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Implementation of Renewable Energy National Action Plans in Selected ECE Countries

Note by the secretariat

Summary

Progress and efforts of selected United Nations Economic Commission for Europe (ECE) member States to achieve their stated National Renewable Energy Action Plans (NREAPs) and renewable energy commitments are here summarized. These renewable energy pledges assist in decarbonizing electricity production in line with the considered countries' Nationally Determined Commitments (NDCs) to reduce carbon emissions under the United Nations Framework Convention on Climate Change (UNFCCC). The following analysis also shows the progress of the considered countries toward achieving SDG 7.2 which aims to increase substantially the share of renewable energy in the global energy mix by 2030.

As example, the ECE member States considered are Albania, Bosnia and Herzegovina, Montenegro, Serbia, Georgia, Azerbaijan, Kazakhstan, Uzbekistan, Germany, Italy, Netherlands, and Sweden. These countries offer an example of heterogeneity in terms of differences in domestic energy resource endowment, various levels of renewable energy development, and a wide range of renewable energy ambitions. They are divided into regional categories based upon the seven sub-regions used in the ECE 2017 report entitled the "Global Tracking Framework: ECE Progress in Sustainable Energy." The considered regional categories are South East Europe, the Caucasus, Central Asia, and Western and Central Europe.

I. Introduction

1. Many ECE member States have pledged to increase their use of renewable energy to reduce carbon emissions to fulfill their commitments within the United Nations Framework Convention on Climate Change (UNFCCC). The following analysis also shows the progress of the selected countries toward achieving SDG 7.2 which aims to increase substantially the share of renewable energy in the global energy mix by 2030. Specifically, those countries that are part of the Energy Community were required to prepare and approve a National Renewable Energy Action Plan (NREAP) by 2013 to comply with European Union (EU) Directive 2009/28/EC. Each country agreed to produce a specified percentage of Total Final Energy Consumption (TFC) using renewable energy by 2020 with the larger goal of reducing greenhouse gas emissions (GHGs) in line with their Nationally Determined Contribution (NDC) to the UNFCCC. The NREAPs discuss state policies and strategies aimed at meeting these targets, and establish benchmarks for the main energy-consuming economic sectors including electricity production, heating/cooling, and transportation.

2. The considered ECE member States have undertaken various paths to achieve their renewable energy targets, and also vary in their current status toward the fulfillment of these targets. This document uses the ECE regional clusters as defined in the report entitled "Global Tracking Framework: ECE Progress in Sustainable Energy" and highlights a few countries from South East Europe, the Caucasus, Central Asia, and Western and Central Europe regions to show the challenges countries face both domestically and regionally. These countries include Bosnia and Herzegovina, Albania, Montenegro, Serbia, Georgia, Azerbaijan, Kazakhstan, Uzbekistan Germany, Italy, Netherlands, and Sweden. Azerbaijan, Kazakhstan, and Uzbekistan are not members of the Energy Community, and Georgia only recently joined, so the four countries do not have formal NREAPs, but they have made commitments to carbon emission reduction and the integration of renewable energy.

3. The countries of South East Europe largely rely on hydro power and coal-based thermal power, though are beginning to make progress integrating wind and solar. The Caucasus countries represent a mix of natural gas production for thermal power production, with Azerbaijan producing more than 80% of its electricity with natural gas. In contrast, Georgia produces more than 80% of its electricity with hydropower with natural gas filling the remaining demand. The countries of Central Asia all have substantial renewable energy potential, and Kazakhstan has recently made renewable energy pledges in its transition to a "Green Economy" model and plans to become a regional wind energy hub. Uzbekistan has also made renewable energy pledges, but plans to bolster its solar manufacturing and energy production industries. The Western and Central Europe region countries have more diversified energy mixes than the other regions, but show varying ability and will to fulfil their respective pledges.

