United Nations ECE/ENERGY/2021/15

Economic and Social Council

Distr.: General
12 July 2021

Original: English

Economic Commission for Europe

Committee on Sustainable Energy

Thirtieth session
Geneva, 22-24 September 2021
Item 5 of the provisional agenda
Pathways to sustainable energy

Considerations for draft position on attaining carbon neutrality in the United Nations Economic Commission for Europe region

Prepared by the secretariat

Summary

Carbon neutrality will require structural change in the energy sector and beyond. Recognising that United Nations Economic Commission for Europe (ECE) member States take different views regarding the use of fossil fuels, carbon capture, use and storage (CCUS) and nuclear power, all technologies will be needed to achieve net-zero carbon dioxide emissions. Cross-border cooperation and dialogue is critical to enhance inclusive multi-stakeholder initiatives across industry and government to deliver affordable access to modern, sustainable energy services across the ECE region.

The Committee on Sustainable Energy at its twenty-ninth session requested the secretariat, with the support of the subsidiary bodies of the Committee, to consolidate the analyses conducted by the Expert Groups to continue drafting a position paper of the ECE on carbon neutrality to be considered at the thirtieth session of the Committee. This policy paper provides a high-level overview of the analyses conducted, highlights non-exclusive possible approaches to delivering carbon neutrality, outlines the principles to attain carbon neutrality and, whilst recognising that ECE member States take different views regarding the use of fossil fuels, CCUS and nuclear power, calls for a holistic energy approach in which all technologies have a role to play. Notably, it requests that countries should commit to carbon neutrality by 2050 in their plans and targets to attain the 2030 Agenda for Sustainable Development and the Paris Agreement.

I. Introduction

1. "Carbon neutrality" is defined as a balance of anthropogenic emissions of greenhouse gases (GHGs) and their removal. Achieving such a balance requires that all anthropogenic GHGs emitted be offset by an equivalent amount of GHGs removed, either through natural sinks or removal technologies such as carbon capture, use and storage (CCUS), bioenergy with carbon capture and storage (BECCS), direct air capture, and the like. This perspective assumes that the natural carbon cycle will remain stable and will not become a net emitter of GHGs. Ensuring such stability would require that global warming be limited to 1.5-2°C above pre-industrial levels.

2. Temperature rises above 1.5-2°C above pre-industrial levels are considered to be a tipping point beyond which the natural carbon cycle will become a source of GHGs. The World Meteorological Organization (WMO) issued a report warning that average global temperatures will have risen by 1.5°C within the next 5 years.[1] It would appear that the sands of time have run out.

3. National commitments made to date to address climate change are considered insufficient to keep global warming below a 2°C increase above pre-industrial temperatures. With growing evidence that climate change is accelerating, there are increasingly strident calls to take serious action to reduce the carbon intensity of the energy system. The window of opportunity to prevent climate change with a smooth transition has narrowed and more radical policy options are becoming necessary. Approximately 80% of the primary energy mix both globally and in the United Nations Economic Commission for Europe (ECE) region is fossil fuel based. Many countries and regions consider achieving carbon neutrality as a stepping-stone to delivering on their climate commitments, but there has yet to be a full reckoning of the implications of that approach for delivering on the 2°C objective let alone the remainder of the 2030 Agenda for Sustainable Development (2030 Agenda). ECE considers that integrated solutions are possible but that they require financing and involve bold action on resource management, reducing the environmental footprint of existing predominantly fossil-fuelled energy systems, and pursuing fundamental transitions. Achieving carbon neutrality by 2050 will cost ECE member States approximately 41 trillion US$.[2] Continuing with current market models means that achieving the 2030 Agenda for Sustainable Development will involve making trade-offs among the various goals. The pressure on policymakers to weigh the trade-offs in one direction or another will intensify as there is growing tension between securing reliable, accessible, and affordable energy to meet enhanced quality of life expectations and mitigating climate change.

