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Group of Experts on Cleaner Electricity Systems

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Item 4 of the provisional agenda
Attaining Carbon Neutrality

Pathways to Sustainable Energy – policy recommendations by the Group of Experts on Cleaner Electricity Systems

Note by the secretariat

I. Introduction

1. In 2014, United Nations Economic Commission for Europe (ECE) member States conceived a project called "Strengthening the Capacity of the ECE member States to Achieve the Energy-related Sustainable Development Goals – Pathways to Sustainable Energy" (Pathways Project) to help countries develop, implement and track national sustainable energy policies to mitigate climate change and contribute to sustainable development. The Pathways project phase I was completed in October 2019 and reported to the Committee on Sustainable Energy (the Committee) at its twenty-eighth session on 25-27 September 2019 (see also document ECE/ENERGY/2019/1).

2. The Group of Experts on Cleaner Electricity Systems (Group of Experts) has been engaging together with the other expert groups of the Committee in the Pathways project and the inputs of the three-year multi-stakeholder consultation process were published in the report Pathways to Sustainable Energy - Accelerating Energy Transition in the ECE region (ECE/ENERGY/131).

3. The project concluded that attaining sustainable energy is extremely challenging and the Committee tasked the Group of Experts to initiate a dialogue about delivering on the 2030 Agenda in an integrated way that develops carbon neutrality as a concept and that is pragmatic and rational economically, socially and environmentally with a particular focus on carbon capture and storage technologies (ECE/ENERGY/123, para. 34-41).

4. As a consequence, the Group of Experts discussed the request in its fifteenth session on 5-6 November 2019 and recommended priority areas based on Group of Experts recommendations in the Pathways project process. The Group of Experts decided to focus its activities on carbon capture, utilization and storage (CCUS), negative emissions technologies (e.g. biomass with CCS (BECCS)), smart grids, energy efficiencies, energy storage, demand side management, environment-focused R&D, and a "just" transition coupled with new business models and innovation (ECE/ENERGY/2019/2, para. 11-25).

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5. The purpose of this document is to review Pathways project findings related to electricity sector and revisit policy recommendations provided by Group of Experts in the context of ongoing energy transition and COVID-19 pandemic. The pandemic has highlighted the importance of electricity in driving energy transformation as well as the importance of the resilience of the electricity systems.

6. The document further demonstrates how the Group of Experts took a lead in implementing some recommendation from the Pathways project and launched a project on "Enhancing the understanding of the implications and opportunities of moving to carbon neutrality in the ECE region across the power and energy intensive industries by 2050" (Carbon Neutrality project).

II. Background: Pathways to Sustainable Energy

7. During the twenty-eight session, the Committee acknowledged that attaining sustainable energy is a complex social, political, economic and technological challenge and that the sustainable energy framework in the ECE region is out of balance. It was highlighted that sustainable energy cannot be achieved without significant trade-offs, as maintaining a balance among security of energy supply, carbon emission reductions and energy system cost is not possible (see annex Figure I). Countries will make their own decisions and there will be necessarily a mosaic of choices across the region and globally.

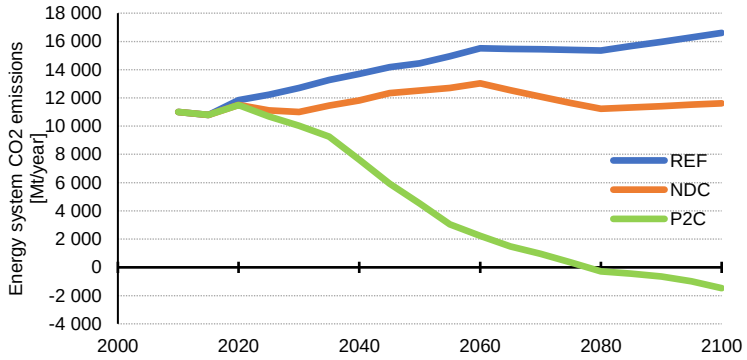
8. Today, about 80% of the energy mix is fossil fuels-based (see annex Figure II & III). Fossil fuels remain vital for the majority of the ECE member States as the means to maintain energy security and ensure economic well-being. The number of people whose livelihoods depend on fossil energy is vast and it cannot be expected that they easily sacrifice their quality of life ambitions in favour of a 2°C target.

