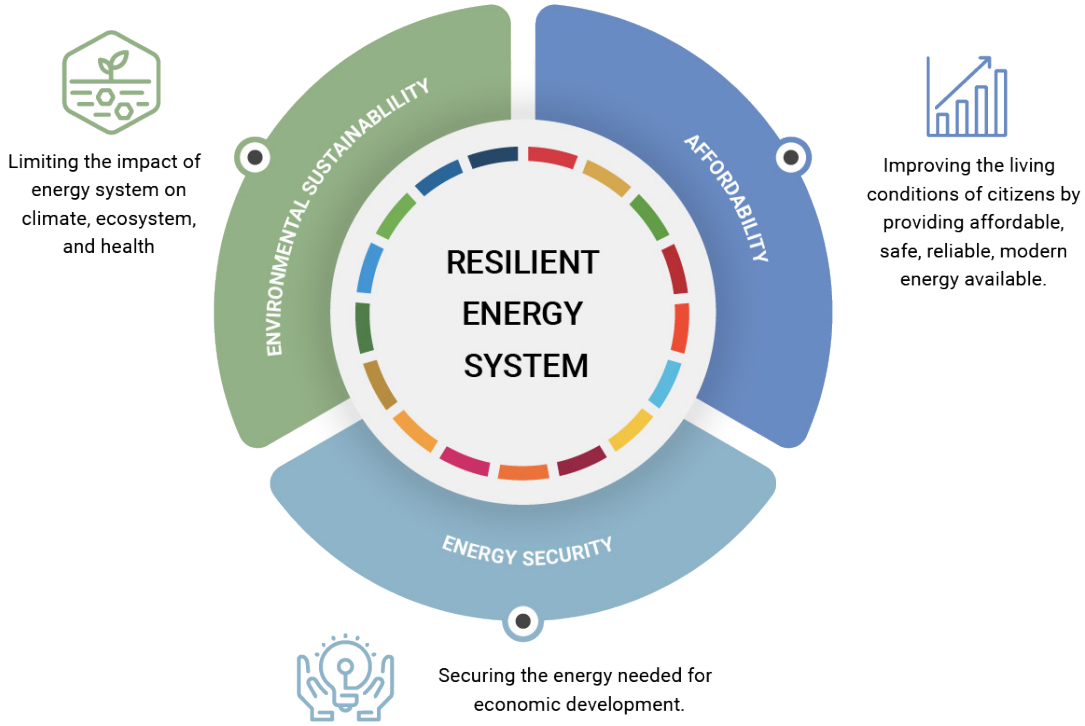
Building Resilient Energy Systems

Actions for Achieving Greater Energy Security, Affordability and Net-zero in the UNECE Region

The United Nations Economic Commission for Europe (UNECE) region is at a crossroads and the time is now for member States to implement policies to build resilient energy systems that provide reliable and affordable access to energy, enhance quality of life and economic growth and minimize the overall environmental impact of the energy sector.

FIGURE 1

What is a resilient energy system?



A resilient energy system is one where energy makes an optimal contribution to a country's social, economic, and environmental development, and that is able to withstand and recover quickly from any unanticipated shocks and reflects potential impacts of climate change on energy resources in its planning and operations.

It includes the following elements where:

- **Energy security** allows reliable energy needed for economic development.
- **Affordability** of green energy reduces the costs of electricity, heating, cooling, and transport while increasingsystemic energy efficiency.
- **Environmental sustainability** lowers the carbon footprint across the energy supply chain.

A resilient energy system will keep all three aspects of resilience in balance; over focus on one to the detriment of others will nearly always be suboptimum.

The Groups of Experts[1] under the UNECE Committee for Sustainable Energy (Committee) have collaborated to produce a technical menu of options to balance competing priorities in recognition of today's climate, security, and affordability challenges. It respects each country's right to make decisions that meet their own priorities and as such does not prescribe the specific path forward but lays out the technical considerations that are in critical need of balance at this point in time.

