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Tracking progress of the uptake of renewable energy and synergies with energy efficiency

Reviewing the state of renewable energy development: key findings, barriers and options

Note by the secretariat

Summary

Despite widespread untapped capacities, overall investments into renewable energy projects have shown a marked decrease within the United Nations Economic Commission for Europe region in recent years. Explaining this, there are certain economic and environmental barriers to investment that are widespread across similarly developed energy systems.

This document seeks to address the predominant barriers to investment, the measures that might be adopted to overcome them, and why member States, particularly those 17 reviewed within the United Nations Economic Commission for Europe Renewable Energy Status Report, have seen a reduction in investments and the implementation of renewable energy projects despite opposite trends in the rest of the world.

Findings suggests that the decreasing investments in renewable energy projects witnessed within this area are largely the result of high capital costs, instability of policies and regulatory frameworks, administrative bottlenecks, lack of private investment, and the nascent development stage of many technologies. If countries adopt stable policy frameworks, harness both public and private sector investments, reduce barriers and obstacles (including incentives where needed) to enable commercially viable projects with immediate focus on large scale installations, various renewable energy technologies will be able to achieve more widespread commercial penetration and development opening way for small and medium sized projects.

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I. Introduction

1. Renewable energy resources and consumption varies widely among the United Nations Economic Commission for Europe (ECE) member States, and governments of these countries have been actively working to better utilize their respective resources. Despite these efforts however, investments in renewable energy projects have shown a marked decrease in recent years. Whereas an abundance of investment in developing nations led to a global increase in renewable energy investment, several ECE countries demonstrated their lowest level of investment in nearly a decade. Achieving the de-carbonisation of energy sectors among ECE members, particularly those 17 considered within the United Nations Economic Commission for Europe Renewable Energy Status Report (the Status Report) prepared together with the Renewable Energy Policy Network for the 21st Century - REN21, will require addressing the causes of this decreased financing and the ways these barriers can be addressed[1].

2. The general downward trend of investment into renewable energy within the ECE region largely stems from the fact that developed nations have begun allocating fewer of their financial resources than developing nations towards renewable energy installations. Currently, funding across both groups comes predominantly from international donors and government programmes, with a notable lack of private sector innovation and investment in these 17 ECE countries.

3. Renewable energy investment within the ECE region began to exhibit wide fluctuations from 2004–2014, with investment sharply decreasing from 2013-2014. This occurred significantly within the 17 considered countries, as they displayed a drop of 44% in investments from 2011–2014.

4. The Status Report demonstrates that although selected countries may display a relatively high proportion of renewable energy within their total final energy consumption (TFEC), this is typically due to a large amount of hydropower or traditional biomass generation. In reality, the proportion of contemporary renewables within the TFEC for most nations falls short of even 1%. Although the global use of renewable energy has been increasing, the selected 17 ECE countries were responsible for a mere 0.5% - or USD 0.9 billion - of investments into renewable energy projects in 2014.

5. The information and data presented within this paper, unless otherwise stated, are derived from the Status Report, and UNEP's report on "Global Trends in Renewable Energy Investment 2016"[2].

II. Trends in global renewable energy investment

6. The high upfront cost is the greatest preliminary barrier to gaining investment into renewable energy projects across the ECE region. At a plant's outset, the largest proportion of investment is dedicated towards debt in the form of non-recourse loans, bonds, or leasing. At the project-level within more commercially mature and widespread markets, the

[1] The United Nations Economic Commission for Europe Renewable Energy Status Report Status Report is available at: http://www.unece.org/energywelcome/areas-of-work/renewable-energy/unece-renewable-energy-status-report.html

[2] UNEP's 10th "Global Trends in Renewable Energy Investment 2016", prepared by the Frankfurt School-UNEP Collaborating Centre for Climate & Sustainable Energy Finance and Bloomberg New Energy Finance is available at: http://fs-unep-centre.org/publications/global-trends-renewable-energy-investment-2016

majority of this debt comes from commercial banks, particularly for solar and wind farms. Project bonds are another option, although they usually only represent of a small source of funding for renewable energy projects.

