UNECE

Technology Interplay and Carbon Neutrality
Executive Summary

Emissions of greenhouse gases must peak now if global warming is to be limited to 2°C.
Only bold, immediate, and sustained action can decarbonize energy in time.

Improving energy efficiency and decarbonising energy supply are essential to meet the
Paris Agreement targets.

Renewable energy, highly efficient fossil fuels with CCUS,
nuclear power, and hydrogen will all be part of the mix.

CO_2 removal is key to eliminate GHG emissions from the existing, predominantly fossil fuel-based
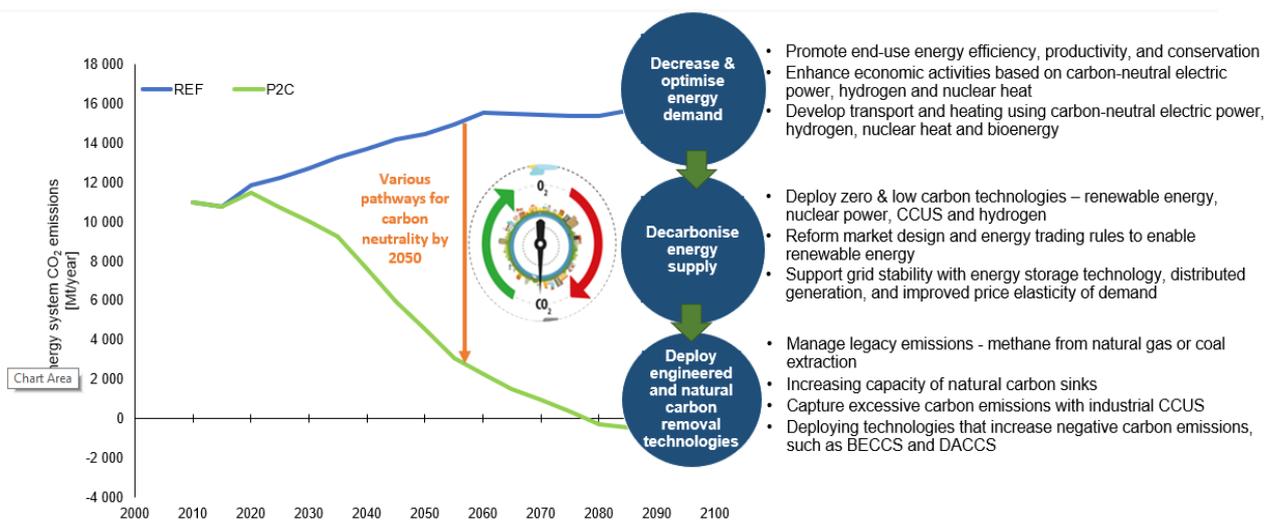*infrastructure, ensure reliable energy services and social cohesion, and enable a smooth transition.*

Human activity is causing the climate to change. National commitments made to date to address climate change are insufficient to keep global warming well below a 2°C increase above pre-industrial temperatures.

Different countries will support different technologies in different ways according to political priorities and national circumstances.

Approximately 80% of primary energy is fossil fuel. Technology solutions such as nuclear power or fossil fuel energy with carbon capture, use and storage cannot be rejected as long as alternatives are not readily available at the required scope and scale to deliver quality of life aspirations globally. There is need for a policy and technology parity across the range of low- and no-carbon technologies.

Recent developments in energy markets worldwide show that energy security and affordability remain priorities. Prices for energy are spiking worldwide. These spikes are a consequence of economic recovery post-COVID, reliance on renewable energy capacity that has under-performed, a lack of technology to store grid-level amounts of electricity, and a shortage of specific fuels. Increasing carbon prices have added additional pressure. If keeping the lights on remains the highest priority, flexibility about fossil fuels remaining in the energy mix during a transition needs to be supported by effective policies regarding efficiency and carbon capture.

Countries in the UNECE region need to cut or capture 90Gt of CO_2 by 2050 to attain Paris Agreement targets. Attaining carbon neutrality is a first milestone towards sustainable energy, but countries are challenged in their attempts to phase out unabated fossil fuels as fast as required to stay on a pathway to keep well below the 2°C target as they need to satisfy social and quality of life aspirations. This tension highlights the policy challenge, but it does not excuse inaction.

