

RPSEA

2009 Draft Annual Plan

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Executive Summary

This document is the Research Partnership to Secure Energy for America (RPSEA) 2009 Draft Annual Plan (DAP) for the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program (Program) established pursuant to Subtitle J, Section 999, of the Energy Policy Act of 2005 (EPAct). RPSEA administers three of the four programs identified in EPAct, pursuant to an annual plan, which include: ultra-deepwater architecture and technology, unconventional natural gas and other petroleum resources exploration and production technology, and technology challenges of small producers. The Department of Energy (DOE) through its National Energy Technology Laboratory (NETL) implements a complementary research and development (R&D) program of Section 999. RPSEA previously submitted DAPs for 2007 and 2008 and gathered extensive input through industry workshops, road mapping sessions, and expert opinion in their development, including input from two Federal Advisory Committees. The 2009 DAP is an evolutionary document building upon the foundation of the 2007 and 2008 Annual Plans, both of which DOE has submitted to Congress, and both of which incorporated RPSEA's 2007 and 2008 DAPs.

RPSEA Activities

The first solicitations were released by RPSEA in mid-October 2007 with proposals received in early December 2007. Additional solicitations were released in November 2007, December 2007, and February 2008. Proposals from the Small Producer Program and the Unconventional Natural Gas and Other Petroleum Resource Program (Unconventional Resources Program) were received in early December 2007. The proposal reviews were completed in early January 2008 and submitted to the RPSEA Program Advisory Committees (PACs) for project selections. Seven projects were selected for award under the Small Producer Program, and 19 projects were selected for award under the Unconventional Resources Program. In the Ultra-Deepwater Program (UDW), 17 projects have been selected for award. The project selections were approved by NETL and are described in their respective program chapters.

In addition to the activities associated with commencement of operations under EPAct, RPSEA also has undertaken other activities in order to leverage the valuable public investment from Section 999. These activities are intended to support research and promote broad involvement and include a private Fellowship/Scholarship Program, a RPSEA summer internship, participation and exhibits at multiple industry functions, and sponsorship of innovative initiatives such as the Young Professionals in Energy and the Oil & Gas Innovation Center.

Organization and Planning

The extensive advisory network that provides input and direction for the DAP and operational activities has involved many hours and meetings. In the overall process, there have been 40 meetings with 840 participants, who have volunteered almost 3,800 hours of time and effort. As an example, the UDW advisory committees met 29 times with 591 participants involving over 2,800 hours of time and effort to focus the 120+

project ideas for 2007 and 2008 down to 26 ideas representing approximately \$30 million in R&D funds.

In addition, RPSEA broadly reached out to involve the oil and gas community through an outreach program of technology forums, holding 19 forums hosted by member organizations in which 940 people participated (not including RPSEA or Department of Energy (DOE) personnel). This participation amounts to over 9,500 hours of participant commitment and does not include the hours of commitment from the host organization or individual efforts, which in terms of time, effort, and monetary support have been substantial.

Moreover, RPSEA membership continues to grow, doubling since January 2007 from 66 members to the current membership of 132 members and includes natural gas and oil stakeholder groups from universities, private research organizations, integrated oil and gas companies, large and small independent producers, trade associations, financial entities and institutions, service companies and providers, national labs, non-governmental organizations, and consumer and civic organizations. These members represent 28 states, the District of Columbia, and the Province of Newfoundland, Canada. From information gathered from their public websites, RPSEA has found that these members collectively have more than 500,000 employees worldwide and represent approximately 50 percent of U.S. natural gas and oil production.

2009 Planning

The UDW for 2007 and 2008 was divided into theme areas based on four generic field types that represent the most challenging field development scenarios facing ultra-deepwater operators in the Gulf of Mexico: low permeability reservoirs, flow assurance, small field development, and high pressure/high temperature. RPSEA solicited R&D projects to develop technologies that will facilitate development of these field types. For 2009, six need areas further define the four field development scenarios:

1. Drilling, completion, and intervention breakthroughs
2. Appraisal and development geoscience and reservoir engineering
3. Significantly extend subsea tieback distances/surface host elimination
4. Dry trees/direct well intervention and risers in 10,000 foot water depth
5. Continuous improvement/optimization of field development
6. Associated safety and environmental concerns

The Unconventional Resources Program for 2007 and 2008 focused on three theme areas that target gas shales, water management for both coalbed methane and gas shales, and tight sands, emphasizing unconventional natural gas rather than “other petroleum resources” (e.g., shale oil, oil sands, deep gas). Unconventional oil resources are currently being addressed within National Energy Technology Laboratory’s (NETL) R&D portfolio and will continue to be addressed by NETL consistent with the recommendation from the 2008 Unconventional Resources Technology Advisory Committee. For 2009, the focus on unconventional natural gas remains essentially unchanged, with gas shales as the highest priority. The 2009 solicitation(s) will

encourage the development of integrated programs targeting specific resources with a likely focus on technology or resource gaps that may remain in the program after the 2007 and 2008 awards. Areas that are currently identified as requiring additional emphasis include the development of unconventional gas in the Appalachian region, decreasing the environmental footprint of unconventional gas development, and innovative approaches for integrating program results and ensuring that technologies developed under the program are made available to the producer community.

The Small Producer Program for 2007 and 2008 targeted advancing technologies for mature fields, which primarily covers the technology challenges of managing water production, improving recovery, and reducing costs. Mature fields are the domain of small producers, and they face these three challenges on a daily basis. Accordingly, the initial solicitation under this Program was aimed toward developing and proving the application of technologies that will increase the value of mature fields by reducing operating costs, decreasing the cost and environmental impact of additional development, and improving oil and gas recovery. For 2009, the focus will remain on the theme of advancing technology for mature fields, however, opportunities will be sought to complement the project selections in the 2007 and 2008 Programs by funding research that builds upon earlier results and expands their geographic application.

Chapter 1 Background

Energy Policy Act of 2005: Section 999

The Energy Policy Act of 2005 (EPAAct), Subtitle J, Section 999 supports oil and gas research and development (R&D) through a program of research, development, demonstration, and commercial application of technologies for ultra-deepwater and unconventional natural gas and other petroleum resource exploration and production to maximize the value of natural gas and other petroleum resources of the United States.

Section 999 sets the funding for the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program (Program) at a level of \$50-million-per-year provided from federal lease royalties, rents, and bonuses paid by oil and gas companies. The funds are to be directed towards research specifically targeting four areas: ultra-deepwater resources, unconventional natural gas and other petroleum resources, technology challenges of small producers, and research complementary to these areas. The complementary research is being performed by the National Energy Technology Laboratory (NETL), while all other research is administered by the Research Partnership to Secure Energy for America (RPSEA). See Table 1.1 for a breakdown of funding as directed by Section 999.

The investment in research provides the public with a two-for-one benefit. New federal revenues are created because much of the technology investment impacts natural gas and oil production from federal lands, and the projects enhance the nation's intellectual capital through the process of new technology development. The technology also applies to non-federal lands, which although don't directly provide federal royalties, they do make a significant contribution to gross national product and domestic energy security. Technically challenging resources cannot be fully exploited to their full public economic and security benefit potential without the necessary technology. One example of such a required technology is the *Ultra-High Conductivity Umbilicals*' project, which has the potential of improving power transmission to the sea floor from formerly non-produceable water depths on federal tracts. The research and subsequent technology developed from this effort could also impact the energy sector well beyond the scope of just natural gas and oil. Another example onshore is the *New Albany Shale Gas* project. This extensive resource has been known and produced for some time, but has never reached its full potential. Without new R&D, it will continue to languish. By bringing together the best and brightest minds and capabilities nationwide to discover methods to better understand and more efficiently produce this onshore natural gas shale resource, this project will increase our nation's national security by enhancing the domestic supply of energy making the United States less vulnerable to foreign supply disruptions and costs, and providing plentiful clean burning natural gas to Americans for years to come. Details on both projects can be found in the following sections regarding each program at <http://www.rpsea.org/en/cms/?1560> and http://www.rpsea.org/attachments/contentmanagers/1417/RFP2007DW1302_Final_Archive2.pdf on the NETL/SCNGO webpage at <http://www.netl.doe.gov/technologies/oil-gas/EPAAct2005>.

To enable high-payoff activities and attain longer-term national goals, especially national security and increased energy independence, there must be extensive collaboration of researchers and service providers, both supported by industry. This extensive collaboration is not easily achieved with current industry constraints and market incentives and can only happen with effective public policy and leadership. A fundamental objective of the Program is to generate collaborative projects that are not well suited or practical for industry to perform itself by combining the unique and valuable contributions of industry, academia, and the research community leveraged by significant public investment. This is especially crucial for independent producers who drill 90 percent of the wells in the United States and produce 82 percent of the nation’s natural gas and 68 percent of the nation’s oil, yet many have little or no internal technology development capability.

([http://www.ipaa.org/issues/testimony/IPAA Testimony-HouseOversiteGovtReform10-31-2007.pdf](http://www.ipaa.org/issues/testimony/IPAA%20Testimony-HouseOversiteGovtReform10-31-2007.pdf)). An example is exemplified in the project *An Integrated Framework for the Treatment and Management of Produced Water*. This project has 15 participants, whose participation is the result of the creation of an effective mechanism for collaboration on a project that addresses a critical need associated with domestic production. Another example of collaboration between industry, academia, and a state regulatory agency is the project *Reducing Impacts of New Pit Rules on Small Producers* under the Small Producer Program. This project seeks to improve access to and functionality of data necessary for compliance with new rules in order to improve the permitting process.

A. Consortium Selection

NETL contracted with RPSEA, a 501(c)(3) not-for-profit corporation consisting of more than 130 member organizations, to administer the distribution of about \$32 million per year in R&D contracts (Table 1.1). The federal government will maintain management oversight of the Program, and RPSEA’s administration funds are limited to no more than 10 percent of the funds.

Area	Allocation	Area Funds	NETL Review & Oversight 5%	RPSEA Administration 10%	R&D Funds for Distribution
Ultra-Deepwater	35%	17,500,000	875,000	1,662,500	14,962,500
Unconventional and Other	32.5%	16,250,000	812,500	1,543,750	13,893,750
Small Producers	7.5%	3,750,000	187,500	356,250	3,206,250
Consortium Total		37,500,000	1,875,000	3,562,500	32,062,500
Complementary	25%	12,500,000	0	0	12,500,000
Section 999 Total	100%	50,000,000	1,875,000	3,562,500	44,562,500

Table 1.1: Distribution of Section 999 Funds (US\$)

RPSEA is organized as a consortium and has a broad membership base that includes representatives from all levels and sectors of both the oil and gas exploration and production (E&P) and oil and gas R&D communities. For a complete list of RPSEA members, see Appendix A. RPSEA members represent virtually all critical elements of the natural gas and oil supply technology value chain. This breadth of membership helps ensure that consortium-administered R&D funds are directed towards key problems in ways that leverage existing industry efforts. A variety of advisory committees and meetings drawn from this membership are incorporated into RPSEA's planning process, as well as in the recommendation of R&D projects to be awarded and the review of project results. Collectively, this network has accounted for approximately 14,300 hours of volunteer participation, the value of which cannot be over emphasized and is not something that could otherwise be easily procured at any cost. This voluntary participation has occurred because industry recognizes the value to economically and efficiently find and produce natural gas and oil, which ultimately benefits American consumers and supports a program of wide ranging methods to increase energy supply.

The companies, universities, and other organizations that receive funds through this Program will provide cost-share contributions of at least 20 percent of total project costs. The involvement of industry partners in all phases of the oil and gas R&D process increases the likelihood that technologies developed by the Program will move into the marketplace.

RPSEA is a new model for public/private partnership that has never existed at this scale in the natural gas and oil industry and resembles the model recommended by the 1999 National Petroleum Council (NPC) study. Using a collaborative approach with industry, academia, and government to advance technology, RPSEA's membership includes E&P corporations, service companies, research organizations, universities, national labs, financial entities, non-governmental organizations, and consumer and civic organizations. This "network of networks" avoids "reinventing the wheel" by utilizing and leveraging the robust individual capabilities of the network components. The model, uniquely developed for the natural gas and oil sector, seeks to replicate the success of other models uniquely developed for other public and private sectors such as the National Aeronautical Space Administration, Defense Advanced Research Projects Agency, and others that employed flexible, innovative, and relevant methods to achieve their objectives by matching capabilities with needs and goals.

B. RPSEA Structure

Key features of RPSEA's organization are illustrated in Figure 1.1. RPSEA is the consortium selected by the Department of Energy (DOE) to administer three programs of Section 999. Information on RPSEA and its members can be found at <http://www.rpsea.org/en/cms/?38> and membership is depicted in Appendix A.

The key features of RPSEA's organization are illustrated below showing the broad process of engagement both internally and externally.

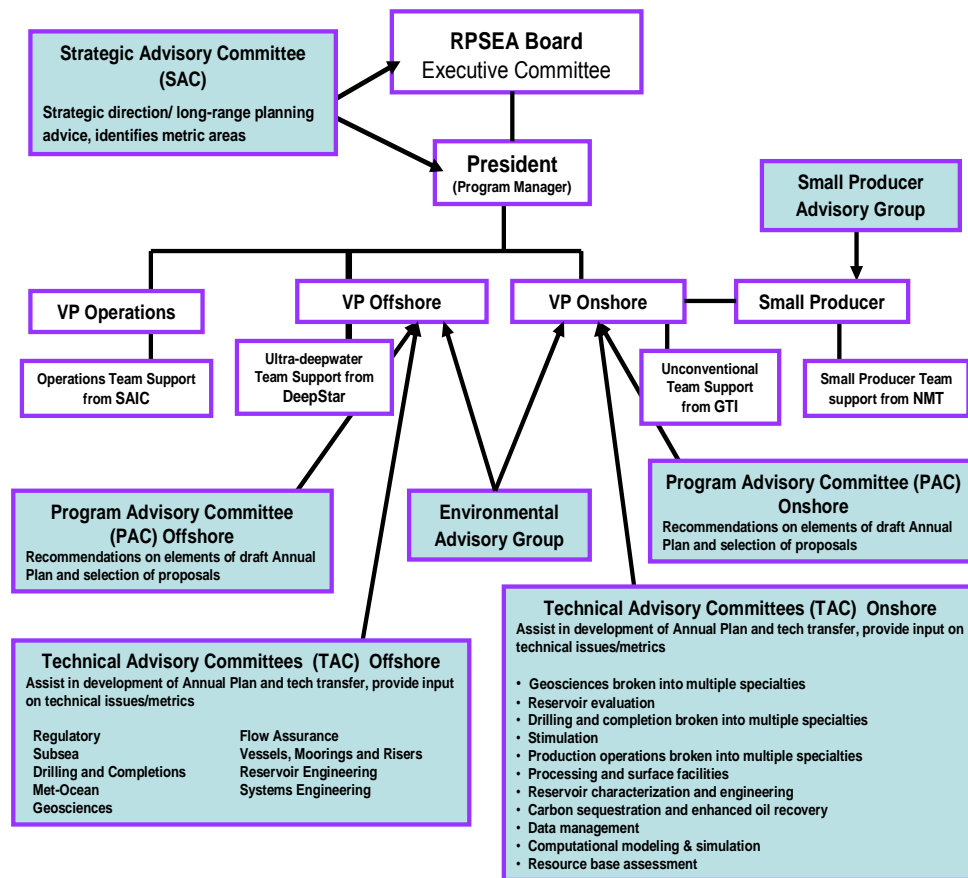


Figure 1.1: Organization of RPSEA and Advisory Committee Relationships

The makeup of the Board of Directors and the external advisory committees and groups are provided in Appendix A, and their respective roles are described below.

Board of Directors (BOD) - In addition to operational oversight, the BOD provides significant input and direction to the preparation of the RPSEA Draft Annual Plan (DAP). RPSEA has a diverse BOD, whose members are each renowned for their expertise and give RPSEA valuable guidance. RPSEA by-laws require a two-thirds super majority vote for approval of the DAP.

Strategic Advisory Committee (SAC) - RPSEA established the SAC to provide strategic direction, advice on the shape of the research portfolio, long-range planning recommendations, and metrics determination to the BOD and to the president. The SAC is comprised of a group of industry leaders in the energy field, including both RPSEA members and non-members. The SAC provides guidance regarding the process used to develop the RPSEA DAP, the proposed R&D portfolio, and the metrics to be used to track progress toward Program goals.