II. South East Europe

4. Albania, Bosnia and Herzegovina, Montenegro, and Serbia are the representative countries of the South East Europe region in this document. All four countries obtain more than 25% of their respective TFC from renewable sources, showing good progress toward increasing their share of renewable energy under SDG 7.2. Albania relies heavily on hydropower, and thus its ability to achieve its renewable target varies dependent on yearly precipitation. Bosnia and Herzegovina and Montenegro have reached their 2020 NREAP goals. Serbia can potentially meet its 2020 target by adding additional wind capacity

5. All four countries obtain large amounts of their respective energy needs from hydropower, which serves as the backbone for the region's energy mix. Domestic coal resources support further use of coal-fired power generation, but wind power capacity is

increasing throughout the region. The development of solar PV is limited largely due to fear of increased electricity prices, which is a result of previous failed attempts at feed-in tariffs (FiTs). The expansion of biomass generation, other than traditional use of fuel wood for residential heating and cooking, has not yet developed on a large scale.

6. Additionally, an ECE study assessing the water-food-energy nexus of the Drina River Basin shows how a cooperative approach can benefit all four riparian countries. Multi-state cooperation can mitigate against the effects of variability on downstream hydropower production, improve agricultural production, and reduce flooding. Transparent hydropower development planning and increased electricity interconnection could improve electricity production in the four countries and produce not only substantial savings, but also potential profits from the export of electricity to Italy and Croatia. With increased hydropower production, the need for thermal capacity will be reduced, thus reducing carbon emissions. Improved irrigation could also bolster the cultivation of biofuel crops.[1]

A. Albania

7. Albania's NREAP has a renewable energy target of 38% of TFC by 2020.[2] The country's NDC is to reduce carbon emissions 11.5% by 2013 as compared to its Business-As-Usual (BAU) scenario. In 2014, 33% of TFC originated from renewable sources.[3]

8. Albania has pledged for 100% of electricity to come from renewable sources by 2020. Hydropower makes up 95% of the country's domestic electricity production capacity, though imports supplement electricity consumption. Variability in yearly rainfall affects yearly electricity production. For example, hydropower production fell 37% year-on-year in 2017 due to a lack of rainfall, though Albania had been a net exporter of electricity in 2016.[4]

9. Diversification of renewable energy generation will reduce Albania's dependence on annual rainfall for its electricity requirements. Additionally, increased renewable energy capacity will reduce dependence on imports, improve security of supply, and decrease the budget deficit. The International Renewable Energy Agency (IRENA) estimates Albania's cost competitive renewable energy potential to be 2 GW for hydro, 1.9 GW for solar, and 987–2153 MW for wind.[5] Albania's current hydro capacity is 1.5 GW so its potential for diversification is great, though dependent on obtaining financing through proper policy mechanisms.

10. The implementation of a feed-in-tariff (FiT) and a feed-in premium (FiP) intend to expand the country's renewable energy infrastructure. Unfortunately, the 2007 FiT for small hydro power plants (SHPPs) was set too high, representing a financial burden to the state-owned utility, and was reduced 30% after a loss of €32 M in 2012-2013. The revised 2013 Law on Renewable Energy continued the FiT for SHPPs up to 2 MW, and a FiP was introduced for wind and solar PV, but limited to the 2020 renewable energy targets of 30 MW and 50 MW respectively. Competitive, non-discriminatory auctions will allocate future FiPs, though installations larger than 10 MW will not be included.[6] The 2013 law also instituted net metering, but a low and regulated electricity price of €0.07/kWh provides little incentive for distributed generation. The country's underdeveloped transmission and distribution system limit the ability for renewable energy additions to the state's grid. A National Licensing Centre acts as one-stop-shop to shorten processing times and increase transparency. The National Energy Efficiency Fund plans to provide financing for renewable and energy efficiency projects but is not yet operational.

B. Bosnia and Herzegovina

11. Bosnia and Herzegovina has a stated renewable energy target of 40% of TFC by 2020, which it achieved in 2014 with 42.3% of energy originating from renewable resources.[7] The country has pledged to reduce carbon emissions to 3% below its 1990 emissions or 23% below the BAU scenario by 2030.[8] Coal-based thermal and large-scale hydropower dominate the electricity sector, making up roughly 60 and 40% of total electricity production respectively. Hydropower production varies depending on yearly rainfall, so diversification of renewable sources is required to ensure that Bosnia and Herzegovina will maintain its NREAP achievement.

