

PREREQUISITES FOR CAPTURING THE BENEFITS FROM NEW YORK'S NATURAL GAS AND OIL RESOURCES

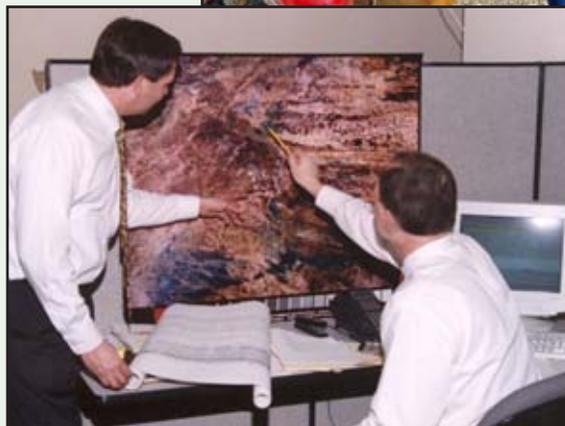
Natural gas and oil development makes a significant contribution to New York's economy, especially upstate; generating jobs, tax and royalty revenue to state and local government, and royalties and other revenues to landowners and local businesses. Natural gas development in particular provides an economic stimulus to rural communities in New York.

The current pace and scale of development in New York can create challenges for the relationships between all stakeholders: private landowners, exploration and production companies, State and local government, and the general public. Consequently, State government has the obligation to manage natural resources and protect environmental quality and improve public health while facilitating the benefits that flow from environmentally sound natural gas and oil development. To do this, the State must ensure that hydrocarbon development proceeds with protection of the environment and the public interest as its primary focus.

The recent growth in gas and oil exploration and development activity in New York has been facilitated both by proactive state agencies that ensure environmentally responsible development and protect the interests of all stakeholders, and by operators that remain responsive to public concerns.

Continued success in capturing the benefits of New York's hydrocarbon resource endowment will require concerted action from both government and the private sector in several areas:

- **Environmental stewardship.** State government must support strong and responsive regulatory programs to ensure effective protection of the environment and the public interest, incorporating cost-effective regulatory strategies and public education and outreach, along with expeditious permitting. Developers need to continue to focus on superior environmental performance, effectively addressing landowner and public concerns.



- **Technology progress.** Advanced technologies and state-of-the-art practices, applicable to the unique characteristics of New York's resource endowment, must be developed, demonstrated and applied to extend the lives of existing wells and to economically find and produce new prospects. This will require continued public-private partnerships in research, development, and demonstration of new technologies and development approaches.
- **Access to high-quality data.** Potential developers and investors in the oil and gas sector in New York will require access to high-quality data about the State's resources and production, coupled with effective data analysis and data management capabilities. Both government and industry must work collaboratively to ensure that all stakeholders have access to high quality data.

- **Access to resources.** State policies and programs must continue to support access to resources on public and private lands in an environmentally sound manner, to resolve mineral rights conflicts, to address unique access issues in urbanized areas, and to keep certain designated areas, such as in some State Parks and Preserves, permanently off-limits to development. Developers need to continue to respect the interests of the landowners.

Statewide perspectives and public/private collaboration are fundamental to addressing these prerequisites. New York's long history of oil and gas development has allowed for substantial progress on each of these fronts, contributing, in part, to the recent resurgence of oil and gas development in the State.

ENVIRONMENTAL STEWARDSHIP

New York has strong and mature regulatory programs for oil and gas exploration and development that are effective at protecting the environment and public safety. The Division of Mineral Resources in the Department of Environmental Conservation (DEC) is responsible for ensuring the environmentally sound economic development of New York's non-renewable energy and mineral resources for the benefit of current and future generations.

Role of New York Oil and Gas Industry in Reducing Greenhouse Gas Emissions

The New York Advanced "Clean Coal" Power Plant Initiative (ACCPP) was established to identify sites for the potential development of one or more advanced "clean coal" power plants. Winning plant sites will act as host sites for the research, development, and deployment of CO₂ capture and/or sequestration technologies. NYSERDA will coordinate and facilitate capture and/or sequestration RD&D projects at the project sites.

