WORKING DOCUMENT

The University Of Queensland
AUSTRALIA

Centre for Natural Gas

The development of US unconventional gas: 30 years of policy & technology support

Author

Professor Andrew Garnett, The University of Queensland Centre for Natural Gas

Acknowledgements

This working document was prepared for The University of Queensland Centre for Natural Gas. We sincerely thank all of our participants for their time, insights and reflections on the natural gas industry experience in Queensland.

Citation

Garnett A (2020*), The development of US unconventional gas: 30 years of policy & technology support*, The University of Queensland Centre Natural Gas Working Document, The University of Queensland.

Publication details

June 2020

ISBN: 978-1-74272-328-0

Disclosure

The UQ Centre for Natural Gas is currently funded by the University of Queensland and the Industry members (Arrow Energy, APLNG and Santos). The Centre conducts research across Water, Geoscience, Petroleum Engineering and Social Performance themes.

For more information about the Centre's activities and governance see natural-gas.centre.uq.edu.au

Disclaimer

The information, opinions and views expressed in this report do not necessarily represent those of The University of Queensland, the Centre for Natural Gas or its constituent members or associated companies. Researchers within or working with the Centre for Natural Gas are bound by the same policies and procedures as other researchers within The University of Queensland, which are designed to ensure the integrity of research. You can view these policies at: http://ppl.app.uq.edu.au/content/4.-research-and-research-training

The Australian Code for the Responsible Conduct of Research outlines expectations and responsibilities of researchers to further ensure independent and rigorous investigations.

This report has not yet been independently peer reviewed.

Table of contents

1 Introduction 4

2 Key US fiscal policies 4

2.1 US technology development support - Department of Energy 5

2.2 Clear investment goals for UGR investment 5

2.3 US technology development support - Gas Research Institute 6

3 References (Supplementary Information) 7

1 Introduction

Experience in the US with development of unconventional oil and gas resources is significantly different from the Australian situation. Motivated by experience during the 1973-74 "*Arab Oil Embargo*" (AOE), and an outlook of declining conventional gas, the US developed and has maintained a long term focus on energy security. They have a clear focus on stimulating abundance of supply and have eschewed market or price interference, recognising that sustainable low prices result from (technology enabled) supply growth. Since 1976, a coordinated national policy effort (primarily Department of Energy (DoE)) with significant and aligned State government policy support was put in place to improve the investment attractiveness (better fiscal settings and removal of price controls) of unconventional oil and gas resources. Over the same period, significant R&D efforts were also funded by DoE and undertaken by academia, SMEs and gas field operators. These were in well-focussed areas with clear economic goals regarding increases in reserves and in production. National goals were set, national incentives and stimuli put in place and State government initiatives were largely aligned with these. R&D investment levels over $100 million pa were sustained for at least 30 years. Australia has benefited significantly from this technology development. However, the US experimentation did not cover the Australia-specific range of conditions and this gap needs to be closed.

Consequently, in 2015, Porter, Gee and Pope (2015) noted that "***The U.S. has had a 10- to 15-year head start in commercialising unconventional resources versus other countries***."

2 Key US fiscal policies

The US Government has had a continuous focus on stimulating the domestic energy industry, especially upstream unconventional oil and gas (Victor, Nichols & Balash, 2014; Swift, 2013). Government policy support for unconventional gas development has been consistent and continuous with fiscal terms improved and defined for significant periods of time i.e. tailored to the challenging nature of this resource type (e.g. CEA, 2019) as well as to the competitive environment for investment.

In 1978, the Natural Gas Policy Act (American Congress, 1978) was implemented. This had two main beneficial effects. First, it ended overt interference in the market by removing regulated price caps (e.g. Mogel and Mapes, 1980) and second, it included specific incentives and subsidies for unconventional gas resources such as shale gas and coalbed methane (Brown, 1980).