12. Current projections forecast an increase in electricity production, and the country plans to provide future electricity demand growth with fossil-based generation, specifically coal, increasing carbon emissions. Domestic coal resources are robust given domestic consumption requirements and Bosnia and Herzegovina's utilities own both the coal mines and coal-fired power plants, making a transition to renewable energy difficult given the vested interest in coal consumption. Vertical integration of energy production, domestic coal resources, and recent investments in future coal-based electricity generation may make the integration of additional renewable energy difficult in the near future.

13. Bosnia and Herzegovina's current quotas for renewable energy are relatively small and current state policies somewhat limit expansion, though the technical potential for renewable energy is large. For example, the current quota for solar PV is only 16.2 MW, yet IRENA estimates a cost competitive capacity for solar PV to be 1 GW. IRENA's estimate for wind potential is 2.5-5.9 GW yet the lack of a bankable Power Purchasing Agreement (PPAs) limits its expansion.[9]

14. Electricity subsidies keep retail prices artificially low making the entrance of renewables difficult to justify financially, but also lead to an unmaintained and upgraded transmission grid, which makes adding the variable generation of renewable energy difficult.[10] Reduction of subsidies and energy market liberalization will attract investment capital, but represents a burden to the state's citizens due to higher energy prices, thus a compensation mechanism may be required.

15. PPAs are not considered reliable enough to attract large-scale investment, even though feed-in-tariffs and feed-in-premiums are the some of the highest in the region. Permits for renewables projects often take more than a year to obtain leaving investors exposed to risk.[11] Net metering exists, but surplus production is not subject to remuneration.

16. The 50.6 MW Mesihovina wind power plant came online 2018, and negotiations are currently taking place for 50 MW wind farms at Galica and Vlasic, but overall the expansion in wind generation is still limited.[12]

C. Montenegro

17. Montenegro has already achieved both its TFC and renewable energy electricity sectoral targets. In 2014, 44.9% of TFC and 53.4% of electricity consumption came from renewable energy sources.[13] The country has also pledged to reduce carbon emissions to 30% below the 1990 level by 2030.

18. Hydropower and coal-based thermal power provide the large majority of Montenegro's electricity with 658 MW and 218.5 MW of capacity respectively.[14] Domestic coal resources supply and are co-located with the country's sole thermal plant, Pljevlja, though coal production has been on a downward trend. Two wind power plants are in the development stage with signed concession and PPA agreements. The Krnovo wind farm

partially came online in 2017 adding 72 MW of capacity using financing originating from the European Bank for Reconstruction and Development (EBRD), the German Development Bank, and French investment company Proparco.[15] The Mozura wind farm is currently under construction and will add 46 MW of capacity when completed. The expansion of solar PV has been somewhat limited, but Montenegro's government has currently begun taking bids for a 200 MW solar farm at Briska Gora.[16]

19. Montenegro's FiT system applies to all renewable energy technologies and has government support for 12 years. Net metering is also in place for systems up to 50 kW, which promotes small-scale residential solar PV.[17] Foreign investors consider the purchasing power agreement (PPA) stable, as exemplified by the expansion of large-scale wind production. The government's land registry is limited making property acquisition for large-scale RE projects an obstacle to development. The wind and proposed solar farms are located on government land leased from the state of Montenegro.

20. The renewables investment environment is promising with large-scale solar and wind development in the country ongoing, as exemplified by the current auction for the solar farm at Briska Gora (200 MW) and a signed memorandum of agreement for an additional 50 MW of capacity at the Gvozd wind farm in Niksic municipality.[18] The Gvozd wind farm could power Montenegro's largest contributor to GDP and carbon emissions, its aluminum smelting industry, also located in Niksic municipality.

