

Distinguished guests, esteemed keynote speakers, respected colleagues, and dear participants,

A warm welcome to all of you, wherever you are joining us from around the world. It is my great pleasure to welcome all of you to International Conference on Underground Energy Storage and Recovery virtual scientific gathering on behalf of Semnan University. We are united by a common scientific interest and a shared responsibility: to develop innovative, reliable, and sustainable solutions for the future of energy. I would like to begin by thanking all participants for joining us and contributing to this important international event.

The global energy system is undergoing a deep transformation. Increasing energy demand, concerns about energy security, the growth of renewable energy, and the need to reduce greenhouse gas emissions are creating new challenges for energy production, storage, and utilization. Solar and wind energy are essential components of the energy transition. However, their availability fluctuates with weather conditions and time. Therefore, storing energy efficiently and recovering it when needed is becoming increasingly important.

The future of energy depends not only on how we produce it, but also on how effectively we store it, recover it, and use it when and where it is needed. Underground energy storage and recovery can make an important contribution to energy security and the development of more flexible and sustainable energy systems. Achieving this goal, however, requires scientific rigor, technological innovation, international cooperation, and responsible decision-making. Underground energy storage offers promising opportunities to address this challenge. Geological formations can potentially provide large storage capacities and support long-duration and seasonal energy storage, depending on their characteristics and the intended application.

Depleted oil and gas reservoirs, deep saline formations, and suitable salt caverns may provide opportunities for storing natural gas, hydrogen, and other energy carriers. Underground thermal energy storage and compressed-air energy storage also represent important areas for scientific investigation and technological development.

However, successful underground storage requires much more than identifying an appropriate geological formation. We must understand fluid–rock interactions, multiphase flow, reservoir behavior, geomechanical integrity, leakage risks, environmental impacts, and the economic feasibility of each project.

These challenges require close cooperation among geoscientists, engineers, environmental researchers, data scientists, economists, and policymakers. Iran possesses substantial oil and natural gas resources, considerable experience in subsurface engineering, and geological formations that may offer opportunities for underground storage.

Salt formations and suitable depleted hydrocarbon reservoirs deserve careful scientific and technical assessment for potential storage applications. Nevertheless, realizing this potential requires reliable geological data, advanced modeling, experimental research, appropriate monitoring systems, and strict safety and environmental evaluations.

Universities have an essential role in this process. They must advance scientific understanding, educate skilled professionals, support innovation, and strengthen cooperation between academia, industry, and government.

As a major academic institution, Semnan University is pleased to support scientific dialogue and collaboration in this important field. The main objective of this conference is to provide a platform for exchanging scientific knowledge, discussing emerging technologies, identifying research priorities, and establishing new collaborations.

I hope our discussions will help address several fundamental questions:

1. How can we improve the characterization and selection of underground storage sites?
2. How can we increase storage efficiency and energy recovery while maintaining reservoir integrity and operational safety?
3. How can numerical simulation, artificial intelligence, and advanced monitoring improve our understanding and management of underground storage systems?
4. How can we translate scientific advances into technically reliable, economically viable, and environmentally responsible projects?

I encourage all participants, especially young researchers and students, to engage actively in the scientific discussions and use this opportunity to exchange ideas and establish new research connections. Although this conference is being held virtually, we hope that it will lead to the formation of lasting collaborations, joint research projects, and opportunities for continued international scientific exchange.

My special thanks go to the Policy Council Dr. Masihi, Dr. Mahani from Sharif University of Technology and Dr. Abdi from Semnan University. I am grateful to the Scientific Committee and all reviewers for their valuable contributions to the scientific quality of the conference.

I also extend my sincere thanks to the organizing and executive team for their dedication and hard work, as well as to our keynote speakers, workshop leaders, authors, participants, and supporting organizations. Their collective efforts have made this scientific gathering possible. I hope this conference will contribute to advancing knowledge, strengthening scientific partnerships, and identifying practical solutions to the challenges ahead.

The central challenge in underground energy storage and recovery is understanding how uncertainties propagate from pore-scale fluid–rock interactions to reservoir performance, field-scale energy recovery, operational safety, and economic viability. A comprehensive assessment of these uncertainties is essential to improve storage efficiency, ensure long-term reservoir integrity, minimize environmental risks, and evaluate the actual contribution of underground energy storage to achieving net-zero carbon emissions. A fundamental question arises here: How do uncertainties propagate from pore-scale fluid–rock interactions to field-scale energy recovery, storage integrity, and net-zero carbon performance?

Thank you very much for your attention. I look forward to fruitful scientific discussions and successful collaboration. I hope you all have a productive and inspiring conference.

The End

This is the slogan of our conference:

“Managing Uncertainty, Enabling Underground Energy Storage, Advancing Net-Zero Carbon.”