4. There are various ways to define a climate change objective: (i) set a focused goal to attain carbon neutrality by 2050; (ii) set tighter goals at a level to meet the 2°C target by 2050; (iii) set even tighter targets to meet a 1.5°C target by 2050; (iv) accept an overshoot of carbon budgets associated with 1.5-2°C targets but commit to negative emissions later to meet the objectives. Interim milestones can signal any gaps that are emerging relative to the selected emissions pathway. The alternative pathways reflect a 'budget' for carbon emissions that will vary by sub-region, climate mitigation policy measures and level of deployment of zero- and low-carbon technologies. Each of the carbon pathways would need to consider the possible implications for the broader 2030 Agenda.

5. This paper focuses on the contribution of the energy sector to attainment of carbon neutrality. Achieving carbon neutrality necessarily would involve the whole economy considering embedded carbon in products and GHG emissions from non-energy sectors (agriculture, municipal solid waste, landfills). Similarly, approaches to limit global warming to 2°C will involve comprehensive carbon neutrality policies that go way beyond energy.

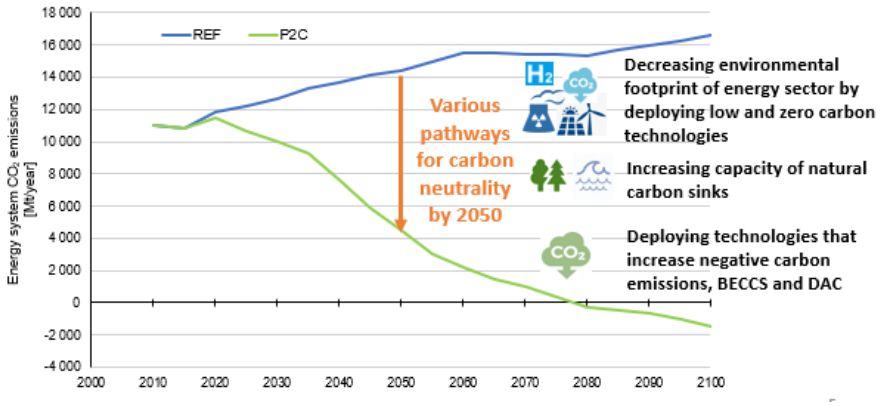
6. Achieving carbon neutrality will require a holistic system approach and an "all technology" approach. There is no single technology that will enable a fast energy transition and decarbonisation of the energy sector. Recognising that ECE member States take different

[1] World Meteorological Organization, 2021. State of the Global Climate 2020, https://public.wmo.int/en/our-mandate/climate/wmo-statement-state-of-global-climate

[2] ECE, 2021, https://unece.org/sites/default/files/2021-07/02June2021_MESSAGE%20Modelling%20introduction.pdf

views regarding the use of fossil fuels, CCUS and nuclear power, this approach obliges a technology interplay involving accelerated deployment of energy efficiency, renewable energy, CCUS, low emissions technology, low carbon gases, clean hydrogen, nuclear power, natural carbon sinks, and possibly direct CO_2 removal.

Figure I
Pathways to Carbon Neutrality



Source: UNECE, 2020, Pathways to Sustainable Energy - Accelerating Energy Transition in the UNECE Region [3]

7. There are several non-exclusive possible approaches to delivering carbon neutrality:

(a) Improve end-use energy efficiency and productivity cost-effectively to minimize the primary energy supply needed to meet demand (all economic sectors with energy and resources as service industries, minimum performance standards for equipment, efficient organisation of urban environments, rationalisation of subsidies, institution of a real price on GHG emissions, etc.);

(b) Reduce losses in transformation, transmission, and distribution (reduce methane emissions, improve power generation efficiencies, improve total system efficiency);

(c) Shift to zero- and low-carbon primary energy sources;

(d) Capture CO_2 emissions through faster deployment of CCUS and direct air removal technologies;

(e) Promote research and innovation in clean hydrogen and develop hydrogen infrastructure;

(f) Deploy smart technology for systemic decarbonization that delivers quality of life;

(g) Manage carbon sinks, notably forests and oceans.