Many of the skills, technologies, and analytical approaches used for oil and natural gas exploration and development are directly applicable to underground injection of CO₂ for permanent storage. The expertise and infrastructure of New York's oil and natural gas industry could play an important role in identifying, evaluating, and implementing potential CO₂ storage (sequestration) projects in the State's geologic formations.

New York's Oil, Gas and Solution Mining Law 37 requires oil and gas producers to apply sound environmental principles and ensure that areas affected by minerals development are returned to a condition that allows productive use of the land. The Division of Minerals is responsible for regulating all oil, gas, underground storage or solution salt mining wells of any depth, and brine disposal, geothermal or stratigraphic wells deeper than 500 feet. The Division of Minerals reviews all well drilling and plugging permit applications and inspects drilling wells, production sites, and abandoned well sites. Minerals Division staff are all highly trained and well qualified for reviewing permits and inspecting drilling sites. Many are petroleum engineers, petroleum geologists or technicians.

Features of New York's oil and gas regulatory program include the following:

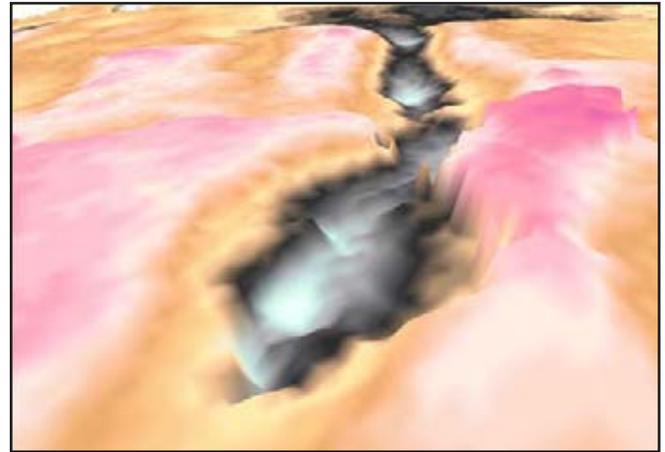
- To protect the land environment during and after oil and gas extraction, drilling permit requirements prevent oil spills and ground-water contamination, and require proper disposal of highly saline brines and other wastes. Land impacted by drilling operations must be properly reclaimed for productive use.
- To protect surface and groundwater, drilling permits require that well casing be cemented in place from the ground surface to at least seventy-five feet below the deepest freshwater aquifer penetrated by the well. In addition, all oil and gas-bearing zones in the well must be further isolated by production casing cemented in place across the hydrocarbon bearing zones. These measures prevent the flow of gas, oil or salt water between underground formations. Municipal and private water wells, reservoirs, and streams, lakes and ponds are protected with required drilling setbacks. Permits also require proper disposal of drilling waste and proper containment of drilling fluids.



DEC staff person inspects a producing gas well. A new rust-proof tank helps prevent leaks at the site.

- To protect public health and safety, and prevent waste during drilling, each permit includes conditions designed to prevent the escape of methane and dangerous gases from wells. Regulators monitor drilling sites for compliance with these conditions, and bring enforcement actions against violators.
- Site-specific permit conditions ensure that the environmental impact of resource extraction is mitigated to the greatest extent possible and that public safety is maintained. All well drilling permit applicants must submit an Environmental Assessment Form, which allows the DMN to evaluate the environmental impacts and determine whether special environmental protection and mitigation measures are required. For example, additional measures of protection are generally required for wells drilled in environmentally or technically sensitive areas, such as locations in the vicinity of primary or principal aquifers.

Ongoing efforts of New York's Division of Mineral Resources ensure that oil and gas operations in New York continue to be pursued with a high priority on environmental protection. This especially applies to environmentally sensitive areas such as the Finger Lakes region or areas where suburban expansion and oil and gas development overlap. Clear, simple and predictable regulations and policies provide substantial benefits to both developers and the public.