Following this, policy support for unconventional gas was further strengthened via a series of tax incentives which were sustained over substantial periods of time. As an example:

- In 1980, the Crude Oil Windfall Profit Tax Act (American Congress, 1980), covering a period from 1980 to 1992, this included tax reduction, exemption and financial subsidies for CBM and shale oil and gas, including a subsidy of $3/boe (Drapkin & Verleger, 1981).
- In 1992, the Crude Oil Windfall Profit Tax Act (ibid) extended a tax reduction of $0.5/mscf for gas from unconventional fields developed between 1979 and 1999 and sold before 2003 (Mei, 2020).

In a recent summary of US policy experience, Mei (2020) further noted that multiple additional bills were issued which also "*extended the application range and renewed subsidy policies for*

unconventional energy". These included (a) the Energy Policy Act of 1992 (range-extending) (Isser, 2015); (b) the Taxpayer Relief Act of 1997 (tax reduction) (Colburn & Englebrecht, 1997); and (c) the 1345th article of Energy Policy Act of 2005 which subsidised $3/boe for each well that produced unconventional gas during the period from 2006 to 2010 (Malmedal, Kroposki & Sen, 2007). Mei (2020) also noted that State governments were also active in incentivising unconventional gas development including Texas, Louisiana, Ohio, Pennsylvania and Arkansas.

2.1 US technology development support - Department of Energy

Also motivated by the 1974 oil crisis, "*Beginning about 1976, ground breaking research directed by the Department of Energy catalysed several innovative industry "firsts" that later became commercial technologies, and also resulted in the acquisition, analysis and wide dissemination of an enormous quantity of "ground truth" data on a topic that at the time generated little interest: unconventional sources of natural gas*" (US DoE, 2007). The government-funded research programs and projects provide technical support to continuous innovation of the shale gas industry.

While fiscal incentives were critical to resource commercialisation, without significant DoE investment "*the tools for tapping into these resources when economics began to make sense would not have been there, or would not have been adapted as quickly, if the groundwork had not been laid by research carried out through the DOE's Unconventional Gas Research (UGR) Programs*" (ibid).

The DOE's Unconventional Gas Research program defined three unconventional gas resource areas and types for special treatment. These were the Eastern Gas Shales Program (EGSP), the Western Gas Sands Programme (WGSP) and the Methane Recovery from Coalbeds Project (MRCP). Between 1978 and 1992, the DOE spent $220m million (~$15 million pa) specifically on these programs. The return on these investments is estimated at better than 10:1 (ibid) – and this excludes wider economic benefits being realised from abundant, cheap gas.

2.2 Clear investment goals for UGR investment

At the same time as providing fiscal incentives for "*prompt and orderly*" development of the nation's gas resources, the DoE's UGR had clear techno-economic goals i.e. (a) to increase per well gas recovery efficiencies; and (b) lower unit development costs. In addition, the Program had two quantitative goals, national-level natural gas supply growth goals:

1. Increase gas production by an incremental 3 Bcf per day by 1986 (10 years), and
2. Add 10 Tcf of producible reserves by 1985 (9 years).

Each sub-program also had clear goals. For example, the EGSP was designed as a multidisciplinary research effort to provide the information that was lacking. Its primary overall goals were to (*ibid*):

- Develop technologies that would establish effective and environmentally acceptable means for locating and producing natural gas from Devonian shales, and
- Reduce the uncertainty surrounding the potential magnitude of reserves so that the private sector would be encouraged to develop the resource on a large scale.

Specific objectives of the EGSP were to:

- Develop accurate estimates of gas-in-place and economically recoverable resources,
- Develop exploration rationales for the identification of prospects, and
- Develop and improve cost-effective extraction methods.

In summary, US DOE investment has been material, continuous and strategic. It has also been cross-sector. The Department of Energy invested $92 million to set up a special fund to support academic research institutions and small and medium-sized enterprises for carrying out core technology research programs (Ma and Hu, 2019). In 2004, US Energy Law proposed $45 million annually to 2014 to support further research and development of unconventional natural gas exploration and exploitation technologies (ibid).