8. In each of these areas there will be a set of technology and policy options, and the costs of the options will vary for each country. In an ideal world the options will accumulate to a point at which carbon neutrality is achieved at least cost for the region.

II. Principles

9. Carbon neutrality is not an end goal. Achieving sustainable energy is a complex social, political, economic and technological challenge. Recognising that ECE member States take different views regarding the use of fossil fuels, CCUS and nuclear power, investment will be needed in all technologies including energy efficiency, renewable energy, fossil fuels with CCUS, nuclear, and hydrogen to bend the curve on GHG emissions. Attaining carbon

[3] https://unece.org/fileadmin/DAM/energy/se/pdfs/CSE/Publications/Final_Report_PathwaysToSE.pdf

neutrality is a first milestone towards sustainable energy as social and quality of life aspirations need to be satisfied and countries are challenged in their attempts to phase out fossil fuels as fast as required to stay on a pathway to meet the 2°C target.

10. A first principle in efforts to attain carbon neutrality is to do no harm. Near-term steps to achieve carbon neutrality should not create financial, policy, or technical obstacles to taking the deeper steps that will be needed to achieve the longer-term 2°C or better objective. Taking steps and investing in infrastructure in ways that are not consistent with the longer-term goals would be self-defeating in the long run even if short-term goals are met. An example of this near-term/long-term conflict comes from the buildings sector that is responsible for 40% of CO_2 emissions by virtue of the energy services used in buildings. It is possible to improve the performance of buildings and the built environment significantly very rapidly and thereby accelerate attainment of carbon neutrality. However, because buildings can last for 30-60 years, building them to standards that are less stringent than best practice would embed sub-par performance for a very long time. The same logic applies in all sectors.

11. A second principle in efforts to attain carbon neutrality is avoiding tunnel vision. Focusing only on carbon neutrality without considering the remaining objectives of the 2030 Agenda risks accepting trade-offs unnecessarily. Integrated solutions that deliver on the 2030 Agenda comprehensively over the long run, with correctly conceived interim targets, will deliver enduring outcomes that meet social, environmental, and political constraints.

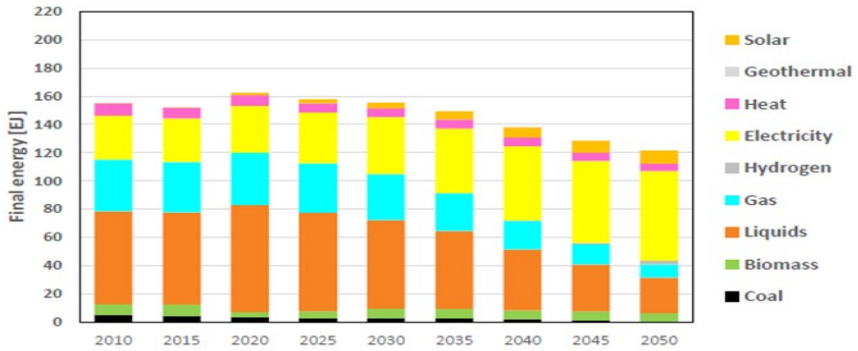
12. Third and finally, the 2030 Agenda was conceived in a human context, and there is a need to recognise the reality that we are caretakers of a planetary ecosystem that we damage at our own risk and peril. The term “Anthropocene” that applies to the current period of Earth’s history was coined in recognition of the impacts humans are having on planetary systems and the sixth extinction event that is underway. Efforts to attain carbon neutrality on the pathway to “energy for sustainable development” must be pursued from a holistic perspective that places humankind as servants to and not as masters of nature.

13. A holistic system approach involves developing a portfolio of technology options for energy services such as heating and mobility. The portfolio then could be adapted and deployed by countries as needed to respond to their own specific requirements. Countries would provide policy support to accelerate the deployment of mature low carbon technologies, commercialize emerging technologies, and establish a monitoring and reporting system.