7. Although the private sector often invests most heavily into larger hydropower, public sector investments cover a wider array of renewable energy projects. National governments, international donors, and multilateral development banks typically back these public sector investments. Banks can couple with international donors to provide the funding necessary for projects, often in the form of fiscal incentives or public financing. Additionally, investments can be directed through a third party, examples being the Climate Investment Funds or Global Environment Facility.

8. The total amount of financing from the public sector dropped by 21% in 2015 globally, down to the 2008 average of $12.8 billion. As the public sector is one of the largest sources of funding for various renewable energy projects, this drop drastically reduced the resources that could be used for investment within the region. Although organizations like the World Bank and the United Nations Development Programme (UNDP) work to provide funding for renewable energy projects, these tend to be relatively small-scale.

9. Geopolitical uncertainty among nations, where tensions may disrupt the manufacture and production of materials necessary for new utilities, has also triggered the decreasing investment, as instability leads to fluctuating policies. Another demonstration of inconsistent policies is the use of Production Tax Credits (PTCs). These are adopted at the global level to encourage investment into renewables, but their use has resulted in a boom-and-bust cycle of development. Administrative bottlenecks further slowdown project development in the region as obtaining licences and permits is a lengthy process.

III. Flows of renewable energy investment in the ECE region

10. Although global investments into renewable energy were record-breaking in 2015, with $285.9 billion invested in projects beyond large-scale hydroelectric power, it was also the first year that developing nations were investing more into renewable energy projects than developed nations. Across the ECE region, there was in fact a 21% decrease in financing for various renewable energy projects, although select nations maintained relatively high levels of investment.

11. Europe invested 60% less into the renewable energy sector between 2011 and 2015 for several important reasons. Firstly, many of their most active countries suffered cutbacks for existing projects. Secondly, the global economic crisis made renewable energy investments less appealing to investors. Additionally, the solar photovoltaics (PV) boom throughout the ECE, particularly in Germany and Italy, had begun to lose momentum.

12. Demonstrating the drop in resources available for renewable energy projects, venture capital investments peaked in 2008 at $3.2 billion, then dropped sharply and have increased only incrementally since. Furthermore, as of 2014 the level of funding available from government research fell by 3% down to $4.4 billion. As the government and public sector are two of the most prominent sources of funding for various renewable energy installations, a cut in either results in a deficit in overall investments. Large hydropower projects often skew the statistics for investment into renewable energy, as they typically receive large amounts of private funding. Excluding them, investment levels have dropped 23% from their record peak in 2011.

13. The majority of financing into renewable energy projects is devoted to utility-scale wind and solar development projects. Other forms of renewable energy have obtained a far

smaller proportion of investments with the drop in financing. Additionally, beyond investment for project construction and installation, solar also receives the greatest amount of funding for research and development. Solar power's funding is 2.5x that of wind power as of 2014, and approximately 3x greater than that of biofuels.

IV. State of investment by renewable energy technology[3]

14. Bioenergy

(a) Bioenergy is a notably complex form of renewable technology, given that its forms range in their level of commercial and technological maturity, with solid biomass, biogas, renewable solid waste, and liquid biofuels having the most widespread commercial penetration. The investment costs thus differ based upon the type of feedstock used, the technology, its capacity, and the expenses associated with the plant's location;

(b) Investment costs range on average from 2400/kW to 4500/kW USD for a 50 MW plant, and are largely influenced by capital costs, which are in turn dependent upon the type of facility. In the medium term, the capacity for bioenergy generation is projected to grow to a 125 GW global capacity by 2020, up from 90 GW in 2014. However, the adoption of bioenergy is predominantly based upon the available resources within a region and the necessity of importing biomass to meet renewable energy targets.

