Fossil Energy

Problem Statement

Sandia's Fossil Energy Program aligns itself to support the Department of Energy's (DOE's) major programs in the following areas:

- Ensure economic vitality and minimize environmental impacts of coal
- Optimize the production of oil and natural gas from fracked reservoirs
- Have safe transportation and sufficient, safe, effective, and appropriately located storage for these resources
- Implement optimal life extension options and dynamic operation of the Strategic Petroleum Reserve

We are working to earn national leadership roles in these domains:

- Optimal design of small coal power plants
- Beneficiation of coal, methane, CO_2
- Water treatment
- Pore-scale science of carbon sequestration
- Field demonstration of real-time optimization of natural-gas production
- Cybersecurity for natural-gas pipeline systems
- Real-time monitoring and management of induced seismicity
- Risk-based pipeline monitoring and repair to minimize cost and time delays
- Ensuring integrity of subsurface natural gas storage, including well integrity

Outreach activities emphasize the following:

- Developing fully entwined relationships and joint projects with the National Energy Technology Laboratory (NETL)
- Building industry cooperative research and development agreements CRADAs in Oil & Gas Upstream and Midstream program areas
- Growing key university and laboratory partnerships

Focus Areas

Clean Coal and Carbon Management:

Sandia has a long history of investigating subsurface processes relevant to hydrocarbons and other forms of energy extraction; mining; storage of carbon dioxide; remediation of contaminants; storage of spent nuclear fuel; and fundamental coupled processes for geochemistry, geomechanics, flow, and transport. Collaborations across Sandia help to develop novel materials, filtration processes, and techniques relevant to batteries and gas separations. The integration of these capabilities is being applied to carbon capture and sequestration and will be extended to material conversion (Beneficiation).

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Sandia partners with NETL and others to develop optimization tools for plant design and to build advanced energy conversion systems (e.g., those using the Brayton cycle). These tools will be expanded to help develop modular coal energy production systems.

Oil and Natural Gas—Upstream

Sandia has computational modeling, lab and field measurement, and analytical capabilities that span the spectrum of upstream research and development from pore scale to field scale. We partner with industry, academia, and other national labs to achieve industry-relevant results. We are pursuing a university/industry partnership that would focus on optimizing natural gas production from shale.

Oil and Natural Gas—Midstream

Sandia is drawing on materials science, risk assessment, pipeline, and rail safety experience to create new approaches for pipeline inspection, repair, and optimization with multiple fluids, ensuring safe rail transportation of oil and its many byproducts, fire safety for pipelines and plants, and cybersecurity for all forms of the fossil energy infrastructure.

U.S. Strategic Petroleum Reserve

Sandia is the geotechnical adviser for the Strategic Petroleum Reserve (SPR), the world's largest supply of emergency crude oil. We are responsible for characterizing the site, which includes cavern and well development, geomechanical analysis, ensuring the integrity of caverns and wells, subsidence, and monitoring. Sandia's many subsurface capabilities enable us to support the major changes that are taking place at SPR in terms of life extension programs and the possibility of more dynamic fill/withdrawal operations. This experience, coupled with drilling technology and cement seal research, provides Sandia with a leadership role in subsurface storage for hydrogen, helium, compressed air, natural gas, and oil products, including the identification and repair of existing well bores.

Recent Accomplishment(s)

Crude-Oil Fireball Test

- Sandia successfully completed an assessment of crude-oil characterization approaches. This assessment, which was conducted for DOE, the Department of Transportation, and Transport Canada, provided recommendations for changes to the characterization standards. We have also recently completed crude-oil pool fire and fireball tests that provide critical information about the relative consequences between different types of crude oil if involved in transportation accidents that result in fires. The results of these tests are under review and will be delivered to the three-agency team in May.

- The Institute for the Design of Advanced Energy Systems team (NETL, Sandia, and others) delivered the Phase 1 plant optimization tool and is working to refine the power plant design.

- Sandia completed a water atlas of available supplies for power plant cooling for the 48 lower states. We are now making additional refinements to the atlas.

Strategic Partners

- DOE's Office of Fossil Energy and NETL
- National labs: Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, and Oak Ridge National Laboratory
- Industry: Marathon; Chevron; Pioneer; Korea Gas Corporation (KOGAS); Haliburton; ExxonMobil; Conoco Phillips; and Japan Oil, Gas, and Metals National Corporation (JOGMEC)
- Academia: University of Texas Bureau of Economic Geology, Advanced Energy Consortium (AEC), Texas A&M University, University of Utah, University of New Mexico, New Mexico Institute of Mining and Technology, Penn State University, University of Oklahoma, and Stanford University