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Best practices on how to increase the uptake of renewable energy

Key drivers for renewable energy within future energy systems – case studies

Note by the secretariat

Summary

The major aim of the United Nations Economic Commission for Europe is to promote pan-European economic integration among its 56 member States. The Group of Experts on Renewable Energy (Group of Experts) 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 countries in the region.

The region is considered to have great potential for renewable energy deployment. On the one hand it comprises established renewable energy markets within several countries of the region, which offer a sound market environment and well-developed infrastructure for deploying renewable energies. On the other hand, several member States provide the opportunity of picking the "low hanging fruit" of fairly unexploited renewable energy markets. Nevertheless, the uptake of renewable energies in several countries 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. This paper is an abstract of the overview report recently prepared by dena, the German Energy Agency, on the status and perspectives for renewable energy development in the region.

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I. Executive Summary

1. The United Nations Economic Commission for Europe (ECE) 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 ECE 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.

2. While several ECE countries offer sound market conditions and an established infrastructure for further deployment of renewable energies, other ECE still countries provide high potential for picking the 'low hanging fruit' within mostly unexploited renewable energy markets. In recent years ECE 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 ECE 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 ECE region.

3. 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 ECE member States. The report "Status and Perspectives for Renewable Energy Development in the ECE Region" (the Report) conducted by dena, the German Energy Agency, and prepared for the Group of Experts, aims at supporting the market uptake of renewable energies in the ECE region by demonstrating the potential for renewable energy deployment and applicability of renewable energy promoting policy instruments for ECE member States. With this objective, the report on one hand examines the current situation and challenges of renewable energy deployment in the ECE region and on the other hand presents different policy options for the promotion of renewable energies, their current state of implementation and applicability in ECE member States. The report draws from rich experience of renewable energy market development in several ECE countries which is also analysed exemplary through case studies of Albania, France, Germany, Kazakhstan, Turkey, California/United States of America[1].

4. The report reveals that the ECE 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 solar photovoltaics (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%.

[1] This document comes from the findings and analysis presented by the dena report "Status and Perspectives for Renewable Energy Development in the ECE Region", prepared for the Group of Experts in Renewable Energy. The full report and detailed information on the six case studies are available at http://www.unece.org/index.php?id=43327 .

5. On the policy level the report concludes that the majority of ECE 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 ECE 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.

6. The country-by-country market analysis of the presented case studies reveals that in four out of the six analysed ECE 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 ECE 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.

7. In summary, the report concludes that no general blueprint can be applied for strengthening the uptake of renewable energy in the ECE 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 ECE region. In the last chapter a recommendation for the future work of the Group of Experts on Renewable Energy is presented.

8. This project is part of the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) supports this initiative on the basis of a decision adopted by the German Bundestag. Furthermore, this report has been compiled within the GIZ program "Capacity Development for Climate Policy in the Western Balkan, Central and Eastern Europe and Central Asia".

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

9. During the last decade the worldwide expansion of renewable energies progressed rapidly. In 2014, the installed electricity capacity of renewable energy sources in the ECE region amounted to about 863 GW, of which 380 GW corresponded to large hydropower plants[2] (LHP). The electricity capacity from renewable energies in the ECE region

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

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 ECE market of renewable energies has grown annually on average by 4.4%, with LHP having only grown by 0.68%. Renewable energy 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.

10. Across the ECE region there are differing degrees of establishment/implementation of renewable energy technologies. 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 ECE countries have well established hydropower markets. While hydro energy is used for electricity generation across the ECE 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 more advanced ECE countries.

11. There are a significant number 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. Both wind energy and PV energy markets are increasingly growing all across the ECE region.

12. Hydropower capacity has grown less or stagnated in recent years, and at times even receded in ECE 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 ECE 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. 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%.

13. 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[3] had the smallest electricity generation capacity of the four technologies in the ECE 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.

14. Main sources for renewable heat generation are geothermal, solar thermal, bioenergy as well as concentrated solar power. Despite its potential, geothermal energy is exploited only in some ECE 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. In many countries, this technology is gaining in importance. The modern use of bioenergy for heat generation is less common in the ECE region. Concentrated solar power plants are only relevant in the United States and Spain due to site requirements of high solar radiation. Overall, the renewable heat sector of the ECE region is not as developed as electricity generation from renewable energy sources, despite a high potential in many member States.

[3] 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.”