21. Clarification of land ownership and the creation of accurate land ownership maps will attract further foreign investment. A financing mechanism for residential or village-scale PV systems could expand distributed solar development and reduce the necessity for construction of transmission infrastructure. Electric heating and cooling are the norm in Montenegro, thus policies aimed at residential energy efficiency can both reduce reliance on electricity consumption and reduce carbon emissions. Montenegro could revisit implementing a policy such as MONTESOL, a 2011 UNEP program aimed at giving interest free loans to Montenegrin citizens to purchase residential solar water heaters, and add an educational campaign would lead to further adoption of the previously successful program.[19]

22. Overall, the total cost competitive potential for renewable energy expansion when compared to combined cycle gas turbine (CCGT) is 3.3 GW, which is larger than the current domestic generation capacity of roughly 1 GW.[20] Offshore wind generation is another potential avenue for the expansion of renewable capacity Therefore, any movement toward the construction of fossil fuel generation capacity is ill advised and the further expansion of renewable energy in the country is not only carbon neutral, but also cost competitive.

D. Serbia

23. Serbia plans for renewable energy to make up 27% of TFC and 36.6% of electricity production by 2020. Coal leads Serbia's electricity generation mix with 3.9 GW of capacity, followed by hydropower and gas power plants, with 2.9 GW and 353 MW respectively. Serbia's electricity generation mix is mostly self-reliant due to domestically mined coal and hydropower, though Serbia imports the large majority of its natural gas from Russia. Serbia has pledged to reduce carbon emissions to 30% below its 1990 level by 2030.[21] IRENA projects that Serbia has a cost competitive renewable energy potential of 6.9 GW for solar PV and 5.6 GW for wind.[22]

24. By the end of 2015, Serbia had installed 10.8 MW of solar PV, which is larger than its NREAP solar commitment, but only 5 MW of biomass capacity, well below its 143 MW biomass commitment. Serbia has an installed wind capacity of 10.4 MW, though its NREAP commitment projected 500 MW of wind capacity installed by 2020.

25. Recent policy actions appear to have made Serbia an attractive destination for foreign investment in large-scale renewable capacity additions, though smaller projects still face issues at the local level regarding land rights. In June 2016, Serbia instituted a new Purchase Power Agreement (PPA) model and a one-stop-shop for construction permits.

26. The Cibuk 1 plans to be one of the largest wind farms in South East Europe with 158 MW capacity, and the Alibunar farm will add 42 MW of capacity. The International Finance Corporation of the World Bank and the Green Growth Fund in partnership with foreign investors provided financing for these projects.[23] Cibuk 1 acquired a preliminary power producer agreement (P-PPA) and grid connection approval, and falls within Serbia's stated cap of 500 MW for wind energy support. The P-PPA requires a 2% deposit and, already 800 MW of wind capacity has achieved this status, indicating that Serbia will likely reach its 500 MW goal, though potentially not by 2020. The quota for solar PV (10 MW) has already been achieved. The low quota for PV was established due to fears of increasing the price of electricity, which is currently low and regulated. Net metering has not been expanded, because the subsidized electricity price makes it financially unviable. Overall, plans for the expansion of wind generation capacity are encouraging, but achievement of Serbia's NREAP goals by 2020 may not be possible.

III. The Caucasus

27. Azerbaijan and Georgia are the two counties chosen as representative of the Caucasus. Both countries have substantial potential for growth in renewable energy generation. Azerbaijan's energy sector is dominated by its fossil fuel industry, but the country has now pledged to use its oil and gas wealth to add renewable capacity, most notably wind generation. Georgia intends to further expand its hydro capacity, and supplement electricity capacity with wind power during the low hydropower production winter months.

A. Azerbaijan

28. Azerbaijan plans to obtain 20% of its electricity consumption and 9.7% of its TFC from renewable energy sources by 2020. The county has committed to reduce CO_2 emissions by 35% by 2030 in comparison to 1990.

