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Tracking progress and exchange of experiences on how to increase the uptake of renewable energy

Perspectives for renewable energy in the ECE region

Note by the secretariat

Summary

The United Nations Economic Commission for Europe (ECE) Group of Experts on Renewable Energy (GERE) is mandated to focus on activities directed toward the achievement of the energy related Sustainable Development Goal - SDG7, including substantially increasing the share of renewable energy in the global energy mix.

The ECE region has great potential for renewable energy deployment. It comprises member States with well-established renewable energy markets including sound market environments and well-developed infrastructure for deploying renewable energy. These countries can serve as examples for the other countries in the region with unexploited renewable energy markets. However, many countries face challenges to uptake renewable energy. These challenges include inadequate legal and regulatory frameworks, price distortion due to energy subsidies, a lack of energy market liberalisation, absence of public acceptance and/or low awareness and capacities about the potentials and application of renewable energy resources.

This paper is an abstract of a report prepared by dena, the German Energy Agency, entitled "Status and perspectives for renewable energy development in the ECE region." In addition to the review and analysis, the report uses experience from renewable energy market development in three ECE countries and the results of two discussions held with regional energy experts during COP23 in November 2017. It concludes that, besides the existence of strategic targets and accompanying policies, the actual form of policy implementation is crucial to successfully fostering renewable energy use in the electricity and heating sectors.

I. Overview

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

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

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

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

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

6. This report aims to support the market uptake of renewable energy by demonstrating its potential and applicability through selected policy instruments for ECE member States. It examines the current situation and challenges to renewable energy deployment across the region. It then presents different policy options for promoting renewable energy, their current state of implementation and their applicability. The report draws from the experience of renewable energy policymaking in several ECE countries, and looks specifically at Ukraine, Georgia and Azerbaijan as case studies.[1]

[1] The full report "Status and Perspectives for Renewable Energy Development in the ECE Region" is available at https://shop.dena.de/fileadmin/denashop/media/Downloads_Dateien/erneuerbare/9251_Status_and_perspectives_for_renewable_energy_development_in_the_UNECE_region.pdf

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

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

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

10. In order to determine the initial situation of an energy market and provide the future trajectory of each renewable energy technology four key factors are taken into consideration: political, economic, technical and social (Annex II). Accordingly, as a result of two expert meetings organised in Germany during the 23rd session of the Conference of the Parties (COP23) to the United Nations Convention on Climate Change (UNFCCC) and Hard Talks organized by the ECE a set of recommendations was made which can be used as an example for further successful policy implementation overall the ECE region.

II. Status Quo of renewable energy deployment and electricity pricing in the ECE region

11. During the last decade, the worldwide expansion of renewable energy has progressed rapidly. In 2016, the installed electricity capacity of renewable energy sources in the ECE region (without pumped storage and mixed plants) amounted to about 869 GW, of which 388 GW came from LHP.[2] The electricity capacity from renewable energy in the ECE region therefore accounted for almost half of the 1,971 GW of renewable electricity capacity installed worldwide. Thus, renewable energy sources for generating electricity (excluding LHP) have developed faster and more dynamically in recent years and have therefore contributed the bulk of newly installed capacities.

12. The report entitled "Global Tracking Framework: ECE Progress in Sustainable Energy" provides insights into the status of renewable energy deployment in the ECE region. It also measures progress made on achieving target 7.2 of SDG 7, which aims to, "By 2030, increase substantially the share of renewable energy in the global energy mix" by providing data on the share of renewable energy in total final energy consumption (TFC). The 2017 report reveals that the ECE region was the only UN region that consistently increased its share of renewable energy in the mix over the tracking period 2012-2014. In addition, growth has recently accelerated. The share of renewable energy in TFC increased from 6% in 1990 to 11% in 2014, with growth happening fastest in South East Europe. The share of modern renewable energy in TFC reached 11%, the second highest globally, as traditional biomass consumption is negligible in the region.

13. Countries in the ECE region differ in terms of the degree to which renewable energy technologies are established and in operation. While some renewable energy sources are used in many countries, others have yet to become popular. Hydropower is the most established source of renewable energy for electricity generation, and is used in both large and small plants. About one third of all ECE countries have well-established hydropower markets.

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

While hydropower is used for electricity generation across the ECE region, it is important to note that markets for wind energy, PV, solar thermal energy, geothermal energy, biogas and biomass exist almost exclusively in ECE countries that belong to the Organization of Economic Cooperation and Development (OECD).

