Unconventional Resources Technology Advisory Committee

Advisory Committee to The Secretary of Energy

March 8th, 2012

The Honorable Dr. Steven Chu
Secretary of Energy
Washington, DC 20585

Dear Mr. Secretary:

On behalf of the Unconventional Resources Technology Advisory Committee (URTAC), it is my pleasure to submit our findings and recommendations based on our review of the Unconventional Resources Technology and Small Producers' portion of the *2012 Annual Plan* for the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research Program.

The emphasis on Environmental, Safety and Health (ESH) research topics in the 2012 Draft Annual Plan, while focused on areas of recent public concern, could diminish the broader goals of the Section 999 program. We seek efficient development and production technologies that increase oil and gas supplies while reducing environmental impacts. This program has already done and continues to do ESH research.

As acknowledged by the President in his 2012 State of the Union Address, the increase in domestic gas supply from shale reservoirs was largely the result of long-term, proactive and innovative public research. Research into other large oil and gas resources is now needed to meet the future need for domestic energy. We recommend continuing the Program beyond the current 2014 termination date.

We find this program has been remarkably successful in meeting its objectives.

These key findings are addressed in the report along with other observations and recommendations made by the Committee members. As experts and professionals in our areas of expertise, we believe that they are worthy of consideration and implementation.

The URTAC recommends proceeding with the continued implementation of the *2012 Annual Plan* consistent with the guidance outlined in our report.

Respectfully submitted,

James P. Dwyer, Chair
(281) 701-6791

Unconventional Resources Technology Advisory Committee

Comments and Recommendations 2012 Annual Plan

February 2012

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1.0 INTRODUCTION

The Unconventional Resources Technology Advisory Committee (URTAC) was formed in accordance with provisions of Section 999D(a) of the 2005 Energy Policy Act (EPACT).

The Committee consists of:

- A majority of members who are employees or representatives of Independent Producers of natural gas and other petroleum, including small producers;
- Individuals with extensive research experience, operational knowledge or unconventional natural gas and other petroleum resource exploration and production;
- Individuals broadly representative of the affected interests in unconventional natural gas and other petroleum resource exploration and production, including interests in environmental protection and safe operations;
- Individuals with expertise in the various geographic areas of potential supply of unconventional onshore natural gas and other petroleum in the United States.

The provisions of EPACT excluded from eligibility to participate in URTAC the following: Federal employees and board members, officers and employees of Research Partnership to Secure Energy for America (RPSEA).

The duties of the URTAC under EPACT Section 999 are to advise the Secretary of Energy on the development and implementation of programs related to unconventional natural gas and other petroleum resources and to review the draft annual research plan.

The Committee members were appointed by letters from the Secretary on September 2, 2010. Key milestones for the Committee included:

- Committee members received the initial Draft 2012 Annual Plan on January 10, 2012.
- Committee members met on January 18th, 2012 in Houston, Texas. The agenda included a status update and overview of the onshore elements of the Section 999 Complementary Research Program by NETL, and an overview of the Section 999 Program cost-shared research portfolio by RPSEA. Committee members provided comments on Deputy Assistant Secretary Smith's briefing and initial comments regarding the original plan received on January 10, 2012. The Chair appointed sub-groups to work on sections of the plan.
- During the period from January 18 through February 28th, the appointed sub-group members conducted several meetings by teleconference and E-mail to develop and consolidate recommendations regarding the draft annual plan.
- The Committee met on February 28th and 29th, 2012 in Houston, Texas to receive sub-group reports and to draft the final recommendations of the Committee.
- The Committee met via teleconference on March 8, 2012 in Washington, D.C. to complete final approval of the Committee report in accordance with the deadline set by the Secretary and conveyed through the Designated Federal Officer.