2.3 US technology development support - Gas Research Institute

In a complementary development, in 1978 the Federal government also established a non-profit Gas Research Institute (GRI, www.gti.energy/) to conduct research work on the exploration and development of unconventional natural gas, supporting shale gas, coalbed methane and tight gas. It was funded by a tax on interstate gas shipments. In addition to strategic DoE funding, the GRI has played a major role in technology and hence resource development (e.g. Abelson, 1992; Megginson, 1998; Burnett, Monetta & Silverman, 1993). Both DOE and GRI were responsible for significant and large field trials of production technologies including at multi-well experimental facilities. Their work also resulted in significant new data acquisition (e.g. 35 wells) and in new characterisation technologies. Technology trials in the oil and gas sector (i) are expensive; (ii) carry a relatively high risk of failure; and (iii) are essential to commercialisation both from a technology and resource-understanding perspective.

Experiments in the field began in the early 1980s. Coal Bed Methane proved easiest to commercialise by the mid-1980s, significantly helped by tax incentives. It proved an important boost to domestic supply for 20 years. It was however limited in profitability (low rate, dry gas) and CBM production peaked in 2008. However, this is largely due to a shift in focus to more profitable shale-gas which has valuable liquids components. Nevertheless, CBM reserves remained at around 11.9 Tcf in 2017.

Throughout the period, there was extensive experimentation and a significant number of "failures" (and financial losses) along the way, for example in the Barnet Shale region, which could be covered at least in part by public funds. Approximately 20 years after the start of the UGR program, typically cited as 1997, following significant and costly trials, Mitchell Energy proved the profitability of the shale gas. Technical and geological lessons spread rapidly and development started to grow. Another 10 years saw a recognised "shale gas boom". An R&D investment profile is shown right (extracted from US DOE, 2007).

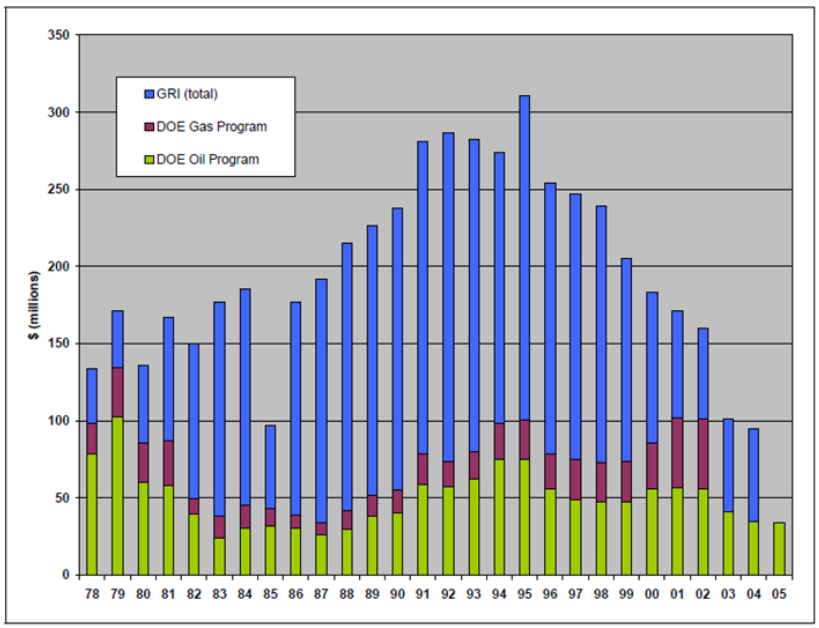

Figure 2: Funding of DOE Oil and Gas R&D Relative to GTI Funding 1978-2005.

3 References (Supplementary Information)

Abelson, P. H. (1992). The gas research institute. Science (New York, N.Y.), 258(5089), 1715–1715.