Environmental Advisory Group (EAG) - Environmental stewardship is at the core of all RPSEA activities. The EAG is designed to provide input to the Program regarding environmental issues. It organizes and brings together key experts and policy leaders from academia, regulatory entities, non-governmental organizations, and industry for road mapping exercises to identify key regulatory barriers/issues.

Program Advisory (PAC) and Technical Advisory (TAC) Committees - The roles of the PACs and TACs within each program are further defined in Chapters 4-6, as they are specific to each program. Generally, the PACs provide recommendations on elements of the proposed plan, but primarily make project selection recommendations from the pool of reviewed proposals into an integrated R&D portfolio. The TACs provide subject specific technical advice on the development of the proposed plan and conduct the quantitative proposal reviews at the direction of the PACs.

Small Producers Research Advisory Group (RAG) - The Small Producer Program receives guidance from the RAG consisting of industry and academic representatives that are closely tied to the national small producer community. The RAG reviews proposals, makes project selection recommendations, and follows each selected project's progress, plans, results, and especially, technology transfer. All projects will be reviewed by the RAG annually. While the RAG will be responsible for directing the Small Producer Program, the Unconventional Resources Program PAC will remain responsible for oversight of the entire onshore program, which includes the Small Producer Program.

In addition to the BOD and the advisory committees described above, RPSEA has contracted with four organizations: Chevron, through the Chevron administered DeepStar Consortium (DeepStar), Gas Technology Institute (GTI), Science Applications International Corporation (SAIC), and New Mexico Institute of Mining and Technology (NMT), as part of its management team.

RPSEA's Management Approach

RPSEA's approach to the administration of this critical and innovative Program is intended to provide substantial benefits to American consumers by meeting significant public policy objectives. Key features of this approach include:

- **Broad and deep stakeholder engagement** to accurately identify and expertly execute high-impact research
- **A rigorous technology portfolio management structure** to align programs, projects, technologies, and technology transfer with the high-level strategic objectives of the statute
- **Integration of diverse programs** into a cohesive and coherent program that maximizes programmatic impacts
- **Aggressive, informed, and effective technology transfer** focused on each step of the technology maturation process to ensure maximum technology penetration and diffusion in the marketplace

C. Planning Process

In late 2006, NETL contracted with RPSEA to begin its work with an effective date of January 4, 2007. RPSEA submitted its first DAP to the DOE on April 3, 2007. In November 2007, RPSEA provided recommendations for the 2008 Annual Plan.

Each year, the Annual Plan for RPSEA must be published by the Secretary of Energy (Secretary) before the solicitation of R&D project proposals can begin. Prior to submitting the Annual Plan to the Secretary, the legislation calls for the DOE to gather input on the Annual Plan from Federal Advisory Committees (FACA), as well as from other industry experts. These two committees are the Ultra-Deepwater Advisory Committee (UDAC) and the Unconventional Resources Technology Advisory Committee (URTAC). The DOE's Office of Fossil Energy is responsible for organizing both of these committees. This approach is designed to bring together a broad range of ideas to ensure that the Program returns the maximum benefit to the nation.

Upon publication, the Secretary must transmit the Annual Plan to Congress, along with the recommendations of RPSEA's DAP, the advisory committees, and any other experts from whom comments have been received. Each year's Annual Plan must include details of: ongoing activities; a list of solicitations for awards to carry out research, development, demonstration, or commercial application activities, including topics for such work; who would be eligible to apply; selection criteria; duration of awards; and, a description of the activities expected of RPSEA to fulfill its administrative responsibility.

Timely approval and implementation of each year's Annual Plan is critical to effective results. Achieving these results within the ten-year time specified by Section 999 requires that each year's plan build upon previous years as an integrated and evolving Program. Subsequent year solicitations and project selection are a function of proposals received in a given year, and gaps are identified and addressed as quickly as possible. Groundwork is laid within the research and producer community to assemble the teams to propose. Commitments are made to secure human and capital resources well in advance. Delays in plan approval and/or transmittal, research solicitations, or in project selection and award complicate and discourage participation. Unrelated schedule disruptions significantly impair Program effectiveness and undermine the efforts of all those involved. Committing personnel or budgetary resources and then not utilizing them effectively represents a lost opportunity cost, as it precludes an entity from employing its limited assets somewhere more productively. This is especially true in today's highly constrained workforce environment. It also pertains to universities who seek to recruit, incentivize, and schedule students to participate in projects.

RPSEA has received broad and diverse input from its member organizations, as well as from additional experts. Input was solicited and/or developed from:

- Nineteen RPSEA member forums held in various regions of the country; universities have served as hosts of the majority of the RPSEA member forums. While RPSEA members hosted the forums, participation was not limited to RPSEA members. Member forums included 940 individual participants

representing multiple organizations with interests in technologies to enhance domestic natural gas and oil production. Most of these forums have been oriented to the Unconventional Resources Program and the Small Producer Program. While a few of the forums have been oriented to UDW, the primary inputs for UDW are the TAC meetings. Additional forums and meetings are continually being planned in order to secure input to future plans and R&D solicitations.

- Multiple individual meetings and contacts with individual RPSEA members
- RPSEA’s offshore and onshore PACs and the RAG for general guidance and project selection, the various TACs, and the SAC for high level direction
- Multiple road-mapping exercises conducted by DOE, RPSEA, and others prior to 2007

The process of integrating these inputs is illustrated in the schematic shown in Figure 1.2, which describes detailed steps leading to the development of the DAP. It should be noted that this is an iterative process, both initially and over time, that is not precisely linear. The process itself lends strong transparency to how the DAP is developed, as no one interest can dominate. This holds true for project selection and portfolio development, where the open and robust process with multiple inputs overrides individual biases and provides invaluable credibility. This process is ongoing.

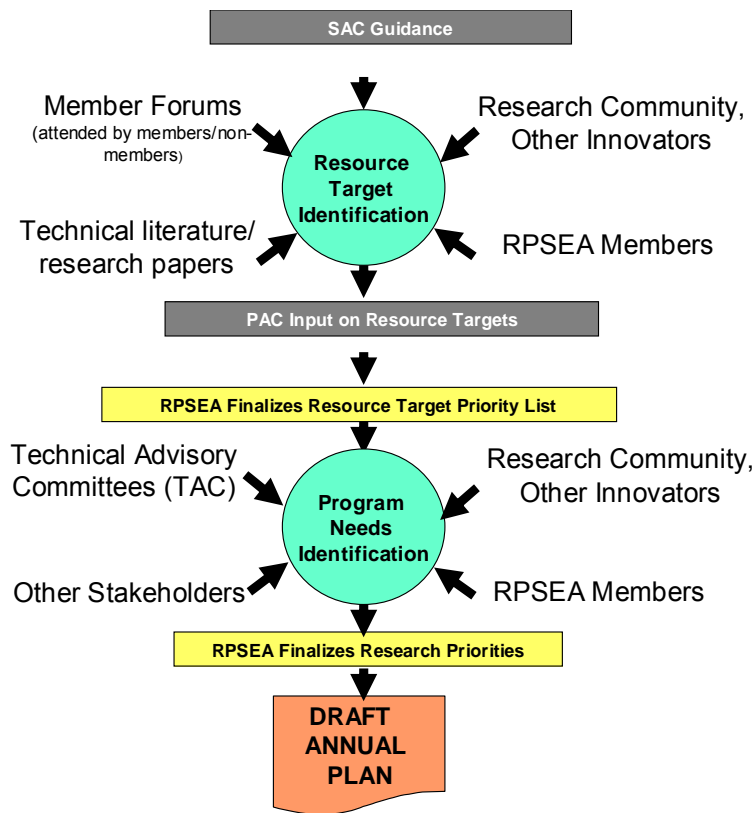


Figure 1.2: RPSEA DAP Development Process

Chapter 2 Strategic Overview

RPSEA Mission, Goals and Objectives

The primary mission of RPSEA with regard to Section 999 of EPO is to administer a program of “*research, development, demonstration, and commercial application of technologies for ultra-deepwater and unconventional natural gas and other petroleum resource exploration and production, including addressing the technology challenges for small producers, safe operations, and environmental mitigation (including reduction of greenhouse gas emissions and sequestration of carbon).*”

All RPSEA activities contemplated in this DAP are focused on achieving this mission. This third year plan is RPSEA’s continuing effort towards meeting the more specific goal in EPO of “[*maximizing*] the value of natural gas and other petroleum resources of the United States, by increasing the supply of such resources, through reducing the cost and increasing the efficiency of exploration for and production of such resources, while improving safety and minimizing environmental impacts.”

RPSEA, as the program consortium selected by DOE, is directed by statute to administer a program of research, development, demonstration, and commercialization in two of the nation’s most promising, but technically challenged natural gas and petroleum resource areas:

- Ultra-deepwater integrated system technologies and architectures for water depths in excess of 1,500 meters or drilled depths greater than 15,000 feet in the Outer Continental Shelf (OCS)
- Unconventional natural gas and other petroleum resource E&P technology, with unconventional being defined as economically inaccessible. This resource-based, prioritized research program focuses on converting technically recoverable tight gas sands, coalbed methane, and gas shales resources to economic gas production.

Further, RPSEA is required to specifically address the unique technology challenges of small producers through a consortia approach. This research component is focused on advancing technologies for mature oil and gas fields. Small producers are defined as those with production of less than 1,000 barrels oil equivalent per day (BOEPD).

Proactively embedded in the DAP and cross-cutting all elements of the Program is a focus on the environment, including projects that minimize or mitigate environmental impact or risk, mitigate water usage, reduce the “footprint,” and lower emissions. In addition, all projects in the Program will be evaluated for potential and ongoing environmental impacts as applicable, both positive and negative, to ensure that these impacts are fully understood during project selection and management.

The Environment

Research Program Development Principles

It is the obligation of RPSEA and the goal of this DAP to appropriately balance the critical research needs of the Program with the capabilities of the research community and, in so doing, meet its responsibility to the American public - developing technologies to enhance domestic energy supplies in environmentally responsible ways.

In the United States, energy demand is growing at the same time the domestic natural gas and oil industry is transitioning from “harder to find and easier to produce conventional reservoirs, to easier to find and harder to produce unconventional reservoirs.” The United States, however, is not resource poor, but rather resource long and technology short. This technology dearth, in turn, places substantial new demand on the nation’s research infrastructure to meet the challenge of developing the portion of the resource base addressed in this DAP.

As recommended in the 1999 NPC Natural Gas Supply study, *“the government should continue investing in research and development through collaborations with industry, state organizations, national laboratories and universities.”* The research collaboration envisioned in this Program is critical; integrating these diverse but capable sectors in the energy research value chain represents one of the largest challenges for the Program, as well as one of its greatest potential rewards.

It is important that a fundamental point be understood prior to discussing other guiding principles for RPSEA’s portfolio development: the Program mission cannot be achieved without a vibrant and diverse technical workforce of scientists and engineers. This necessarily entails a strong organizational commitment to the academic and research community, and a Program structure that specifically enables their unique problem-solving and innovation capabilities. This robust R&D emphasis also supports the nation’s intellectual capital, helping to maintain America’s global technological leadership position, as the universities are the training ground and consequently the source for this skilled workforce.

Workforce

RPSEA also works to educate both the professionals in the oil and gas industry and the general public on the issues surrounding technology development and deployment and the corresponding public benefits. RPSEA:

RPSEA will be instrumental in advocating the advanced technology aspects of the natural gas and oil E&P industries sufficient to attract the best minds in the energy technology industry.

- Works with industry to enhance technology transfer and deployment, demonstrating technology utilization as technologies are developed

- Encourages public appreciation of the natural gas and oil industry as both an innovator and consumer of technology solutions through its communications efforts

It is also critical to acknowledge the importance of collaborative partnership with industry to the success of the mission, and academic research, while absolutely necessary, is clearly not sufficient. Along with other research institutions, industry, as the ultimate end user investing in the application of the technologies developed in this Program, must play a key, and in many instances, the lead role in technology development, particularly as projects move to the development and demonstration phase.

RPSEA's research portfolio includes projects that focus on near-term and longer-term time scales. It will seek to mitigate research investment risks by building upon early successes and provide stringent mechanisms for interim continuation or termination decisions on individual projects. RPSEA's portfolio of projects specifically seeks to:

- Create leverage wherever possible on funding, personnel, equipment, operations, and other resources
- Create synergies through integration or investments in cross-cutting and enabling technologies, allowing the whole to be greater than the sum of its parts
- Allow for investment in high risk, high reward activities and ensure that good project management derives maximum learning benefit from failures that are expected from a portfolio with an appropriate risk profile
- Avoid the funding of many disparate small and/or one time projects which generally minimize the potential for high impact results
- Conversely, focus on a relatively fewer number of larger and/or higher potential projects, which create legacy opportunities with appropriate provisions for follow on funding and resources
- Provide for coordination with the complementary program administered by NETL to maximize the federal investment in the Section 999 program
- Identify technologies outside of the natural gas and oil industry that may have application to help achieve the mission of the Program
- In concert with DOE/NETL strongly emphasize technology transfer to effectively disseminate the results of the R&D

Reliable and reasonably priced natural gas and oil supplies will be a critical component of a future energy mix that combines near term use of traditional sources and long term development of alternatives with conservation and energy efficiency. In order to achieve this mix, the Program must balance incremental technology developments with breakthrough technologies, such as grand challenges that

Consumer Benefits

will have fundamental and lasting impact for energy consumers. This necessarily entails multiple perspectives to identify problems, as well as solutions. This DAP must encourage and make provisions for “out of the box” approaches and applications to enable powerful entrepreneurial enterprise and innovation. Further, RPSEA must provide safeguards against “development by committee” and promote a commitment to commercialization, not just technology transfer.

Fostering research that is commercially viable that enables faster-than-average adoption will enhance the industry’s role as both a “high-tech” developer, as well as a consumer, and will help attract the best minds to the energy industry.

These attributes of portfolio construction are graphically depicted below in Figure 2.1. This strategic triangle developed by the SAC conveys Program timeframes against the spectrum of technology development levels from basic to applied. It also depicts a broad foundation of projects in early years migrating to fewer more focused field demonstration projects, which are outgrowths of the early foundation projects. Not all early projects will develop. Finally, grand challenges are superimposed as they can leap frog the conventional development cycle.

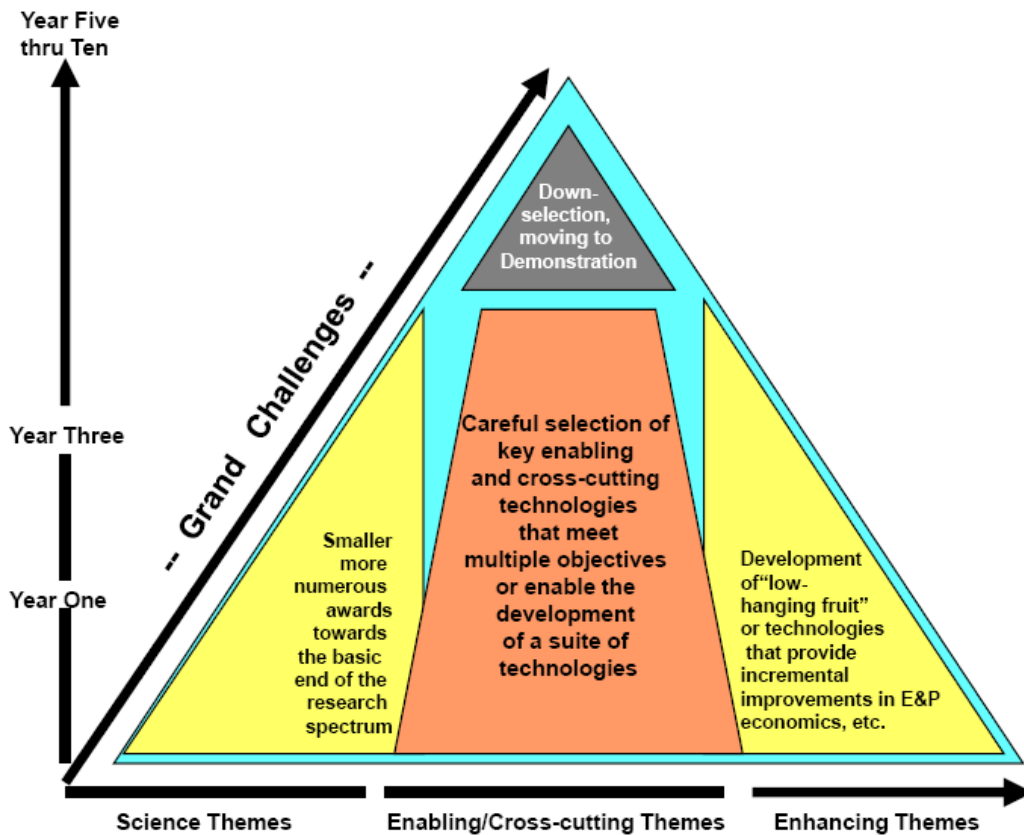


Figure 2.1: SAC Research Portfolio Guidance

Draft Annual Plan Organization

Following the structure of the strategic triangle in Figure 2.1, this third-year DAP builds upon the foundation laid by the 2007 and 2008 DAPs and incorporates lessons learned and evolving technology and resource needs. It seeks to transition the early-term research portfolio into a more specific later-term portfolio. It retains the fundamental components of the year 2007 and 2008 DAPs as follows:

- Four ultra-deepwater field types have evolved to six industry needs
- Three unconventional onshore resource types
- One small producer technology challenge

While RPSEA has established a generic process to identify resource targets, opportunities, barriers, research themes, and thrusts for the research plan, there are process differences across the Program. Figure 2.2 details these variations in industry structure and the ramifications for RPSEA management in the development of the DAP.