EPACT Subtitle J "Section 999" sets the funding for the overall program at a level of $50-million-per-year over 8 years, provided from Federal lease royalties, rents, and bonuses paid by oil and gas companies. Of this, $37.5 million is awarded for the consortium research and development program administered by RPSEA and $12.5 million for the Complementary Program administered by NETL. The RPSEA program is broken into the Ultra-Deepwater ($14.493 million), the Unconventional Gas ($13.854 million), the Small Producer Program ($3.562 million) and funding for administration and oversight ($5.437 million).

The URTAC Committee focused on the Unconventional Gas and the Small Producer Programs of the Consortium Program and the applicable portions of the NETL Complementary Program.

2.0 EXECUTIVE SUMMARY AND RECOMMENDATION HIGHLIGHTS

The Committee reviewed the 2012 Annual Plan and identified major areas requiring further discussion. Sub-groups were formed to submit findings and recommendations for these areas. The sub-group reports were distributed to the entire Committee and each was discussed by the Committee as a whole. Following this discussion, a majority of the Committee agreed on and drafted the findings and recommendations included in this report.

The Committee wishes to note that steps have been taken by both NETL and RPSEA to implement many of the past recommendations of the URTAC, specifically in the areas of program, technology transfer, knowledge management database as well as metrics and benefit assessment.

We acknowledge the Department of Energy's continued focus on environmental and safety issues as they provide funding to develop sustainable, secure domestic energy supplies. We further recognize that these environmental and safety issues are not new and are not unique to the development of unconventional (or shale) resources. We therefore acknowledge the Department of Energy's need to focus on research to further understand the inherent risks in order to inform the federal and state governments.

For the 2012 Annual Plan, the Committee has the following comments:

- Increasing domestic oil and gas resources is in the national interest. The Section 999 program continues to achieve this goal.
- We provide recommendations for specific research projects that are broader in scope than those presented in the *Draft 2012 Annual Plan.*
- The emphasis on Environmental, Safety and Health (ESH) research topics in the 2012 Draft Annual Plan, while focused on areas of recent public concern, could diminish the broader goals of the Section 999 program. We seek efficient development and production technologies that increase oil and gas supplies while reducing environmental impacts. This program has already done and continues to do ESH research.
- Improving safety and minimizing environmental impacts is synergistic with improving operational efficiency and reducing the cost of oil and gas production. Providing sound science contributes to the optimum development of a domestic energy supply while enhancing the safety of its operation, and protecting the environment. Technical innovations that support all of these goals will be more rapidly adopted.
- Program outreach and technology transfer should be more comprehensive and include the producers, state, federal, public, and non-government stakeholders.
- Long-term R&D is valuable and necessary. This often cannot be done by independent producers who are responsible for a large portion of the current oil and gas development in the United States. Section 999 of the Energy Policy Act of 2005 has provided steady funding for the long-term cooperative research required to make progress toward safe and efficient development of the gas shale resource base. We believe this approach to be much more efficient than intermittent funding which depends on annual appropriations.

- Due to the long-term requirements for field demonstration projects to yield reliable scientific data necessary to address public concerns and to develop innovative solutions required to continue to develop affordable clean energy from unconventional reservoirs, URTAC recommends continuing the RPSEA program beyond the current 2014 termination date.

3.0 TOPICAL REPORTS

The Advisory Committee developed their analysis of the 2012 Annual Plan through a series of meetings and sub-groups (as outlined in Section 5.0: Sub-Group Topics and Member Assignments). There are four areas of findings and recommendations:

- Policy & Regulation
- Environmental
- Research & Development
- Value & Public Outreach

Treatment of Non-Consensus
In situations where members were divided on agreement with specific recommendations or statements in the report, the following categorization was used:

- ***Majority Agreement*** – 50% or greater of Committee members were in agreement with the statement.

- ***Minority Opinion*** – fewer than 50% of Committee members were in agreement with the statement.

A Minority Opinion by one member of the Committee was expressed related to Section 3.3 of this report, and is included in Appendix B. The remainder of this report is supported by the full Committee.

