An Energy Policy That

Photo courtesy of Office of Fossil Energy, U.S. Department of Energy

Actually Worked

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For the past three decades there has been vigorous debate over the necessity and effectiveness of federal incentives programs designed to encourage domestic U.S. energy production. To the surprise of skeptics, some of these programs really do work.

From the late 1970s through the early 1990s, the federal government used research and development (R&D) programs and tax incentives to stimulate the production of Devonian shale gas in the Midwest and Appalachia. These incentives programs and the results they produced were analyzed as part of a larger project conducted by the National Research Council of the National Academy of Sciences.1 The findings show that the programs were well timed and coordinated, were cost effective in stimulating significant additional resource production, and represent a good example of a successful federal energy development program.

By the mid-1970s, about 70 billion cubic feet (Bcf) of Devonian shale gas was being produced annually in the United States with cumulative production from the shales through the 1980s totaling about 3 trillion cubic feet (Tcf) of natural gas. Devonian shale may be thought of as a conventional gas resource. Yet, it is also an unconventional gas resource because of its complex geology and the advanced exploration and extraction technologies that are required to produce it. As a result of the nation's energy problems during the 1970s, and the perceived natural gas shortage, gas from Devonian shale became the focus of substantial interest in the federal government.

Devonian Shale Gas

Devonian shale gas refers to natural gas produced from the fractures, pore spaces, and physical matrix of shales deposited during the Devonian period of geologic time. Devonian shales occur predominantly in the Appalachian, Illinois, and Michigan basins.

Enter, DOE

The Eastern Gas Shales R&D Project was initiated in 1976 by the Energy Research and Development Administration, a forerunner of DOE; funding continued until the program was terminated in 1992.2

DOE estimated that the Eastern Gas Shales R&D Project resulted in substantial technological and economic benefits. The program made available to industry a major new source of natural gas, revitalized gas shale drilling and development in the Appalachian basin, helped initiate development of several other previously overlooked gas shale basins, and

[1] See National Research Council. Energy Efficiency and Fossil Energy R&D at the Department of Energy: Was it Worth It? Washington, D.C.: National Academy Press, November 2001.

[2] Between 1978 and 1992 the DOE R&D program totaled $137 million (constant 1999 dollars).

A Success By Any Measure

By any objective measure, DOE's Eastern Gas Shales R&D Project can be termed a success:

- **The R&D resulted in technological advancements, resource characterizations, the provision of necessary information, and cost reductions that accelerated development of a viable commercial shale gas industry.**
- **The R&D and the tax credits facilitated production of shale gas and the expansion of reserves earlier and at much lower natural gas prices than would have occurred in the absence of these incentives, and thus contributed to the nation's energy objectives.**
- **The program resulted in the deployment of products and processes that were widely utilized by industry.**
- **The program was well coordinated with private R&D programs.**
- **The federal Section 29 shale gas tax credits were appropriately timed to take advantage of the DOE R&D program.**
- **DOE successfully conducted basic research initiatives that, at the time, were considered unconventional and risky by industry.**
- **The DOE-funded technologies would not have been funded by the private sector, or, at best, would have been funded only at a much later date. The programs did not displace private industry R&D, and thus cannot be termed "corporate welfare."**
- **The R&D and the tax incentives were both necessary and useful to the shale gas industry.**
- **The quantitative benefits — while difficult to estimate precisely — are positive and substantial.**

demonstrated more efficient and lower cost gas shale production recovery technology.

The project was important because uncertainty about the magnitude of potential gas resources could have precluded industry from knowing where to drill. Prior to this project, there was little information available on the stratigraphic and the structural framework in the eastern basins, and state geological survey activities had not funded the mapping of these speculative resources. Further, little was known about the geochemistry of the natural gas bearing shales and the degree of maturity necessary to support the presence of gas. Without cores, logs, and maps of the shale gas depositional environment and tectonic activity, the knowledge base was lacking for exploration into this high-risk, limited economic resource. The project also helped derive a number of significant industry innovations that later became commercial technologies or products.

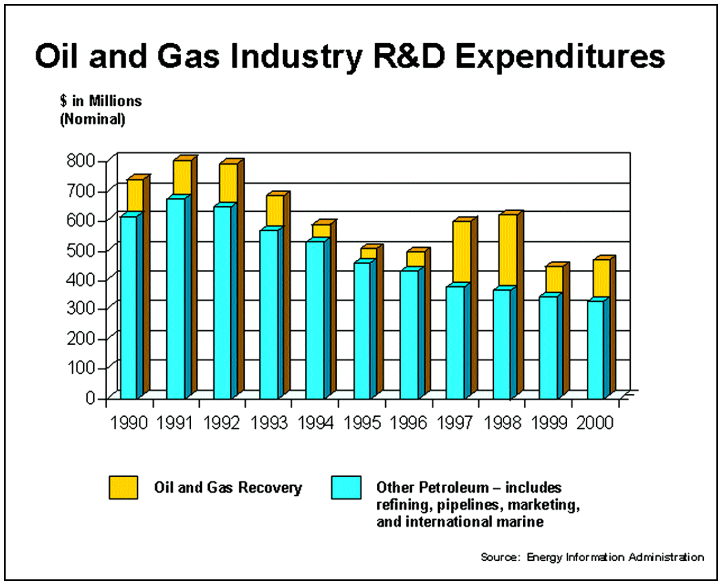
Never Ignore Tax Laws (I)

Until 1993, natural gas produced from Devonian shale was eligible for tax credits against income taxes of $3.00 multiplied by the barrel of oil equivalent of the natural gas produced. These "Section 29" tax credits were available for wells drilled between 1980 and December 31, 1992, and are applicable to gas produced from eligible wells through December 31, 2002. The price incentives of the Section 29 tax credits were equal to about $1 per Mcf for gas shale. For much of this period, at least during the early 1990s, wellhead gas prices averaged between $1.75/Mcf and $2/Mcf.