	Industry Structure	Research Management Implications
Ultra-Deepwater Program	<ul style="list-style-type: none"> • Relatively small number of industry players • Significant capital requirements • Consistent regulatory environment • Some internal research capability • Very high cost, high risk working environment 	<ul style="list-style-type: none"> • Focus on infrastructure/harsh environmental conditions • Setting priorities with industry input critical to success • Potential to provide significant cash matching funds • Demonstration is very expensive. High value on risk avoidance forces limited number of focus areas • Formal collaborative research model exists
Unconventional Onshore Program	<ul style="list-style-type: none"> • Large number of players, some very small in size • Somewhat limited access to capital • Multiple regulatory jurisdictions • Limited internal research capability • Ability to adopt new technology varies • Technology issues vary considerably with geographic/geologic area 	<ul style="list-style-type: none"> • Focus on production/geology/environmental issues • Need to identify and pursue specific resource targets • Less potential for cash matching funds, but history of in-kind contributions • Formal tech transfer mechanisms exist, but are challenging due to the high diversity of the users • Historical but no current formal collaborative research model • Research programs need to be designed with geographic area and technology user in mind
Small Producer Program	<p>Number of small producers is 7,400 and growing in diverse regions and resources (http://www.eia.doe.gov/emeu/perfpro/independ/pt1ch3.html)</p> <ul style="list-style-type: none"> • Limited access to capital • Multiple regulatory jurisdictions • No internal research capability • Most do not have capability to internalize new technology • Small producers are threatened by technical, environmental, and market challenges 	<ul style="list-style-type: none"> • Focus on geology, environmental, regulatory compliance, cost reduction • Must work with small producers to identify issues that impact small producers across and within regions • Little potential for cash matching funds but history of in-kind contributions • Formal tech transfer mechanisms exist, but are challenging due to the high diversity of the users • Some successful examples of collaborative research exist • Small producers may lack the staff to internalize complicated technology, so tech transfer must involve appropriate service providers

Figure 2.2: Variations by Programs

This DAP has been written by RPSEA in consultation with its BOD. In addition, input has been provided by NETL throughout the process. Each of these three programs is individually outlined in the sections that follow.

Chapter 3 RPSEA Accomplishments

Since the inception of the Program, significant progress has been made by RPSEA towards the overall, high-level goals of the Program. A list of these accomplishments is listed below.

- Commenced a new, fully-functional management structure and developed compliant policies and procedures specifically for administering the Program
- Developed a federally compliant set of policies and procedures for a new revolutionary Program, including management and operating plans
- Held 19 nationwide member technology input forums
- Established a comprehensive advisory committee network
- Developed and received approval for the 2007 Annual Plan
- Developed the 2008 DAP
- Built support among oil and gas research and industry constituencies
- Increased membership within the different oil and gas community stakeholder groups
- Issued research solicitations for the 2007 Program
- Received and reviewed 99 research proposals, plus 120 Ultra-Deepwater project ideas
- Made 43 project selections
- Developed research solicitations for the 2008 Program
- Established a Fellowship/Scholarship Program with private funding of \$255,000 for eight member universities providing much needed support for 16 students per year over three years
- Established a RPSEA summer internship
- Hosted multiple membership meetings
- Participated/exhibited and/or sponsored/supported multiple industry functions
- Launched new content-rich website to support strategic communications, technology transfer, and the solicitation process
- Promoted links to other associations and members and have utilized the RPSEA website as a “network of networks”
- Sponsored the Young Professionals in Energy (YPE) website
- Contributed to the development of the Oil & Gas Innovation Center

- Sponsored an award at the senior level for the Science Engineering Fair of Houston
- Sponsored an award for the best energy business plan at the Rice Alliance competition

In order for RPSEA to effectively meet the overall high level goals of this Program as described in EAct and ensure that Program funds are used efficiently, RPSEA also set and met several goals which were considered important to the day-to-day operations within the organization.

Diverse Membership

To broadly increase RPSEA membership to include all stakeholder groups in the oil and gas community, RPSEA has made great strides in growing its membership base. Membership has doubled since January 2007, growing from 66 members to the current membership of 132 members. These members represent 28 states, the District of Columbia and the Province of Newfoundland, Canada. As previously stated, these members collectively have more than 500,000 employees worldwide and represent approximately 50 percent of U.S. natural gas and oil production.

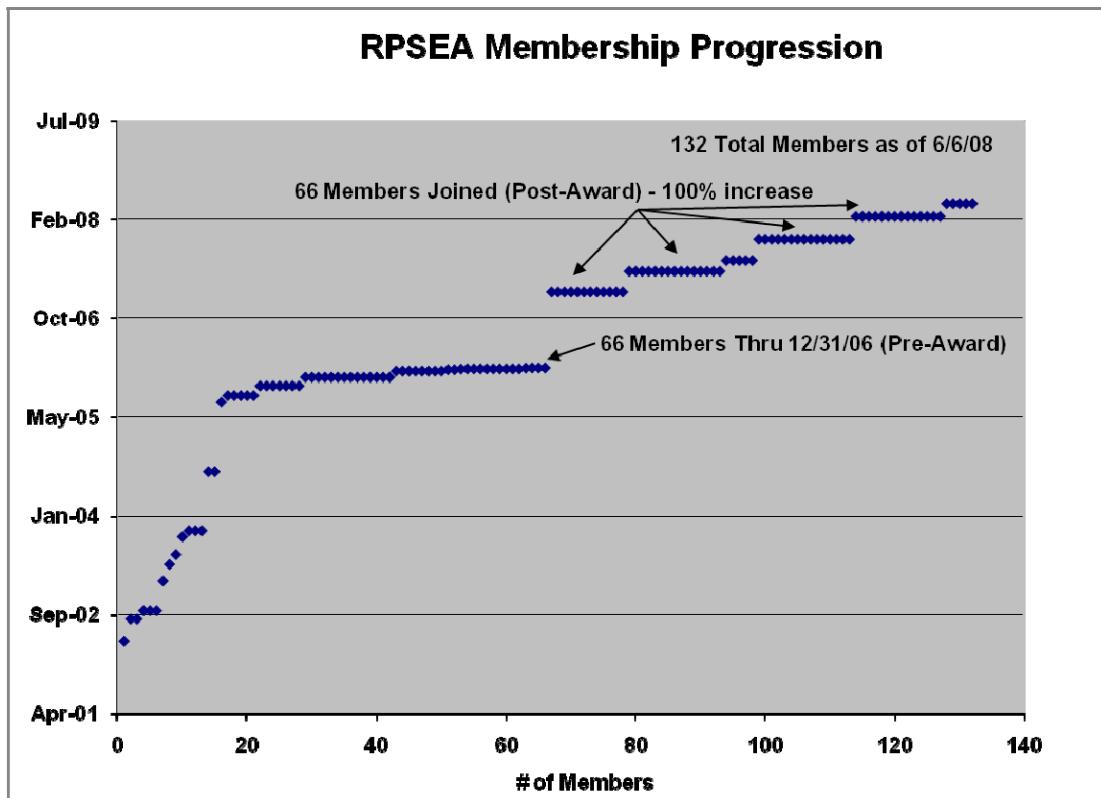


Figure 3.1: RPSEA Membership Progression

The overall RPSEA membership represents the diverse stakeholder communities in the oil and gas industry. The following graphic depicts a percentage breakdown of these communities:

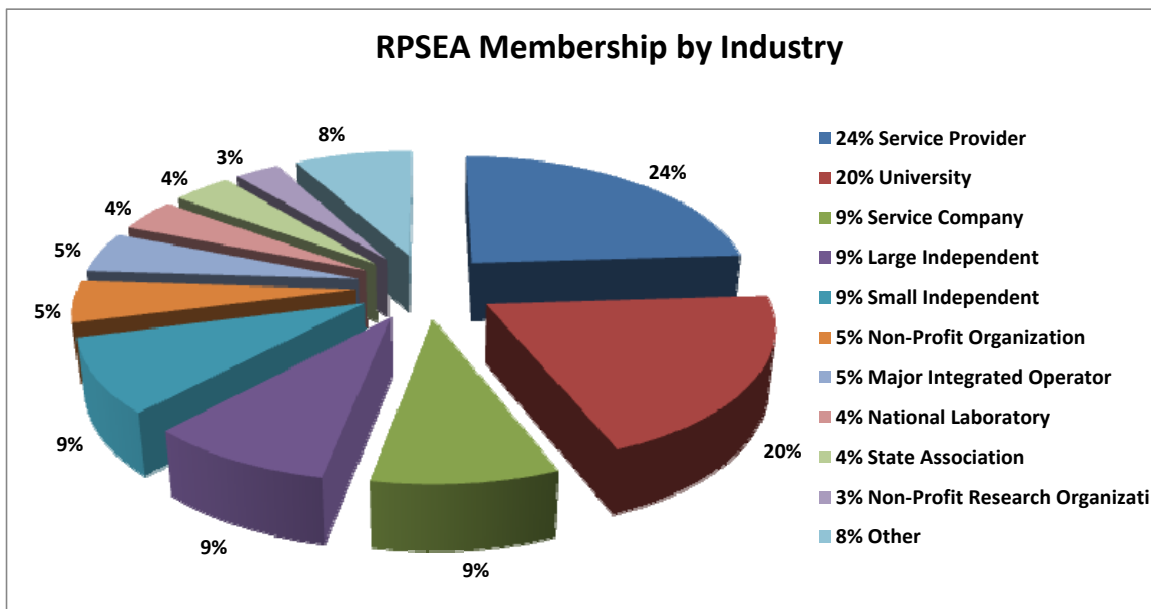


Figure 3.2: RPSEA Membership by Industry

Advisory Structure

From the diverse natural gas and oil constituency, RPSEA developed a comprehensive advisory committee infrastructure that efficiently and effectively provides input and direction to the overall Program goals, including development of high level, program level, and technical level advisory committees, and small producer and environmental advisory groups. These groups have met multiple times to review overall Program goals, project ideas, and review and select projects. The PACs, TACs, and RAG have been the workhorse committees, but in the overall process there have been 40 meetings with 840 participants who have volunteered approximately 3,800 hours of time and effort. As an example, the Ultra-Deepwater Program (UDW) PAC and TACs combined met 29 times with 591 participants involving over 2,800 hours of time and effort to focus the 120-plus project ideas for 2007 and 2008 down to 26 ideas representing approximately \$30 million dollars in R&D funds. Participation on the advisory committees is an opportunity for industry experts to broadly ensure that the most promising technological approaches and solutions are brought to bear on the technical challenges associated with developing domestic resources. These advisory committees/groups are crucial for the successful execution of the Program and to ensure that the Program is aligned with the interest and requirements of industry, so that results will be rapidly applied to impact the nation's energy supply.

Member Forums

RPSEA has broadly reached out to involve the oil and gas community through an outreach program of technology forums, holding 19 forums hosted by member organizations, in which 940 people participated (not including RPSEA, NETL or DOE

personnel). This participation amounts to over 9,500 hours of participant commitment and does not include the hours of commitment from the host organization. The host commitment in terms of time, effort, and monetary support was substantial in all cases.

A list of the forums is as follows:

Member Forum	Host
Seismic E&P Forum	University of Houston
Autonomous Intervention for Deepwater O&G Operations Forum	Massachusetts Institute of Technology
Tight Gas Shale Gas & Coalbed Methane Forum	Colorado School of Mines
Problem Identification Forum	University of Southern California
Shale Gas Forum	University of Oklahoma
Produced Water Forum	New Mexico Institute of Mining and Technology
Small Producer Forum	New Mexico Institute of Mining and Technology
Vortex Induced Vibrations Forum	Massachusetts Institute of Technology
Flow Assurance Forum	University of Tulsa
Unconventional Plays & Research Needs for Appalachian Basin Small Producers Forum	West Virginia University
Seafloor Engineering Forum	Texas A&M University
Bakken Shale Forum	North Dakota Energy & Environmental Research Center
Shale Plays Technology and Permian Basin Trends Symposium	Midland College
Fracture in Devonian Black Shale of the Appalachian Basin Workshop	West Virginia University
Alaskan Unconventional Gas Resource Forum	The University of Alaska Fairbanks at the BP Energy Center
CO2 EOR & Carbon Sequestration Forum	The CO2 Conference
Technologies for Mitigation of Environmental Impact of Rocky Mountain Unconventional O&G Operations	Colorado School of Mines
Coalbed & Shale Gas Forum (in conjunction with the International Coalbed & Shale Gas Symposium)	University of Alabama
Low Impact O&G Operations in Environmentally Sensitive Areas Forum	Texas A&M University

One of the unique aspects of the Program is a focusing of the specific challenges and technology needs for resource theme. RPSEA, in conjunction with other organizations or alone with our member institutions, has held these various meetings across the United States where theme based technical experts from universities, service providers,

producer/operators, and others within the oil and gas industry can present and discuss technical topics that address specific R&D perspectives. This broad based perspective is important as different oil and gas industry communities have different perspectives and needs requirements. The process allows the meeting participants to prioritize those ideas that they feel should be addressed through the Program. This process will continue to be utilized throughout the life of the Program.

Technology Transfer and Outreach

The RPSEA technology transfer plan, working in conjunction with DOE/NETL, is described in Chapter 9. Successful technology transfer and the uptake of technology within an organization can be enhanced by a familiarity with RPSEA's ongoing process and the projects funded under this Program. To this end, RPSEA seeks to participate or exhibit at multiple industry functions to engage with industry stakeholders and to disseminate information on RPSEA and the Program. RPSEA has participated, exhibited, sponsored, or otherwise supported the following industry functions:

Alabama Coalbed Methane and Shale Gas Conference 2008

Alliance Expo and Annual Meeting 2008

American Association of Petroleum Geologists (AAPG) Annual Convention 2008

American Rock Mechanics Association Workshop 2007

Barnett Shale Produced Water Conference 2007

BOMA Optimizing Mature Assets 2007

Colorado Oil & Gas Conference (COGA) 2007 & 2008

Deep Offshore Technology (DOT) and Demo2000 Conference 2007

Developing Unconventional Gas (DUG) 2007 and 2008

Energy and Environment Subcommittee Meeting 2008

Energy Technology Venture Capital Conference 2007 and 2008

Energy in Transition Houston Technology Center (HTC) 2008

Florida Independent Petroleum Producers Association (FLIPPA) Annual Meeting 2007

Hart's CO2 Conference 2007

Houston Small Business Administration 2007

Independent Oil and Gas Association of New York 2007

Independent Petroleum Association of America (IPAA) Crude Oil Committee Mid-Year Meeting 2007

Independent Petroleum Association of America (IPAA) Offshore Committee 2007

Independent Petroleum Association of Mountain States (IPAMS) Annual meeting 2007

Insight Gas Shales Summit 2008

International Association of Drilling Contractors (IADC)/Drilling Engineering Association (DEA) Forum 2007

International Coalbed & Shale Gas Symposium 2008

INTSOK 2007 and 2008

Interstate Oil and Gas Compact Commission (IOGCC) Mid-Year Conference 2007

Mid-America Regulatory Conference (MARK) 2008

More Bytes & More Barrels - 2008 Digital Energy Conference & Exhibition

North American Prospect Expo (NAPE) 2007 and 2008

Offshore Technology Conference (OTC) 2007 and 2008

Oil & Gas Innovation Center organizational sponsor

Oklahoma Independent Petroleum Association Annual Meeting (OIPA) 2008

Rice Alliance Business Plan Competition 2008

Rice Nanotechnology Venture Forum 2008

Rice University Congressional Field Hearing 2008

Science Engineering Fair of Houston 2008 Society of Exploration Geophysicists Annual Meeting 2007

Society of Petroleum Engineers (SPE) workshop on Life of Field Surveillance for Unconventional Gas 2007

Society of Petroleum Engineers (SPE) Seismic While Drilling Advanced Technology Workshop 2007

Society of Petroleum Engineers (SPE) Annual Technical Conference Exhibition (ATCE) 2007 and 2008

SW Petroleum Show 2008

The Making of Energy Policy: Where Are We Going? Conference 2008

University of Tulsa Energy Management Program 2008

Washington Post Energy Conference 2007

Young Professionals in Energy (YPE) website sponsor

5th Rice Alliance Energy and Clean Technology Venture Forum 2007

7th Annual Gas Shale Summit 2008

57th Annual Convention of the Gulf Coast Association of Geological Societies 2007

In addition to its responsibilities under EPAAct, RPSEA has sought to leverage its efforts in ways that also provide broad public benefit, such as the creation of an industry/education partnership by establishing and managing a Fellowship/Scholarship Program. With designated financial resources supplied from RPSEA members Schlumberger and Strata Production, RPSEA has awarded multiple scholarships to date

to the following member universities: Colorado School of Mines, Louisiana State University, New Mexico Institute of Mining and Technology, Stanford University, Texas A&M University, The University of Texas at Austin, University of Oklahoma, and West Virginia University.