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

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

16. In numerous countries, the modern use of biomass (as opposed to traditional uses such as burning wood at home) and biogas to generate electricity is either already established or new markets have recently begun to emerge. However, bioenergy had the smallest electricity generation capacity of the four technologies in the ECE region: 54 GW in 2016. The sector grew by an annual average of 2.8%, from 47 GW in 2013 to 53 GW in 2016. [3]

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

18. The PV and wind energy markets can be described as "dynamic" renewable energy markets for electricity, since their relative growth is noticeably higher than other renewable energy sources. Analysis of PV deployment in the ECE region shows that the average market growth rate between 2013 and 2016 was high, at 37.1%. However, the share of total electricity generation capacity stayed low, at 3.89%.

[3] IRENA defines bioenergy as "energy derived from organic, non-fossil material of biological origins (biofuels), which can used for the generation of heat or electricity."

19. The average annual growth rate of wind energy between 2013 and 2016 was lower than that of PV, amounting to 14.2%. However, the average ECE market share of total electricity generation capacity in 2014 was higher for wind than PV, reaching almost 8%.

20. Electricity prices are a crucial factor for the deployment of renewable energy. They have a major influence on the economic viability of renewable energy generation and on social acceptance for renewable energy expansion and are a competitive factor for local energy-intensive industries. Electricity prices are composed of electricity generation costs and various taxes and levies. Electricity generation costs from all types of generating plants determine the electricity market price and therefore play a decisive role in the economic viability of renewable energy generation. ECE member States with particularly low electricity prices or subsidised electricity from conventional energy sources present a difficult starting position for the uptake of renewable energy. This makes it even more important that renewable energy promotion schemes are in place. However, running these schemes entails promotion costs, usually redistributed in the form of taxes or levies that increase final consumer electricity prices. This might lead to lower social acceptance for renewable energy deployment. At the same time, high electricity prices mean that local energy-intensive industries might suffer competitive disadvantages and consider shifting their production sites abroad.

21. Hence, in the context of renewable energy deployment, electricity pricing constitutes an important trade-off between implemented renewable energy promotion schemes, social acceptance and the international competitiveness of local industries. Therefore, thorough consideration and monitoring of electricity pricing is necessary for the successful uptake of renewable energy. In terms of electricity prices, large differences exist between ECE member States regarding electricity prices for households and electricity prices for industrial consumers. The average ECE household electricity price is €0.125. The price of household electricity varies throughout the ECE region, with Denmark paying the highest rate at €0.308 and Kyrgyzstan the lowest at €0.010.

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

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

24. An analysis of renewable energy investments in 17 ECE countries, including the Caucasus, Central Asia, the Russian Federation, and South East and Eastern Europe, is provided in the ECE Renewable Energy Status Report 2017, which was produced by REN21 and ECE. The report reveals that despite having a total population of 300 million, the 17 countries received only a fraction – 0.2% – of global investment in renewable energy in 2015. This was down from 0.5% in 2014. Investment in renewable energy in these countries totalled $400 million in 2015, a notable decline from $700 million in 2014.

25. The status quo analysis shows that renewable energy deployment in the ECE region varies considerably across the member States. Electricity capacities from renewable energy sources have grown substantially for more than a decade. While the “dynamic” renewable

energy technologies – wind energy and PV – are expanding a great deal, hydropower and bioenergy markets have had lower growth rates. LHP makes a large contribution to the total installed renewable electricity capacity. Overall, the renewable electricity market is much more developed than the renewable heat sector in the ECE region.

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

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

III. Renewable energy policies in the ECE region

28. The market for renewable electricity generation is rapidly growing in the ECE region. This is strongly linked to the introduction of a wide range of renewable energy promotion schemes and measures in the ECE electricity sector. These major renewable energy promotion schemes and measures in the electricity sector can be broadly categorised into non-financial and financial schemes.

29. Non-financial schemes encourage the deployment of renewable energy by improving the necessary infrastructure so that market entry and integration become easier. Examples of non-financial instruments include officially communicated renewable electricity expansion goals, guaranteed grid access, priority feed-in, net metering and net billing. Guaranteed grid access entitles independent power producers (IPPs) and autoproducers, such as private households and industrial entities, to grid access. Guaranteed grid access for power plants might be limited by a certain minimum or maximum capacity. Priority feed-in schemes build on guaranteed grid access and require utilities to purchase renewable electricity.

30. Net metering and net billing are billing mechanisms, which credit renewable electricity producers for the net value between the electricity they feed into the grid and the electricity they use. Electricity surpluses are remunerated either as credit for future electricity demand (net metering) or as direct financial compensation at an agreed rate or tariff (net billing).

