American Energy Innovation Council

CASE STUDIES ON THE GOVERNMENT'S ROLE IN ENERGY TECHNOLOGY INNOVATION

Unconventional Gas Exploration & Production

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EXECUTIVE SUMMARY

The outlook for North America's natural gas supply has improved dramatically in recent years as horizontal drilling and hydraulic fracturing technologies have made it possible to commercially develop unconventional gas reserves, particularly shale gas reserves. These gas basins are located in diverse geographical areas, spanning at least 31 states in the continental United States. Whereas domestic production was thought to be on a declining trajectory as recently as 2007, the United States is now believed to have sufficient gas resources to meet domestic demand for decades at current rates of consumption.

While the private sector has driven the continuous improvements and breakthroughs in exploration and production technologies for unconventional natural gas, unconventional gas production through these combined techniques became commonplace only in the 1990s after years of federal support and further innovations. The federal government substantively aided private efforts in several ways: basic science and resource mapping; coordinating and complementing industry efforts; applied research and development; and tax credits for unconventional gas.

EXECUTIVE SUMMARY (Continued)

Basic science and resource mapping: In 1976, Congress funded the Energy Research and Development Administration (now the Department of Energy) to launch the Unconventional Gas Research (UGR) program. Designed as collaboration with academia and industry, the UGR developed an inventory of the unconventional gas resources across several regions. In particular, the Eastern Gas Shales Project (EGSP) determined the recoverable reserves of Devonian shale gas and financed experimental shale wells—at a time when most firms in unconventional gas recovery had little or no research budgets. The resulting maps and technical reports both proved the extent of shale gas resources and shared technological know-how with industry, demonstrating market potential and lowering risks to early entrants.

Coordinating and complementing industry efforts: The Gas Research Institute (GRI) was funded by a charge on interstate gas sales (as approved by the Federal Energy Regulatory Commission in 1976). Designed as an industry research collaboration, GRI managed and financed natural gas-related research and development jointly with the Department of Energy (DOE). Experimental horizontal wells for shale gas, drilled conjointly with DOE, GRI, and individual companies, proved methods for the industry at a time when no firm was willing to try on its own. Moreover, these partnerships were crucial for speeding up diffusion of new drilling practices among the dozens of well operators.

Applied research and development: Starting in the early 1980s, major oil and gas companies began to decrease their research and development (R&D) spending, driven in large part by a decision to "buy versus build" new technology. DOE funded R&D activities through both national labs and universities that contributed to a steady stream of technology innovations during this time, resulting in notable contributions such as microseismic mapping and advanced drill bits. Some DOE and national labs personnel moved into private sector, following breakthroughs in their basic R&D work; additionally, numerous graduates of government-funded university research in unconventional gas moved into the industry.

Tax credits for unconventional gas: The Windfall Profits Tax Act of 1980 established a production tax credit (called the Section 29 credit) for unconventional gas. Although the range of companies that could take advantage was limited, the tax credits reduced risks and increased returns to unconventional gas, enabling new gas shale projects to pass risk-weighted economic hurdles common to the resource. This attracted new sources of capital and increased exploration and development activity, tripling production of unconventional gas from 1980 to 2002 and driving further technological innovations through learning-by-doing.

When prices for natural gas rose in the early 2000s, making the economics of unconventional gas production more favorable, the combination of technological innovation and promotional policies in the previous two decades enabled a swift and dramatic response by industry. Since 2000, proven natural gas reserves have increased over 70%, almost entirely due to shale gas resources. Natural gas-fired power plants are projected to account for over 60% of new electric capacity additions between 2011 and 2035, and the US is now expected to become a net exporter of natural gas in the next decade.

One lesson from the history of unconventional gas is that the federal government does not supplant private sector innovation, but rather lowers risks to the private sector and provides complementary inputs that quicken the pace of private sector discovery and innovation. More importantly, the history of unconventional gas technology development demonstrates how many threads of effort came together from sometimes unexpected sources over a period of decades before resulting in identifiable successes. The federal government undertook R&D without being able to predict the full scope of its applications, and technologies developed in one area transferred to other domains. Years or decades passed before the benefits of some technological advances were fully realized. Innovation did not occur on a linear path, showing that government support for R&D cannot simply be predicated on a near-horizon, A-to-B mindset if it is to support major energy technology breakthroughs and energy market transformations.