the UNECE electricity and heat sector has been determined for each member state. Eventually six exemplary case studies of renewable energy policies and deployment in UNECE member States have been presented, identifying possible courses of action and evaluating gathered experience in order to draw conclusions on major market entry barriers, opportunities and best practice for renewable energy development in the UNECE region.

5.1. Conclusion and lessons learned

When looking at the development of international renewable energy deployment, there is a clear emergence of some distinct global trends. In the early stages of global renewable energy deployment, the promotion of renewable energies has taken place especially in developed and emerging UNECE countries. In the course of time, investment costs for renewable energy technologies have dropped and transnational technology transfer as well as the international dissemination of renewable energy policy goals have increased, which led to an increase in the uptake of renewable energies particularly in developing UNECE countries. In established renewable energy markets, policies aiming initially at mere renewable energy expansion have evolved into policies pursuing a cost-efficient and steered renewable energy deployment. Also, the complexity of promotion schemes and the need to adapt energy system infrastructures to the highly fluctuating and decentralised feed in of renewable energies have increased. Further, the regulatory integration of renewable energy auto-producers and newly evolving business models has gained importance. On the macroeconomic level, the monitoring of the influence of renewable energy deployment on pricing mechanisms, such as on the level of electricity and energy prices or CO_2 prices within emission trading schemes, has become a crucial aspect.

Analysing the status quo of renewable energy deployment in the UNECE region, the report has revealed that the uptake of renewable energies has already progressed well, although major differences considering the stage of renewable energy expansion have been recognised between the individual UNECE member States (see chapter 2, referring to shares of total generation capacity). With an installed renewable energy electricity capacity of 863 GW, the UNECE region accounts for almost half of the 1829 GW worldwide installed renewable energy electricity capacity. Hydro energy has been identified as the most established renewable energy technology for electricity generation, making up 485 GW (379 GW corresponding to large hydro plants) of total renewable energy electricity capacity. Electricity capacities from renewable energy sources have grown substantially in the UNECE region since 2000, which is largely due to the rapid expansion of wind energy and PV, showing high growth rates in several UNECE countries such as Ukraine and Finland (wind energy), Romania and Denmark (PV). Although wind energy and PV markets are the most dynamic growing renewable energy electricity markets in the UNECE region, with a compound annual growth rate of respectively 12% and 24% between 2011 and 2014, they represent only the second and third largest renewable energy electricity markets with installed capacities of respectively 209 GW and 109 GW.

The level of electricity prices has been highlighted as a crucial factor in the transition of energy markets with increasing renewable energy shares, since electricity prices have a major influence on social acceptance for renewable energy deployment. Electricity prices are considered a deciding competitive factor for energy-intensive industries and do strongly affect the economic viability of renewable energy technologies, as well as the effectiveness of renewable energy promotion schemes. UNECE member States with particular low electricity prices might constitute a difficult terrain for the uptake of renewable energies, since low electricity market prices hamper the economic viability of renewable energy technologies, especially when strongly competing with conventional energy sources. Additionally, it might prove difficult to implement effective energy efficiency promotion schemes, since low electricity prices reduce energy saving incentives. Therefore, a thorough consideration and monitoring of electricity price formation is necessary for the successful uptake of renewable energies.

Against this background UNECE electricity prices have been determined and split into shares of electricity generation and network costs and into shares of taxes and levies for each UNECE Member State. The comparison of UNECE electricity prices has shown that the level of electricity prices and the included shares of taxes and levies vary noticeably within the UNECE region. A significant correlation between the level of electricity prices and GDP per capita has been observed in both the private and the industry sector. However, the analysis reveals a smaller divergence between electricity prices of OECD and non-OECD countries[17] in the industry sector compared to the private sector. On average, OECD industrial electricity prices are 25% higher than non-OECD industrial electricity prices, while in the private sector OECD electricity prices are 71% higher than non-OECD electricity prices. The recognised stronger similarity of electricity prices in the industrial sector can be explained by industrial electricity price subsidies, which are granted mainly in OECD countries to inhibit local competitive disadvantages arising from high electricity prices.