3.1 POLICY & REGULATION FINDINGS AND RECOMMENDATIONS

Finding

George Mitchell, a pioneer of gas shale development, stated that his decision to invest in the Barnett shale came from work sponsored by the Department of Energy in the 1970s, and that shale development would have not have occurred without that early government funding of basic research.[1] The time from the early research to the emergence of gas shale as a resource of national significance was about three decades. Companies will not typically undertake pre-commercial research and development over this time scale. Previously funded research over 1978-1992 of $137 million would not likely have been supported by independent companies. Private research would not have the same impact or have been disseminated and leveraged by the industry. Drawing on this example and others, we find that major new resource developments require steady, long-term cooperation and funding between government and industry.

Section 999 of the Energy Policy Act of 2005 has been a mechanism for providing long-term cooperative research with the steady funding required to make progress toward the development of a safe and efficient gas shale industry. We find this program has been remarkably successful in meeting its objectives. We believe this approach to be much more efficient than intermittent funding which depends on annual appropriations.

The Section 999 program has functioned as envisioned:

- The program provided a stable funding source with which the Department of Energy could invest in helping to seed and transfer technology enabling new development and operating concepts while being more ESH sustainable and robust.
- Mid and long term programs and projects can be planned and executed without threats of annual shutdowns or cutbacks while funding sources were uncertain.
- The funding is less vulnerable to the vagaries of annual appropriations debates and the changes in direction imposed by political agendas.
- Program management by RPSEA has successfully advanced the goals of the program
- Completed Section 999 projects continue to contribute to the growth of the gas shale development.
- We agree with the SEAB Shale Gas Production Subcommittee 90-day report finding supporting the Section 999 research program. Section 999 is in fact long-term and is not designed to respond to short-term issues

Recommendations

The Committee recommends the following:

[1] http://thebreakthrough.org/blog/2011/12/interview_with_dan_steward_for.shtml

accessed 2-19-2012

- DOE should include research directed towards these other main resource areas: 1) both gas and liquid petroleum resources and 2) unconventional reservoirs other than shale, such as low-permeability ("tight") sandstone and carbonates, 3) methane hydrate, and 4) other potential oil and gas resources.
- Ultimate amendment of Section 999 to change the "sunset" to extend the program.
- The Department of Energy should request additional funding as authorized under Section 999.
- A renewed program should incorporate management schemes similar to those in the present program.

3.2 ENVIRONMENTAL FINDINGS AND RECOMMENDATIONS

Finding

As stated in the Executive Summary of the 2012 Draft Annual Plan, "[T]he *2012 Annual Plan* proposes scientific research that will quantify and mitigate risks associated with oil and gas exploration and production onshore and offshore, thereby improving safety and minimizing environmental impacts."

We find this overarching objective is synergistic with improving operational efficiency and reducing the cost of oil and gas production. A few of many examples are:

- Reduction of fresh water demand for hydraulic fracturing reduces the environmental impacts of obtaining and transporting water while reducing the cost of its provision.
- Improving the safety of drilling and completion operations by reducing the risk associated with certain fluid additives.
- Reduction of fugitive methane emissions reduces the greenhouse gas footprint of hydrocarbon production while minimizing loss of valuable product.

We further find that technical innovations that improve safety and minimize environmental impacts will be more rapidly adopted if they also improve operational efficiency and reduce costs.

Recommendation

DOE should direct RPSEA:

- In its Requests for Proposals, to associate operational efficiency improvements and cost reduction with safety and environmental objectives whenever feasible.
- In selecting proposals to be funded, combine ESH with potential improvements in operational efficiency and cost reduction, among its other selection criteria.

3.3 RESEARCH AND DEVELOPMENT PROGRAM FINDINGS AND RECOMMENDATIONS

The 2012 Annual Plan continues the change in research focus initiated by the 2011 Annual Plan as an effort to help address the perceived environmental and safety concerns. This Subcommittee has reviewed the 2012 planned solicitation topics. However, rather than commenting specifically on the individual proposed topics, we have summarized our remarks into three main categories: 1) ensure a balanced research program, 2) expanding research to petroleum resources and unconventional reservoirs other than shale gas, and 3) to continue funding long-term petroleum energy research through RPSEA.