Recommendations for Policymakers

The Expert Groups have aligned on five important recommendations to build a resilient energy system and achieve balance among affordability, energy security, and environmental sustainability:

1. **Prioritize and maximize the implementation of energy efficiency solutions** to drive down primary energy consumed while meeting economic and societal needs.
2. **Digitalize the energy system** and take advantage of increasing consumer digital literacy capturing the enormous optimization opportunity in the value chain.
3. **Accelerate fuel switching** to optimize the carbon footprint of end use energy and replace carbon intensive fuels where practical with low- and zero-carbon options.
4. **Manage resources effectively, sustainably, and with circular economy considerations**, using the UN framework Classification (UNFC) and UN Resource Management System (UMRMS).
5. **Accelerate the deployment of low- and zero-carbon technologies** by scaling renewable energy, nuclear power and advanced fossil fuels with carbon capture, use and storage.

Key Considerations for Policymakers

As policymakers look across the options included and assess what will be best for their circumstances, it is important to bear in mind the following key considerations:

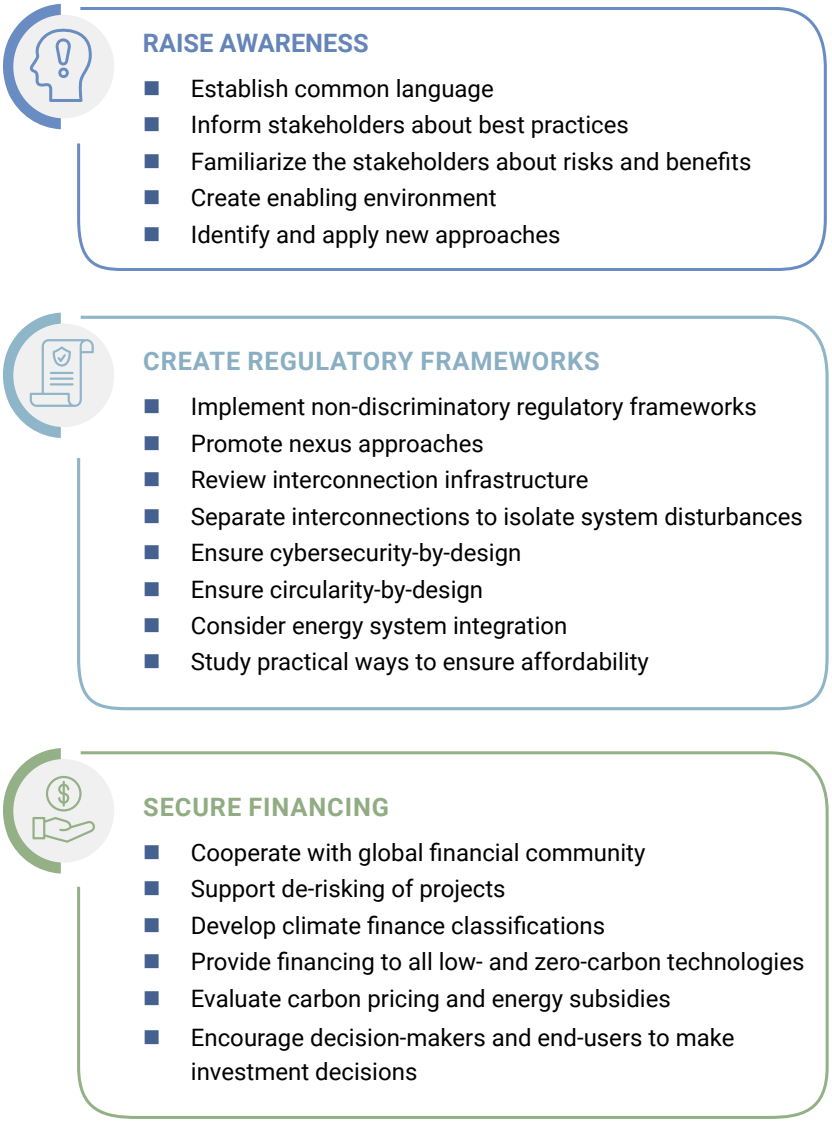
1. **Recognize that there is not a one-size-fits-all approach**.
2. **Consider long term goals as they design policies today.**
3. **Address behavioural barriers to unlock innovation and digitalization potential.**
4. **Build a workforce to deliver on a just energy transition and address the skills shortage.**
5. **Integrate resiliency concerns into existing and related planning efforts.**
6. **Consider climate change impacts on supply and demand.**

Success in meeting the multiple challenges that the energy systems in the UNECE region are facing, will require focused action by member states to take steps to raise awareness, develop the appropriate regulatory framework, and secure the necessary financing. The Expert Groups suggest a series of immediate cross-cutting actions in each arena as summarized in Figure 2.