15. The markets of solar photovoltaics (PV) and wind energy can be determined as "dynamic" renewable energy markets for electricity, since their relative growth is noticeably higher than other renewable energy sources. Analysing the ECE deployment of PV, it can be noticed that the average market growth rate[4] 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%.

16. Looking at the recent wind energy development in the ECE region, 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 ECE wind energy market share of total electricity generation capacity in 2014 was higher than the PV market share, reaching 7.2%.

17. 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. ECE member States with particularly 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.

18. 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. Analysing ECE electricity prices, a strong heterogeneity between ECE member States can be recognised for both electricity prices for households and electricity prices for industrial consumers[5]. Interestingly, the average ECE 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

[4] 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 5 is due to the same reason.

[5] For Fig. 11 and 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), Russian Federation (2008/2012), Switzerland (2012), Ukraine (2012) and Uzbekistan (2013). Data sources: Eurostat and others. Only countries for which data were available are included.

ECE region pays. However, this drop change is mainly caused by Russian Federation and the USA, the two most populated countries in the ECE region, which have very low electricity prices (6.5 €-cents). When taking into account the ECE populations while omitting Russian Federation 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.

19. Industrial electricity prices member States in the ECE region show a smaller divergence than electricity prices in the private sector. The similarity of electricity prices – despite varying levels of gross domestic product per capita ECE 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.

20. 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.

21. The status quo analysis shows that the renewable energy deployment in the ECE 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 ECE region.

22. The analysis of ECE 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 ECE member States, a greater heterogeneity can be recognised between the ECE 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.

III. Renewable energy policies in the ECE region

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

24. 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.

25. 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).

26. 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.

(a) 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.

(b) 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.

27. 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).

28. 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.

29. 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.

30. Out of 52 analysed ECE member States[6], 44 have official, and to a certain extent technology-specific, renewable energy expansion goals. While in 30 ECE 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 ECE countries.

31. 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 ECE 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.

IV. Policy options to promote renewable energies: conclusion and lessons learned

32. In view of the Group of Experts 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 ECE 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 ECE have been examined. Furthermore, all major promotion schemes have been described and the status of their implementation in the ECE electricity and heat sector has been determined for each member State. Eventually six exemplary case studies of renewable energy policies and deployment in ECE 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 ECE region.

33. 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 ECE 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 ECE 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

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

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 CO2 prices within emission trading schemes, has become a crucial aspect.

34. Analysing the status quo of renewable energy deployment in the ECE 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 ECE member States (see chapter 2, referring to shares of total generation capacity). With an installed renewable energy electricity capacity of 863 GW, the ECE 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 ECE region since 2000, which is largely due to the rapid expansion of wind energy and PV, showing high growth rates in several ECE 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 ECE 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.

35. 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. ECE member States with particularly 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.

36. Against this background ECE electricity prices have been determined and split into shares of electricity generation and network costs and into shares of taxes and levies for each ECE member State. The comparison of ECE electricity prices has shown that the level of electricity prices and the included shares of taxes and levies vary noticeably within the ECE 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 ECE countries in the industry sector compared to the private sector. The recognised stronger similarity of electricity prices in the industrial sector can be explained by industrial electricity price subsidies, which are granted in several ECE countries to inhibit local competitive disadvantages arising from high electricity prices.

37. The report finds that the large majority of ECE 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 ECE 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 ECE countries, while another eleven ECE 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 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 ECE 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.

38. 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, ECE 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 ECE 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.

39. 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.

Policy Toolbox

40. 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 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.

V. Recommendations and fields of action for the Group of Experts

41. This report supports the achievement of the long-term objectives and the implementation of the current work plan of the Group of Experts 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 ECE 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.

42. 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 ECE 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.

43. 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 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.

44. 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 Group of Experts, including countries of South-East Europe, Central Asia, the Caucasus and the Russian Federation.

45. As electricity has been relevant for most activities of the Group of Experts 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 ECE 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 ECE member States:

(a) As a first step, the Group of Experts could cluster ECE member States according to their main barriers and potential future challenges, which allows a targeted approach to increase the share of renewable energies;

(b) Based on the created clusters, the Group of Experts could establish barrier-specific working groups, which focus their activities on finding solutions for the respective barrier or challenge;

(c) Within the work of the barrier-specific working groups twinning 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 (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;

(d) 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.

46. 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 ECE 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 or another relevant event, could be a meaningful measure to facilitate the promotion of renewable energy and foster the exchange of technologies and policies.

Annex

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)

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