



the **ENERGY** lab

PROGRAM FACTS

Strategic Center for
Natural Gas & Oil

Arctic Energy Office

Alaska's fossil energy resources will continue to play a greater role in meeting the nation's energy needs. Alaska holds several billion more barrels of oil, equivalent to about one-fifth of America's remaining proved oil reserves, and more than 30 trillion cubic feet of natural gas awaiting a means to reach a market.^{1,2} Undeveloped natural resources abound as well. Alaska contains 25 to 30 billion barrels³ of viscous or heavy oil that is largely untapped due to lack of technology, and the fact that it is largely within the existing North Slope infrastructure means it can be developed without growing the environmental footprint. NETL is also continuing to invest in developing technology to safely produce natural gas from the vast methane hydrate resource also located on the North Slope. And Alaska holds about one-half of the nation's coal deposits. The untapped energy resources of the high north make the area a key national energy asset.

There are many technological and economic challenges associated with the developing Alaska's abundant fossil energy resources. NETL's Arctic Energy Office is coordinating with industry, academia, and other Government agencies to identify new technologies and methods for safely developing Alaska's fossil energy wealth while maintaining the pristine environment in which it is contained. A listing of NETL sponsored projects is contained in this Fact Sheet.

Environment

The Arctic Energy Office's objectives include a strong focus on environmental issues pertaining to developing of Alaska's resources. These issues are important due to the cold climate, fragile tundra, permafrost, wildlife protection, and the focus of the nation on preserving the pristine nature of Alaska.

The Arctic Energy Office works with state agencies and the University of Alaska to identify research that will address environmental issues that limit oil, gas, and coal development. For example, on Alaska's North Slope, the oil industry must travel off-road across the tundra during winter for a variety of reasons: to carry out seismic exploration, to build ice roads for exploratory drilling, to carry out construction activity, or to resupply remote oilfields. NETL's Arctic Energy Office is working with industry, academia, and state government agencies to improve access and efficiency of Arctic Transportation Networks needed to access Alaska's fossil fuel resources while maintaining the pristine environments in which it is contained.

¹ Alaska Oil and Gas Report, November 2009, Alaska Department of Natural Resources, Division of Oil and Gas, Table I.1 November 2009 and "Summary: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Proved Reserves 2009", Table 6, Nov 2010

² The Alaska reserves include proven producing, proven unproducing, and some probable reserves. Using EIA values for proven reserves only, Alaska reserves are listed as 3.6 billion barrels compared to 22.3 billion barrels for total U.S. or 16%.

³ Thomas et al, "Alaska North Slope Oil and Gas: A Promising Future or an Area in Decline? Addendum Report", US DOE/NETL/Arctic Energy Office, April 2009.

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U.S. DEPARTMENT OF
ENERGY

Project Summaries

- ***North Slope Decision Support for Water Resource Planning and Management***

Ice roads and ice pads provide a cost effective means of oil and gas exploration on Alaska's North Slope with minimal impact to the sensitive underlying tundra. This project is developing tools that support stakeholders' needs while meeting regulatory requirements. Key components include information system technology, Arctic hydrology and climatology, water resources management, and decision support through modeling. The project team continues to meet with industry and regulators to incorporate modules that will make this a useful ice road planning tool. Researchers met with members of the life science National Science Foundation Data Conservancy (DC) Team at John Hopkins University to discuss adopting the NSDSS system for preserving and presenting scientific data for the global community. Data Conservancy team members will document the NSDSS project over the next year as the DC program develops a standard for national and global data research infrastructure organizations that will be used by researchers as a collaborative tool to advance science, research and learning.

http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ArcticResources/05683_WaterManagement.html

- ***Using Artificial Barriers (Snow Fences) to Augment Fresh Water Supply***

Current Arctic energy production is situated in a "Polar Desert." Total annual precipitation averages a mere 6"-10". With water available only 12 weeks of the year, difficulties with storing and distributing water in Arctic conditions, and high operating costs, water is a precious resource. This project evaluates the use of snow management with snow fences to augment lake water supplies. Finding an optimum location for creating snow drifts could increase the probability that this captured snow will effectively recharge a lake through most of the summer. Snow depths at the site will be measured with sensors during the 2010/2011 winter. Pretreatment water balance analysis for 2009 indicates that the majority of water loss was due to evaporation from the lake surface with only half of the water loss being replaced through summer rainfall. The cumulative rainfall in 2010 was below average and equaled only half the rainfall total for 2009. Water balance calculations indicate there is additional inflow into the man-made lake. The Alaska Dept. of Transportation has contacted the project performer, University of Alaska Fairbanks, and expressed interest in creating vegetation snow fences along highways based on the results of this project.

<http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ArcticResources/05684ArcticLakes.html>

- ***Alaska North Slope Oil and Gas Transportation Support System (Arctic Transportation Networks)***

A majority of oil and gas development and exploration on the North Slope takes place in winter when the tundra surface is stable (i.e. frozen). This project uses scientific understanding to develop a set of tools useful to industry and management such as providing the ability to forecast environmental conditions so that management agencies can respond to snow cover and soil temperature audits more effectively and industry can plan the significant mobilization efforts which take place every transportation season. This project is responsible for establishing eight data collection stations on the North Slope which can help in the modeling efforts leading to forecast. The project team also collaborates with other environmental networks in the hope of establishing standard for data collection in order to be able to extend findings from this project to other regions such as the Brooks Range Foothills, an area of interest for gas-prone exploration. So far, soil temperature modeling methods have been developed and tested, soil strength studies have been completed, a snow measurement methods manual has been created with the hope that the regulators, industry, and researchers will adopt a common method for data collection. Further, the recent development