9. The region needs to act upon its overdependency on fossil fuels and its carbon emission legacy while embracing the concept of just energy transition that leaves no-one behind. This requires a bottom-up social, institutional and technological approach while modernising and optimising the existing fossil fuels-based infrastructure and integrating low and zero carbon energy infrastructure. Social and quality of life aspirations need to be satisfied and countries cannot economically phase-out fossil fuels as fast as required to stay on a pathway toward the 2°C target pledged during the Paris Agreement.

10. Results from Pathways project show that the countries in the ECE region will need both reduce its dependence on fossil fuels from over 80% to around 50% by 2050, and to achieve significant negative carbon emissions. The countries in the ECE region need to cut or capture at least 90Gt of CO_2 emissions by 2050 to stay on a pathway to meet the 2ºC target given the technology options modelled[1](see figure 1). As fossil fuels are likely to continue to play an important role for ECE member States in the short and medium term, achieving carbon neutrality will require deployment of CCUS technologies and other compensation technologies and measures, such as increasing the absorptive capacity of natural carbon sinks – forests and oceans (see next section on policy recommendations).

[1] Reference scenario is based on shared socio-economic pathway (SSP2) a "Middle of the Road" or Business-as-Usual Pathway, as point of departure. Its socio-economic, market and technology assumptions represent middle-of-the-road developments. SSPs do not include climate mitigations policies or measures (other than those existing in 2010). SSP2 provides an appropriate 'base case' for the exploration of multiple (alternative) pathways and is also basis for the IPCC work. The NDC scenario assumes the implementation of the Nationally Determined Contributions (NDCs) under the Paris Agreement up to 2030 and then maintains them effectively forever. The P2C scenario is a techno-economic scenario, where regional CO2 constraints, consistent with NDC through 2030, are assumed to continue reduction beyond 2030 and thus allows to stay below 2°C by the end of the century.

Figure I
CO_2 Emissions in the ECE Region by Policy Scenario



11. The window of opportunity to meet the Paris Agreement targets and prevent climate change with a smooth transition to a sustainable future is narrowing. If serious action is not taken now the region will have to rely on more radical policy options, and the trade-offs to be made to attain the various goals will be intensified.

12. The long-term impacts of the COVID-19 pandemic on electricity sector are not clear. In light of a deepening worldwide economic crisis, it is more urgent than ever for the region to embrace transformative strategic and integrated policymaking to mitigate negative socio-economic implications and focus on sustainable low-carbon solutions. The region needs to develop concrete actions to accelerate the transformation of electricity systems and revisit its resource base as low-carbon, resilient and interconnected electricity systems are a precondition for region's economic recovery.

III. Policy Recommendations

13. Based on the results from Pathways project modelling exercise and multi-stakeholder consultations, the policy recommendations on possible ways of accelerating transition to sustainable energy systems in the ECE region from the cleaner electricity standpoint are as follows:

(a) Pursue energy efficiency and productivity as the core of the future energy system. Improve efficiency of production, transmission, distribution and consumption of energy;

(b) Prevent excessive fugitive emissions in the energy sector. Deploy and disseminate best practice guidance on methane management (monitoring and remediation) in extractive industries and natural gas system;

(c) Embrace solutions that allow reduced and negative carbon emissions to bridge the gap until innovative, next generation low-, zero-, or negative-carbon energy technologies are commercialized.

(i) Position carbon capture, use and storage (CCUS) and high efficiency and low emissions (HELE) and negative carbon technologies in policy parity with other carbon neutral electricity generation technologies (such as nuclear energy, hydrogen or renewable energy) and phase out production and consumption subsidies that are not promoting carbon efficiency;

(ii) Identify and support lowest cost CCUS opportunities across sectors and implement them to build experience and capability;

(iii) Develop and disseminate investment guidelines for low-carbon technologies HELE and CCUS. Engage with international investment community to acknowledge and seize these opportunities and to reinvest in modernisation of existing fossil fuels-based infrastructure.

(d) Modernise and optimise existing fossil fuels-based infrastructure and integrating renewable energy-based infrastructure. Any reductions in fossil fuel contribution must be managed with appropriate action to mitigate negative socio-economic implications.

(i) Address the social and economic impacts of energy transition starting now. Mitigating the negative social dimension is key to a just energy transition. All stakeholders need to be involved in developing new business models and creating job opportunities in order to not to leave anybody behind and avoid regional desertification;

(ii) Address the challenge of integrating intermittent renewable energy into power and heating grids. Demand-side flexibility and storage can facilitate integration of variable renewable generation. Standards are required to optimise flexible power systems that rely on the interplay of fossil fuels and renewable energy;

(iii) Build cross border integration and resilience of energy networks with quality energy access in mind.