Chapter 4 Ultra-Deepwater Program

The EPO Act states the UDW “shall focus on the development and demonstration of individual exploration and production technologies as well as integrated systems technologies including new architectures for production in ultra-deepwater.”

Relevant EPO Act definitions for the UDW include:

- **Deepwater** - a water depth that is greater than 200 meters but less than 1,500 meters
- **Ultra-Deepwater** - a water depth that is equal to or greater than 1,500 meters
- **Ultra-Deepwater architecture** - the integration of technologies for the exploration for, or production of, natural gas or other petroleum resources located at ultra-deepwater depths
- **Ultra-Deepwater technology** - a discrete technology that is specially suited to address one or more challenges associated with the exploration for, or production of, natural gas or other petroleum resources located at ultra-deepwater depths

A. Mission

The mission of the UDW is to identify and develop economically viable (full-life cycle), acceptable risk technologies, architectures, and methods to explore for, drill for, and produce hydrocarbons from ultra-deepwater and formations in the OCS deeper than 15,000 feet.

This mission of technology development encompasses (not in order of priority):

- Extending basic scientific understanding of the various processes and phenomena directly impacting the design and reliable operation of a ultra-deepwater production system
- Developing “enabling” technologies
- Enhancing existing technologies to help lower overall cost and risks
- Pursuing new technologies which, if successfully developed, are capable of “leapfrogging” over conventional pathways
- Accomplishing ultra-deepwater resource development in an environmentally responsible manner

B. Goals

The goals of the UDW are to exploit the ultra-deepwater resource base and to convert currently identified (discovered) resources into economic recoverable (proven) reserves, while protecting the environment, thereby providing the U.S. consumer with secure and affordable petroleum supplies. These goals will be achieved by:

1. Increasing the production of ultra-deepwater oil and gas resources
2. Reducing the costs to find, develop, and produce such resources

3. Increasing the efficiency of exploitation of such resources
4. Increasing production efficiency and ultimate recovery of such resources
5. Improving safety and environmental performance, by minimizing environmental impacts associated with ultra-deepwater E&P

The significant importance of these goals is illustrated by Figure 4.1, which shows the difficulty the oil and gas industry has had since 2002 converting discovered resources into proven reserves (producing developments). Proven reserves add value to royalty revenues, consumers, and the oil and gas industry. Identified non-producing resources do not contribute to the supply base or generate royalties.

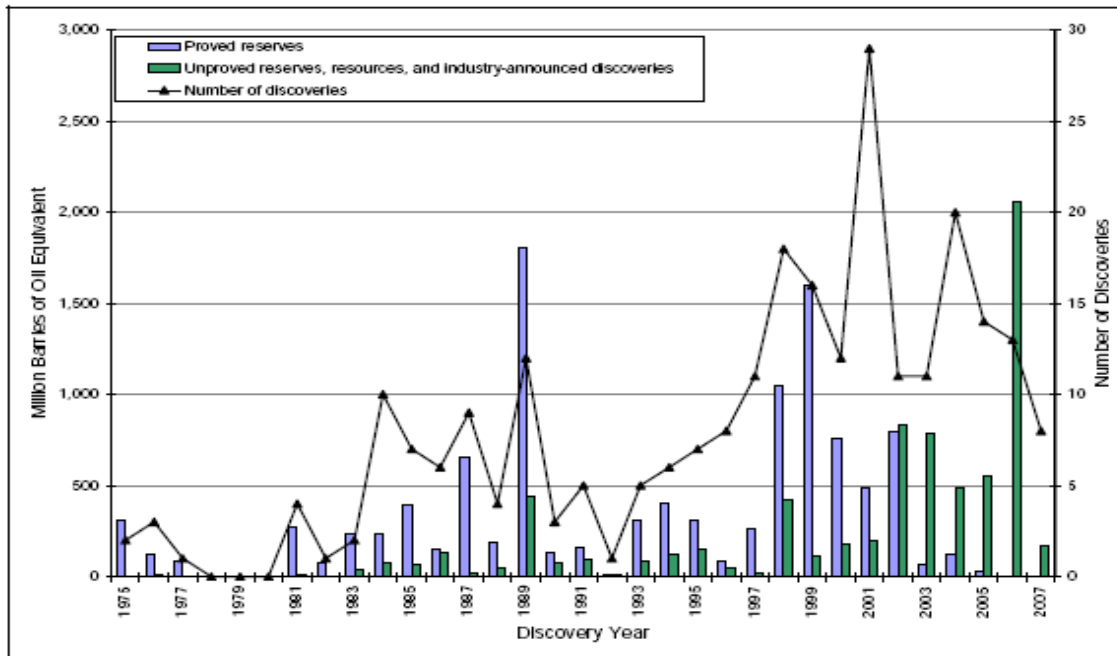


Figure 4.1: Proven Reserves Add Value

Latest Minerals Management Service (MMS) report (May, 2008) shows an increasing lag between discovery and production in deepwater Gulf of Mexico – demonstrating the need to focus on development related technology development

C. Objectives

To meet the goals of converting the ultra-deepwater resource base to economically recoverable reserves, new planning and analytical models must be built, new equipment must be designed and manufactured, and the equipment must then be demonstrated to be dependable and reliable, and ultimately manufactured and deployed in commercial quantities. This will be achieved by meeting the following near-term and longer-term objectives.

Near Term

Objective 1: Ongoing Identification of Technology Needs – Capitalize on the 2006

DeepStar Systems Engineering Study and Roadmap, which identified the specific technology gaps that hinder ultra-deepwater development. These gaps have been and will continue to be periodically revisited throughout the Program duration utilizing UDW TAC input and through UDW workshops. Identified gaps will be utilized to develop UDW theme areas and frame UDW solicitations during the first three years of the Program.

Objective 2: Ultra-Deepwater Technology Development – The early years of the UDW will form the base of the technology development triangle (Figure 2.1). Subsequent years will fund additional technical development, demonstration, and potential commercialization of promising technologies. During the first three years, the program will design and administer multiple rounds of solicitations for R&D contracts designed to meet the stated goals and needs of the UDW. The UDW will successfully administer a selection process resulting in a portfolio of R&D contracts that will best achieve this goal. Given the limited amount of funding, projects will be selected that are deemed likely to result in significant increases in value through cost reduction, efficiency improvement, and effectiveness.

Objective 3: Program Awareness and Cost-Share Development – The UDW will network with academia, industry, and other key stakeholders to increase its awareness, promote involvement, and identify cost-share funding for development of new technologies.

Longer Term

Objective 4: Ultra-Deepwater Technology Development and Deployment – Through assessment of R&D results and additional solicitations (as needed), the UDW will continue the development and maturation of the most promising technologies identified during the first three years of solicitations. It will maintain a strong focus on demonstration and industry deployment and will terminate weaker projects and focus budget and efforts on those technologies that carry the greatest potential for meeting the UDW goal.

Objective 5: Environmental and Safety Technology Development and Deployment –The UDW will assess the environmental and safety impact of UDW funded projects. This effort may take the form of individual solicitations or elements of more extensive project-based solicitations.

Objective 6: Technology Demonstration – The UDW will work with industry, appropriate regulatory agencies, and other key stakeholders to provide seed-level funding and other incentives for demonstration and validation of newly developed technologies.

Objective 7: Technology Commercialization and Industry Deployment – The UDW will work with industry, appropriate regulatory agencies, and other key stakeholders to provide seed-level funding and other incentives to ensure commercialization and industry deployment of emerging technologies.

D. Implementation Plan

DeepStar and Advisory Committee Roles in the UDW

The UDW is managed by Chevron, through a sub-contract with RPSEA, utilizing the Chevron administered DeepStar consortium. DeepStar, with eight deepwater operating companies and 52 contributing member companies, is the world's largest ultra-deepwater stakeholder group and has an 18-year history of managing collaborative research. Through this arrangement, the UDW will have access to 700+ technical and management committee volunteers, as well as a successful process for technology research, development, and commercialization. In addition to providing high-level input from oil and gas operating companies that are ultimately responsible for the production of deepwater energy resources, this highly developed process formally facilitates the direct input of universities, regulatory bodies, service companies, and other key stakeholder groups. This process of broad engagement through expansive and inclusive advisory committees provides the UDW with significant pro bono expertise, as well as potentially significant cost share funds to further accelerate the development of ultra-deepwater technologies.

The UDW utilizes a PAC and nine TACs in an advisory role. The UDW PAC provides high-level input on program priorities, field areas of interest, and technology dissemination, as well as a link to the producer and research communities, but its primary role is project selection. PAC engagement in the process is critical as these operators will be the organizations called upon to actually deploy and operate the new technologies developed under the program.

Supporting the PAC are nine TACs, each of which is focused on a particular ultra-deepwater technology area (see Table 4.1). The role of the TACs, with representation from subject matter experts who study and apply ultra-deepwater technologies in real field situations, is to identify current technology gaps and define the specific R&D efforts needed to address these gaps. As such, the TACs provide a bottom-up, end-user-driven program.

Drilling & Completion	Environmental, Safety & Regulatory	Floating Facilities
Flow Assurance	Geoscience	Metocean
Reservoir	Subsea Facilities	System Engineering & Architecture

Table 4.1: UDW TACs

Identification of Focus Areas for New Technology Development

In developing the UDW focus areas for solicitation, DeepStar provided a systems engineering study based on industry ultra-deepwater experience and needs. Four base

case field development scenarios were identified as representative of future Gulf of Mexico (GOM) ultra-deepwater developments with technical barriers, which challenge development. These scenarios are drawn from four key areas of activity in the deepwater GOM (Walker Ridge, Keathley Canyon, Alaminos Canyon, and the Eastern Gulf) and the associated technology challenges (Figure 4.2). Four generic fields were created (Canopy, Gumout, Coyote, and Diablo) based upon the areas of current activity. Each of the generic fields is characterized by unique design features currently hindering technical and economic development (Table 4.2). The field development scenarios have been matured into design bases and are being used as input for the UDW solicitations. The systems engineering study will be revisited periodically over the duration of the UDW to ensure relevance with ongoing industry exploration and development activities.

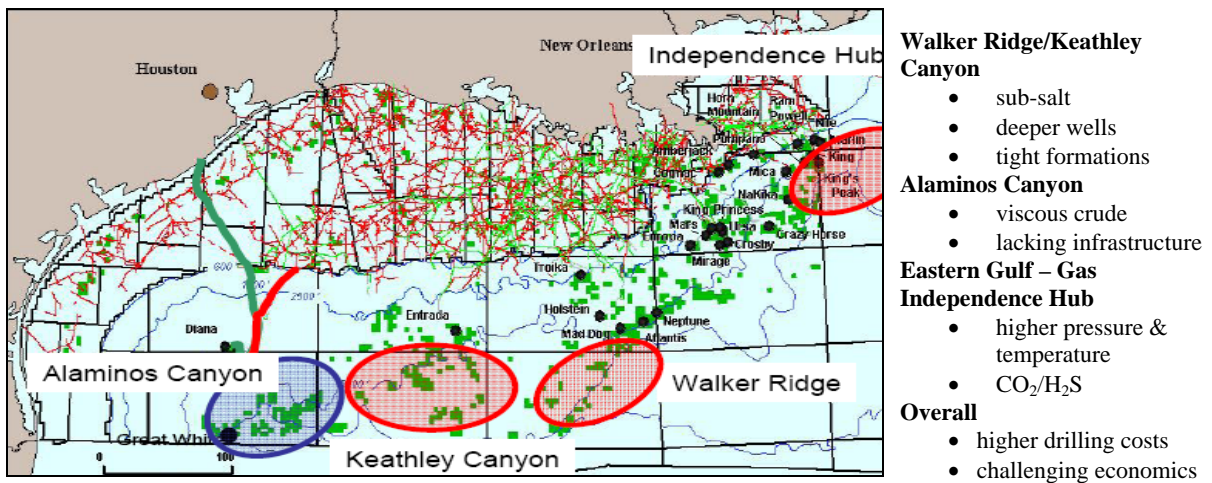


Figure 4.2: Technical Challenges for Identified Basins

Field Type	Technology Challenge	Development Options
Canopy Field	Low Permeability Reservoir	Semi with Wet Trees
		FPSO with Wet Trees
		FPSO EPS
		Produce to Beach
Gumout Field	High Viscosity Oil	Dry Tree Structure
		Satellite Tieback to Host
Coyote Field	Small Reserve Fields	Satellite Tieback to Host
Diablo Field	XHPHT (22.5 ksi x 350+°F)	Semi w/ Gas Sweetening
		Dry Tree Structure
		Produce to Beach thru Sour Gas Pipeline

Table 4.2: UDW Base Case Scenarios

E. 2007 and 2008 UDW Status

2007 and 2008 UDW Prioritization Methodology

The nine TACs provided systems engineering study input by reviewing the four base case scenarios and identifying the highest priority technology gaps required to bridge technology challenges and remove barriers to development. A number of the gaps identified are either multi-disciplinary or cut across several TAC discipline areas.

The UDW TACs further refined the gaps into specific project ideas which address one or multiple gaps. The process included the development of more than 120 project ideas, which were proposed by the TACs themselves or by any interested/knowledgeable entity involved in the process. All project ideas were compiled and reviewed by each TAC, which then refined and combined similar ideas, refined the scope of work, identified deliverables, and estimated the schedule and costs. Each TAC ranked the resulting respective list of project ideas and submitted the highest ranking project ideas to the PAC. The PAC evaluated and prioritized the projects from all TACs. The PAC prioritization was based upon projected project impact, available budget, and alignment with overall program goals. The prioritization process used by the PAC called for each of the 11 UDW operating companies in the PAC to select project ideas, which would do the most to bridge technology gaps of particular relevance to their operations and meet the goals of the UDW. Only those project ideas receiving a majority vote (6 of 11 companies) were considered. Figure 4.3 shows a schematic representation of the 2007/2008 UDW prioritization process. This effort entailed 29 meetings of the UDW TACs, with 591 participants representing over 2,800 hours of voluntary time and effort to focus the 120-plus project ideas to 26 high quality ideas needing approximately \$30 million in R&D funds. Few government or industry cooperative development programs have utilized such a comprehensive process of input and review to effectively vet its results.