15. Geothermal Power and Heat

(a) Geothermal power projects, capable of providing both baseload and flexible power, are often hindered by their long lead-time, exploratory risks and investment expenses. In order to mitigate these concerns, governments in regions with high geothermal potential may provide funding during the early and more risky stages of geothermal projects, and then seek private investments;

(b) The expenses associated with geothermal projects are determined by the location of the plant and the extent of the project, as well as plant-specific O&M costs. On average, the typical capital cost of a high-temperature geothermal electrical facility ranges from 2000/kW-5000/kW USD, although binary plants can reach costs of 5600/kW USD. With a cumulative capacity of over 12 GW as of 2014, the majority of recent additions have occurred outside of the ECE. The global power capacity for geothermal energy is projected to attain over 16 GW by 2020, with the largest deployments continuing beyond the ECE.

16. Hydropower

(a) Given topography, capacity, hydrology, and power market differences, costs for hydropower projects vary widely by location. The two largest costs for investors are the electro-mechanical equipment costs followed by construction and engineering costs. With bigger hydropower facilities, a larger proportion of investment must go towards construction and engineering costs, whereas smaller projects see more of the investment expenses going towards electro-mechanical equipment. Consequently, the investment costs for a large-scale hydropower plant range from 900/kW-3500/kW in USD, with smaller facilities requiring investments of 1000/MW-6000/MW;

(b) With the widespread commercial penetration of hydropower, equipment costs have fallen. By connecting hydropower plants to new demand centres and markets, risks to

[3] See Renewable Energy Medium-term Market Report 2015: Market Analysis and Forecasts to 2020, Paris, OECD/IEA, 2015. Executive summary available at https://www.iea.org/Textbase/npsum/MTrenew2015sum.pdf

investors are lessened and investment can increase, although the attractiveness of such options depends on the additional infrastructure required to achieve a grid connection;

(c) During the 2014-2020 period, hydropower generation is expected to grow by 152 GW, attaining 1326 GW by 2020. Despite this, because of environmental concerns, a diminishing amount of economically viable sites, and the risks of potential resettlement compensation, fewer large hydropower projects may be pursued than previously thought. The majority of hydropower projects are occurring beyond the ECE, yet Canada and Turkey both adopted 1 GW capacity projects in 2014.

17. Ocean Energy

(a) Renewable energy generated from ocean power remains a small fraction of renewable power, but generation is expected to increase in the medium-term given its largely untapped potential. The greatest barrier to investment is the nascent stage of technology and volatility of financing. Investment costs for a 3 MW plant are currently approximately 18100/kW USD, but when scaled up to a 75 MW plant the investment cost drops to 9100/kW for wave energy plants;

(b) As of 2014, ocean power achieved a cumulative capacity of 0.53 GW, up 0.2 MW from 2013. With developments occurring predominantly throughout Canada, followed in the ECE region by the United Kingdom, and France, ocean power is expected to achieve a 1.04 GW capacity by 2020.

18. Solar Thermal Energy (STE) from Concentrated Solar Power (CSP)

(a) STE technology is mostly untapped, but given the nascent state of technology, the coming years will be crucial in obtaining enough investment to reach commercial maturity. The largest barrier to this technology therefore is the high upfront investment cost that each STE plant requires;

(b) The investment costs for a 50 MW STE plant typically range from 4000/kW-9000/kW in USD, depending upon the size of the solar field, storage facility, land availability, and cost of labour. Increasing the level of deployment should lower these costs, particularly if experience with STE technology leads to an increase in conversion efficiency and capacities;

(c) Global STE capacity reached 4.9 GW in 2014, with the majority of installations occurring within the United States, followed by Spain. However, growth has stagnated within both as difficulties in financing, high upfront costs, and competition from more established solar technologies stand as barriers to investment.