(e) Improve the legal, regulatory, and market structure frameworks to enable further transformation and digitalisation of the energy system. The improvements need to be transparent, embrace all technologies that can contribute to attainment of sustainable energy and support the emergence of new business models.

(i) Discourage the use of high carbon energy sources with environmental taxes or a price on carbon. A measure that reflects the costs and consequences of climate change is vital for the economics of lower carbon energy solutions and to catalyse the energy transition;

(ii) Establish regulatory frameworks for big data, smart grids and an integrated systems approach to support energy transition and create opportunities for new entrants;

(iii) Accelerate deployment of Information & Communication Technologies (ICT) to improve demand-side participation in energy markets, improve supply and demand side efficiencies, and enable greater penetration of intermittent renewable energy.

IV. Implementation of Pathways Project Recommendations and Next Steps: Project on Attaining Carbon Neutrality in the ECE Region

14. In May 2020, the Group of Experts launched the Carbon Neutrality project and initiated consultations on the concept of carbon neutrality with the wider energy expert community. The Group of Experts formed a Task Force on Carbon Neutrality to develop a framework on carbon neutrality for the region that will be presented and discussed at the sixteenth session of the Group of Experts on Cleaner Electricity Systems on 24 November 2020 at the workshop on “Concept of Carbon Neutrality” (see document ECE/ENERGY/GE.5/2020/8) and reported to the Committee at its twenty-ninth session on 26 November 2020.

15. The Carbon Neutrality project builds on some immediate policy recommendations from the Pathways project and takes actions on the following:

(a) Pursuing systemic efficiencies across power and energy intensive industries;

(b) Exploring the role of zero (nuclear energy, hydrogen), low (fossils with CCS / CCUS) and negative carbon technologies (BECCS and DAC) to attain carbon neutrality in ECE region;

(c) Modernising and optimising the existing fossil-based infrastructure and integrating renewable energy-based infrastructure and innovative technology solutions such as CCS / CCUS.

16. The Group of Experts is invited to support full implementation of the Carbon Neutrality project and to engage with the Task Force on Carbon Neutrality to deliver on following workstreams (for detailed timeline see document ECE/ENERGY/GE.5/2020/8):

(a) Refinement of data and technology assumptions;

(b) Assessment of contribution of selected technologies to attain carbon neutrality and development of technology briefs on CCS / CCUS, nuclear energy and hydrogen;

(c) Policy dialogue and development of financial guidelines for the modernisation of the power and energy intensive industries.

17. Should additional funds be available, the Group of Experts is encouraged to look at following areas in the context of carbon neutrality:

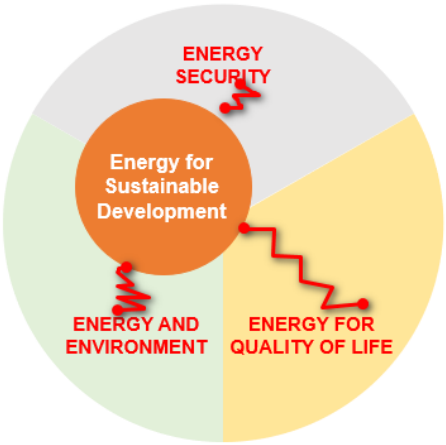
(a) Analysis on energy storage solutions and namely availability of mineral resources to support energy revolution that requires an exponential amount of resources driven by growing demand for electric vehicles and batteries;

(b) Analysis of the role of digitalisation and smart innovative technologies, such as smart grids, internet of things, 5G technology for advanced and smart grids, internet of things, 5G technology for advanced and smart consumption metering, to improve both demand and supply side participation in electricity systems.

Annex

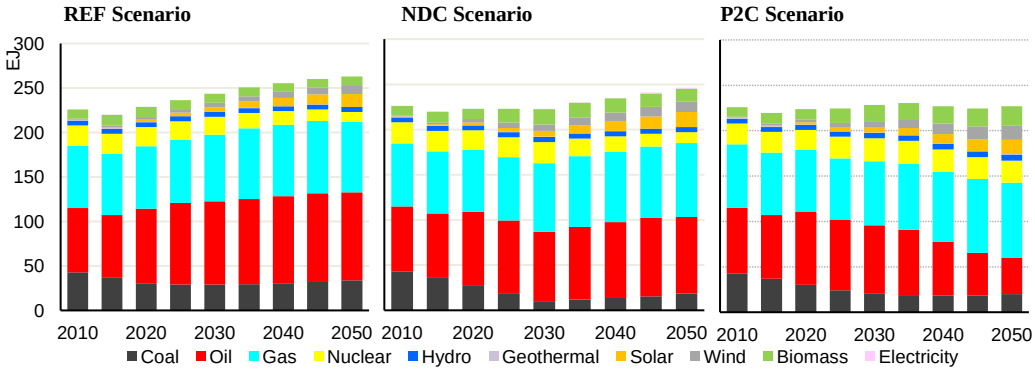
1. Attaining sustainable energy is extremely challenging. The project has shown just how impossible it seems to be to fully satisfy all three preconditions of the sustainable energy – energy security, quality of life and climate change – simultaneously. There are trade-offs as three pillars are in constant competition and thus one could speak of a tension between at least two of the objectives or pillars (see Figure I)