3-D Seismic Image

New York's Orphaned and Abandoned Wells

- To obtain a drilling permit, operators must provide financial security to guarantee well plugging and site reclamation. As of the end of 2006, \$14.9 million in bonds and other security had been posted. In 2005, 150 wells were plugged in accordance with DEC requirements.
- The New York Oil and Gas Account was created to plug "orphaned" wells that predate the State's regulatory programs. These are abandoned wells for which no financially responsible party can be found. The Oil and Gas Account is funded by a \$100 per well permit fee. More than 600 orphaned wells are on the DEC priority plugging list.
- In addition the DEC maintains an ongoing program to locate, identify, and assess previously abandoned and unreported wells.



DEC staff person locates an orphaned and abandoned well in Cattaraugus County

INNOVATION AND TECHNOLOGY PROGRESS

The successful application of cutting edge exploration and production technology to the Trenton-Black River hydrothermal dolomite play shows that recent technology advances can greatly enhance natural gas and oil recovery in the state and reduce environmental impacts. New York benefits from technology progress in four priority areas, described below:

Targeting High Productivity Reservoirs. Past perception of New York's declining natural gas potential was due in part to poor selection of sites and target formations for exploratory drilling. Advances in seismic imaging of the subsurface and integrated geologic and engineering models help to better identify targets for exploration and development in New York. Widely used throughout the world, 3-D seismic imaging can provide detailed information about fault distribution, reservoir continuity, subsurface structure and reservoir fluid movements. Increasingly, operators in New York are finding economic justification for acquiring 3-D seismic data to refine their stratigraphic objectives in complex reservoirs. Seismic data are increasingly used for mapping reservoirs and justifying proposed spacing units in permit applications. Seismic imaging has proved to be definitive for determining the structure of Trenton-Black River hydrothermal dolomite reservoirs, and Trenton-Black River production spacing units are now based on bounding faults defined by seismic data.

Improving Drilling and Well Completion. Advances in drilling and completion technologies are critical to reducing future well costs and making more resources economically producible. For example, the Stripper Well Consortium is funding research on the best fracture imaging best suited to the Appalachian Basin. Improved fracture imaging provides better calibration of fracture models and can be used to optimize hydraulic fracture treatments. Other key advances are continuing improvements in drilling horizontal wells and multi-lateral well completions, which have already proved valuable in Trenton-Black River development in New York. A recent technological development with potential for New York is the successful use of horizontal wells to develop shale gas plays, particularly the Barnett Shale in Texas and the Fayetteville Shale in Arkansas. The success of horizontal wells in other shale formations may stimulate renewed interest in testing New York's Devonian and Ordovician-age gas shales with horizontal wells.



Schlumberger directional drilling assembly photographed at Fortuna Energy's Drumm #1 well in Steuben County. A directional drilling assembly allows the driller to control the direction of the wellbore while a well is being drilled. This type of tool is used to drill horizontal or directional wells.

Extending Well Life. Given the large amount of stripper-well production in New York, extending the lives of low-productivity wells is an important objective of advanced natural gas and oil development technology. Production levels in many wells decline prematurely, often due to avoidable and repairable wellbore damage. Higher oil and natural gas prices alone are not enough to save wells — and entire fields — from premature abandonment.

The Pennsylvania State University, with support from NYSERDA and the U.S. Department of Energy, established the Stripper Well Consortium (SWC) to assist small and independent operators who own and operate marginal wells in New York and throughout the Appalachian Basin. The SWC is an industry-driven consortium focused on the development, demonstration, and deployment of new technologies needed to improve the production performance of stripper wells. Through the SWC, small operators who would otherwise have no staff or resources for research can leverage their resources to analyze the causes of premature production decline and develop effective remediation approaches. Such efforts can result in higher production volumes, longer well life, and, thus, greater production and resulting economic benefits.

Reducing Greenhouse Gas Emissions. Reducing greenhouse gas emissions has become an important priority for New York and the nation. Seven northeastern states, including New York, have formed the Regional Greenhouse Gas Initiative (RGGI) with the goal of reducing greenhouse gas emissions in the region. The oil and gas sector could play an important role in this initiative by assisting in the storage of greenhouse gases, particularly CO₂, in geologic formations. Substantial research and development efforts are required to better understand the risks and opportunities for geologic storage of CO₂ in New York, and NYSERDA has recently initiated several research efforts with this goal in mind.