1 Committee expert groups include the Groups of Experts on Coal Mine Methane and Just Transition, Cleaner Electricity Systems, Energy Efficiency, Gas, Renewable Energy and the Expert Group on Resource Management.

FIGURE 2

Immediate Cross-cutting Actions



By implementing these recommendations over time, the UNECE expert community envisions a comprehensive transformation of the energy systems from the existing traditional energy system to one which achieves balance across these resilience concepts and optimizes the use of energy resources (supply side) and energy consumption (demand side). This transformation vision is summarized in Figure 3 below.

FIGURE 3

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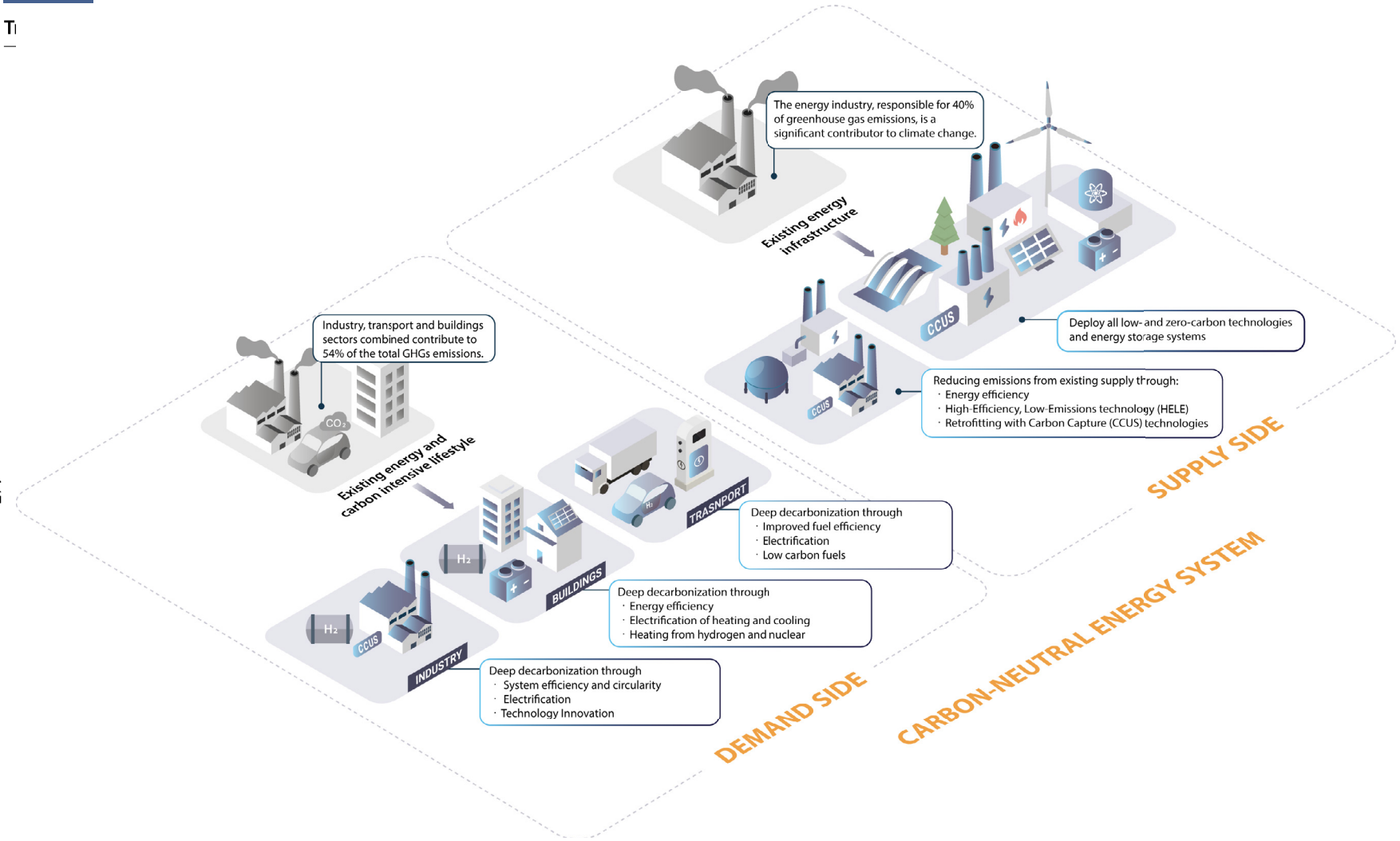
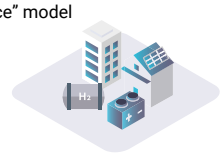