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

market prices in order to help renewable energy compete with conventional energy sources. General financial support instruments include investment subsidies, credit grants, lower interest rates, tax credits or exemptions, and government R&D spending. Schemes to raise electricity prices can be subdivided into price-based, quantity-based or hybrid promotion schemes. FiTs or premiums are price-based promotion schemes because they grant long-term, stable remuneration for generating renewable electricity and feeding it into the grid. The FiT is either remunerated with a fixed tariff or at the electricity market price, which is topped up by a variable market premium.

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

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

34. Out of 52 analysed countries, 45 have official – and to a certain extent technology-specific – renewable energy expansion goals.[4] Thirty-three ECE countries give utilities, IPPs and smaller-scale autoproducers in the industrial and private sector unlimited grid access, while 15 countries restrict guaranteed grid access by capacity limits. Priority feed-in exists in 25 ECE countries.

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

36. In view of the GERE objectives of promoting the uptake of renewable energy, improving access to affordable energy sources and increasing energy efficiency, this report analysed the status of and perspectives for renewable energy development in the ECE region. The background of renewable energy deployment was described, key dimensions and factors were determined as well as global trends and fields of application were examined. The current status of renewable energy deployment and the corresponding growth of renewable energy markets in the ECE region were explored. In addition, all the major promotion schemes and

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

their stage of implementation in the electricity and heat sectors for each member State were describe.

IV. Making the energy transition work: Evidence from successful policy implementation

37. Even if policy measures to foster renewable energy are in place, they do not necessarily and automatically lead to renewable energy investments. Adverse effects and obstacles indirectly linked to the political and regulatory framework of energy markets may have a negative impact on project realisation. The key factors influencing the success of renewable energy policies at the implementation level can be grouped as follows:

(a) Political framework and market regulation;

(b) Infrastructure capacity and technical feasibility;

(c) Economic viability and financing;

(d) Acceptance and awareness raising.

38. Two expert meetings organised in Germany during COP23 in November 2017 focused on the successful implementation of renewable energy policies in the electricity sectors and heating markets of ECE member States. The ECE organizes national renewable energy Hard Talks that are specific multi-stakeholder policy dialogue events in cooperation with host countries, local counterparts and other partners such as the Renewable Energy Policy Network for the 21st Century (REN21), the German Energy Agency (dena) and Revelle Group.

The aim is to:

(a) Investigate barriers that hinder the full unfolding of renewable energy potential in the host country;

(b) Facilitate the exchange between political decision makers, project developers, investors and technology providers and thus between the public and private sector;

(c) Point out prioritised solutions to improve the investment climate for renewable energy and to foster discussion to what the ECE can provide with similar initiatives.

39. In 2016 and 2017, Hard Talks adapted to the specifications and requirements of each host country were held in Georgia, Ukraine, and Azerbaijan. At the heart of the Hard Talk format is the Discussion Paper, a “problem/solution” format document, which facilitates a practical dialogue. The common denominator of the Hard Talk experience is that, despite the many differences in the three host countries, common themes have arisen that prove that the main influencing factors to pave the way for renewable energy uptake are fundamentally identical even if different policy frameworks apply. Moreover, the discussions in all three Hard Talks have proven that the experience and good practices associated with addressing those common, largely identical influencing factors are easily transferable from one country to another. Therein lays the added value of the Hard Talks: mobilizing international experience to address domestic issues.

40. The discussions held and experience gained during the three Hard Talks and two expert meetings show that, besides political targets and accompanying policies, the actual form of policy implementation is crucial to successfully fostering renewable energy use in the electricity and heating sectors. Strategies should also consider the different aspects that might result in the non-realisation of renewable energy projects. To implement policies effectively, policymakers must take account of the various drivers and obstacles discussed in the four key factors previously mentioned.

41. The market conditions for renewable heat appear to be more challenging than those for renewable electricity. This is because of the comparatively high subsidies for gas and oil, and a lack of incentives and subsidies for renewable heat. Building regulations, energy efficiency regulations and different standards for the fuel and the technologies add to the complexity of the renewable heat sector. Furthermore, gas networks directly compete with networks for district heating.

42. Thereby, policymakers should be aware of the specific challenges that renewable energy face in the heating sector. Expert meetings and talks of the kind held in Ukraine, Georgia and Azerbaijan create scope for identifying constraints and sharing examples of good practice in renewable energy development. Multi-stakeholder-based dialogue can help to develop a common view and accelerate the deployment of renewable energy.