Finding

Annual plans prior to 2011 have contained a balance of research topics, including environmental, safety, and health (ESH) in accordance with the Section 999 goals. Past and current environmental focused research themes include:

- Technology Integration Program and Environmentally Friendly Drilling Program
- Pre-Treatment and Water Management of Frac Water Re-Use
- An Integrated Framework for the Treatment and Management of Produced Water
- Marcellus Shale Field Demonstration Project

The change in focus to consider only environmental and safety research proposals as proposed in the 2012 Annual Plan, and recommendations to continue these objectives through the end of the multi-year program as proposed by the RPSEA 2012-2014 Draft Annual Plan, will fail to meet key objectives expressed by Congress in the 2005 Energy Policy Act, Section 999, to "… *maximize the value of natural gas and other petroleum resources of the United States, by increasing the supply of such resources, through reducing costs and increasing the efficiency of exploration for and production of such resources, while improving safety and minimizing environmental impacts."*

A Minority Opinion by one member of the committee was expressed related to this Finding, and is included in Appendix B.

Recommendation

The DOE 2012 Draft Annual Plan should be revised to meet the Section 999 requirements to include research proposals designed to address the following objectives to re-establish a more balanced research program that takes into account public health, safety and the environment while:

- increasing supplies of domestic natural gas and other petroleum resources
- increasing exploration and production efficiency

The 2010 URTAC recommendations are hereby confirmed again and should be carried forward:

- better communicate to the public past RPSEA project ESH accomplishments
- all research proposals should continue to include statements of ESH benefits

- ESH objectives continue to be a formal part of the selection committee criteria

Finding

The energy industry has been successful in increasing domestic natural gas supplies. This success was highlighted in President Obama's January 2012 State of the Union address to Congress. The 2012 Draft Annual Plan and past Annual Plans have stated focus on natural gas although the Section 999A goals include increasing the domestic supply of "other petroleum resources," including oil, condensate and natural gas liquids. Unconventional reservoirs including, but not limited to shale, have the potential to also produce oil and other liquid hydrocarbons which could contribute in reducing the country's dependence on foreign oil imports and reducing domestic prices for gasoline and other petroleum-derived products.

The current ESH research directives of the proposed 2012 Annual Plan, while founded on areas of recent public concern, could diminish the broader goals of Section 999. We seek efficient development and production technologies that increase oil and gas supplies while reducing environmental impacts.

Specific examples of the needed technologies research topics are:

1. Well isolation and integrity (e.g. cementing, swellable packers, and evaluation of the effectiveness of the isolation)
2. Stimulation technologies that significantly reduce or eliminate water use, and that increases re-use of produced and stimulation flowback waters
3. Surface systems (facilities, roads, etc) studies that improve efficiency, reduce air emissions, minimize surface impacts, encourage more use of stranded gas, including alternate (non-flare) techniques to reduce pipeline cost risk and air quality impacts (liquefaction, compression, etc.).
4. Reservoir characterization and modeling improvements are needed to fully understand unconventional reservoirs, including fracture systems and the interaction with subsurface activities including induced seismicity (e.g. understanding fluid flow and uncertainties will enable reduced surface activities and provide optimization and recovery insight and enhancement methods to identify areas of key risk and static and dynamic (over time) "sweet spots" to minimize drilling unnecessary wells).
5. Technologies for mature fields, including low pressure (and near depleted) gas and oil fields that improve recovery and field life in environmentally robust manner, for all reservoir types, including technologies that address issues of: 1) Low BTU gas, 2) problem or off-spec and high NGL content natural gas, 3) low thermal maturity organic-rich shale, and 4) resources in formation types where we have little knowledge.

Recommendation

The 2012 Draft Annual Plan should be modified to include research directed towards these other main resource areas: 1) both gas and liquid petroleum resources, 2) unconventional reservoirs

other than shale, such as low-permeability ("tight") sandstone and carbonates, 3) methane hydrate and 4) other potential resources.