29. Azerbaijan's energy mix is still dominated by fossil fuels, currently making up 80% of TFC, and the energy sector is the country's largest emitter of GHGs. Phase 2 of the Shah Deniz gas field is set to come online in 2020 and will allow Azerbaijan to export gas to the EU and Turkey. Funds obtained from oil and gas exports are allocated to the State Oil Fund of the Republic of Azerbaijan (SOFAZ) to finance state infrastructure projects, such as renewable energy development.

30. The renewable share of TFC was 4.4% in 2010 and 2.1% in 2014. The variation is due to seasonal and year-on-year changes in hydropower production, which makes up 1,132 MW of Azerbaijan's 1,267 MW of installed renewable power capacity. Additional renewable energy capacity can smooth this variability.

31. In 2017, Azerbaijan reported an installed capacity of 66 MW of wind, 38 MW in biomass, and 34.6 MW of solar PV.

32. In order to meet its 2020 goals, Azerbaijan intends to install new generation capacity equaling 350 MW of wind, 50 MW of solar, and 20 MW of bioenergy in accordance with the Strategic Road Map and action plan for 2016-2020, adopted in 2016 and featuring a long-term vision toward 2025.

33. Further legislation is required to attract investment capital for renewables projects. This includes transparent and efficient permitting, defining responsibilities of the various state agencies, competitive feed-in tariff rates, purchasing power agreements within international standards, and dedicated financing facilities for renewable energy.[24]

B. Georgia

34. In April 2017, Georgia officially joined the Energy Community, but does not yet have a formal NREAP or a NDC in place.

35. Georgia has the potential to position itself as a regional renewable energy hub. Increasing hydro production can bolster revenues from the export of electricity, while additional wind capacity can provide energy during the winter months when hydro production is reduced, and energy demand is highest.

36. The country has mostly focused on the expansion of its hydropower potential, as it is still the most cost-effective renewable energy resource in the country. Hydropower accounts for more than 80% of current electricity capacity, and more than 30% of TFC.

37. During the high energy demand winter months, security of supply is an issue due to depleted storage in reservoirs, sometimes requiring electricity imports. Electricity is exported to Turkey in the summer and spring. A diversification strategy featuring wind generation will reduce the need to import, as wind power is typically higher in winter months.

38. As one of the world's leaders in water resources per capita, the Ministry of Energy, now merged into Ministry of Economy and Sustainable Development, estimated Georgia's hydro potential at 40 TWh, yet only 20% of this potential has been utilized. Between 2013 and 2016, small scale hydro received USD 92M in investment and large scale hydro USD 309M. These investments represent more than 282 MW of additional hydro capacity.[25] These projects are facilitated by the Georgian Energy Development Fund in partnership with private investors.

39. Wind capacity will reduce the need for electricity imports in the winter months, when hydro production is lowest. 1.5 GW of wind energy potential is estimated and investments have begun to expand wind capacity.

40. The 20.7 MW Kartli wind farm, located outside of Tbilisi in Gori was completed in 2016.[26] The project was a joint venture between the state-owned Georgian Energy Development Fund and the Georgian Oil and Gas Corporation with partial financing from the European Bank for Reconstruction and Development (EBRD).

41. The country is still in the process of harmonizing its energy policies with those of the Energy Community and does not currently have any established laws or targets for renewable energy or energy efficiency.

42. Georgia's investor friendly tax environment has brought investment, but government policy is not viewed as stable, and a more structured approach to obtaining permits and agreements, such as PPAs, is required. Georgia has implemented a net metering program, which is conducive to SHPPs as local communities have been resistant to large scale hydro projects, and access to local industry professionals is limited.

IV. Central Asia

43. The countries of Central Asia all have substantial renewable energy potential, which in some cases can be funded from fossil fuel and uranium resource exports. Kazakhstan has substantial coal, oil, natural gas, and uranium resources that can be exported to fund

renewable energy investments, as it intends to become a regional wind energy hub. Uzbekistan, as well, has substantial coal, oil, natural gas and uranium resources, and is still dependent on fossil fuel electricity production, though is positioning itself as a solar PV manufacturing and solar power generation hub. Turkmenistan has large solar and wind potential but does not have any RE targets currently. In 2015, Kyrgyzstan and Tajikistan produced 45% and 23% of TFC by hydropower production respectively.