19. Solar Photovoltaics (PV)

(a) Overall costs for investing and employing solar PV have been decreasing as a result of commercial and technology maturity, widespread development, cost reductions throughout the supply chain, and a growing number of potential markets. From 2008 to 2012, solar PV technology grew significantly cheaper in mature and large markets throughout much of Europe. Reflective of the lack of new investment in renewables within the ECE region, the solar PV market is expected to demonstrate a shift towards nations that will show an increasing demand for electricity in the coming years;

(b) Total investment costs for commercial-scale projects tend to range from 1000-2000/kW in USD, although this fluctuates depending upon land availability, the complexity of the licensing process, and the ease of grid connection. The residential sector, because it is smaller and more fragmented, has higher investment costs than the commercial sector. Therefore, third-party agreements or power purchase agreements (PPAs) tend to be pivotal in reducing these expenses;

(c) Global solar PV capacity reached 176 GW in 2014, and is projected to achieve 430 GW by 2020. Where ECE growth does occur, in France and Germany most likely, it will mostly be due to the financial support of tenders.

20. Offshore Wind

(a) Distance from shore, depth of water, underwater topography, and ease of grid connection influence the level of investment required for offshore wind projects. The most commercially widespread system has investment costs ranging from 4000/kW-5250/kW in USD, with these expenses covering both the onshore and offshore requisite equipment. These costs will likely be reduced in the medium term, as turbines with larger capacities lessen the overall number of installations required for a project. Investment costs will decrease further as market competition drives supply chain prices down, infrastructure grows more standardized, and larger power plants are connected to the grid;

(b) A number of offshore wind installations were developed in the ECE and China during 2014. Problems arose however, in attempts to form grid connections, and in the decisions of some governments to either reduce their mandated targets or delay their projects. Despite this uncertainty hindering investments, offshore wind capacity is expected to grow to 29 GW by 2020.

21. Onshore Wind

(a) Onshore wind capacity has grown with increasing turbine size, larger generators, and the maturing of the technology. The lower cost of onshore wind turbine investments is largely the result of increasing competition. There are three key variables reducing investment however, the first being that the number of profitable high wind-speed locations has been diminishing. Secondly, as government financing packages have been eliminated or reduced (such as PTCs); there is less of a profit margin available for wind energy producers. Lastly, with the adoption of tender schemes, competition between manufacturers has increased;

(b) Within the European Union costs range from 1.7 million/MW-2.2 million/MW USD. Globally, cumulative wind capacity grew by 16% between 2013 and 2014, predominantly led by installations throughout China, although Germany had a record-breaking installation of 4.75 GW from 2013-2014. China’s installed capacity for onshore wind is projected to dispatch an additional 113 GW from 2014-2020 or 35% of global capacity, while the annual rate of deployment throughout OECD Europe is predicted to remain stable at 7 GW.

V. Barriers to renewable energy investment

22. Subsidies are still wide spread and high comparing to other world regions, especially in the 17 countries of the ECE covered by the Status Report. Presence of energy subsidies prevents emergence of commercially viable business models for renewable energy projects. Moreover, the infrastructure and transmission equipment for more conventional energy sources is already in place, negating the high upfront capital cost of construction. Renewable energy development cannot be considered in isolation, but within a future energy system in which fossil fuels and renewables will benefit from synergies and cooperation.

23. Energy security concerns would presumably stimulate an increase in renewable energy projects, but where more conventional fossil fuel industries are well entrenched, there is little opening within the energy market for small-scale renewable energy investors and companies. In addition, given the progress of exploration and drilling departments within oil and natural gas industries, fossil fuel reserves have increased and become more

accessible. This greater availability of fossil fuels has resulted in their growing less expensive at the same time as renewable energy technologies, lessening cost-competitiveness.

24. Despite globally decreasing investment costs, the majority of development appears to be occurring in large and developing markets, such as China and India. This is likely the result of previously untapped resources, the implementation of stable policy frameworks and government mandated financing within developing nations, and the need for energy security to meet rising demand. Many ECE members States had previously achieved some level of market penetration with various renewable technologies, and consequently there are fewer new resources for them to utilize.