Further, the cross-cutting technologies needed to develop those resources include:

1. Well isolation and integrity (e.g. cementing, swellable packers, and evaluation of the effectiveness of the isolation).
2. Stimulation technologies that significantly reduce or eliminate water use and increase re-use of produced and stimulation flowback waters.
3. Surface systems (facilities, roads, etc) studies that improve efficiency, reduce air emissions, minimize surface impacts, encourage more use of stranded gas, including alternate (non-flare)techniques to reduce pipeline cost risk and air quality impacts (liquefaction, compression, etc.).
4. Reservoir characterization and modeling improvements are needed to fully understand unconventional reservoirs, including fracture systems and the interaction with subsurface activities including induced seismicity (e.g. understanding fluid flow and uncertainties will enable reduced surface activities and provide optimization and recovery insight and enhancement methods to identify areas of key risk and static and dynamic (over time) sweet spots to minimize drilling unnecessary wells).
5. Technologies for mature fields, including low pressure (and near depleted) gas and oil fields that improve recovery and field life in environmentally robust manner, for all reservoir types, including technologies that address issues of: 1) Low BTU gas, 2) problem or off-spec and high NGL content natural gas, 3) low thermal maturity organic-rich shale, and 4) resources in formation types where we have little knowledge.

Finding

RPSEA's compressed solicitation schedule makes it difficult for interdisciplinary teams to form. This is particularly a problem for projects with important environmental components. Experts in those areas may not share institutional affiliations with the principal investigators.

Recommendation

Give researchers more time to develop proposals for submission, to improve submissions and to provide more time to organize research teams with diverse expertise, including environmental experts.

3.4 VALUE & PUBLIC OUTREACH FINDINGS AND RECOMMENDATIONS

Finding

Long-term R&D is valuable and necessary. This often cannot be done by independent producers who are responsible for a large portion of the current oil and gas development in the United States.[2]

The R&D efforts that resulted in game changing technologies (cited by President Obama in his January 2012 State of the Union Address), have led to an abundant supply of natural gas. This can supply the United States for more than 100 years at current rates of consumption. Natural gas is cleaner burning than any other fossil fuel and is a good energy alternative for the environment. (See Appendix A for details regarding the benefits of prior DOE research.)

Long-term R&D is required to more efficiently produce supplies of liquid hydrocarbons in an environmentally sound manner. Areas of shale development are just starting to unlock resources that yield liquid hydrocarbons in commercial quantities as efficiently as is now being realized for natural gas, but additional R&D is needed in this area before the complexities of such hydrocarbon generation and fluid flow will fully be understood and exploitable.

Recommendation

Continue to fund long-term research and development programs similar to those created by the Energy Policy Act of 2005, Section 999 legislation to help secure more energy for America.

Finding

RPSEA is well known in the oil and gas industry, but has no public profile outside of it. As the manager of a technology portfolio that includes projects relevant to safety and environmental protection, RPSEA is in a position to provide reliable, nonpartisan, technical information to state and local government officials, and to the public at large.

Small producers need extra assistance in adopting DOE-funded technology improvements.

Recommendations

- Technical forums should provide information of interest to the widest audience of producers possible for maximum dissemination (national coverage).
- Allocate resources for improving public dissemination of research results through expanded geographic outreach around the country, particularly to state and local government officials and citizens groups.

[2] GAO, 2007, "Department of Energy: Oil and Natural Gas Research and Development Activities Briefing to the Committee on Appropriations, Subcommittee on Energy and Water Development," U.S. Senate, September 25, 2007, GAO08-190R.

- The technology transfer component of the program should be extended to all petroleum producing regions of the United States (e.g. the PTTC/NETL website model, cooperative extension model)
- Assist small producers with producing at the highest levels of safety, environmental sustainability, and operating efficiency.

Finding

The metrics used to evaluate the effectiveness of the Section 999 program continue to be a concern. Often, metrics are used that are narrowly focused on incremental production as the sole measure of the return on investment of the program. There are other benefits that should be taken into consideration.