14. Several ECE countries, such as Belgium, France, Hungary, Slovakia, and Ukraine, have reduced the carbon intensity of their energy sectors with nuclear energy contributing to approximately 50% of electricity generation. Priority areas for further exploration for countries would include hydrogen, CCUS and negative emissions technologies. Coupled with new business models and innovation, smart grids, energy efficiencies, energy storage, demand side management and environment-focused research and development (R&D), all have the ability to support a “just” transition. Countries may seek to attain carbon neutrality as a single goal, or as part of multiple goals with a higher degree of ambition or compensate high carbon emissions in the short-term with negative emissions later.

15. Analysis indicates that the ECE region will need to reduce its dependence on fossil fuels and achieve significant negative carbon emissions. Recognising that ECE member States take different views regarding the use of fossil fuels, CCUS and nuclear power, a “whole of energy” approach is considered the most effective way to reduce carbon emissions and reach a cost-effective energy mix.

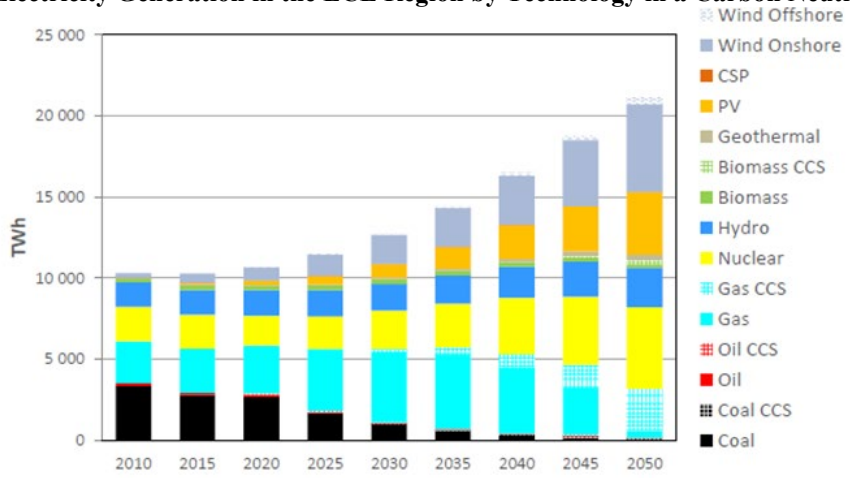
Figure II
Final Energy Mix in a Carbon Neutral Scenario



Source: International Institute for Applied Systems Analysis (IIASA), 2021. Draft results: modelling Carbon Neutrality – UNECE[4]

16. As shown in Figure II, the lion's share of final energy in the future will be electricity, most of which is consumed in buildings. Managing electricity demand will be a critical first step. In addition, managing the carbon intensity of electricity generation will be an important dimension of achieving carbon neutrality. As more electricity generation is expected to be required in the energy system of the future, there is a need to relieve pressure on electricity grids. A strong focus on wind and solar technology will require preparation of the needed land and materials. At current levels of performance, 2.5 million wind turbines or solar panels covering the equivalent of 13.5 million football pitches will be required to fill the electricity gap.

Figure III
Electricity Generation in the ECE Region by Technology in a Carbon Neutral Scenario

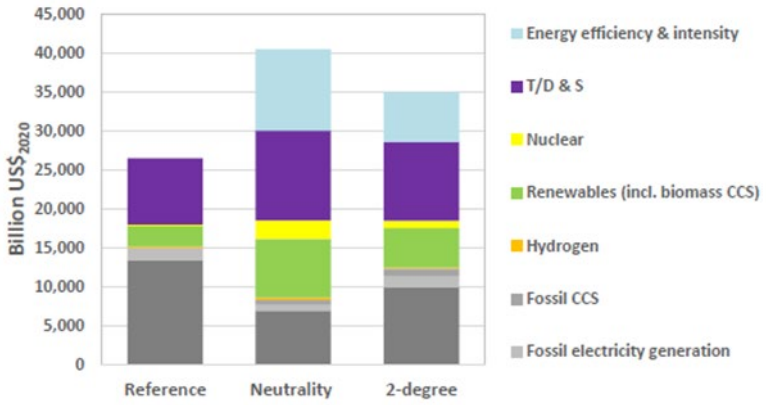


Source: IIASA, 2021. Draft results: modelling Carbon Neutrality – UNECE [5]

17. Investment will be critical to attaining carbon neutrality. Investment is increasing in carbon neutral technologies, but it is not happening fast enough or at sufficient scale, nor is it equally distributed across ECE sub-regions. In addition to mid-long-term targets for energy intensive sectors, analysis indicates much more investment will be required in energy efficiency and renewable energy.