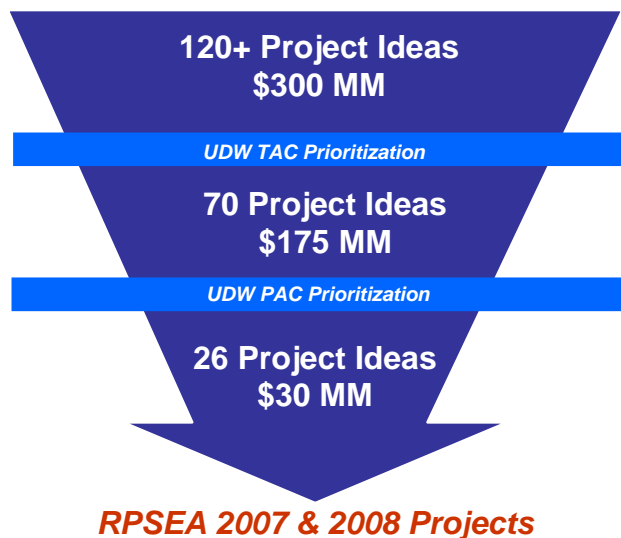


Figure 4.3: UDW Prioritization

2007 and 2008 Project Summary and Status

Selected projects can be categorized as addressing one of six major development and operation needs currently pursued by the worldwide ultra-deepwater community. In the 2008 Annual Plan, four industry needs were defined. These four needs have evolved into the six listed below based on UDW PAC, TACs, and UDAC feedback. These needs will continuously evolve over the Program duration to ensure continued relevance.

Additional information can be found at the website www.rpsea.org regarding UDW abstracts, meeting minutes, request for proposal (RFPs), etc. Addressing each of these needs will enhance the commerciality and, in many cases, enable development of UDW base case fields shown in Table 4.2. These high-level industry needs are:

1. Drilling, Completion, and Intervention Breakthroughs
2. Appraisal and Development Geoscience and Reservoir Engineering
3. Significantly Extend Subsea Tieback Distances/Surface Host Elimination
4. Dry Trees/Direct Well Intervention and Risers in 10,000 Feet Water Depth
5. Continuous Improvement/Optimization of Field Development
6. Associated Safety and Environmental Concerns

All 2007 UDW projects have been selected and are in the process of being awarded, and the technical content for 2008 projects has been determined. Selected projects address key initiatives, which are expected to continue through the duration of the UDW. Each 2007 selected project and planned 2008 project is described below in the context of how it fits into the initiative and UDW need. Table 4.3 describes the 2007 projects and anticipated awards. Figure 4.4 shows the geographic distribution of 2007 anticipated awards.

Many of the UDW projects will require additional phases of work funded by subsequent years of the Program to further mature the technologies and pursue eventual demonstration.

Need 1: Drilling, Completion, and Intervention Breakthroughs

Benefit: Drilling, completion, and intervention costs now represent 50 to 70 percent of the total capital expenditures on UDW projects. With ultra-deepwater drilling rig day rates approaching \$1 million, significant cost reduction is required for UDW project viability.

Initiative 1: Drilling and Completions

Target: Reduce ultra-deepwater drilling and completions costs by 30 percent

DW1501 (2007): Extreme Reach Development

This project will conceptualize the tools and service capabilities required to safely drill, complete, produce, maintain, and abandon reservoirs located up to 20 miles away from the surface facilities and well access point.

DW2501 (2008): Early Reservoir Appraisal Utilizing a Low Cost Well Testing System

This project will evaluate cost-effective systems for testing deepwater reservoirs without the need of high-cost mobile offshore drilling units (MODUs) and related test equipment. The work includes: (1) evaluation of the various GOM deepwater reservoirs to identify what facility capabilities are required to achieve a successful test and (2) to evaluate alternative deepwater well testing system configurations and insure they adequately handle the range of reservoir conditions defined in (1), optimize the hardware and equipment configurations, identify their technology readiness levels and technical gaps, and define their well test economics to show such test programs are cost effective and justified.

DW2502 (2008): Modeling and Simulation of Managed Pressure Drilling (MPD)

This project will expand existing capabilities for analysis and simulation of MPD ultra-deepwater well design and operations. The objective is to create an integrated capability for the modeling of fluid circulation in MPD wells, including the effects of multiple flow paths, formation influx, lost returns, pressure and temperature effects, multi-phase flow, and transient effects.

Initiative 2: Intervention (Downhole Services)

Target: Enable ultra-deepwater subsea well intervention, utilizing low cost surface vessels or via subsea intervention equipment. Intervention is directly correlated to ultimate recovery factors. Cost reductions and/or efficiency improvements in well intervention will serve to increase overall hydrocarbon recovery.

DW2301 (2008): Deepwater Riserless Light Well Intervention

This project will develop a certified ready-to-fabricate riserless intervention system design for 10 ksi wireline and electric line service in up to 10,000 feet water depths.

DW1502 (2008): Coil Tubing Drilling and Intervention System Using Cost Effective Vessels

This project will establish the conceptual design, operational performance, and system feasibility for an ultra-deepwater coiled tubing subsea well intervention system. This project will also contribute to the goals of the drilling and completions initiative above.

Need 2: Appraisal and Development Geoscience and Reservoir Engineering

Benefit: The ultra-deepwater part of the GOM poses many geological and geophysical challenges to the exploitation of hydrocarbons. Many of these challenges are related to a combination of the ultra-deepwater environment and the presence of a regionally extensive, thick salt canopy which overlies the prospective subsalt section. The combination of a thick water column and thick salt layer pose a formidable challenge for acquiring data and accessing resources. The environmental conditions and costs associated with the ultra-deepwater setting and deep reservoirs also impact the type and

amount of data that can be gathered to increase reservoir understanding and reduce uncertainty. High drilling costs result in expensive exploration wells, sparse appraisal wells, limited sampling/production testing, and development decisions based on very limited data.

Initiative 1: Exploitation and Appraisal

Target: Delineation of the reservoir including fluid and rock properties, commerciality, internal architecture and continuity, and drive mechanism for full field development planning without additional drilling and additional time for reservoir characterization.

DW2001 (2007): Synthetic Benchmark Models of Complex Salt

This geophysical imaging technology project will generate realistic benchmark geological models, associated synthetic seismic and potential field data. Such information will allow industry to effectively and efficiently assess seismic (and other) acquisition and processing techniques to generate hydrocarbon reservoir images beneath massive, complex salt bodies.

DW2701 (2008): Resources to Reserves; Development and Acceleration Through Appraisal

Reservoir appraisal is required to provide information to reduce the range of uncertainty and, therefore, reduce the risk of the subsequent development phase. Currently, appraisal is mostly comprised of seismic interpretation and data from drilling wells. The vast majority of this data is static data and does not help define reservoir continuity. The high cost of drilling in deepwater limits the amount of data from wells to no more than a handful. The extreme costs and regulatory/environmental concerns all but eliminate early production testing for dynamic data on reservoir continuity. Therefore, operators are forced to make decisions on developments with ranges in in-place hydrocarbons of 3-4 fold without understanding reservoir continuity. The result is a potential loss of resources in undeveloped deepwater and ultra-deepwater discoveries. Phase 1 of this multi-phase project focuses on the technical gap assessment and concepts identification to help accelerate reserve development through more effective appraisal.

Initiative 2: Field Development

Target: Build and implement field and reservoir development plans that are flexible enough to meet changing physical conditions and achieve commerciality.

DW1701 (2007): Improved Recovery

Deepwater subsea wells have ultimate recovery factors lower than conventional platform dry tree wells. In addition recovery factors in the GOM are less than optimal. The oil remaining in these fields is significant and provides the incentive for the development of processes and methodologies to unlock these additional residual barrels. The purpose of this RFP is identification of improved recovery opportunities in the early stages of field development planning, such that the

facility and well designs can be optimized to take advantage of those opportunities.

Need 3: Significantly Extend Subsea Tieback Distances/Surface Host Elimination

Benefit: Frequently, many reserves reside in a collection of small fields. Such small fields do not justify commercial development. However, such small fields provide excellent production opportunities for major facilities once they come off of peak production. Extending the reach of subsea tiebacks will enable existing production facilities to effectively and commercially produce these smaller fields over a larger geographical area.

As the offset between the well and the surface facility grows, it will become possible to produce larger unitized reserves (one large or several smaller fields) over long distances directly to onshore (beach) facilities eliminating the need for offshore production stabilization, their related surface facilities, and impact.

Initiative 1: Stabilized Flow

Target: Developing sufficient understanding of flow assurance concerns, including wax, asphaltenes, and hydrates, will enable subsea production that will eliminate expensive flow assurance risk mitigation measures currently employed to prevent blockages. Elimination of these mitigation measures, including insulation, pigging, chemical injection, etc., will significantly reduce project capital expenditures, operational expenditures, development times, increase ultimate recovery, and decrease production downtime.

DW1201 (2007): Wax Control

This project will evaluate current and new flow assurance technologies to develop options for flowline cold, stable flow without pipe insulation.

DW1202 (2008): Equation of State Improvement for Extreme High Pressure and High Temperature Conditions (xHPHT)

Current Equations of State (EOS) are known to give poor predictions for some deepwater reservoir fluids and conditions where pressures can exceed 20,000 psi, temperatures exceed 350°F, and the fluids are complex. This project will generate lab data at xHPHT conditions to validate, and if necessary, develop a new EOS to better predict pressure, volume, and temperature (PVT) information and transport properties.

DW2201 (2008): Viscous Oil PVT

Heavy viscous oils present new PVT relationships and technical challenges for deepwater conditions. This project will further our understanding of the fluid system's physical properties. It will develop new laboratory procedures to characterize such fluids and will validate the predictive models for such fluids.

Initiative 2: Subsea Power

Target: Encourage development of safe, cost effective, reliable electrical power delivery to subsea equipment. Significant power will be required for pumps and compressors used to pump production products through the export pipelines in ultra-deepwater. Such pressure boosting will aid in maximizing recovery of reserves from these reservoirs.

DW1902 (2007): Deep Sea Hybrid Power System

This project evaluates alternative methods for locally generating significant electrical power on the seafloor near large consumption points.

DW1302 (2007): Ultra-High Conductivity Umbilicals

This project will deliver an engineering prototype of a working ultra-high conductivity wire (conductor) utilizing nanotube technology and perform a sufficient suite of tests and analysis from both a technical and a commercial perspective to determine and qualify the strengths, weaknesses, and opportunities of further maturing the technology.

DW2901 (2008): Reliable Deepwater Power Distribution and Components

This project will leverage existing industry experience to improve subsea electrical power system reliability at a reduced cost. The project will first establish baseline power system designs and requirements. Analysis and trade-offs will be performed to optimize and improve over-all system reliability through identification of components which would benefit from redesign and component improvements.

Initiative 3: Subsea Processing

Target: Encourage deployment of subsea processing through development of technologies, which will reduce the deployment risk in the GOM. Subsea processing holds the possibility of significantly reducing overall facility cost, reducing topsides requirements, improving overall ultimate recovery, and minimizing surface impact.

DW1301 (2007): Subsea Metering

This project's objective is to address gaps in the deployment and use of multiphase and wet gas meter technology in deepwater production systems. Specifically, the project will develop and standardize deepwater well fluid sampling, develop the means to deploy clamp-on measurement systems to deepwater wells via ROV, understand the ways in which production alteration of meters affects their response and measurement, develop and qualify meter sensors for high pressure/high temperature (HP/HT) environments, evaluate the effectiveness of wellbore flow models, such as virtual flow meters, and develop uncertainty models for the complete multi-well production system from subsea meter to topside.

DW1901 (2007): Subsea Processing System Integration Engineering

This project will develop a process simulator for a subsea production system. The work includes: developing physical and chemical models of multiphase fluid

behavior; developing a dynamic and static integrated separation simulator; developing methodologies to evaluate the operating envelope of process systems; and, starting a simulator validation program through a testing program.

Need 4: Dry Trees/Direct Well Intervention and Risers in 10,000 Feet Water Depth

Benefit: Some reservoirs are complex and will require frequent well intervention to effectively produce the reservoir's reserves. Currently, the most cost effective near-term well intervention technology is via dry tree systems. The deepest dry tree system is currently installed in 5,610 feet of water. Extending the water depth capability of dry tree risers to 8,000 foot to 10,000 foot water depths will be required to effectively develop many discoveries in the GOM.

Initiative 1: Dry Trees/Direct Well Intervention and Risers

Target: Enable dry trees/direct well intervention and risers in 10,000 feet water depths especially for xHPHT conditions.

DW1401 (2007): Carbon Fiber Wrapped High Pressure Drilling and Production Riser Qualification Program

Develop and qualify 14" to 19" ID composite reinforced metal tubulars for 15 ksi working pressure riser service in 10,000 feet water depth. This project will also contribute to the goals in the drilling and completions area.

DW 1402 (2007): Ultra-Deepwater Dry Tree System for Drilling and Production

Develop the feasibility design of a (low motion) semisubmersible qualified to support dry tree risers in the GOM which can be integrated with its topside quayside. This includes critical equipment specification and identification of any technology gaps. This project will also contribute to the goals in the drilling and completions area.

DW 1403 (2007): Fatigue Performance of High Strength Riser Materials

This testing and material qualification program will collect fatigue performance data for high strength materials sufficient that engineers may reliably use this data for critical service deepwater riser design. This project starts a rigorous materials testing program that will also contribute to the goals in the drilling and completions area.

Need 5: Continuous Improvement/Optimize Field Development

Benefit: This need area addresses two needs: improving existing operations and long term research and development. Ultra-deepwater fields installed just three years ago are now mature and experiencing reliability issues. Significant opportunity exists to address these reliability concerns and ensure hydrocarbons continue producing for the benefit of the American consumer. Long term research and development is necessary to ensure focus on the oil field of the future and the human capital which will keep future fields producing oil and gas.

Initiative 1: Improve Operating and Inspection Processes

Target: Improve the reliability and cost effectiveness for verifying the production system is qualified and ready for the next period of operations.

DW 2101 (2008): New Safety Barrier Testing Methods

This project will investigate alternative (subsea) methods for assessing the capability of a safety barrier (valve or possibly a blowout preventer) to hold pressure with only a minimum (acceptable) leakage rate in the closed position. The most viable verification method(s) will be investigated in greater detail to develop a repeatable and reliable safety barrier, alternative, qualification test (if feasible).

Initiative 2: Graduate Student and Long Term Research and Development

Target: Provide practical project opportunities for graduate students to promote careers in the offshore oil and gas industry. Identify potentially viable novel technologies that might offer game-changing solutions for deepwater oil and gas. Provide seed money to the providers of these technologies for a period of approximately two years.

DW1603 - A (2007): Graduate Student Design Project - Design of Extreme High Pressure and High Temperature Subsurface Safety Valve

This project will also contribute to goals of the drilling and completions initiative.

DW1603 - B (2007): Graduate Student Design Project - Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers

This project will also contribute to the goals of the dry trees/direct well intervention and risers in 10,000 feet water depth initiative. If this project matures, then a follow-on project may occur in Need 5, Initiative 1 – for improved field inspection methods.

DW1603 - C (2007): Graduate Student Design Project - Hydrate Plug Characterization and Dissociation Strategies

This project will also contribute to the goals of the stabilized flow initiative.

DW1603 - D (2007): Graduate Student Design Project - Flow Phenomena in Jumpers

This project will also contribute to the goals of the stabilized flow initiative.

DW2601 (2008): Longer Term Research and Development

Identify potentially viable novel technologies that might offer game-changing solutions for deepwater oil and gas. Provide seed money to the providers of these technologies for a period of approximately one year. Provide longer-term funding to 1-2 technologies that show the best promise.

Need 6: Associated Safety and Environmental Concerns

Benefit: While the benefits in this area are challenging to quantify, there is good value in appropriate regulatory agencies, academia, industry, non-governmental organizations,

and other key stakeholders working together to identify strategies to assess the impact of new technologies on deepwater development and subsequent operations.

DW1801 (2007): Effect of Global Warming on Hurricane Activity

The primary objective of this study is to assess the threat that global warming will substantially increase GOM hurricane activity (intensity and/or frequency). This assessment is to be based on simulations using a high resolution climate model capable of generating hurricanes without data assimilation. The subcontractor will make the necessary model simulations and will also be responsible for analyzing the results. At the end of this study, the subcontractor will provide an estimate of how much the hurricane intensity and frequency is likely to change in the GOM over approximately the next 50 years. It is understood that many of the tools involved in such a study are immature and large gaps remain in the knowledge of critical processes. Nevertheless, the offshore industry is faced with major decisions concerning offshore structure design that must be made in the near term, and these need to be based on the best available science at this time.

DW2801 (2008): Gulf Three Dimensional Operational Current Model Pilot

The overarching goal of this pilot is to improve the ability of numerical models to forecast the loop current and its associated eddies. The vision of success at the end of the pilot is that there will be a well-validated operational model (or perhaps ensembles from multiple models) in place that produces timely, accurate forecasts, which are summarized by web-based products that provide substantial benefits to many well understood users.