Recommendation

Better metrics should be identified to measure and disseminate the successes of the program:

- A committee of industry and other stakeholders should be established for this purpose.
- Metrics should be developed which go beyond those required by statute (e.g., impact on Federal royalty revenues; recent NPC report, specifically the macroeconomic chapter), to include others that may be of concern to various stakeholders, including:
  - Increased resources and reserves (both technically recoverable resources and increased economic reserves due to application of new technologies and reduced operating costs.
  - Economic metrics
  - Environmental: reduced overall footprint including: reduced emissions, chemicals, and waste.
  - Construct a "backward-looking" model to assess how past technology successes using data from previous projects funded by DOE have resulted in increased reserves and/or production. This data can be used to help evaluate the expected benefits of the current program.
- Benefits analyses similar to those carried out for other federal research programs such as jobs generated should be done for this program.

Finding

While the Department of Energy is not specifically tasked with regulatory responsibilities, it does interact with other departments and agencies to provide strong science to underpin the rules and regulations which are enacted to promote responsible oil and gas development. In this capacity it should strive to promote responsible industry practices and the role of domestic oil and gas development in the nation's energy portfolio.

Recommendation

The Department of Energy is in a unique position to work with the industry, the regulators, and other stakeholders. This can best be achieved by their providing sound science which

contributes to finding the optimum balance between the need to support a crucial domestic energy industry, while enhancing the safety of its operation, and protecting the environment.

4.0 COMMITTEE MEMBERS

Title	Last Name	First Name	Employer	City	State
Mr.	Arthur	J. Daniel	ALL Consulting, LLC	Tulsa	OK
Mr.	Bromfield	Kenneth	Dow Hydrocarbons and Resources, LLC	Houston	TX
Dr.	Brown	Nancy J.	Lawrence Berkeley National Laboratory	Berkeley	CA
Mr.	Camp	Wayne K.	Anadarko Petroleum Corporation	Woodlands	TX
Ms.	Cavens	Jessica J.	EnCana Oil & Gas (USA)	Denver	CO
Mr.	Daugherty	William S.	Blackridge Resources	Lexington	KY
Mr.	Dwyer	James P.	Baker Hughes	Houston	TX
Mr.	Hall	J. Chris	Drilling & Production Co.	Torrance	CA
Dr.	Hardage	Bob	University of Texas at Austin	Austin	TX
Mr.	Harju	John A.	Energy & Environmental Research Center	Grand Forks	ND
Mr.	Kleinberg	Robert L.	Schlumberger-Doll Research	Cambridge	MA
Mr..	Lewis	Fletcher S.	Rainmaker Oil & Gas	Oklahoma City	OK
Ms.	Mall	Amy	Natural Resources Defense Council	Washington	DC
Dr.	Martin	John P.	University of Buffalo	Amherst	NY
Mr.	Mason	Gregory	The Energy Cooperative	Newark	OH
Dr.	Mohaghegh	Shahab D.	West Virginia University	Morgantown	WV
Mr.	Nilson	Gary J.	Pioneer Natural Resources USA, Inc,	Irving	TX
Mr.	Oglesby	Kenneth D.	Acorn Resources, Inc.	Tulsa	OK
Mr.	Rodgers	Brady D.	New Frontier Energy, Inc.	Denver	CO
Mr.	Sparks	Don L.	Discovery Operating, Inc.	Midland	TX
Mr.	Whitney	Sam W.	Shell E&P Company	Houston	TX

5.0 SUB-GROUP TOPICS AND MEMBER ASSIGNMENTS

At the January 18th, 2012 meeting in Houston, Texas the following Subgroups and Schedule were established for developing the Subgroup analyses and reports. At the Committee meeting in Houston, Texas on February 28th and 29th the Subgroup reports were reviewed and incorporated into this final report.