A. Kazakhstan

44. Kazakhstan has recently made renewable energy pledges of 3% of TFC by 2020, 10% by 2030, and 50% by 2050 in its transition to a "Green Economy" model. Kazakhstan was recently the host of a ECE Renewable Energy Hard Talk, 26–27 April 2018.

45. In 2016, Kazakhstan reported a total installed renewable energy capacity of 2,855 MW, including 2,688 MW of large-scale hydropower, 98.52 MW of wind and 57.3 MW of solar PV.

46. In 2016, the country took additional steps to amend its legislation on renewable energy through the law on "amendments and additions to some legislative acts of Kazakhstan on the transition of the Republic of Kazakhstan to the green economy" and the law on "supporting the use of renewable sources of energy".

47. A first round of Renewable Energy (RE) auctions in May 2018 was successful in procuring ten wind energy projects for a total of 20GW of capacity. The total capacity to be auctioned in 2018 is 1 GW. The results of the solar auctions were mixed and some re-working of the auction rules may be required.[27]

48. The RE Energy Hard Talks have led to the initiation of a number of RE specific policies including the previously mentioned RE auctions, the integration of a national systems operator, secure PPA agreements, tariff indexation to account for interest rate and currency fluctuation, and a land plot granting regime. These policies overall are aimed at increasing transparency and RE regulation, while reducing investor risk to increase investment in the renewable sector.

B. Uzbekistan

49. Uzbekistan's current 2015 RE share of TFC was 3%, and the country has made RE pledges for electricity generation.

50. Uzbekistan has pledged to construct 100-200 MW of wind and solar capacity by 2020. The country has also pledged to increase its share of RE in its electricity generation mix to 16% by 2030 and 19% by 2050.

51. Uzbekistan does not yet have a NREAP of FiT, but it has a policy of special premiums for solar projects built with domestic solar PV modules, intending to bolster domestic PV manufacturing and solar energy production. FiT and net metering would increase domestic demand for solar panels.

V. Western and Central Europe

52. The countries described in this study as "Western and Central Europe," are in general larger than the other countries discussed in terms of GDP, and thus can be considered as more advanced economically, but many of the same issues regarding the integration of renewable energy exist in these countries as those in the countries discussed in South East Europe, Caucasus, and Central Asia regions.

53. The countries considered in the "Western and Central Europe" region are all EU members and as members of the Energy Community have produced NREAPs with estimated trajectories with yearly benchmarks for renewables integration in overall TFC and in the electricity, heating/cooling, and transportation sectors. The countries considered as representative of Western and Central Europe are Germany, Italy, Netherlands, and Sweden. Overall, their energy mixes are more diversified than the other ECE regions, though they have varied capacity and will to obtain their respective renewable energy pledges. The use of EU-region data highlights the trends in achieving NREAPs and sectoral pledges. The Eurostat data includes some countries of the South East Europe region as defined in the 2017 report "Global Tracking Framework: ECE Progress in Sustainable Energy," though the four countries highlighted in this report as South East Europe are not in the EU.

54. In 2017, the EU Commission produced the "Renewable Energy Progress Report" which tracks the EU, as a single entity, in its move to achieve its Renewable Energy Directive 2009/28/EC. In 2015, the EU's renewable energy share of TFC was 16.4%, while the trajectory set forth in the NREAPs was 13.8% for 205/2016.28 The use of EU Commission data is more up-to-date than the data provided for non-EU members, and additionally it has been divided by sector, which is useful for policymakers when deciding where to focus efforts.

55. The EU heating/cooling sector has an estimated renewable energy share of 18.1% in 2015, above its 16% expected share.

56. 28.3% of the EU's electricity came from renewable energy sources, again ahead of trajectory.

57. Hydropower produces the largest share of the EU's renewable electricity at 38%. Sweden, France, Austria, and Spain account for roughly 70% of the EU's hydropower.