Figure I
Energy for Sustainable Development in the ECE Region



2. Since energy security is a priority for countries, countries that have access to fossil fuels are likely to continue to burn them as long as their economies continue to rely on them. There is no economically rational scenario involving a substantial fall in fossil energy. Carbon emissions must be captured and prevented from entering the atmosphere in any scenario that reduces climate change if the 2°C target is to be achieved by the end of the century (see Figure II). Technological change is crucial to accelerate energy transition and achieve sustainable energy.

Figure II
Primary Energy Demand in the ECE Region by Policy Scenario



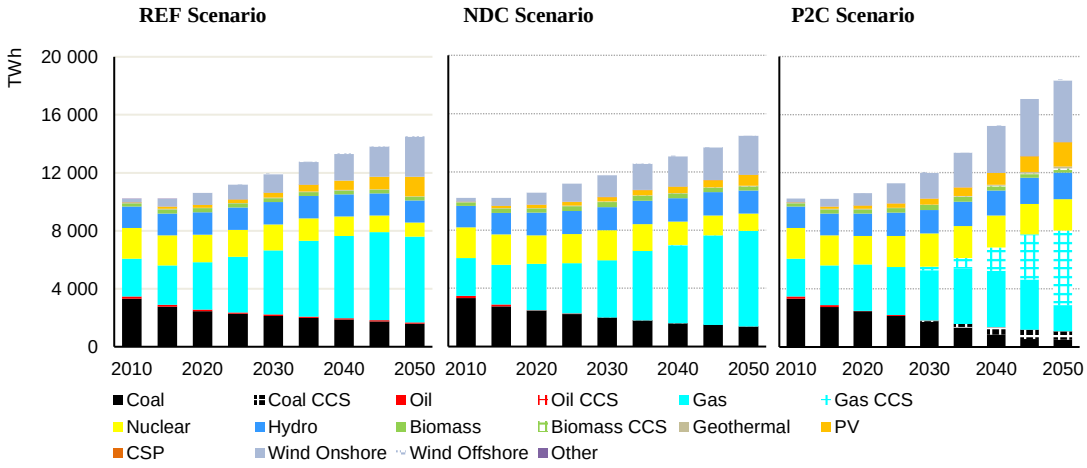
3. Similarly to the primary energy mix, the electricity generation mix in the ECE region is predominately fossil fuels-based (coal and natural gas), followed by nuclear energy and hydro. The current traditional electricity supply system in the region is defined by large scale plants that generate single-directional, mainly fossil fuel-based, power and heat to end-users.

4. More ambitious climate mitigation policies imply higher degree of diversification with faster uptake of low-carbon emitting technologies. The modelling results shows that in the most ambitious P2C scenario, on the back of the expected widespread electrification of

the energy system, 30% higher electricity demand is expected by 2050 (see Figure III). Surge in low carbon electrification from 2035 is expected to be supported by two trends: i) rapid expansion in renewable energy primarily driven by wind and solar PV. This is under the assumption that required investments will be targeted towards regions where renewable energy infrastructure is still underdeveloped, such as the Caucasus, Central Asia, East and South East Europe; ii) retrofitted coal and gas with CCS will slowly be introduced from 2030 and will increasingly gain traction through to 2050. Whilst conventional coal is expected to slowly phase out, some coal-fired power generation with CCS is expected to retain the role of coal in the power generation mix. Gas and coal with CCS have great potential in the region and if accelerated can serve as an immediate solution to limit CO_2 emissions from the energy sector.