- Promote end-use energy efficiency, productivity, and conservation
- Enhance economic activities based on carbon-neutral electric power, hydrogen and nuclear heat
- Develop transport and heating using carbon-neutral electric power, hydrogen, nuclear heat and bioenergy

Decrease & optimise energy demand

- Deploy zero & low carbon technologies – renewable energy, nuclear power, CCUS and hydrogen
- Reform market design and energy trading rules to enable renewable energy
- Support grid stability with energy storage technology, distributed generation, and improved price elasticity of demand

Decarbonise energy supply

- Manage legacy emissions - methane from natural gas or coal extraction
- Increasing capacity of natural carbon sinks
- Capture excessive carbon emissions with industrial CCUS
- Deploying technologies that increase negative carbon emissions, such as BECCS and DACCS

Deploy engineered and natural carbon removal technologies

Integrated solutions are possible. The interplay among technologies points to clear pathways to attain a carbon neutral energy system. Attainment of carbon neutrality requires an integrated systems approach and the financial, technical, and policy capacity to build needed infrastructure and access natural resources sustainably.
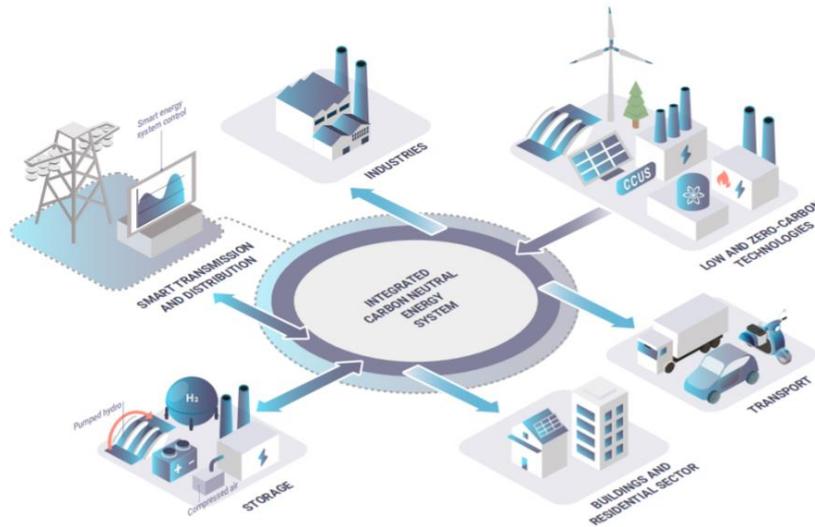
UNECE has reviewed national approaches for attaining carbon neutrality and has developed a series of recommendations to accelerate the transition to a carbon neutral energy system. Policies are needed to moderate demand for energy services, decarbonise the energy supply needed to meet demand, and address the social and economic disruptions of energy transitions that prevent countries from committing to serious action on climate change:

- **Incentivise the private sector, regulators and governments with economically, socially, and environmentally effective tools** to enable financing and development of needed infrastructure and resources. Restructure energy market frameworks and transform the financial system to a low-carbon economy. Investments required to attain carbon neutrality are significantly less than the economic, social, and human costs of the pending climate catastrophe.

- **Conduct life cycle analysis of all technology** to understand potential environmental, economic, and social implications of the array of low- and zero-carbon technologies and the contribution these technologies can make to global sustainable development.

- **Develop and deploy agnostic, rational, and pragmatic policy parity frameworks for technology based on the life cycle assessments.** Many developing technologies need supportive regulatory frameworks to enable rapid commercialisation. Policymakers need to develop and integrate polices that would support faster technology deployment.

- **To the extent possible, use existing energy infrastructure on the pathway to carbon neutrality** to reduce the financial burden of the transitions and to avoid stranding assets. This approach will be important across the energy system including industry, transport and buildings.

- **Embrace the concept of a circular carbon economy.** Reducing, reusing, recycling and removing greenhouse gases (notably CO_2 and methane) will drive structural shifts throughout the value chain and enable a systemic approach to industrial clusters across the region.

- **Assess the impact of carbon neutrality on energy intensive industries.** These deserve special attention as their integration into the energy system and large carbon footprints make their transformation towards a carbon neutral form of production challenging. Requirements for un-interruptible baseload electricity, high temperature process heat, Scope 1 and 3 emissions need special consideration.

International cooperation is essential to support all countries in the UNECE region to build resilience of the energy system and to accelerate energy transition towards attaining carbon neutrality. Different countries and sub-regions require different solutions based on their socio-economic and political circumstances as well as access to natural resources. UNECE continues to offer a neutral platform for inclusive and transparent dialogue, exchanges of best practices and lessons learned, and development of consensus on effective approaches to achieving carbon neutrality.