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1201: Wax Control	University of Utah	24 months \$400,000	Evaluate current and new flow assurance technologies to develop options for flowline cold stable flow without pipe insulation	SINTEF Petroleum Research, BP, StatoilHydro, University of Tulsa
DW1301: Improvements to Deepwater Subsea Measurements	Letton-Hall Group	24 months \$3,654,000	Address gaps in the deployment and use of multiphase and we gas meter technology in deepwater production systems.	Chevron, Shell, Total, ConocoPhillips, BHP, StatoilHydro, Petrobras, Oceaneering, Multiphase Systems Integration Welker Engineering, Lake Charles Instruments/Neffemer Asept, Intertek, BP, Southwest Research Institute, ENI, Anadarko, Devon, Schlumberger, Weatherford
DW1302: Ultra-High Conductivity Umbilicals	Technip	12 months \$448,000	Engineering prototype of a working ultra-high conductivity 'wire' (conductor) utilizing nanotube technology and test and analytical data	Rice University, Duco, NanoRidge Materials
DW1401: Carbon Fiber Wrapped High Pressure Drilling and Production Riser Qualification Program	Lincoln Composites	24 months \$400,000	Develop and qualify composite reinforced metal tubulars for 15 ksi W/P riser service in 10,000 fsw	Stress Engineering
DW1402A: Ultra-Deepwater Dry Tree System for Drilling and Production	Houston Offshore Engineering	Stage1 3 months \$106,000 (Optional additional stages)	Feasibility design of a (low motion) semisubmersible qualified to support dry tree risers in the GOM which can be integrated with its topside quayside	Keppel Fels, Kiewit Offshore Services

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1402B: Ultra-Deepwater Dry Tree System for Drilling and Production	Floatech	Stage1 3 months \$234,000 (Optional additional stages)	Feasibility design of a (low motion) semisubmersible qualified to support dry tree risers in the GOM which can be integrated with its topside quayside	Seadrill Americas, Inc., GE/VetcoGray, 2H Offshore
DW1403: Fatigue Performance of High Strength Riser Materials	Southwest Research Institute	18 months \$800,000	Testing and material qualification program will collect fatigue performance data for high strength materials for riser design	
DW1501: Extreme Reach Development	Tejas	9 months \$200,000	Study, conceptualize tools and service capabilities required to safely drill, complete, produce, maintain, and abandon reservoirs located up to 20 miles away from the surface facilities	Total, Chevron
DW1603-A: Graduate Student Design Project. Design of Extreme High Pressure and High Temperature Subsurface Safety Valve	Rice University	24 months \$150,000	Project will contribute to goals of the drilling and completions initiative	
DW1603-B: Graduate Student Design Project. Robotic MFL Sensor for Monitoring and Inspection of Deepwater Risers	Rice University	24 months \$150,000	Project will contribute to the goals of the dry trees/direct well intervention and risers in 10,000' water depth	itRobotics
DW1603-C: Graduate Student Design Project. Hydrate Plug Characterization and Dissociation Strategies	Tulsa University	24 months \$150,000	Project will contribute to the goals of the stabilized flow initiative	BP
DW1603-D: Graduate Student Design Project. Flow Phenomena in Jumpers	Tulsa University	24 months \$150,000	Project will contribute to the goals of the stabilized flow initiative	Chevron
DW1701: Improved Recovery	Knowledge Reservoir	18 months \$1,600,000	Identification of improved recovery opportunities in the early stages of field development planning	Anadarko
DW1801: Effect of Global Warming on Hurricane Activity	National Center for Atmospheric Research (UCAR)	12 months \$560,000	Study to assess the threat that global on Gulf of Mexico hurricane activity (intensity and/or frequency)	Georgia Institute of Technology
DW1901: Subsea Processing System Integration Engineering	GE Global Research	12 months \$1,200,000	Process simulator for a subsea production system	GE/VetcoGray
DW1902: Deep Sea Hybrid Power System	Houston Advanced Research Center	12 months \$480,000	Evaluate alternative methods for locally generating significant electrical power on the seafloor near large consumption points	Lawrence Livermore National Laboratory, Naval Facilities Engineering Service Center, Yardney Lithion, GE, Shell, Chevron
DW2001: Synthetic Benchmark Models of Complex Salt	SEAM	24 months \$2,000,000	Project will generate realistic benchmark geological models, associated synthetic seismic and potential field data	3DGeo Development, Anadarko, BHP Billiton, CGGV Veritas, Chevron, Conoco Phillips, Devon, EMGS ASA, EnI, Exxon Mobil, Geotrace Technologies, Hess Corporation, ION, Landmark Graphics, Maersk Oil, Marathon Oil, Petrobras, PGS Americas, Repsol Services, Rock Solid Images, StatoilHydro, Total, WesternGeco

Table 4.3: UDW 2007 Project Selections

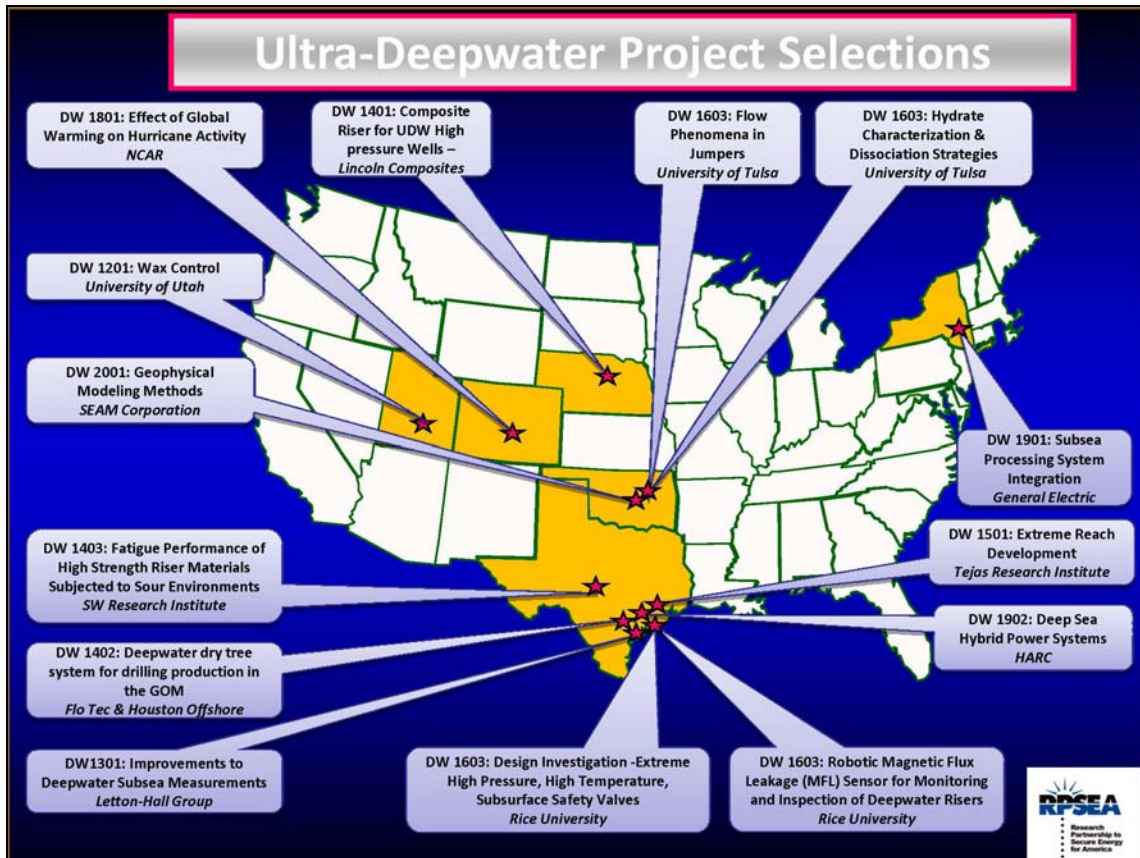


Figure 4.4: UDW 2007 Project Selection Geographic Distribution

F. 2009 UDW

The 2009 UDW will have \$14.96 million available for project awards. The 2009 UDW will target funding of five to ten projects, with a value of \$1 to \$5 million per project. Each project will have a duration of one to three years. Projects will be aligned with the six UDW needs. Project integration across multiple disciplines will be encouraged (e.g. geoscience, reservoir and drilling, or flow assurance and subsea).

A methodology similar to the 2007 and 2008 project selection process will be utilized by the UDW TACs and PAC to assist in prioritizing, rating, and selecting 2009 proposals for funding. The 2009 process is different than the process used in 2007 and 2008, in that the UDW TACs prioritized project ideas by initiatives instead of developing and voting for specific individual projects. The TAC input for 2009 was submitted to the PAC and will be evaluated and prioritized by the PAC prior to September 1, 2008 to develop the appropriate balance for the 2009 UDW program. Figure 4.5 describes the 2009 project selection process.

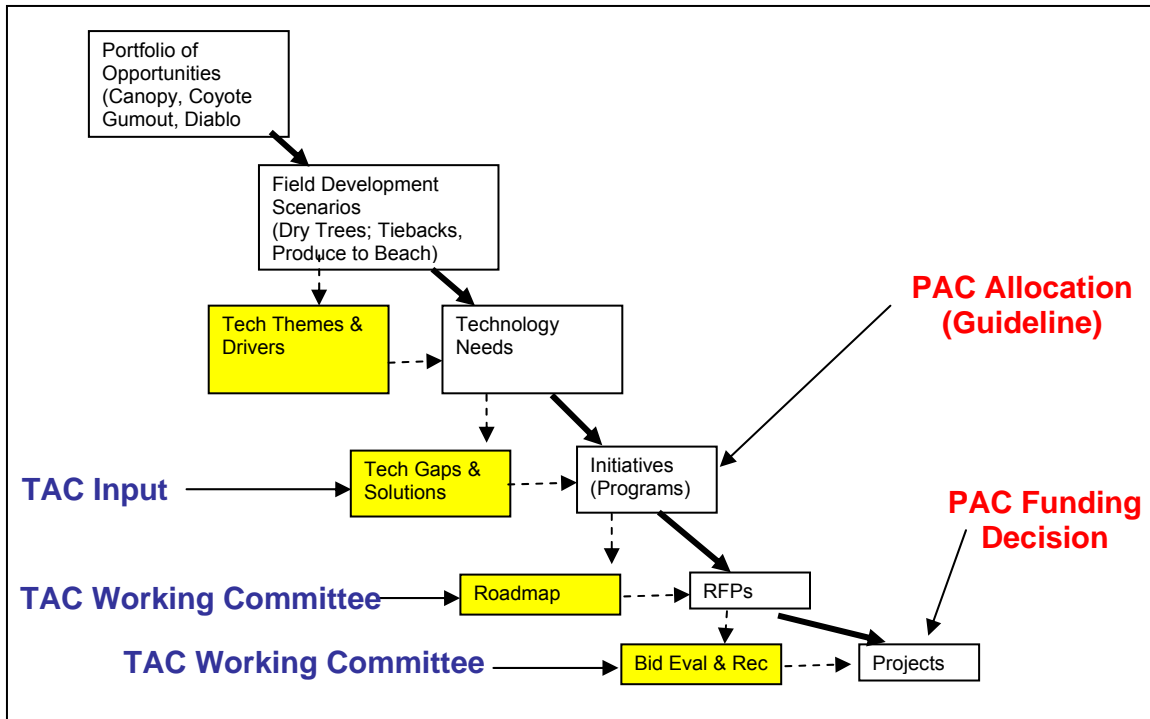


Figure 4.5: 2009 UDW Project Selection Process

UDW 2009 RFPs will consist of both specific project ideas and broader initiative-based requests. Anticipated 2009 UDW initiatives and/or projects are listed below in the context of each UDW need. The actual 2009 UDW may differ from the anticipated portfolio listed below. The actual 2009 UDW portfolio will be driven by further guidance from the UDW PAC and the timing associated with 2009 program funding.

Need 1: Drilling, Completion, and Intervention Breakthroughs

Proposals will be requested identifying novel ideas to reduce well construction and completion costs.

Need 2: Appraisal and Development Geoscience and Reservoir Engineering

Proposals will be requested in the area of production and reservoir surveillance. The goal of this effort is to reduce the amount of unproduced hydrocarbons upon well or field abandonment, contributing to increased recovery.

Need 3: Significantly Extend Subsea Tieback Distances/Surface Host Elimination

Proposals may be requested in one or more of the following areas:

- Ultra-deepwater flow assurance especially for the areas of solids (asphaltenes, hydrates, waxes, and scale) deposition and plug formation management
- Pressure boosting
- Autonomous underwater vehicles and intervention
- Subsea processing/produced water treatment

Need 4: Dry Trees/Direct Well Intervention and Risers in 10,000' Water Depth

This need area was addressed in the 2007 and 2008 UDW program. Additional follow-on activities may be funded in subsequent years.

Need 5: Continuous Improvement/Optimize Field Development

Proposals in this need area may include:

- Advancing industry understanding of phenomena impacting ultra-deepwater operations such as vortex-induced vibration
- Improvements in integrity management and reliability
- Additional graduate student project funding
- High risk, high reward “long-shot” R&D opportunities

Need 6: Associated Safety and Environmental Concerns

Ultra-deepwater efforts in this need area will involve the assessment of environmental and safety impact of UDW funded technology development projects. This effort may take the form of individual solicitations or elements of more extensive project based solicitations. Areas of study may include:

- Improved Metocean understanding
- Discharge of produced water subsea – technology and regulatory aspects

Chapter 5 Unconventional Natural Gas and Other Petroleum Resources Program

A. Mission

The mission of the Unconventional Natural Gas and Other Petroleum Resources Program (Unconventional Resources Program) is to identify and develop economically viable technologies to locate, characterize, and produce unconventional natural gas and other petroleum resources in an environmentally acceptable manner.

Unconventional natural gas and other petroleum resource is defined in Section 999G of EPLA as “*natural gas and other petroleum resource[s] located onshore in an economically inaccessible geological formation, including resources of small producers.*”

B. Goal

The overall goal of the Unconventional Resources Program is to increase the supply of domestic natural gas and other petroleum resources through the development, demonstration, and commercialization of technologies that reduce the cost and increase the efficiency of exploration for and production of such resources, while improving safety and minimizing environmental impact.

The contribution of natural gas to the nation’s gas supply from three specific unconventional resources, gas shales, coal seams, and tight sands, has grown significantly during the past 20 years. These resources have been highlighted by the Energy Information Administration (EIA) and others as important supply sources during the next 20 years. According to the latest estimate by the National Petroleum Council 2003 Natural Gas Study (NPC 2003), the volume of technically recoverable gas from these three resources in the lower 48 states is in excess of 293 trillion cubic feet. In view of the significant additional work accomplished since the NPC 2003 study on the development of gas shales and other unconventional gas resources, it is likely that this resource number is very conservative. Due to their potential and significance and in view of the limited resources available to the research program, gas shales, tight gas sands, and coalbed methane were determined to be the unconventional resources to be specifically addressed in the initial years of the program. Opportunities to leverage developed technologies through application to other unconventional natural gas and petroleum resources will be sought, and other petroleum resources may be specifically targeted in subsequent years. Oil shale and unconventional oil resources are addressed by the EPLA Section 999 complementary program and the traditional DOE R&D program, both implemented by NETL.

In order for the program to be successful by maximizing the value of natural gas and other petroleum resources of the United States through new technology, the transfer of that technology to companies operating in the targeted resources will need to be an integral part of the program planning and execution. Additionally, any development of

new resources must be accomplished in an environmentally acceptable manner, so it will be important that technologies developed under the program be applied in ways that minimize the impact of resource development on the environment.

C. Objectives

Objectives for the Unconventional Resources Program were initially developed with input from RPSEA's unconventional onshore PAC, along with the results of a series of workshops and forums held from 2003 through early 2007. The objectives have been updated as additional information has been gathered through ongoing efforts to identify and prioritize the technology challenges to development of unconventional resources. These recent efforts include: (1) a series of eight forums on topics relevant to unconventional resources held in various producing basins by RPSEA members beginning in late 2007 and continuing through May 2008, (2) participation by RPSEA staff in industry meetings, addressing unconventional resources organized by professional societies such as SPE and AAPG, as well as organizations such as Hart's Energy Publishing, Platts and Pennwell, (3) input provided to the 2007 and 2008 Annual Plans by the URTAC, and (4) input provided by PAC and TAC members associated with projects selected for the 2007 program. All of these inputs were combined to arrive at the prioritized list of technology challenges that underlie both the objectives of this program and the list of solicitation topics found in the implementation plan. The issued solicitations will likely be further focused as a result of the selections made for the 2008 program.