58. During the period of 2004–2005, wind power production more than quadrupled, and now accounts for roughly a third of renewable energy production. Onshore wind production is slightly behind its planned trajectory for the EU overall, and is led by Germany and Spain. Sweden, Germany, the United Kingdom, and Denmark are ahead of their respective offshore wind trajectories, but the EU as a whole is 12% behind its 2015 trajectory, though offshore wind development is increasing in recent years, as capital costs have decreased and grid connection is becoming easier.

59. Solar PV made up 12% of EU renewable energy production, surpassing biomass for the first time. Germany, Italy, and Spain are the EU leaders in solar PV accounting for 38% of all EU solar PV generation. Rapid technological progress, cost reductions, and shorter project development times have increased the deployment of solar PV, and prospects for increased deployment are strong.

60. Biomass electricity generation is growing, but did not meet its 2015 target. Biomass and bioliquids combined to produce 7% of renewable electricity, which is faster growth than expected from the negligible levels of production in 2004. Germany and Italy lead in biogas production.

61. The transport sector is the only EU sector currently lagging behind its aggregated NREAP trajectory, with renewable energy making up only 6% of transport energy consumed, below the 10% 2020 target. This is due to relatively high GHG mitigation costs and regulatory uncertainty.

62. Biofuels make up 88% of the renewable energy consumed in the transport sector, with electricity still playing a smaller role in transport. Renewable electricity is 13% its 2015 NREAP trajectory.

63. All EU members achieved their RES trajectories for 2013/2014 except for Netherlands. Three member States, Netherlands, France, and Luxembourg, had estimated renewable energy shares below the 2015/2016 trajectory. Below some countries are considered as example.

A. Germany

64. Germany has achieved its 2016 trajectory benchmark for RE share of TFC and electricity and appears to be on course to achieve its 2020 NREAP goal. Germany is an EU leader in solar, wind, and biomass production. The country is only slightly below trajectory for 2016 in heating/cooling for its NREAP, indicating that country can meet its 2020 goals. In 2016, 12.9% of heating/cooling and 6.9% of transport came from renewable energy sources, and the 2016 benchmark goals establish in its NREAP were 12.4% and 7.1% respectively, overall reflecting positively on Germany's 2020 prospects.

B. Italy

65. Italy has achieved its TFC, electricity, and heating/cooling pledges defined with its NREAP.[29] The country has yet to achieve its transport 2020 goal, but it is on trajectory to do so given its NREAP benchmark for 2016 is 7.3% of transport to be derived from renewable sources, where the Eurostat data shows Italy had achieved 7.24% of transport from renewable sources in 2016.

C. Netherlands

66. Netherlands is not on track to meet its 2020 NREAP targets. The country is behind its 2016 trajectory goals in all three sectors and its overall TFC. Notably, the country's RE share of TFC in 2016 was 5.97%, yet its trajectory goal for 2016 was 9.7%, and its 2020 goal is 14% of TFC, which is no longer considered likely.

67. The oil and gas industry of Netherlands provides roughly €7B per year to the Dutch government, and a long-term reliance on fossil fuels for primary energy production has created dependence and entrenched infrastructure.[30] Additionally, sharply declining gas production has now forced Netherlands to begin large-scale and costly imports of natural gas. Recent announcements of €100M to be allocated toward offshore North Sea wind production, the implementation of a tax on coal production, and the announced closing 5 coal-fired power plants by 2020 are indications of movement toward its renewable energy and carbon emission goals, but Netherlands likely will not meet its NREAP 2020 benchmarks until 2030.