[4] https://unece.org/sites/default/files/2021-07/02June2021_MESSAGE%20Modelling%20introduction.pdf
[5] https://unece.org/sites/default/files/2021-07/02June2021_MESSAGE%20Modelling%20introduction.pdf

Figure IV
Cumulative Investment Requirements for Reference, Carbon Neutrality, and 2° limit Scenarios



Note: T/D & S: transmission, distribution and storage of electricity and district heat
Source: IIASA Analysis, 2021. Draft results: modelling Carbon Neutrality – UNECE[6]

III. Carbon Neutrality: A Call to Action

18. There is a gap between commitments and action, and time has run out to commence the needed structural change. The greater the delay, the greater the change required. All technologies are required to address this gap. Recognising that ECE member States take different views regarding the use of fossil fuels, CCUS and nuclear power, this policy paper calls for a holistic approach that enables technologies to be able to play the role that is required of them. Using all technologies will be essential in supporting countries to attain carbon neutrality. Sharing good practice, inclusive multi-stakeholder initiatives across industry and government, and creating favourable conditions will be crucial to support the cross-border cooperation required to reach carbon neutrality.

19. Governments and industry are being encouraged to rethink energy in terms of securing affordable access to modern, sustainable energy services for all. As noted above, the first priority will be on the demand side to improve energy efficiency and productivity to deliver quality of life with a lower environmental footprint. There also is a need to modernise energy policy and technical infrastructure throughout global supply chains to enable it to integrate clean energy solutions. Further, care must be taken to enhance the capacity of natural and engineered carbon sinks, such as soil, forests and oceans and industrial CCUS, through comprehensive management techniques that consider near- and long-term implications. Finally, countries will not be able to embark on this journey in isolation. There will be need for sub-regional and regional coordination and cooperation to deliver common objectives.

20. In the near-term, several specific actions can be taken that would have significant impact at scale and would not interfere with attainment of longer-term objectives. The first three of these are described in greater detail in the document “United Nations Economic Commission for Europe member States delivering the 2030 Agenda for Sustainable Development and the Paris Agreement - A Commitment Trifecta” (ECE/ENERGY/2021/17):

(a) Improve energy efficiency and productivity in buildings and in industry;

(b) Manage methane from anthropogenic sources;

(c) Implement a global framework for sustainable resource management in line with the 2030 Agenda for Sustainable Development;

(d) Place a real price on GHGs;

(e) Re-design energy markets.

[6] https://unece.org/sites/default/files/2021-07/02June2021_MESSAGE%20Modelling%20introduction.pdf

21. In the medium-term, concrete steps should be taken to decarbonize transport (moderate demand; design transport systems; decarbonize primary fuels), adapt the built environment to deliver superior outcomes (urban design; building retrofits), and institute policies on just transition, including standards for mine closure, to ensure full societal and political support for needed changes.

22. For longer-term outcomes, as described in the "Push to Pivot" room paper prepared for the thirtieth session of the Committee on Sustainable Energy, steps should be taken now to prepare a hydrogen economy, ensure a just transition, and achieve carbon neutrality as an interim goal to limit global warming to well below 2°C. Achieving carbon neutrality will require ensuring safe and acceptable deployment of nuclear power, developing efficient and cost-effective storage technologies, and ultimately reinventing energy as a service industry. A robust policy and regulatory framework is needed for zero- and low-carbon technologies such as CCUS, hydrogen and nuclear power if they are to be available in a relevant timeframe