These concepts are further fleshed out with detailed options and recommendations in the report on Building Resilient Energy Systems: Technical Considerations and Actions for Achieving Greater Energy Security, Affordability and Net-zero in the ECE Region. Figure 4 summarizes the detailed actions the Expert groups recommend member States consider. The experts hope that this paper proves to be a valuable resource tool for policy makers and decision makers across the ECE Region to address the urgent needs facing the energy system to improve affordability, address energy security concerns, and reduce the carbon footprint of the sector through a just and equitable transition.

FIGURE 4

Framework of Member State Actions

	DEMAND SIDE	STORAGE AND TRANSMISSION SIDE	SUPPLY SIDE
Energy Efficiency System-Wide Digitalisation Fuel Switching-Options	**Buildings** • Decarbonize building supply chain • Modernize heating, cooling and energy distribution • Apply smart meters • Optimise resource and energy use with artificial intelligence • Integrate local generation with clean energy • Introduce "Energy and Resource as a Service" model 	**Grid Network** • Develop controls, and digitally enabled load management systems • Integrate with decentralized system • Increase routable connectivity	**Renewable Energy** • Accelerate deployment • Adopt socially and environmentally focused standards • Explore support from coal and gas • Scale up hydropower projects • Deploy decentralised smaller scale installations
	Industry • Adopt smart meters • Deploy all low- and zero-carbon solutions • Track energy use • Achieve full circularity of products • Apply principles from the UN resource management systems 	**Energy Storage** • Develop effective dispatch of variable generation • Expand transmission system and integrate electrolyzers capacity into the grid • Extend battery duration capacity • Develop pumped hydro storage • Develop hydrogen as a chemical feedstock and an energy carrier • Depleted reservoir can be used for energy storage	**Biofuel & Waste** • Deploy corn ethanol or biogas • Develop biomass projects with carbon capture utilization and storage • Unlock biomass and waste as feedstock for biogas **Natural Gas** • Integrate with CCUS for reducing emission and enhanced gas recovery • Secure liquefied natural gas import • Develop synthetic gas • Reduce fugitive emissions **Coal** • Deploy carbon capture utilization and storage and high-efficiency low emission technologies • Manage fugitive emissions • Implement rigid regulatory and financial frame-works for current projects amid phasedown
	Transport • Electrify the transport system • Develop alternative low carbon fuel 	**Geological Storage** • Develop deep saline aquifers for geological CO_2 storage • Depleted oil and gas fields used for geological CO_2 storage • Develop geological storage for hydrogen • Share practical deployment experience • Collaborative research on subsurface resource consumption	**Nuclear** • Extend operational lifetime • Deploy advance nuclear technologies for nuclear reactors **Hydrogen** •Scale up renewable hydrogen • Develop regulatory framework and support mechanisms • Expand on existing natural gas infrastructure

REGIONAL INNOVATION-RELATED
Advance efficiencies
Develop digital controls and load management systems
Innovative low- and zero-carbon technology solutions, including hydrogen, CCUS, small modular reactors
Encourage open energy data, social, and environmental reference data
Improve cyber security