D. Sweden

68. Sweden reached all its 2020 NREAP benchmarks by 2016. Additionally, the country has 2020 percentage shares of renewable energy goals higher for each sector and for overall TFC than any of the other countries from Western and Central Europe examined. Currently more than half of TFC, more than 60% of heating/cooling and electricity, and more than 30% of transport are derived from renewable sources. Further, more than 83% of electricity comes from nuclear and hydroelectric power, and 7% from wind energy.[31]

69. In 1970, fossil fuels accounted for roughly 75% of Swedish energy consumption. This is largely due, at the time, to the use of oil for residential heating. Today, Sweden has one of the highest energy use per capita in the world, but only releases 4.25 tonnes of CO2 per capita

per year. This is low compared to the EU average of 6.91 tonnes and the US average of 16.15. The country turned away from fossil fuel use after the 1973 and 1979 oil crises.

VI. Conclusion

70. The progress of the considered ECE member States to achieve their respective renewable energy pledges vary depending on natural resource endowment, capability and other factors to achieving these goals. The countries of South East Europe largely produce energy via hydropower and coal. The potential for EU accession has led these countries to develop NREAPs, and all have made progress toward achieving these goals. The movement in this region toward expanding renewable energy capacity is positive, but a potential regression to coal generation is possible. The Caucasus and Central Asia members highlighted have made non-binding commitments and are developing policies to obtain them. Recent ECE Hard Talks in Kazakhstan, Azerbaijan, and Georgia have had a positive impact on the development of these policies and the eventual uptake of renewable energy. Kazakhstan has made renewable energy pledges and passed legislation aimed at achieving these goals. Azerbaijan has made renewable energy pledges, though still needs to pass the legislation required to implement these pledges. Georgia has joined the Energy Community and will therefore be required to make renewable energy pledges, though its electricity production is already heavily dominated by hydropower. The ECE members of Western and Central Europe have showed mixed progression toward their NREAPs. Sweden has shown that a long-term commitment to diversification from fossil fuels has proved beneficial in grid decarbonization. Germany and Italy both appear to moving toward achieving their 2020 renewable energy commitments, and a long-term reliance on fossil fuel production and consumption has made Netherland's path difficult.

Annex

2020 Renewable Energy Targets in the considered ECE countries

Country	*RE Share of TFC*	*RE Share of Electricity*	*RE share of Heating/Cooling*	*RE share of Transport*
Bosnia and Herzegovina	40.0%	56.9%	52.4%	10.1%
Albania	38.0%	100.0%	n/a	n/a
Montenegro	33.0%	51.4%	28.2%	10.2%
Serbia	27.0%	36.6%	30.0%	10.0%
Georgia	n/a	n/a	n/a	n/a
Azerbaijan	9.7%	20.0%	n/a	n/a
Kazakhstan	3%	n/a	n/a	n/a
Uzbekistan	100-200 MW	n/a	n/a	n/a
Germany	18.0%	38.6%	15.5%	13.2%
Italy	17.0%	26.4%	17.1%	10.0%
Netherlands	14.0%	37.0%	8.7%	10.3%
Sweden	49.0%	63.0%	62.0%	14.0%

RE Share of TFC in 2016 in the considered ECE countries[32]

Country	*RE Share of TFC*	*RE Share of Electricity*	*RE share of Heating/Cooling*	*RE share of Transport*
Bosnia and Herzegovina	42.3%	n/a	n/a	n/a
Albania	37.9%	85.97%	33.83%	0%
Montenegro	41.55%	50.96%	69.19%	1.10%
Serbia	20.90%	29.23%	24.24%	1.22%
Georgia	>30%	n/a	n/a	n/a
Azerbaijan	2% (2014)	n/a	n/a	n/a
Kazakhstan	1.4%	n/a	n/a	n/a
Uzbekistan	3% (2015)	n/a	n/a	n/a
Germany	14.80%	32.20%	12.90%	6.90%
Italy	17.4%	34%	18.9%	7.24%
Netherlands	5.97%	12.50%	5.45%	4.63%
Sweden	53.82%	64.86%	68.60%	30.29%

[1] UNECE Assessment of the water-food-energy-ecosystems nexus and benefits of transboundary cooperation in the Drina River Basin, New York & Geneva, 2017.
[2] "National Action plan for Renewable Energy Resources in Albania 2015-2010," September 2015.
Note: NREAP and sectoral targets are unclear in English translation version.
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