Six Sub-Group Areas of Analysis and Member Assignments:

Policy and Regulation
Brown, Hall (co-chair), Kleinberg, Bromfield, Cavens, Oglesby, Mason (co-chair)

Value and Public Outreach
Hall, Lewis, Martin, Nilson (chair), Daugherty, Arthur

Environmental
Mall, Mason, Mohaghegh, Hardage, Kleinberg (chair), Martin, Arthur

Research and Development
Camp, Harju, Lewis, Martin, Mohaghegh, Nilson, Oglesby (chair), Whitney (co-chair), Mall, Sparks

Editing
Dwyer (chair), Cavens, Mason, Hall

6.0 APPENDIX A: RELEVANT DOCUMENTATION

Quotation from the DOE's 2012 Annual Plan Appendix B: RPSEA 2012 Draft Annual Plan (pg. 18-19):

"The program outlined in this plan is specifically directed toward developing the technology that will attract additional industry investment to development these large but economically marginal resources. The impact of public research funding in attracting industry development investment has been clearly established. Back in 1982, the U.S. Department of Energy in collaboration with the Gas Research Institute (GRI, now the Gas Technology Institute), led the world's first effort to develop unconventional gas resources with a research program targeting coalbed methane. GRI managed a collaboration of experts from industry and academia that evolved throughout the 1980's and generated the advancements enabling 12% of U.S. gas supplies today coming from coalbed methane (CBM). This R&D funding occurred in advance of industry's heavy involvement and so set the stage for the developments to come. For example, the Coalbed Methane R&D program provided $30 million in funding from 1978 to 1982 with production starting just a couple years after this. The Shale Gas R&D program provided $137 million from 1978 to 1992 and again production started just a couple years later. Figure 2.1 illustrates the relationship between the early R&D investment by DOE and CBM and shale gas production in the U.S. This program will enable R&D to continue to reduce the cost and environmental footprint of development of these resources to insure this development is sustainable for the long-term.