The exact value of these tax credits is not available and is difficult to estimate. Companies with net operating loses could not use the credit and many companies producing shale gas in the late 1980s and early 1990s were in that position. Thus, the only way that most independent producers could benefit from Section 29 was to negotiate a long-term deal with a third party who placed a higher value on shale gas because it could use the credit.

Shale gas producers cannot use the Section 29 credits to offset current year alternative minimum tax (AMT) liabilities. Consequently, in some years during this period, 50 percent of major companies and 70 percent of independents were unable to use the credits. Nevertheless, the value of the Section 29 tax credits to producers of eastern gas shales was substantial.

The Section 29 tax credits attracted new sources of capital and increased exploration and development activity. They reduced risks and increased returns, enabling new gas shale projects to pass risk-weighted economic hurdles common to the resource. And they helped facilitate new exploration, completion, and production technologies based on improved understanding of unconventional gas reservoirs. While the Section 29 incentives were important, the base of science and technology created at least in part by DOE's R&D program has maintained the viability of these gas resources beyond 1992.



How DOE Rode To The Rescue

In the late 1970s, widespread industry consensus was that the only technology suitable for recovery of shale gas resources was borehole shooting with explosives. At that time, DOE embarked on a variety of research initiatives designed to explore other technologies for recovery, and many in the industry thought that DOE was wasting its money.

The magnitude and scope of the DOE program were important because most of the firms involved in gas shale recovery at that time were small independents who had little or no research budgets. These producers could not have mounted R&D on the scale and the scope of the DOE effort, nor could they have continued DOE's level of effort during the late 1970s and 1980s. Thus, it is likely that the DOE effort did not displace or substitute for R&D that would have occurred otherwise in the private sector.

During the late 1970s, industry believed that eastern gas shales could be profitably produced only at natural gas prices that were much higher than currently existed, and that development of these resources would not commence until the higher natural gas prices had been reached. A major result of DOE's R&D program was to reduce the production costs of these resources to the point where they could be profitably produced at natural gas prices that were much lower than anticipated.

DOE's R&D program was well integrated with similar R&D programs funded by NASA and the Gas Research Institute (GRI). The NASA program was small, totaling about $2 million, and involved basin modeling, gravity surveys, and satellite imagery. GRI's program was more extensive, totaling approximately $30 million (1999 dollars). Importantly, the DOE and GRI

R&D programs were well integrated and coordinated. DOE concentrated on basic research R&D to develop cutting-edge technologies and techniques, while the GRI program focused on commercialization and deployment of applied technologies of special interest to industry.

The combined efforts of government and industry developed technologies that have enabled gas shale production to survive the end of tax credits in 1993 and continue over the past decade, much of which has been characterized by low natural gas prices. Advances in technology have enabled the established gas shale plays to further develop and new plays to evolve, and gas shale continues to represent a substantial opportunity for adding low cost gas reserves.

Never Ignore Tax Laws (II)

The Section 29 tax credits were an important incentive for the development of eastern gas shales in the late 1980s and early 1990s, and approximately 95 percent of the qualifying wells were drilled in the Appalachian and Michigan basins. The number of new wells drilled increased dramatically between 1987 and 1992, then declined sharply after 1992 and never again came close to reaching the number of wells drilled in 1992. The latter year was the high-point for new drilling, because it was the last year for which wells drilled were eligible for the tax credit. Nevertheless, the amount of gas produced did not decrease after 1992. Rather, it increased every year since then. Nearly twice as much shale gas was being produced in 1998 as in 1992.

The effects of the tax credit, however, should not be overemphasized. According to industry sources, relatively few producers took advantage of the credit until the late 1980s. The value of the credit often was not that large, since over much of the period many shale gas producers were making relatively little profit and paying relatively little taxes against which the credit could be applied. Even profitable producers often could take only limited advantage of the credit due to the complexities of the tax system — especially the AMT. In 1992, while many in the industry and in Congress forecast the collapse of the gas shale industry in 1993 when the credit expired and natural gas prices were relatively low, this did not happen. Instead, the industry continued to thrive and expand and the tax credits alone could not have been critical to its success.

So, what does it all mean?

A quarter century ago, the conventional wisdom was that any significant expansion of shale gas production would require relatively high gas prices, and that technology could do little to substitute for high prices. However, incentives through tax credits, combined with deployment of advanced technology, served to revive a domestic natural gas resource in decline. This combination has allowed production to expand long after termination of both the R&D program and tax credits, and to do so in a period of relatively low — much lower than had earlier been projected — natural gas prices. In a significant way, technology can and does substitute for price in marginal resources, and DOE's Eastern Gas Shales Project proved this critical point.

While it is not possible to say whether these improved recovery technologies would have been developed without DOE R&D, the DOE program, which was non-conventional and contrary to industry's perceptions, was successful in stimulating and accelerating the development of more advanced and profitable Devonian shale gas recovery technologies.

The federal programs designed to facilitate shale gas development were successful, cost-effective, were timed correctly, and were well coordinated with private sector initiatives. These programs provide an interesting and important example of a "federal energy policy that actually worked."

Events of the past two years, and the comprehensive energy bill currently being considered by Congress, indicate that these issues remain timely and relevant.

The author is grateful to Robert Hirsch for comments on an earlier draft of this paper, but retains sole responsibility for the contents of this manuscript. A more detailed analysis of these incentives programs is available; requests should be directed to: rbezdek@misi-net.com. ■

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