Figure III

Electricity Generation in the ECE Region by Policy Scenario



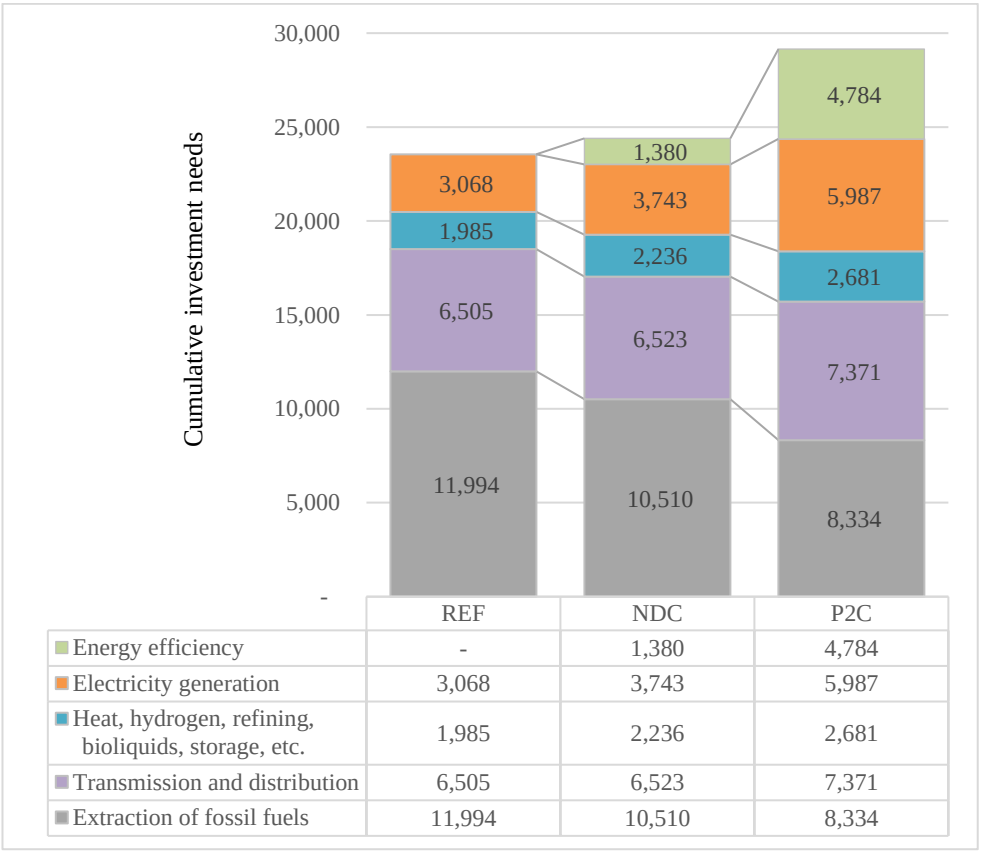
5. The longer structural and policy reforms are delayed the higher the overall cost of the energy transition will get. Today, we estimate that the countries of the ECE region need to invest USD23.5 trillion in the energy system by 2050. Changing policies to meet the 2°C target by 2050 result in additional investments of "only" USD200 billion per year higher for the entire region. Well planned and thought through national strategies can achieve sustainable energy with limited impact on energy prices (see Figure IV).

6. Considering cumulative investment for 2020-2050 in the energy system of the ECE region, both NDC and P2C scenarios suggest that energy efficiency emerges as a separate, significant component of the investment structure, and there is a clearly visible shift from upstream investments and fossil electricity generation to expenditures in energy efficiency and low and zero carbon technologies in power generation.

7. Based on the data above, in 2050 half of the region's energy will still be fossil fuel-based under any economically rational scenario. Across the ECE region, power generation, district heating system as well as transport sector continue to rely on fossil fuels. Investment thus need to be distributed across the broader range of low and zero emission technology options – fossil fuels with CCS, nuclear, hydrogen, renewable energy - and across all ECE region to enable a swift energy transition towards sustainable energy. This also implies that a predictable environment with forward looking policies is a precondition for investments in energy innovation. Poor governance and instability reduce investor confidence in some countries in Central Asia, the Caucasus as well as East and South-East Europe. There is therefore need to continue to focus on promoting mutually beneficial economic-interdependence across the whole ECE region as only trust and interdependence will strengthen resilience of energy infrastructure and address potential risks.

Figure IV

Projected cumulative energy system investment needs in the ECE region in 2020–2050, by scenario, billion US$



	REF	NDC	P2C
Energy efficiency	-	1,380	4,784
Electricity generation	3,068	3,743	5,987
Heat, hydrogen, refining, bioliquids, storage, etc.	1,985	2,236	2,681
Transmission and distribution	6,505	6,523	7,371
Extraction of fossil fuels	11,994	10,510	8,334