Subsurface Challenges

Mastering the subsurface for energy production and storage and for the management of energy waste streams constitutes a substantial energy challenge. The Department of Energy (DOE) has implemented a new collaborative model to address the following common subsurface challenges:

1. Discovering, Characterizing, and Predicting
   - Accurately characterizing the subsurface using integrated geophysical and geochemical technologies
   - Quantitatively inferring subsurface evolution under current and future engineered conditions
   - Finding viable, low-risk resources

2. Accessing
   - Safe, cost-effective drilling and completions with properly managed wellbore integrity

3. Engineering
   - Creating/constructing desired subsurface conditions in challenging high-pressure/high-temperature environments
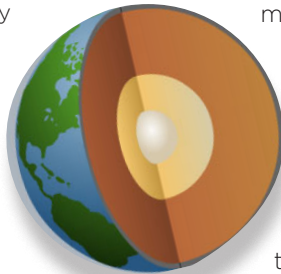
4. Sustaining
   - Maintaining optimal subsurface conditions over multi-decadal or longer time frames through complex system evolution

5. Monitoring
   - Improving observational methods to advance the understanding of multi-scale complexities through system lifetimes

Why is the SubTER Crosscut Important?

Subsurface energy sources satisfy over 80% of total U.S. energy needs. Finding and effectively exploiting these resources while mitigating impacts of their use constitute major technical and socio-political challenges. Still, the opportunities are vast. Next generation advances in subsurface technologies will enable increases in domestic natural gas supplies, as well as 100+ GWe of clean, renewable geothermal energy. The subsurface provides hundreds of years of safe storage capacity for carbon dioxide (CO_2), and opportunities for environmentally responsible management and disposal of hazardous materials and other energy waste streams. The subsurface can also serve as a reservoir for energy storage for power produced from intermittent generation sources. These opportunities have immediate connection to societal needs and Administration priorities. Clean energy deployment and CO_2 storage are critical components of the President's Climate Action Plan, necessary to meet the 2050 greenhouse gas (GHG) emissions reduction target. Increasing domestic energy supply from greater hydrocarbon resource recovery, in a sustainable and environmentally sound manner, is also an Administration goal that enhances national security and fuels economic growth.

JASON Letter Report on State of Stress in Engineered Subsurface Systems

A report prepared for SubTER by the independent JASON advisory group recommends that **"DOE take a leadership role in the science and technology for improved measurement, characterization, and understanding of the state of stress of engineered subsurface systems in order to address major energy and security challenges of the nation."** JASON recommends coordinated research and technology development at dedicated field sites to connect insights from laboratory scales and models to operational environments.

Read the JASON Report at www.energy.gov/articles/2014-jason-report-state-stress-engineered-subsurface-systems

Learn more about SubTER
www.energy.gov/subter

Contact us
Subsurface@hq.doe.gov

Who's Involved?

Representing the geosciences, research, modeling, technology development, policy, and stakeholders, the participating DOE program offices include:

Office of Fossil Energy

Office of Energy Efficiency & Renewable Energy

Office of Nuclear Energy

Office of Environmental Management

Office of Science

SubTER Pillars

Through ongoing engagement with key stakeholders to help identify high priority technology areas for federal advance-ment, DOE has developed a comprehen-sive RD&D strategy focused around four core pillars:

Wellbore Integrity & Drilling Technologies – New sensors and adaptive materials are needed to ensure sustained integrity of the wellbore environment.

Subsurface Stress & Induced Seismicity – Radically new approaches are needed to guide and optimize sustainable energy strategies and reduce the risks associated with subsurface injection.

Permeability Manipulation & Fluid Control – Greater knowledge of coupled processes will lead to improved methods of enhancing, impeding, and eliminating fluid flow.

New Subsurface Signals – DOE seeks to transform our ability to characterize subsurface systems by focusing on four areas of research: new signals, integration of multiple data sets, identification of critical system transitions, and automation.

A critical component of all pillars will be R&D testing at **Energy Field Observatories.** Field tests are critical to the validation of new results and approaches at commercial scale to validate tools, technologies, and methodologies and measure progress.

Upcoming Events

2017 Mastering the Subsurface Through Technology Innovation, Partnerships & Collaboration: Carbon Storage & Oil & Natural Gas Technologies Review Meeting
August 1–3, 2017

Geothermal Resource Council (GRC) Annual Meeting 2017
October 1 – 4th, 2017

GSA 2017 Annual Meeting
October 22-25, 2017

Geothermal Technologies Office Peer Review
November 13-15, 2017

2017 AGU Fall Meeting
December 11-15, 2017

Stanford Geothermal Conference
February 14–18, 2018

With nearly 100 Quadrillion Btu of energy generated by oil, natural gas, coal, nuclear, and geothermal, the Earth's crust affects the greater part of all domestic energy supplies.

SubTER Activities

In March 2016 the Carbon Storage and Geothermal Technologies Office released a joint funding opportunity announcement (FOA) focused on the development of technologies for sensing, analyzing, and utilizing novel subsurface signals. The purpose of the FOA is to award research and development (R&D) projects conducted by industry and universities that concentrate on one area of interest: 1) Deploy and validate prototype carbon storage Monitoring, Verification and Accounting (MVA) technologies in an operational field environment, or 2) Identify and validate new subsurface signals to characterize and image the subsurface advancing the state of knowledge in geothermal exploration. In June 2016 nine projects were selected, and were fully awarded in September 2016.

Joint Crosscutting FOA Awardees

Approximately $9M was awarded by the Carbon Capture and Storage and Geothermal Technologies Offices to Industry and Universities; five focusing on area of interest 1, and three focusing on area of interest 2:

University of Texas at Austin: Validation of MVA Tools for Offshore CCS: Novel Ultra-High-Resolution 3D Marine Seismic Technology Integrated with Coring and Geochemistry.

Clemson University: Robust In-Situ Strain Measurement to Monitor CO_2 Storage.

University of North Dakota Energy & Environmental Research Center: Field Demonstration of the Krauklis Seismic Wave in a Novel MVA Method for Geologic CO_2 Storage.

Colorado School of Mines: Advancing the Integration of Geophysical and Reservoir Simulation Tools to Monitor CO_2 Movement and Storage Permanence.

GPUSA Inc: Automated High Power Permanent Seismic Source System for Long-Term Monitoring of Subsurface CO_2 Containment and Storage.

University of Utah: Geothermal Fault Zone and Fluid Imaging through Joint Airborne ZTEMTM and Ground MT Data Inversion Analysis.

U.S. Geothermal Inc: A Novel Approach to Map geothermal Permeability Using Passive Seismic Emission Tomography and Joint Inversion of Active Seismic and EM Data.

Baylor University: Development of a Novel, Near-Real Time Approach to Geothermal Seismic Exploration and Monitoring via Ambient Seismic Noise Interferometry.