The objectives are defined in terms of the resource (shales, coal, tight sands) and the level of field development category (existing, emerging, frontier). All three resources are important but gas shales, the most difficult and least developed, was identified during this process as the top priority. It was the consensus of the advisory groups that gas shales promised the greatest potential return on investment in terms of reserves additions. The three development categories are:

- Existing - Active development drilling and production
- Emerging - Formations, depth intervals, or geographic areas from which there has been limited commercial development activity and very large areas remain undeveloped
- Frontier Area - Formations, depth intervals, or geographic areas from which there has been no prior commercial development

The relative balance of the program's focus among these three categories, as well as the priority basins identified within each of the three resource areas, are illustrated within Table 5.1. The basins noted are representative based on expressed industry interest and not meant to exclude opportunities in other basins within the three resource types.

Level of Field Development	Program Balance	Priority Gas Shales	Priority Coalbed Methane	Priority Tight Sands
Existing	45%	Ft Worth - Barnett	Appalachian	Green River/Uinta
		Appalachian	San Juan	South Texas
			Powder River	Appalachian
Emerging	45%	Appalachian	Uinta-Piceance	Appalachian
		Permian	Powder River	Piceance
		Arkoma/Ardmore/Anadarko		Uinta
Frontier Area	10%	Permian-Woodford	Illinois & Michigan	Western Oregon
		Green River	N. Mid-continent	Washington

Table 5.1: Resource Prioritization Matrix

Specifically, the objectives of the Unconventional Resources Program are:

Near Term

Objective 1: Develop tools, techniques, and methods that substantially increase in an environmentally sound manner commercial production and ultimate recovery from established unconventional gas formations and accelerate development of existing and emerging unconventional gas plays.

Objective 2: Develop tools, techniques, and methods that substantially decrease the environmental impact of unconventional gas development with particular emphasis on water management and operations footprint.

Objective 3: Integrate the results and deliverables of the existing portfolio of projects to ensure that new technologies are demonstrated to and applied by industry to enhance safe and environmentally responsible production of the domestic unconventional gas resource base. Successful technology transfer is an important component of this objective.

Longer Term

Objective 4: Develop techniques and methods for E&P from high priority emerging gas shale, coal, and tight sand fields, as well as frontier basins and formations, where these operations have been hindered by technical, economic, or environmental challenges.

Development of an Integrated Program

An important aspect of this program is encouragement of teaming efforts to address integrated production needs of a particular unconventional gas resource. To the extent possible, integration of geologic concepts with engineering principles to overcome production and environmental issues is encouraged. The intent is to develop a coordinated program as opposed to individual projects such that the whole has much greater value than the sum of the parts.

D. Implementation Plan

The Unconventional Resources Program is being implemented by developing and administering solicitations for R&D projects in areas that address the objectives outlined above. The following section outlines the major steps in the implementation plan.

Development of Solicitations to Address Prioritized Technology Challenges

The 2007 solicitation was broad in scope in order to allow consideration of a broad range of research topics addressing key issues. Solicitations for the 2008 program continue to seek a broad range of technical solutions, but placed particular emphasis on addressing key technical or resource gaps within the current portfolio of projects. The 2009 program solicitations will encourage the development of integrated programs targeting specific resources with a likely focus on technology or resource gaps that may remain in the program after the 2007 and 2008 selections. Areas that were identified as requiring additional emphasis include the development of unconventional gas in the Appalachian region, decreasing the environmental footprint of unconventional gas development, water management associated with unconventional gas development, and improved methods for complex multi-zone completions.

The topic areas planned to be included in solicitations during the 2009 program year are summarized below. In order to ensure that areas of particular interest and need in the portfolio are addressed, a small number of individual solicitations may be issued that emphasize a particular subset of the technology or resource focus areas described below. In particular, the resource focus of solicitations will depend on the needs necessary to achieve the desired program balance among gas shales, tight sands, and coalbed methane as the 2007 and 2008 projects are selected. At least one, but no more than three, solicitations are anticipated to be issued during the 2009 program year, depending upon the evolving needs of the program. Some or all of the areas below may be covered by solicitations during the 2009 program year.

Description of Planned Solicitations

The 2009 Unconventional Resources Program will seek to broaden the specific unconventional resources to be targeted, while supplementing active projects by addressing technology needs that have arisen during the execution of those projects. Solicitations issued during 2009 will continue to target gas shales, tight sands, and coalbed methane resources with priorities as shown in Table 5.1 and further driven by 2008 program selections when made. Solicitations will continue to be directed towards the development of tools, techniques, and methods that may be applied to substantially increase in an environmentally sound manner, commercial production, and ultimate recovery from established unconventional gas resources and accelerate the development of gas from emerging and frontier unconventional plays. The areas of research shown below apply to each of the targeted unconventional resources, but priorities will be defined by program needs at the time the 2009 solicitations are issued. For example, some specific areas of additional interest that emerged after the 2007 project selections include: the need for more research in water management; improved methods for complex multi-zone completions; reducing the environmental footprint of drilling

operations in Rocky Mountain tight sands; and, additional emphasis on Appalachian shale gas resources.

Specific solicitations may be issued addressing the highest level goals below (1, 2, 3) or targeting specific technology areas (a, b, c...) as the program develops.

1. Develop an integrated program involving key technologies necessary to enable development of a specific unconventional gas resource in a particular geographic area. The program may include research in some or all of the areas a. through i. listed below, depending on the specific barriers to development of the targeted resource. Proposals for integrated programs are encouraged to incorporate and build upon the results of prior and currently active RPSEA projects. Concepts to be pursued within a given area of research may include, but are not limited to the areas listed as i, ii, iii, etc. below.
 - a. Resource Assessment
 - i. Evaluate the potential resources associated with new or underdeveloped unconventional gas plays and identify technical and economic barriers to their development
 - b. Exploration Geosciences
 - i. Characterize geological, geochemical, and geophysical framework of unconventional resource plays
 - c. Basin Analysis and Resource Exploitation
 - i. Characterize geological, geochemical, geophysical, and operational parameters that differentiate high-performing wells
 - d. Drilling
 - i. Development of extra-extended single and multi-lateral drilling techniques
 - ii. Develop improved drilling methods that lower cost, reduce time on location, use less materials, or otherwise increase the efficiency and effectiveness of well construction
 - e. Stimulation and Completion
 - i. Multi-zone completion and stimulation methods
 - ii. Development of steerable hydraulic fractures
 - iii. Development of suitable low-cost fracturing fluids and proppants, e.g. non-damaging fluids and/or high strength, low density proppants
 - iv. Develop stimulation methods that require less water and other fluids to be injected into the subsurface
 - v. Develop stimulation methods that result in a lower volume of treatment fluids produced to the surface
 - vi. Develop approaches for improved treatment, handling, re-use and, disposal of fluids produced and/or used in field operations

- f. Water Management
 - i. Develop comprehensive approaches for the conservation and management of water resources used and produced during all aspects of unconventional gas development
 - ii. Develop water management approaches that minimize the impact of drilling, completion, stimulation, and production operations on natural water resources
 - iii. Develop methods for the treatment of produced water
 - iv. Develop methods for the sustainable beneficial use of produced water
 - v. Develop methods to control fines production
 - vi. Develop techniques to minimize the volume of water produced to the surface
 - g. Reservoir Description and Management
 - i. Methods to accurately assess the potential for shale gas production from common industry petrophysical methods
 - ii. Accurate delineation of natural fracture systems
 - iii. Extend the commercial life of a well through reduction or elimination of workovers and recompletions, as well as reduction of production costs
 - iv. Methods to manage reservoirs to ensure maximum efficient recovery
 - h. Reservoir Engineering
 - i. Methods to plan, model, and predict the results of gas production operations
 - i. Environmental
 - i. Develop advanced drilling, completion and/or stimulation methods that allow a greater volume of reservoir to be accessed from a single surface location
 - ii. Develop advanced drilling approaches that minimize the surface impact of well construction associated with the targeted unconventional gas resource
 - iii. Develop advanced completion, stimulation and/or reservoir management approaches that minimize the environmental impact associated with the development of the targeted resource
 - iv. Develop methods for planning and site selection that minimize the surface impact of drilling and production operations
2. Conduct early-stage research on novel concepts that may be applied to the development of unconventional gas resources.
 3. Develop and execute innovative approaches to integrate the results of individual research projects to address key technical issues in the development of

unconventional gas resources and develop such research into commercially available services.

For new technologies to have an impact on energy production, they must be applied by energy producers. Many producers active in the targeted resources lack the full array of resources or organizational experience to take new technology from the research stage to the point at which it can be applied in field operations. For this reason, the evaluation criteria will be designed to encourage work leading to field applications that will demonstrate the applicability of new technology and encourage its commercial availability. In many cases, however, the developers of innovative new technology lack the resources and the expertise to bring new products to the stage of field application and commercial availability. For this reason, number 3 in the description above is designed to support activities that will integrate the results of individual projects and lead to field demonstrations of new approaches to unconventional gas development using results selected from the entire portfolio of projects.

The evaluation criteria will also be designed to encourage partnerships between oil and gas producers and research organizations. Partnerships are encouraged in order to facilitate the transition from research to application. In addition, the solicitation will encourage oil and gas producers who are not familiar or have expertise in proposal submissions to partner with universities and service companies, who are familiar with this process.

Project Selection Process

Proposals submitted for the Unconventional Resources Program are divided into topic areas (e.g. Completion, Reservoir Engineering, Resource Assessment, etc.) for review in order to align the technical expertise and experience of reviewers with the content of the proposals. Three or more reviewers provide technical evaluations of the proposals within each topic area. To the greatest extent possible, all of the proposals within a topic area are evaluated by the same set of reviewers.

The PAC recommends proposals for funding based on the technical review scores and the priorities associated with the various topic areas and targeted resources. Prior to considering individual proposals, the PAC assigns priorities to each of the topic areas for each of the targeted resources (currently gas shales, tight sands, and coalbed methane). The highest priority resource/topic area combinations are given the most weight in project selection, although all proposals with competitive technical review scores are considered for funding. The PAC considers factors such as balance among the time scales associated with technology and resource development, diversity of technical approach, and the geographic distribution of targeted resources when developing a portfolio of projects intended to maximize the probability of meeting program goals.

Funds Available and Anticipated Awards

It is anticipated that there will be \$13.94 million available for funding the Unconventional Resources Program during each fiscal year. Approximately 5 to 15 awards are anticipated to be awarded in 2009.

The typical award is expected to have a duration of one to three years, although shorter or longer awards may be considered, if warranted, by the nature of the proposed project.

Under the stage/gate approach, all projects will be fully funded to the completion of the appropriate decision point identified in each contract, which may include multiple stages. If a decision is made to move to the next stage or decision point or to gather additional data, additional funding will be provided from available funds.

E. Ongoing Activities

Nineteen projects have either been awarded or are in the process of being awarded based on selections from the 50 proposals submitted in response to the 2007 solicitation for the Unconventional Resources Program. As many of these projects were planned for time frames of two or three years, 35% of the 2008 funds were allocated to the support of projects selected from the response to the 2007 solicitation. Figure 5.1 below provides a synopsis of the type and general geographic location of the projects.

Table 5.2 provides a listing of each of the projects selected. Included for each award is the project title, the awardee, other participants, project duration, the primary project deliverable, and other participants. Additional information can be found at www.rpsea.org and on the NETL/SCNGO webpage at www.netl.doe.gov/technologies/oil-gas/EPAct2005.



Figure 5.1: Unconventional Onshore Project Selections

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DELIVERABLE	PARTICIPANTS
A Self-Teaching Expert System for the Analysis, Design and Prediction of Gas Production from Shales	Lawrence Berkeley National Laboratory	24 months \$1,700,000	User friendly software package for gas shale production prediction	Texas A&M University, University of Houston, University of California Berkeley, Anadarko, Southwestern Energy
Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs	Texas A&M University	36 months \$1,000,000	Design methodology for hydraulic fracturing considering new conductivity model	Carbo Ceramics, Schlumberger, Halliburton Energy Services, BJ Services
An Integrated Framework for the Treatment and Management of Produced Water	Colorado School of Mines	36 months \$1,600,000	Best practices protocol for handling and processing produced water in the Rocky Mountains	Kennedy/Jenks Consultants, Argonne National Laboratory, Stratus Consulting, Eltron Research and Development, Chevron, Pioneer Natural Gas, Marathon, Triangle Petroleum, Anadarko, Awwa Research Foundation, Stewart Environmental, Southern Nevada Water Authority, Veolia Water, Hydration Technology, Petroglyph Operating
Application of Natural Gas Composition to Modeling Communication Within and Filling of Large Tight-Gas-Sand Reservoirs, Rocky Mountains	Colorado School of Mines	24 months \$670,000	Fundamental understanding of gas composition as vs. migration pathways	U.S. Geological Survey, University of Oklahoma, University of Manchester, Fluid Inclusion Technology Permedia Research Group, Williams Exploration and Production, ConocoPhillips, ExxonMobil, Newfield Exploration, BP, Anadarko, EnCana Oil & Gas, Bill Barrett Corporation
Comprehensive Investigation of the Biogeochemical Factors Enhancing Microbially Generated Methane in Coal Beds	Colorado School of Mines	24 months \$860,000	Identification of critical factors for generating gas microbially in coal formations	University of Wyoming, U.S. Geological Survey, Pioneer Natural Resources, Pinnacle Gas Resources, Coleman Oil and Gas, Ciris Energy

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DELIVERABLE	PARTICIPANTS
Enhancing Appalachian Coalbed Methane Extraction by Microwave-Induced Fractures	Penn State University	12 months \$79,000	Fundamentals of efficacy of using microwaves as a CBM stimulation technique	Nottingham University
Gas Condensate Productivity in Tight Gas Sands	Stanford University	36 months \$520,000	Production protocols to minimize formation damage due to liquids precipitation near the wellbore	
Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures	University of Utah	36 months \$1,100,000	Best Practices for development of Utah gas shales integrating natural and hydraulic fracture interaction	Utah Geological Survey, Golder Associates, Utah State University, HClitasca, Anadarko, Wind River Resources Corp
Geological Foundation for Production of Natural Gas from Diverse Shale Formations	Geologic Survey of Alabama	36 months \$500,000	Geologic characterization of diverse shales in Alabama	
Improved Reservoir Access through Refracture Treatments in Tight Gas Sands and Gas Shales	University of Texas	36 months \$950,000	Strategy for refracture of tight gas and gas shale wells. Define window of refracture opportunity	Noble Energy, BJ Services, Anadarko, Jones Energy, Pinnacle Technologies
Improvement of Fracturing for Gas Shales	University of Houston	36 months \$690,000	Design and field test of lightweight proppants in the Barnett shale	Daneshy Consultants, BJ Services
New Albany Shale Gas	Gas Technology Institute	24 months \$3,400,000	Well completion strategy for New Albany Shale wells focusing on well stimulation	Amherst College, University of Massachusetts, ResTech, Texas A&M University, Pinnacle Technologies, West Virginia University, Texas Bureau of Economic Geology, Aurora Oil and Gas, CNX Gas, Diversified Operating Corporation, Noble Energy, Trendwell Energy Corporation, BreitBurn Energy
Novel Concepts for Unconventional Gas Development in Shales, Tight Sands and Coalbeds	Carter Technologies	12 months \$91,680	Feasibility study for the utilization of cables for cutting rock formations in a wellbore for stimulation purposes	University of Oklahoma, University of Houston, M-I LLC
Novel Fluids for Gas Productivity Enhancement in Tight Formations	University of Tulsa	36 months \$220,000	Model for the mitigation of gel damage due to hydraulic fracturing in the near wellbore region	Williams Exploration & Production
Optimization of Infill Well Locations in Wamsutter Field	University of Tulsa	36 months \$440,000	Simulation technique for highgrading downsized spacing locations in a tight gas reservoir	Texas A&M University, Devon Energy
Optimizing Development Strategies to Increase Reserves in Unconventional Gas Reservoirs	Texas A&M University	24 months \$310,000	Reservoir and decision model incorporating uncertainties	Unconventional Gas Resources Canada Operating Inc., Pioneer Natural Resources
Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities	Utah Geologic Survey	36 months \$430,000	Characterization of Paleozoic shales, identification of highest potential areas, best practices for drilling and completion	Bereskin and Associates, GeoX Consulting, Halliburton Energy Services, Shell, Sinclair O&G, EnCana Oil & Gas, Bill Barrett Corporation, CrownCrest Operation LLC
Petrophysical Studies of Unconventional Gas Reservoirs Using High-Resolution Rock Imaging	Lawrence Berkeley National Laboratory	36 months \$1,100,000	Development of recovery strategies mitigating condensate precipitation based on high resolution rock imaging	Schlumberger, BP, Chevron
Reservoir Connectivity and Stimulated Gas Flow in Tight Sands	Colorado School of Mines	24 months \$2,900,000	Mamm creek field characterization and productivity criteria for application to similar environments	University of Colorado, Mesa State University, iReservoir, Bill Barrett Corporation, Noble Energy, Whiting Petroleum Corporation, ConocoPhillips

Table 5.2: Status Update on 2007 R&D Projects

The 2008 program is focused on filling research gaps within the existing R&D portfolio including geographic focus. The 2008 solicitations are expected to be released in late summer 2008, with selections in December 2008. Advisory input has indicated a stronger presence in the Appalachian area of the country, emphasis on produced water technology issues and ongoing environmental focus. Technology dissemination

continues to be highlighted as an area that needs to be developed as the program continues to develop.