The report finds that the large majority of UNECE member States have already adopted renewable energy promotion schemes, 51 member states in the electricity sector and 43 member states in the heat sector. In the electricity sector the most widely established types of renewable energy promotion schemes are feed-in tariffs or premiums, tax reductions and investment incentives, with each of these types of policy instruments being implemented in more than 40 UNECE member States. Promotion schemes in the heat sector are most widely used to encourage heat generation from solar thermal energy, followed by geothermal energy and energy from biogas or biomass. In the building sector renewable energy promotion schemes are implemented by half of the UNECE countries, while another eleven UNECE member States are currently developing renewable energy promotion schemes or measures. So far, the electricity sector has received greater political emphasis as field of application of renewable energies than

[17] The analysis comprises only OECD and non-OECD countries of the UNECE Region.

the heat sector. It is important to note that adopted renewable energy promotion schemes do not automatically translate into a substantial expansion of renewable energies in the respective country, as can be seen from the analysed renewable energy market development in the UNECE member States (see chapter 2). There is a high amount of adopted promotion schemes in the region, but ultimately, the uptake of renewable energies largely depends on market access and the effective implementation of promotion schemes rather than their sheer existence.

The six presented case studies have revealed that there is no blueprint for an ideal set of renewable energy policy options that will guarantee a strong expansion and integration of renewable energies. Countries with high renewable energy deployment rates have used different policy sets to increase the uptake of renewable energies and drive their deployment forward. In the case studies of the national energy markets of Kazakhstan and Albania, UNECE member States which have low renewable energy rates or no renewable energy capacity other than hydropower, feed-in tariffs have been identified as the main renewable energy promotion scheme. By contrast, in national energy markets with higher or more diverse renewable energy shares, in the other four analysed UNECE countries (France, Germany, Turkey, California/USA) a general trend of renewable energy promoting policies becoming more complex has been observed. Further, it has been recognised that the primary policy objectives in these four countries have evolved from merely establishing and expanding renewable energy markets to achieving marked-based and cost-efficient renewable energy deployment. The energy transition is understood as a process where new developments have to be analysed and addressed through the introduction of new policy instruments or amendments of existing frameworks.

In all six case studies the particular need for improving or adapting the prevailing power system infrastructure has been recognised. The analysis of the case studies suggests that the choice and best applicability of policy instruments depends on the particular structural characteristics of national energy markets, such as the degree of state regulation in the energy market, the extent of installed capacity and expansion targets of renewable energies, the share of installed capacity of highly fluctuating renewable energy sources, such as wind energy and PV, which require extended grid balancing mechanisms and market expansion control, and the administrative capacities for implementing certain renewable energy promotion schemes.

5.2. Policy Toolbox

Based on the obtained report results, a toolbox for policy makers has been developed, which is presented in *Fig. 24*. The toolbox provides an overview of the impact dimension and description of all major renewable energy promotion schemes and measures, their particular strengths and primary outputs as well as examples of UNECE and Non-UNECE countries, which have shown good practice when implementing their respective promotion scheme or measure. Policy makers can consider elements from these toolboxes as basis for decision-making processes within the framework of promotion scheme implementations. Good practice examples are especially useful as reference sources in case policy makers need more detailed information about the implementing process of particular promotion schemes. However, this toolbox does not provide a template for decision-making or on how to develop or implement policies. Further information is ultimately needed to inform decision-makers in their renewable energy policy making.

Fig. 24: Policy toolbox: Political and regulatory promotion schemes and measures.