25. Counterparty risk is an important barrier for increasing private investment in renewable energy projects in the 17 countries covered by the Status Report given the level of policy instability and geopolitical uncertainty. A credible counterparty for the renewable energy offtake is necessary to ensure project bankability. In the absence of such a counterparty (e.g. financially strong public, state-owned entity or industrial off-taker) a form of insurance is sought to mitigate such risk.

26. There are non-economic barriers besides policy instability and geopolitical uncertainty that have hindered investments within the ECE region. Complex legal and administrative frameworks often impede the construction and development of renewable energy projects. Within the selected countries of the Status Report, a lack of coordination among member States in both information sharing and energy activism has reduced their ability to fully engage markets and investors. Also, most of the 17 countries covered by the Status Report have not yet fully reaped the benefits of their participation in global collaborations on renewable energy and the related technologies. This impedes the potential for faster technological maturation and large scale installations.

VI. Key elements to promote renewable energy investment

27. The 17 ECE countries considered in the Status Report have employed a variety of regulatory policies and targets to incentivize renewable energy projects. The most widely used regulatory incentive is a feed-in tariff, although tendering, tradable renewable energy certificates, electric utility quotas and obligations, and net metering have also been adopted in several nations. A combination of these policies can be used to reach country’s renewable energy targets and obtain both public and private investment. The establishment of a stable policy framework for future investments is pivotal in obtaining funding from both the private sector and international development banks along with facilitation of private sector investment in terms of administrative requirements. The majority of incentives are to be reduced to allow a development of large-scale renewable energy based on market conditions. Support schemes for energy need to be re-designed to allow progressively for the development of renewable energy projects based on commercially viable business models. The key condition among governments is that any subsidies should be phased out based on a plan which allow the market, and therefore clients, to adapt. This strategy will necessarily apply to both large and small-scale projects.

28. Uncertainty in policies and regulations, which nations are currently struggling to overcome with the adoption and testing of various strategies and environmental targets, has prevented investors from having the confidence to devote substantial resources to renewable energy projects which require commitment over several decades. Another non-economic barrier is a lack of technical experience and knowledge in the market, which is being addressed in some countries with ongoing installations and research. Adopting robust institutions to support the development of consistent policies and seizing the opportunity of

falling supply-chain costs will reduce the number of risks posed to potential private sector investors.

29. Investing more heavily into large-scale commercial renewable energy projects, particularly within solar and wind power, may decrease the costs placed upon investors and catalyse funding. It may also offer an opportunity to build local technical and technology know-how. Increasing the scale of renewable energy projects is often crucial to decreasing costs, but this requires a high upfront capital cost that investors are typically unwilling to provide, unless sufficient incentives are provided or commercially viable business models exist. A transition from large-scale hydropower project investments within the private sector to a greater array of renewables, particularly those most readily available within a locality, can stimulate further growth in the development of renewable energy markets.

30. When energy security, environmental concerns, and regulatory targets are combined with adequate renewable resources and a stable political setting, renewable energy projects can likely overcome the barriers to investment. Furthermore, with the creation of standards and uniform regulations, investors can have confidence in their return of investment, project outcomes, and financing requirements.

31. The gradual commercial penetration of renewable energy technologies, the most significant forms being hydropower, wind, and solar, has resulted in a large decrease in the costs of equipment and infrastructure. By reaching commercial scale deployment, experience and competitive markets will subsequently lower costs and decrease the investment necessary for their installation. Foundationally, countries need clarity within their policies, such as net metering or feed-in tariffs, and a more streamlined permitting process to allow for the licensing of renewable energy plants. Demonstrated by the growth in offshore wind power, the widespread commercialization and standardization of the processes and technology of a given renewable energy resource catalyses a substantial increase in market penetration and investments[4].

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[4] See World Bank Report on Readiness for Investment in Sustainable Energy (RISE), available at http://rise.worldbank.org/reports