Across the board — from exploration, to drilling and completion, to production, to environmental protection — advanced technologies can make all the difference in enabling increased oil and gas supplies from the hydrocarbon plays of New York. Smaller independent producers may lack the access to capital and expertise required to integrate advanced technologies into their operations. Renewed efforts to demonstrate to small independent producers the potential application of advanced technologies could pay substantial future dividends to industry, landowners, and consumers in the State.

ACCESS TO HIGH-QUALITY DATA

Access to high-quality data, including geologic, engineering, reservoir and production data, is invaluable to potential developers and other stakeholders. Good data enable the identification of new prospects, increase the likelihood of successful exploration and production, and assist state agencies in monitoring the progress of development and ensuring use of appropriate environmental safeguards.

New York has one of the best developed information management systems for oil and gas data in the Appalachian Basin and in the U.S. The Division of Mineral Resources has extensive oil and gas data on its website, including live database queries. In addition, the Minerals Division and the Resource Characterization Group of the New York State Museum have collaborated on the development and maintenance of the Empire State Oil and Gas Information System (ESOGIS), a comprehensive data source for oil and gas data in the state of New York. ESOGIS allows users to query and view data for all of New York's 33,000+ recorded wells, and provides online access to maps, papers and other information important to New York's oil and gas industry, potential investors, and the public. Currently, ESOGIS contains paper files for 26,000 wells, formation tops for 11,000 wells, raster images for 13,000 wells and complete digital log suites for 400 wells.³⁸

NYSERDA Supports the Stripper Well Consortium

The Stripper Well Consortium (SWC), established in 2000, is focused on the development, demonstration and deployment of new technologies needed to improve the production performance of natural gas and petroleum stripper wells. The SWC receives base funding from the DOE, NYSERDA, and the Pennsylvania State University. The Pennsylvania State University is responsible for management of the SWC. Research is conducted in three broad areas: reservoir remediation, wellbore liquids removal and clean-up, and surface-system optimization.

NYSERDA co-funds technology development and demonstration projects independently and as a partner in the SWC. Recent projects focused on increasing the productivity and extending the economic life of New York's existing oil and gas wells include:

- Advanced Decline-Curve Modeling for Stripper Well Production Analysis. This project developed software designed for low-permeability gas wells, enabling operators to cost-effectively analyze under-performing wells.
- Improvements to the GOAL PetroPump, an affordable and effective automated casing swab-and-lift designed for stripper gas wells.
- Demonstration of “Hydroslotter” technology in New York to improve near wellbore permeability for wells that cannot be hydraulically fractured.
- Demonstration of a prototype of a new pump designed to reduce casing-head pressure and improve performance of stripper wells

ACCESS TO RESOURCES

Obtaining access to explore and develop oil and natural gas resources can be a complex task, involving the interests of private land and royalty owners, sometimes ambiguous mineral rights, and competing land uses. Approximately 93 percent of the New York portion of the Appalachian Basin is private land. Less than one percent of total Appalachian Basin acreage in New York is federal land or split-estate land (where the federal government owns mineral rights while another entity, either private or state, owns the surface land). Federal lands in the basin are managed primarily by the U.S. Forest Service. Oil and gas resources underlying the 174,984 acres of Federal lands in New York are currently not open to oil and gas leasing, with the exception of two parcels in New York that are owned jointly by the State and the Federal government.³⁹

State Land. New York State controls more than one million acres of land for parks, recreation, reforestation, and other uses. Some lands, such as state parks, have legal or constitutional use restrictions on leasing for oil and gas development. For example, Catskill State Park is excluded from oil and gas leasing. On other lands, multiple uses, including oil and gas development, may be allowed depending on specific circumstances. New York State leases State Reforestation Areas, Multiple Use Areas, Wildlife Management Areas, Department of Transportation rights-of-way, and other state agency and certain State University lands. New York's

Environmental Conservation Law ("ECL") Article 23, Title 11 (§ 23-1101) authorizes the Department of Environmental Conservation to issue leases on behalf of the State for all state-owned lands for the purpose of oil and gas development, except for State park lands and other specifically prohibited lands. This program did not become active on a regular basis until the mid-1980s. Some tracts may be withdrawn from leasing to protect important habitat, wildlife, recreational, and scenic values.