Promotion schemes and measures	Impact dimension	Description	Strengths / primary output	Good practice
Official targets for renewable energies	Political	Definition and official communication of (technology-specific) binding or non-binding expansion goals.	Planning security	**EU member States, USA (state level)**
Market / grid access	Political / Regulatory	Guaranteed grid access for independent power producers or autoproducers possibly restricted by capacity limits.	Market integration	**Chile**
Net Metering / Net Billing	Political / Regulatory	Billing mechanisms, in which renewable electricity generating entities are credited for the net value between their supplied electricity fed into the grid and their demanded electricity. Produced electricity surpluses can be remunerated as electricity credit counting towards future electricity demand (net metering) or as direct financial compensation at an agreed rate or tariff (net billing).	Market integration	**Australia, USA (state level), Turkey**
Priority feed-in and feed-in tariff or premium	Political / Regulatory	Priority feed-in prescribes the mandatory purchase of renewable energy electricity by utilities. Feed-in tariffs or premiums grant long term stable remuneration for the feed-in of renewable energy electricity, either via fixed tariffs (feed-in tariffs) or at electricity market prices topped up by a adjusting market premium (feed-in premium).	Financial support, market integration, investment and planning security, investor diversity	**Germany, Italy**
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 generated and supplied renewable energy electricity.	Market integration	**Sweden, Norway**
Quota system	Political / Regulatory	Obligatory renewable energy share of energy electricity supply or demand, mandated from utilities.	Financial support, market integration, expansion control, cost effectiveness, promotion of innovation	**USA (state level), India (state level)**
Auctions	Political / Regulatory	Public bidding process, which awards long term electricity purchase contracts for an agreed amount of produced renewable electricity or for the electricity output from a certain auctioned quantity of renewable electricity capacity. Long-term contracts are awarded exclusively according to price-based criteria.	Financial support, investment security, market integration, expansion control, cost effectiveness, promotion of innovation	**Brazil, Uruguay, India**
Tender	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	Obliged minimum share of energy demand for heating from renewable energy sources or CHP plants demanded from building owners.	Financial support, market integration, expansion control.	**Denmark, Germany**
Further investment incentives	Political / Regulatory	Investment subsidies, credit grants, reduced rates of interest, tax credits or exemptions, governmental R&D expenditures etc.	Financial support, promotion of innovation	**USA (federal and state level), Germany, France**

The following table gives an overview of mayor fields of actions and measures which commonly are not directly linked to policies promoting renewable energies, but also play a crucial role for their further development.

Fig. 25: Further fields of action and measures

Fields of action and measures	Primary dimension	Description	Strengths / primary output	Lessons learned (good practice)
Renewable energy system integration	Technical	National: Renewable energies are integrated into the energy system by expanding grid capacities and increasing the flexibility of the power system. A flexible power system can be achieved by replacing 'must-run' capacity by flexible power plants, expanding load management, demand side management and storage capacity and by developing local supply concepts	Grid balancing, electricity supply security	**California (obligation for utilities)**
	Political / Regulatory, Technical	International: Internationally the flexibility of the power system can be further increased by cross-border technical and economic integration of electricity markets, referred to as market coupling.		**EU**
Public educational work	Social	Measures to raise public knowledge and awareness about renewable energy deployment	Public knowledge and awareness about RE	**IRENA**
Public participation	Political / Regulatory, Social	Public participation can be increased by including relevant stakeholders and introducing new business models	Social acceptance	**Denmark**
Research and development	Political, Economic	Research and development can be promoted by financial support but also by creating a favourable institutional framework e.g. via a patent system	Innovation, technology transfer	**USA**

5.3. Recommendations and fields of action for the UNECE GERE

This report supports the achievement of the long-term objectives and the implementation of the current work plan of the UNECE GERE in several ways. Firstly, it supports the Group of Experts in monitoring the process of renewable energy development, both at the implementation level, by examining the status quo of renewable energy expansion, and at the policy level, by identifying the extent of adopted renewable energy promotion schemes in UNECE member States. In addition, the study helps to identify possible fields of action for renewable energy deployment, which in turn serves as the basis for regulatory and policy dialogues on the development and implementation of new or further targeted renewable energy promotion measures.