43. Based on the obtained report results, a toolbox for policy makers has been developed, which is presented in Annex I. 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 ECE and non-ECE countries, which have shown good practice when implementing their respective promotion scheme or measure. Policy makers can consider elements from these toolboxes as a basis for decision-making processes within the framework of promotion scheme implementations. 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 policymaking.

V. Recommendations for the Group of Experts

44. In recent years, most countries have focused on policy measures aimed at increasing renewable energy capacity in the electricity sector. These policies are important, but further attention must be directed toward the heating sector, as all ECE member States are located in the northern hemisphere. In addition, policies aimed at the cooling sector are needed as consumption is projected to increase. Further, to highlight the need for improvements in the heating/cooling sector the GERE could support activities and highlight policy options and measures including the development of infrastructure and technologies such as district heating networks, waste heat utilisation, and combined heat and power plant (CHP).

45. The heterogeneity of the ECE region facilitates the establishment of country-to-country partnerships within the GERE to discuss different problem-solving approaches. The experience of member States that lead in renewable energy integration can serve as examples for countries looking for advice on potential solutions. As a first step, the GERE could cluster ECE member States according to their main barriers and potential future challenges allowing for a targeted approach to increase the uptake of renewable energy. Based on the created clusters, the GERE could establish specific working groups, which focus their activities on finding solutions for the respective barrier or challenge. Within the work of the barrier-specific working groups partnerships could be set up between ECE member States facing a particular challenge within their deployment of renewable energies and ECE member States with more experienced renewable energy markets which have already overcome this specific barrier. Based on this approach of interchanging experience, possible solutions and good practices can be identified more purposefully. Results should be shared via a web-based platform.

46. This report serves as a policy toolkit, summarizing options shaping positive frameworks for renewable energy development. However, for the successful implementation

of policies directed toward the uptake of renewable energy, factors other than political should be considered including economic viability, existing infrastructure, consumer education and social acceptance. Member States could be supported by the example of selected countries to develop individual policy implementation pathways.

47. The GERE could interact more frequently with political decision makers, business representatives, academic research organisations and civil society thus enabling a more dialogue-oriented exchange. For example, an online platform could be established where interested stakeholders have the opportunity to pose specific questions or to contact experts directly.

48. Overall, a series of concrete actions directly at ECE countries, on a demand-driven basis and tailored to identify and respond to the specific country needs, could be developed under an umbrella programme. This umbrella programme would include a more integrated ECE work on renewable energy uptake for sustainable development structured, among others, within these main three clusters: (i) policy advice and dialogue, (ii) capacity building and (iii) project development support.

VI. Conclusion

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

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

51. Electricity prices play a crucial role in efforts to shift energy markets towards more renewable energy. This is because the prices have a major influence on social acceptance for renewable energy deployment. Electricity prices are considered a decisive competitive factor

for energy-intensive industries, they strongly affect the economic viability of renewable energy technologies, and they determine the effectiveness of renewable energy promotion schemes. If a country has particularly low electricity prices, it can hamper the uptake of renewable energy, since low prices reduce the economic viability of renewable energy technologies, especially when they face tough competition from conventional energy sources. Introducing effective schemes for promoting energy efficiency might also prove difficult because low prices reduce the incentive to save energy. Therefore, electricity pricing must be thoroughly considered and monitored to ensure a successful uptake of renewable energy.

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

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

Annex I

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, United States of America (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, United States of America (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	United States of America (state level), India (state level)

Promotion schemes and measures	*Impact dimension*	*Description*	*Strengths / primary output*	*Good practice*
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

Key dimensions and important drivers for developing renewable energy markets

1. Political/regulatory				*2. Economic*		*3. Social*	*4. Technical*	
Security of Supply	Regulatory Target	Promotion	Market Access	Energy Prices	Economy and Value	Social	Potential	Integration
Fossil Resources	Share of RES	Fixed Tariff/premium	Priority Purchase	Electricity	New Industries	Costs	Theoretical	Grid integration
Future Demand	Technology Target	Net metering /billing	Full access	Liquid Fuels	Labour Market	Benefits	Technical	Grid expansion
Import Quota	Emissions Reduction	Quota obligation	Limited Access	Gaseous Fuels	Competitiveness	Acceptance	Economic	Decentralized Production
Renewable Resources	Efficiency	Power Purchase Agreement	No access	Solid Fuels		Knowledge	R&D	Storage
Access to Energy		Tender				Awareness		Smart metering
		Auction						Demand
		Taxes/other incentives						
		Investment security						