There are four ways in which New York State receives revenue from leasing of state lands:

- The State receives bonus bid payments from the successful bidders on tracts offered at State lease sales. Competitive oil and gas lease sales were held in 1999, 2003 and 2006.
- In 2005, New York received annual delay rentals, typically \$5 per-acre per-lease, for more than 31,754 acres under primary term.
- In 2005, the State received a 12.5 percent, or one-eighth royalty, on the gross production revenues from 20,856 acres under secondary term leases.
- The remaining 11,911 acres were leased for gas storage fields for which the State received an annual fee.

NYSERDA's Contribution to Oil and Gas R&D

NYSERDA conducts multifaceted energy and environmental research and development (R&D) remains unique as the only state-supported, industry-driven R&D program in the United States. NYSERDA works with New York's oil and gas industry to reduce the risk associated with identifying and developing new resources, and with using new technologies for exploration, drilling, and production.

NYSERDA's support for hydrocarbon exploration and production dates back to its inception in 1975. Early support included the Eastern Gas Shales Program, Trenton Limestone exploration, and the Auburn geothermal/natural gas well, which helped initiate the Trenton-Black River hydrothermal dolomite play. Recent NYSERDA projects and partnerships have led directly to greater industry investment in oil and gas resources in New York and increased production of natural gas. Examples include:

- *A joint venture between Ardent Resources and U.S. Energy Development Corporation drilled a Theresa Sandstone*

discovery well in Erie County using NYSERDA supported geologic data. As of year end 2005, cumulative production from the well exceeds 201 MMcf.

- *NYSERDA funded studies of the Trenton Limestone potential in New York's Northern Tier to determine if the application of technology could create new opportunities in the shallow fractured Trenton limestone. NYSERDA's study led directly to the leasing and drilling of three wells in Oswego County. Four more wells have been drilled in Wayne and Cayuga counties. Three of these wells resulted in natural gas discoveries.*
- *In response to expanding gas production from fractured shale formations throughout the United States, NYSERDA funded new studies of the natural gas production potential of New York's Devonian and Ordovician black shale formations, primarily focused on developing tools and approaches that industry can use to explore and develop reservoirs of this type in New York.*

As of year-end 2006, 64,521 acres of state land were leased for oil and gas development and natural gas storage.

Environmental protection measures in drilling permits stipulate the location of the drill site and access roads to minimize land surface disturbance. Environmental mitigation and land reclamation measures are required to minimize environmental impacts. As of year-end 2006, only 31 acres of the 40,000 state lands leased in the 1999 and 2003 lease sales have been disturbed by drilling and production activities.



The Chemung SRA #1 disturbed 1.5 acres out of a total of 195 acres leased. The use of native vegetation to reclaim the drill site made the producing well barely visible from the road.

Private Land. Most of the natural gas and oil development in New York State occurs on private land. The high percentage of private land ownership New York, often distributed in relatively small parcels, creates technical and operational challenges. Acquiring an acreage position large enough for drilling or for a 3-D seismic program can become expensive and time-consuming.

In 2005, new legislation was enacted that provides additional protections to landowners who lease their properties for oil and natural gas development. The new legislation simplifies the options for integrating landowner interests into oil and gas units and improves consumer protection measures. An oil or natural gas unit includes the landowners and mineral rights owners within a geographic area that corresponds to the reservoir area expected to be drained by a producing well.

Mineral rights owners within the surface boundaries of a proposed unit now have the option to participate in a well as a working interest owner, or to be integrated cost-free into the unit as a royalty interest owner. All individuals participating in oil and natural gas units must have notice of the significant legal import of their leases, and all lease contracts are required to contain an unconditional right of rescission within three business days.

Wells drilled to any formation but the Trenton-Black River, and some other formations, have standard rules for the spacing of wells, the size of oil and gas units, and the well-setbacks from lease boundaries. Well spacing rules for the Trenton-Black River vary by depth. The boundaries of Trenton-Black River units are based on the shape and area of the underlying reservoir as indicated by well data, seismic imaging or other suitable remote sensing technology, such as gravity and magnetic surveys.



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