

ALTERNATİVE ENERGY AND ENERGY SYSTEMS

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Combating global climate change, reducing greenhouse gas emissions, and ensuring energy security require a fundamental transformation of energy systems. The development of renewable and alternative energy sources, improvements in energy efficiency, the expansion of energy storage technologies, and access to critical raw materials are key components of this transformation. In addition to renewable sources such as solar, wind, hydropower, geothermal, and bioenergy, technologies and energy options including natural hydrogen, nuclear energy, and carbon capture, utilization, and storage (CCUS) are increasingly recognized as important pathways towards low-carbon energy systems. However, the energy transition is not limited to the development of new energy sources; it also encompasses the supply of the raw materials required by these systems, energy storage, and the management of environmental impacts.

Geosciences play a fundamental role in both the resource and implementation aspects of the energy transition. Geological, geochemical, and hydrogeological processes within the Earth's crust govern the formation of alternative energy resources such as geothermal energy and natural hydrogen, the concentration of critical and strategic raw materials, and the subsurface capacity for energy storage. Reactions associated with water–rock interactions, such as serpentinization, link several processes, including hydrogen generation, mineral formation, and carbon sequestration. Meanwhile, deep geothermal systems offer opportunities to harness the thermal and mechanical properties of the Earth's crust for energy production. The exploration and supply of raw materials essential to the energy transition, including lithium, nickel, cobalt, manganese, and rare earth elements, also require a thorough understanding of geological processes. Furthermore, applications such as underground hydrogen and compressed air energy storage, geological carbon storage, and the disposal of nuclear waste in deep geological formations require detailed assessment of the physical, chemical, and hydrogeological properties of the subsurface.

Geological and geotechnical conditions are also critical in applications ranging from the development of renewable energy systems based on solar and wind power to the construction of energy storage infrastructure. Site selection, soil and rock mechanics, groundwater conditions, natural hazards, environmental monitoring, and risk assessment are essential components of the safe and sustainable implementation of energy projects. In addition, the repurposing of depleted hydrocarbon fields for geothermal energy production or underground storage offers significant opportunities to adapt existing geological infrastructure to emerging energy systems. Accordingly, the role of geosciences in the energy transition extends beyond resource exploration and identification to encompass the planning, development, implementation, and long-term safety of energy systems.

Within the framework of the 79th Türkiye Geological Congress, whose main theme is "Geosciences in Addressing Global Challenges: Earth–Society–Future," this session aims to bring together original research on renewable and alternative energy sources, geothermal systems, natural hydrogen, critical and strategic raw materials, energy storage technologies, carbon capture and geological storage applications, and the geological and environmental aspects of energy infrastructure. In addition to recent scientific and technological advances in the energy transition, contributions addressing practical applications from



different geographical regions, as well as potential resources, research, and projects in Türkiye, are particularly encouraged. The session seeks to evaluate the contributions of geosciences to the energy transition in conjunction with knowledge and experience from different disciplines, and to provide a scientific forum for discussions on the development of safe, sustainable energy systems capable of meeting future needs.

We look forward to your valuable scientific contributions and to welcoming you to the Congress on 12–16 April 2027.