Trans Alaska Pipeline System (TAPS)

Oil production from known resources as well as new discoveries is essential for keeping the Trans Alaska Pipeline System (TAPS) operating both technically and economically. Current production rates are about 600,000 barrels per day down from a maximum of over 2 million barrels per day in 1988. The mechanical lower operating limit of TAPS is about 300,000 barrels per day. The economic limit of TAPS will depend on world oil prices and operating costs, but as oil production rates continue to decline, the tariffs can be expected to increase, affecting the economic viability of all North Slope production. With currently producing and identified development, the TAPS minimum flow rate could be reached as early as 2045 and strand over a billion barrels of oil currently booked as reserves (economically producible). Maintaining the viability of the TAPS pipeline is essential for maintaining access to undiscovered North Slope resources and requires access in a timely manner to the most promising areas for exploration and development, such as all of National Petroleum Reserve Alaska, and the Outer Continental Shelf.



and deployment of a new “smart phone” application enabling regulators to immediately report snow and soil conditions while still in the field has been utilized for the winter of 2010/2011, eliminating two days off of the former time lag between measurements and reporting, a significant savings in time when the industry has only about 100 days to complete a season’s worth of work.

- ***Fluid and Rock Property Controls on Production and Seismic Monitoring Alaska Heavy Oils***

The Ugnu formation on Alaska’s North Slope contains highly viscous, biodegraded oils. Because of their cold temperatures and low flow rates, standard production methods are ineffective. Seismic responses from pre-production of the reservoir could be used to illuminate the local geology, which could assist in designing well trajectories that would enhance productivity. The rocks containing the fluids have porosities, permeabilities, connectivity, and mineral contents that vary over short distances; and the heterogeneity of the system is a prime factor in sweep efficiency. In addition to variability of the rock matrix, the heavy oil can have varying resin and asphaltene content further complicating recovery. This study is attempting to characterize the reservoir fluid and rock properties by using seismic data to develop a geophysical monitoring program that can potentially be used to enhance heavy oil recovery. A large number of experiments have been completed to date, including molecular beam mass spectroscopy, optical and scanning electron microscopy, x-ray CAT scans, and laboratory seismic measurements. This work is expected to improve seismic resolution through permafrost and the ability to evaluate heavy oil reservoirs. Successful completion of the project will result in the capability to monitor, over time, the progress of a heavy oil recovery process by seismic measurements.

Alaska’s Unconventional Oil Resource:

- The Alaska heavy oil resource is large, on the order of 45 billion barrels of original oil in place.
- The West Sak PA is believed to contain between 15 and 20 billion barrels of oil (BBO) with variable oil gravity from 10 to 22°API.
- West Sak development is restricted to a core area of about 2 BBO of which only 1.2 BBO is considered to be economical to develop.
- The Schrader Bluff PA is believed to contain between 15 and 20 BBO of 17°API oil.
- Schrader Bluff development is restricted to a core area of about 2 BBO of which only 1.3 BBO is considered to be economical to develop.
- Other heavy oil producing formations are Ugnu, Tabasco, Orion, and Polaris.

http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ArcticResources/05663_AlaskaHeavyOil.html



Ice road north of the ConocoPhillips Alpine Facility (M. Lilly, 2008).

- ***Use of Polymers to Recover Viscous Oil***

Alaska's North Slope contains a very large unconventional oil resource, perhaps as much as 30 billion barrels of heavy/viscous oil. Production has been limited to pools in the core area that flow with "cold-heavy-oil-production-with-sand" (CHOPS) technology, but the overwhelming majority of the viscous oil resource is stranded and awaiting technology development. Among the technology improvements could be the injection of polymers designed to change the viscosity of the oil. Therefore, this project is studying the characteristics and effectiveness of existing and new viscoelastic polymers, examining new methods for improving polymer injection techniques, and assessing sweep efficiency enhancements and the potential effects of induced fracturing and formation parting. The data is being made available to industry. Findings so far suggest the key limitation for polymer flood applications is reduced injectivity, not chemical costs, and that even at oil prices as low as \$20 per barrel, polymer floods might make economic sense.

http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/EP/ImprovedRec/06555_Polymers.html

- ***Producing Light Oil from a Frozen Reservoir: Reservoir and Fluid Characterization of Umiat Field, National Petroleum Reserve, Alaska***

The Umiat oil field contains light oil in a shallow, frozen reservoir and may be typical of an abundant supply across the Arctic permafrost making this an exciting class of reservoir. How to produce oil from this icy system, frozen into the permafrost and at low pressures, remains a mystery. This research project is designed to develop a robust reservoir model to test possible production methods for Umiat and similar frozen reservoirs without the use of steam injection or any liquids that have the potential to freeze. But designing a reservoir model is difficult because Umiat core samples showed that natural fractures which allow for subsurface oil movement (hence production) are not abundant. Fieldwork to understand the rock fracture of the area was necessary and conducted during the 2010 field season and results were used to inform one aspect of the reservoir model. In addition to geologic fracturing, an experimental apparatus was constructed to determine the relative permeability of oil and gas in the presence of ice. Armed with the results, the researchers were able to create a desktop reservoir simulation model for proposed production strategies, and to assess the results. Throughout the winter of 2010/2011, this newly created model will be used to test various production strategies and assess their potential effectiveness. This work could potentially discover a technique for unlocking oil from this unique, frozen reservoir.

http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/Arctic_Energy/5641_FrozenReservoirs.html



Trans Alaska Pipeline Traversing the Brooks Range