Live

The Development of Tight Oil and Shale Gas in the U.S.

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Abstract: New technology in the twenty-first century has opened vast new reserves of natural gas and oil from formerly non-economic resources, primarily organic-rich shale. Production techniques such as horizontal drilling and high-volume hydraulic fracturing have led to the recovery of large amounts of natural gas and oil from formations like the Barnett Shale in Texas, the Fayetteville Shale in Arkansas, the Bakken Shale in North Dakota, and the Marcellus Shale in Pennsylvania and West Virginia. These resources have created a surplus of natural gas, have provided abundant supplies of oil, and have made the United States essentially energy independent for the first time in decades.

Although terms like “fracking” and “shale gas” have become commonplace, few people realize that the development of the technology that enabled the economic production of these resources had its origins in the oil embargos and energy crises of the 1970s. The U.S. Department of Energy (DOE) funded the Eastern Gas Shales Project in the late 1970s and through the 1980s to characterize the resource potential of the extensive, organic-rich Devonian shales in eastern geologic basins, and to develop the engineering technology needed to extract natural gas from these rocks economically. Mitchell Energy pursued this into the 1990s, and their persistence eventually achieved the breakthrough needed to produce commercial amounts of gas from low-permeability resources like shale. The application of greatly improved directional drilling technology developed for deep-water offshore platforms, combined with slickwater hydraulic fracturing, allowed Mitchell to use horizontal boreholes with multiple stages of hydraulic fracturing to engineer high-permeability, fracture flow paths into a sufficient volume of reservoir rock to produce significant amounts of gas from the Barnett Shale. Other companies followed suit on other formations, with Range Resources achieving the first commercial horizontal Marcellus Shale well in southwestern Pennsylvania in 2007. Range Resources used data and assessments from the DOE Eastern Gas Shales Project to select target intervals in this well, and their competitors also combed through the DOE archives for relevant reports and data. Estimates of recoverable gas from shales run to many hundreds of trillions of cubic feet, which should supply the United States with natural gas for decades. Shale gas and tight oil have completely changed thinking about world fossil energy supplies.

The development of tight oil and natural gas from shale has not been without controversy. Antifracking activists have made claims that shale gas development in general, and hydraulic fracturing in particular contribute to global climate change and

threaten groundwater resources, terrestrial and aquatic ecosystems, and human health. Based on these claims, the states of New York and Maryland have banned high volume hydraulic fracturing on the Marcellus Shale, although it is permitted in Pennsylvania and West Virginia. Colorado has had some discussions of a similar ban, as has California.

Investigations reveal that the actual environmental impacts are neither as extensive nor as persistent as some activists believe, but there certainly are issues. Shale gas development can affect air quality, water resources, landscapes, and ecosystems. Most of environmental problems stem from the boom-and-bust nature of the oil and gas business. In their hurry to capitalize on this new resource, exploration and production companies often hired many inexperienced people to install a large number of wells as quickly as possible, resulting in significant impacts. These were especially intense in lightly populated states like North Dakota, where the Bakken boom brought in “man camps” and placed intense pressure on existing infrastructure. The booms led first to an oversupply of gas, and later oil, causing prices to drop and slowing drilling activities. When the bust came, only the most experienced drilling crews were retained, but the damage done during the earlier boom cycle left large numbers of people permanently opposed to “fracking.”

Research is attempting to reduce the uncertainties related to the environmental impacts of shale gas and tight oil development. Federal interagency studies have been investigating air pollution and greenhouse gas emissions, impacts to water availability and water quality, subsurface migration of gas and liquids, wellbore integrity, geochemistry of produced fluids, impacts to ecosystems, and exposure routes and possible impacts to human health. Many university and research foundation studies are working along similar lines, and efforts are being made to coordinate, collaborate, and reduce duplication of efforts. Research is also being focused on finding new uses for the abundant natural gas being produced from shale. Two suggested utilization technologies are generating electricity and use as a transportation fuel.

The successful development of shale gas and tight oil achieves the long-sought goal of greater energy independence for the United States. It also contributes to an “all-of-the above” energy strategy that utilizes existing resources while continuing to develop new ones.

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