Based on the analysis of the state of renewable energy deployment and existing promotion policies and schemes, supported by the evidence of the six exemplary case studies, the report finds that the successful uptake of renewable energies in the UNECE region requires targeted implementation, steering and monitoring of renewable energy promotion schemes, the adaption of infrastructure and related pricing mechanisms. The particular design and coordination of promotion schemes is thereby vital. When implementing promotion schemes, all key dimensions and factors need to be considered to reduce or better avoid mutual obstructions of different policy objectives or energy market characteristics. Renewable energy promotion schemes have to be constant and stable in the long term. When promoting specific renewable energy technologies, the corresponding fields of application of the specific renewable energy source should be considered to identify the systemic requirements with regard to the energy system infrastructure and promotion mechanisms.

Renewable energy needs to be considered not in isolation but within the context of future energy systems. An integrated and holistic policy approach is needed to be effective in responding to the challenges recognised as fundamental at a global level, in particular to be able to meet the Sustainable Development Goals, not only the one on energy (SDG7) and its target to “by 2030, increase substantially the share of renewable energy in the global energy mix”, and allow countries to meet their climate change obligation of keeping global warming "well below 2 degrees”. This is the only way to reduce the gap between aspiration and reality.

Considering the required steering and monitoring of renewable energy deployment, especially the continuous adaptation of national energy system, infrastructures to the system integration of renewable energies and the early consideration of infrastructural aspects within energy system transition plans have been identified as particular challenges. Besides, the steering and monitoring of pricing mechanisms, which are linked to renewable energy deployment, such as national electricity and energy pricing, need to be put more into focus. The steering and monitoring of renewable energy promotion schemes is also considered crucial in evaluating the effects of introduced policy measures.

As particular policy gaps, the report identifies a lack of renewable energy promotion schemes in the heat sector, especially in the building sector.

Until today, main activities of the Group of Experts focused on showing the status quo of renewable energy deployment as well as existing policy frameworks. Now a broad data basis is available with the work done by GERE, including for countries of South-East Europe, Central Asia, the Caucasus and the Russian Federation.

As electricity has been relevant for most GERE activities so far, more emphasis should be put on the deployment of sustainable heat markets. The Group of Experts could support activities which highlight policy options and measures to increase the share of renewable energies in UNECE heat markets.

In order to move towards practical solutions, the following four steps could be implemented to identify and address the specific barriers and challenges of renewable energy deployment in all UNECE member States:

1. As a first step, GERE could cluster UNECE member States according to their main barriers and potential future challenges, which allows a targeted approach to increase the share of renewable energies.

2. Based on the created clusters, GERE could establish barrier-specific working groups, which focus their activities on finding solutions for the respective barrier or challenge.

3. Within the work of the barrier-specific working groups twinning partnerships could be set up between UNECE member States facing a particular challenge within their deployment of renewable energies and UNECE member States with more experienced renewable energy markets which have already overcome this specific barrier (e.g. finding instruments to finance renewable energy deployment, public acceptance etc.). Based on this approach of interchanging experience, possible solutions and best practices can be identified more purposefully.

4. Furthermore, a web based platform, which allows building a collection of relevant case studies, exchanging best practice examples, sharing knowledge and ultimately helping to create a portfolio of new project ideas, could be set up as a tool of knowledge management.

It is expected that in the longer run, improved capacities will allow countries to establish more ambitious targets and policies and to develop investment opportunities. These activities could contribute to the development of a suitable market environment under which a portfolio of specific project opportunities can be implemented. A more structured follow-up work could be envisaged by strengthening the role of the UNECE as an intergovernmental and regional platform. The launch of a sub-regional Centre of Excellence on Renewable Energy, if possible during the 8th Forum in Astana, could be a meaningful measure to facilitate the promotion of renewable energy and foster the exchange of technologies and policies.

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