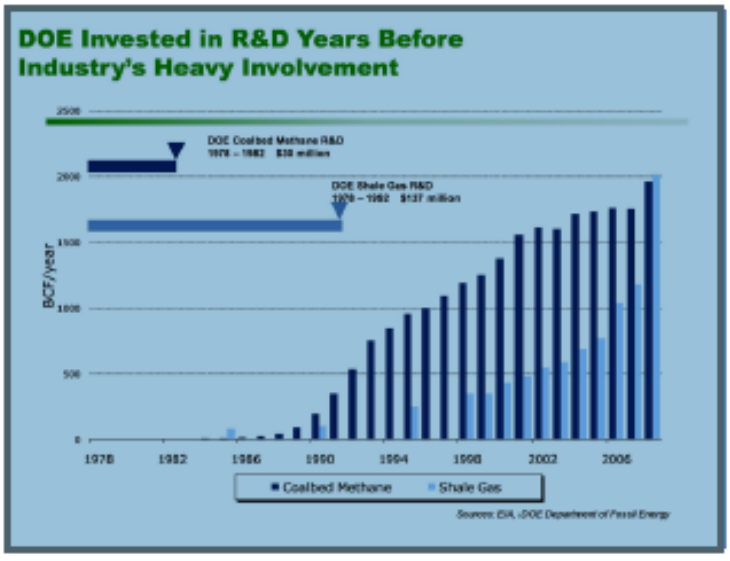


Figure 2.1: Early DOE Investment in Unconventional Gas R&D

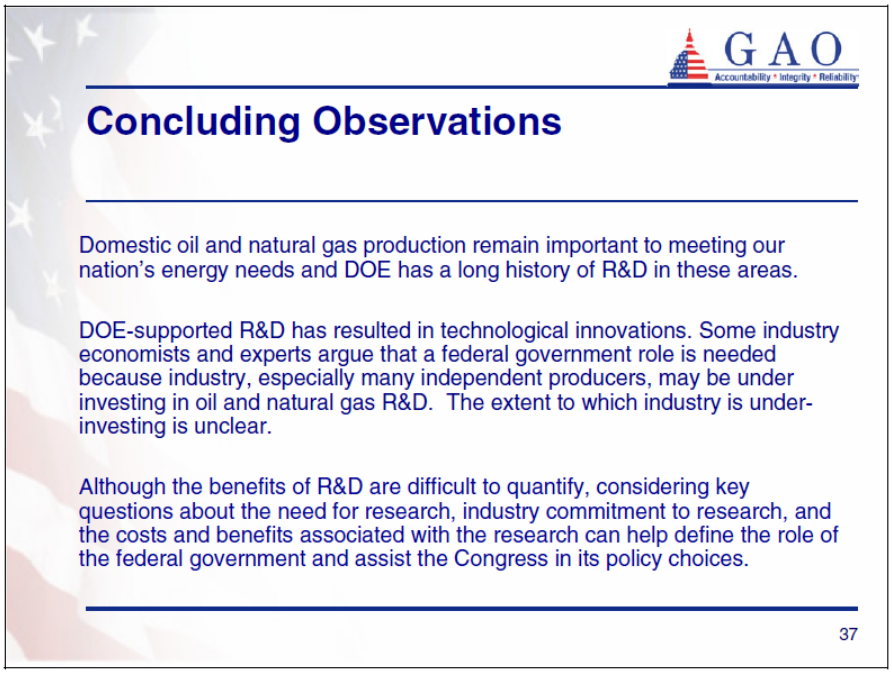
In addition to CBM and gas shale research, DOE funded a tight gas research program (*Western Tight Gas Sand Program*). DOE expenditures in the Western Tight Gas Sand program from 1978 to 1999 amount to $185 million. The program peaked in 1981 at $21 million. The program included both basic and applied research with a strong field-based component. Field-based

research was conducted in the Piceance Basin of Western Colorado at a multi-research well location called the MWX research site. Much of the tight gas sand production in the Western U.S. today is attributable to the fundamental findings established at the MWX site with regard to tight gas flow through a low permeability porous media.

The technologies generated from these investments are now deployed throughout the U.S. and available to other countries now looking to develop their resources. The result of the development and implementation of these technologies is that the U.S. energy picture has been transformed. In 2002, there were 47 liquefied natural gas (LNG) terminals in permitting in preparation for looming shortages.

Six short years later, the view had changed dramatically. Many of these facilities are idle or considering conversion to LNG export facilities. Unconventional gas developed from several resources across the country now represents 46% of U.S. production. Shale is the fastest growing fraction and several basins hold additional potential for drilling beyond those already being developed. Every time the level of technically recoverable resource has been assessed, advances in technology and understanding of resource potential have increased the amount to the degree that the U.S. has the potential to be self-sufficient with 100 to 200 years of technically recoverable resources identified."

From the General Accounting Office 2007 report, "Department of Energy: Oil and Natural Gas Research and Development Activities Briefing to the Committee on Appropriations, Subcommittee on Energy and Water Development," Report to U.S. Senate, September 25, 2007, *GAO08-190R.*



7.0 APPENDIX B: MINORITY REPORT

Minority Opinion

I support the Department of Energy's Draft 2012 Annual Plan, and dissent from the Committee's recommendation that the Draft Annual Plan be revised to increase focus on expanding supplies of oil and gas. In addition, I disagree with the Committee's findings that the Department of Energy's Draft 2012 Annual Plan, because of its change in focus to increase environmental and safety research, will fail to meet objectives and diminish the goals of the 2005 Energy Policy Act.

Instead, I find that environmental, health and safety research must be the top priority of funding for Section 999 funded research. Research into these topics has been underfunded for much too long, and the Department is appropriately planning to make it a much higher priority.
As unconventional oil and gas production rapidly expands across the United States, there are more and more questions and concerns about the environmental, health and safety impacts. Air and water pollution, as well as leaks and spills, are increasingly documented, but there are inadequate answers about the impacts, due to a severe lack of scientific research and analysis. Much more scientific research and analysis are needed to better understand these impacts, whether it is possible to prevent or mitigate them and, if so, how best to accomplish that.

Signed,
Amy Mall