American Congress. (1978). Natural Gas Policy Act of 1978 (NGPA). https://www.govinfo.gov/content/pkg/STATUTE-92/pdf/STATUTE-92-P.3350.pdf (accessed June 2020)

American Congress. (1980). Crude Oil Windfall Profit Tax Act. Summary https://en.wikipedia.org/wiki/Windfall_profits_tax#:~:text=In%201980%2C%20the%20United%20States,decontrol%20of%20crude%20oil%20prices.&text=%22Despite%20its%20name%2C%20the%20crude,was%20an%20excise%20tax ... (accessed June 2020)

American Congress (1992). Energy Policy Act of 1992. 102nd Congress H.R.776.ENR, abbreviated as EPACT92. Summary at https://en.wikipedia.org/wiki/Energy_Policy_Act_of_1992 (retrieved June 2020)

American Congress. (1997). Taxpayer Relief Act of 1997(tax reduction) [*in* Colburn et al, 1997]

Brown. (1980). LEGISLATIVE HISTORY OF THE NATURAL GAS POLICY ACT: TITLE I. Texas Law Review, 59(1), 101

Burnett, W., Monetta, D., & Silverman, B. (1993). How the Gas Research Institute (GRI) Helped Transform the US Natural Gas Industry. Interfaces, 23(1), 44-58. Retrieved June 11, 2020, from www.jstor.org/stable/25061702

CEA. (2019). The Value of U.S. Energy Innovation and Policies Supporting the Shale Revolution. Retrieved from https://www.whitehouse.gov/wp-content/uploads/2019/10/The-Value-of-U.S.-Energy-Innovation-and-Policies-Supporting-the-Shale-Revolution.pdf

Colburn, Steven C., and Englebrecht, Ted D. (1997). The Taxpayer Relief Act of 1997.(Cover Story). The CPA Journal, 67(10), 14–21

Drapkin, Dennis B., and Verleger, Philip K., Jr. (1981). The windfall profit tax: origins, development, implications. Boston College Law Review, 22(4), 704–704

Finkel, M., Hays, J., and Law, A. (2013). The Shale Gas Boom and the Need for Rational Policy. American Journal of Public Health, 103(7), 1161–1163

Isser, S. (2015). The Energy Policy Act of 1992. In Electricity Restructuring in the United States: Markets and Policy from the 1978 Energy Act to the Present (pp. 110–120)

Malmedal, K., Kroposki, B., & Sen, P. (2007). Energy Policy Act of 2005. IEEE Industry Applications Magazine, 13(1), 14–20

Mei, H. (2020). Shale gas development in the Sichuan Basin and the way forward associated with sustainable development goals: A comparative analysis in China and the United States. Masters Research Project. ENGY7115. University of Queensland.

Nelson, K. (2011). State-Level Autonomy and Municipal Government Structure: Influence on Form of Government Outcomes. The American Review of Public Administration, 41(5), 542–561.

Megginson, V. (1998). USA Gas Research Institute (GRI) Publications. Energy Exploration & Exploitation, 16(2/3), 283-285. Retrieved June 11, 2020, from www.jstor.org/stable/43865324

Mogel, William A., & Mapes, William R., Jr. (1980). Assessment of incremental pricing under the Natural Gas Policy Act. Catholic University Law Review, 29(4), 798–798

Porter, M.E., Gee, D.S. and Pope, G.J. (2015). America's Unconventional Energy Opportunity. A win-win plan for the economy, the environment, and a lower-carbon, cleaner-energy future. Technical Report, Harvard Business School.

US DoE (2007). DOE's Unconventional Gas Research Programs 1976-1995: An Archive of Important Results. Strategic Center for Natural Gas and Oil National Energy Technology Laboratory. U.S. Department of Energy. January 31, 2007.

Victor, N., Nichols, C., and Balash, P. (2014). The impacts of shale gas supply and climate policies on energy security: The U.S. energy system analysis based on MARKAL model. Energy Strategy Reviews, 5(C), 26–41

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CREATE CHANGE