Chapter 6 Small Producer Program

A. Mission

The mission of the Small Producer Program is to increase the supply from mature domestic natural gas and other petroleum resources through reducing the cost and increasing the efficiency of production of such resources, while improving safety and minimizing environmental impact, with a specific focus on the technology challenges of small producers.

Small producer is defined in EPAct as “*an entity organized under the laws of the United States with production levels of less than 1,000 barrels per day of oil equivalent.*”

B. Goals

The goal of the Small Producer Program is to address the needs of small producers by focusing on areas including complex geology involving rapid changes in the type and quality of the oil and gas reservoirs across the reservoir; low reservoir pressure; unconventional natural gas reservoirs in coalbeds, deep reservoirs, tight sands, or shales; and, unconventional oil reservoirs in tar sands and oil shales.

C. Objectives

The small producer community is quick to adopt new technology that has been shown to have an economic benefit in their operating environment, but does not generally have the time or resources to provide a test bed for technology development efforts or the demonstration of new applications of existing technology. The Small Producer Program has a crucial role in ensuring that leading edge exploration and production technology is made available to small producers, allowing them to maximize their important contribution to the nation’s secure energy supply. The Section 999 small producer classification is roughly equivalent to the Category III operators as defined by the EIA. In 2006, the EIA reported that these 13,180 operators produced 181 million barrels of oil or 11% of U.S. oil production for that year.

The approach to enhancing the impact of small producers on energy production involves two related, but distinct activities. First, individual small producers facing representative challenges will be engaged to work with technology providers on the development and application of technology to enhance economic and environmentally responsible production and resource recovery. The support provided through the program will mitigate the economic risk normally associated with the application of new technologies. Second, the information acquired as a result of projects funded through the program will serve as the basis for technology transfer efforts that will promote appropriate novel technology applications throughout the small producer community.

The specific objectives of the Small Producer Program are:

Near Term

Objective 1: Apply technologies in new ways to enable improvements in water management and optimization of water use in mature fields.

Objective 2: Apply technologies in new ways to improve oil and gas recovery from mature fields, extending their economic life.

Objective 3: Apply technologies in new ways to reduce field operating costs.

Longer Term

Objective 4: Apply lessons from all near-term projects to new basins/areas and develop new technologies to address the problems of Objectives 1 through 3.

D. Implementation Plan

The Small Producer Program is being implemented by developing and administering solicitations for R&D projects in areas that address the objectives outlined above. The following section outlines the major steps in the implementation plan.

Small Producer Program Advisory Groups

The Small Producer Program receives guidance from the RAG, consisting of industry and academic representatives that are closely tied to the national small producer community. The RAG focuses on identifying, targeting, and prioritizing specific technology needs. This advisory group also provides a key communications focal point for encouraging the formation of the requisite research consortia (see next subsection for description of this requirement). After projects are initiated, the RAG follows each project's progress, plans, and results with particular attention to tech transfer. All projects are reviewed by the RAG annually.

While the RAG will be responsible for directing the Small Producer Program, the Unconventional Resources Program PAC will remain responsible for oversight of the entire onshore program, which includes the Small Producer Program, as well as the Unconventional Resources Program. The RAG will interact with the Unconventional Resources Program PAC through the RPSEA onshore vice president and through its chairman, who will hold a seat on the Unconventional Resources Program PAC.

Development of a Solicitation to Address Prioritized Technology Challenges

The Small Producer Program has been able to draw on the input from the exercises and workshops listed in the Unconventional Resources Program section of this DAP (see Chapter 5, part C), as well as specific events aimed at small producers conducted by NMT and West Virginia University. The overarching theme expressed by small producer representatives at these events was the need for technology, which allows small

producers to maximize the value of the assets they currently hold primarily in mature fields.

Accordingly, the initial solicitation under this program was aimed toward developing and proving the application of technologies, that will increase the value of mature fields by reducing operating costs, decreasing the cost and environmental impact of additional development, and improving oil and gas recovery. Reducing risk is seen as key to reducing costs and, thus, extending the well life and improving recovery. Improved field management, best practices, and lower cost tools (including software) are all within the scope of this effort.

The 2009 solicitation(s) will continue to focus on the theme of advancing technology for mature fields, however, opportunities will be sought to further focus the program to complement the project selections in the 2007 and 2008 programs.

In order to ensure that technologies developed under this program are applied to increase production in a timely fashion, each proposal has been required to outline a path and timeline to an initial application. A specific target field for an initial test of the proposed development must be identified, and ideally, the field operator will be a partner in the proposal.

In compliance with Section 999B(d)(7)(C) of EPAct, all awards resulting from this solicitation “*shall be made to consortia consisting of small producers or organized primarily for the benefit of small producers.*” For the purposes of the solicitation, a consortium shall consist of two or more entities participating in a proposal through prime contractor-subcontractor or other formalized relationship that ensures joint participation in the execution of the scope of work associated with an award. The participation in the consortium of the producer that operates the asset that is identified as the initial target for the proposed work will be highly encouraged.

2009 solicitation(s) may request proposals addressing the following technology challenges:

- Development of approaches and methods for water management, including produced water shutoff or minimization, treatment and disposal of produced water, fluid recovery, chemical treatments, and minimizing water use for drilling and stimulation operations (Objective 1)
- Development of methods for improving oil and gas recovery and/or extending the economic life of reservoirs (Objective 2)
- Development of methods to reduce field operating costs, including reducing production related costs, as well as costs associated with plugging and abandoning wells and well site remediation; consideration will be given to those efforts directed at minimizing the environmental impact of future development activities (Objective 3)

- Development of cost-effective, intelligent well monitoring and reservoir modeling methods that will provide operators with the information required for efficient field operations (Objectives 2 & 3)
- Development of improved methods for well completions and recompletions, including methods of identifying bypassed pay behind pipe, deepening existing wells, and innovative methods for enhancing the volume of reservoir drained per well through fracturing, cost-effective multilaterals, in-fill drilling, or other approaches (Objectives 2 & 3)
- Implementation and documentation of field tests of emerging technology, that will provide operators with the information required to make sound investment decisions regarding the application of that technology (Objective 3)
- Collection and organization of existing well and field data from multiple sources into a readily accessible and usable format that attracts additional investment (Objectives 1, 2, 3, & 4)
- Creative capture and reuse of industrial waste products (produced water, excess heat) to reduce operating costs or improve recovery (Objectives 1, 2, & 3)
- Leverage existing wellbores and surface footprint to maximize recovery of additional hydrocarbons (Objective 2)

The items in the above list are examples only and are not meant to exclude appropriate technologies and topics that may not be included therein. Additional solicitations may be issued based on assessment of proposals received and available funding.

For new technologies to have an impact on energy production, they must be applied by energy producers. Most small producers lack the full array of resources or organizational experience to take new technology from the research stage to the point at which it can be applied in field operations. For this reason, the evaluation criteria will be designed to encourage work leading to field applications that will demonstrate the applicability of new technology and encourage its commercial availability. In many cases, however, the developers of innovative new technology lack the resources and the expertise to bring new products to the stage of field application and commercial availability. For this reason, the solicitations will highly encourage the participation of at least one small producer in the consortium of two or more organizations required for each award under the Small Producer Program. In addition, the Small Producer Program intends to leverage other successful efforts such as the Petroleum Technology Transfer Council (PTTC) in order to reach the geographically dispersed small producer community.

Project Selection Process

Proposals submitted for the Small Producer Program are evaluated by the RAG consisting of representatives of small producers operating in various geographic areas, as well as academics and researchers with experience working with small producers on topics related to the program theme, currently advancing technology for mature fields. In addition to technical merit, alignment with program goals and capabilities of the

proposer, the RAG considers factors such as balance among technology time scales, diversity of technical approach, and the geographic distribution of resources impacted when selecting projects intended to maximize the probability of meeting program goals.

Funds Available and Anticipated Awards

It is anticipated that \$3.21 million will be available for the Small Producer Program during fiscal year 2009. Approximately 4 to 12 awards are anticipated to be awarded under solicitations in 2009.

The typical award is expected to have a duration of one to three years, although shorter or longer awards may be considered if warranted by the nature of the proposed project.

Under the stage/gate approach, all projects will be fully funded to the completion of the appropriate decision point identified in each contract, which may include multiple stages. If a decision is made to move to the next stage or decision point or to gather additional data, additional funding will be provided from available funds.

E. Ongoing Activities

The 2007 solicitation focused on application of available technologies for oil and gas recovery, water management issues, and minimizing the environmental impact on the surface. The solicitation was released on October 17, 2007 and closed on December 3, 2007. The proposals were evaluated by members of the RAG, RPSEA, and NETL. Seven projects selected from the 2007 solicitation are listed in Table 6.1. The seven projects have either been awarded or are in the process of being awarded. All awards were made to consortia consistent with EPAct, with the prime contractor listed as the awardee and the other consortia members listed as participants. The 2008 solicitation, which is planned for release in late summer 2008, has the same general focus as that for the 2007 program year. Project selections for 2008 are expected in December 2008.

Figure 6.1 provides a summary of the type and a general geographic location of the projects awarded under the 2007 solicitation. Additional information can be found at www.rpsea.org and on the NETL/SCNGO webpage at www.netl.doe.gov/technologies/oil-gas/EPAct2005.

The projects can be categorized into three theme areas:

1. Oil and Gas Recovery

a. Enhancing Oil Recovery from Mature Reservoirs Using Radial-Jetted Laterals and High-Volume Progressive Cavity Pumps

This project will field test the addition of radial-jetted laterals as a means to increase the drainage area and, thus, the oil production in a well pumped by a high-volume, progressive cavity pump. Complementing this effort will be the addition of targeted jetted laterals in an injection well for the purpose of improving injectivity and, thus, economically disposing of the additional water production.

b. **Near Miscible CO₂ Application to Improved Oil Recovery for Small Producers**

The goal of this feasibility study is to demonstrate that near miscible CO₂ applications can increase oil production with injection pressures below minimum miscibility pressure. The project will investigate the displacement of oil at near miscible conditions by coupling experimental work with reservoir simulation. The potential benefits are an increase in the resource base for CO₂ flooding and an expanded opportunity for small producers to apply CO₂ flooding.

c. **Seismic Stimulation to Enhance Oil Recovery**

The goal of this project is to field test whether seismic waves sent into a mature oil reservoir can liberate immobile oil and, thus, enhance oil production. The benefit of this novel technique is the stimulation of a wider volume of the reservoir, not confined to only where fluids are injected and, thus, be an alternative to water flooding.

2. Water Management Issues

a. **Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers**

This project will test a low temperature distillation unit to purify produced water at the wellhead and, subsequently, make this water usable for other oilfield operations. This work not only targets the development of the purification technology, but also will provide field demonstration of the unit at two sites operated by small producers.

b. **Preformed Particle Gel for Conformance Control**

This project will establish methods to optimize particle gel treatments in fracture systems to increase oil recovery and reduce water production by improving waterflood sweep efficiency. Experimental work will update theoretical models to improve gel treatment design and predictions of oil recovery and potentially lead to widespread application.

3. Minimizing the Environmental Impact on the Surface

a. **Field Site Testing of Low Impact Oil Field Access Roads: Reducing the Footprint in Desert Ecosystems**

This project will identify and test new techniques to reduce the environmental impact of oil field lease roads in desert-like ecosystems. A selected test site will include instrumentation to monitor the load on various road materials throughout a calendar year. The benefits are the potential of reducing field operating costs and minimizing the environmental impact of oil and gas operations.

b. **Reducing Impacts of New Pit Rules on Small Producers**

The objective of this project is to minimize the impact of pit rules on small producers in New Mexico by reducing the cost of compliance through streamlining the permitting process. This will be accomplished by developing a database of pertinent information and providing easy access to this information via the web and in formats that will allow quick review and decisions to be made.



Figure 6.1: Small Producer Project Selections

PROJECT	AWARDEE *	DURATION/ RPSEA FUNDING	DELIVERABLE	PARTICIPANTS
Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers	New Mexico Institute of Mining and Technology	24 months \$457,000	A process to purify produced water at the wellhead	Robert L. Bayless, Producer LLC, Harvard Petroleum Company
Enhancing Oil Recovery from Mature Reservoirs Using Radial-Jetted Laterals and High-Volume Progressive Cavity Pumps	University of Kansas	12 months \$248,000	Application of available technology to increase oil recovery while effectively disposing of water	Kansas Geological Survey, American Energies Corporation
Field Site Testing of Low Impact Oil Field Access Roads: Reducing the Footprint in Desert Ecosystems	Texas A&M University	24 months \$444,939	Identify materials and processes that will lessen the environmental impact of oilfield operations	Rio Vista Bluff Ranch, Halliburton
Near Miscible CO2 Application to Improved Oil Recovery for Small Producers	University of Kansas	24 months \$329,324	Define the potential for CO2 recovery or sequestration in near-miscible reservoirs	Carmen Schmitt
Preformed Particle Gel for Conformance Control	University of Missouri, Rolla	24 months \$520,000	Assessing gel performance in mitigating water production in fractured systems	ChemEOR Company, BJ Services
Reducing Impacts of New Pit Rules on Small Producers	New Mexico Institute of Mining and Technology	36 months \$560,063	Access to online compliance data and automating permitting process	Independent Petroleum Association of New Mexico, New Mexico Oil Conservation Division
Seismic Stimulation to Enhance Oil Recovery	Lawrence Berkeley National Laboratory	24 months \$723,373	Methodology to predict if a reservoir is amenable to seismic stimulation	U.S. Oil & Gas Corporation, Berkeley Geolmaging Resources

* All awards made to consortia with prime listed as awardee and other members listed as participants

Table 6.1: Small Producer Program Selected Projects

Chapter 7 Program Benefits Assessment and Performance Metrics

The primary overall goal of Section 999 is to increase the supply of domestic natural gas and oil by increasing the supply through cost reduction and efficiency improvement. RPSEA and its SAC will provide support and advice to the NETL-led effort to develop a methodology for determining benefits related to the Program. In general, a comprehensive benefits analysis that evaluates a full range of impacts stemming from the Program is anticipated.

There are four primary objectives of the planned benefits assessment methodology:

- To accurately characterize the full suite of benefits to be assessed, as to both type and timing
- To define reasonably accurate methods for quantifying these benefits as they accrue or for estimating how they are likely to accrue in the future
- To produce benefits assessments considered valid and reasonable by a panel of knowledgeable experts
- To further develop the methodology needed to estimate increases in royalty receipts resulting from the Program

In addition to the benefits assessment, the Program will monitor and report on short-term performance metrics, as well as program management performance and budget metrics. The methodologies for measuring these metrics are provided below.

A. Monitoring Short-Term Performance Metrics

The Program will develop quantitative, short-term performance metrics. Some, but not all of the short-term metrics, will require that individual project metrics be established. The degree to which individual project objectives are met and the degree to which the roll-up of project objectives meet Program objectives must be quantified. However, quantification of project-specific metrics will require the Program to be implemented and underway. Accordingly, the following steps will be followed with regard to quantifying short-term Program impacts that are project dependent.

1. The first round of project proposals must be awarded before establishing project level objectives and metrics.
2. During this time, RPSEA will review and select the most appropriate methodology for quantifying and tracking short-term Program metrics.
3. After a methodology has been selected, a baseline will be established for all areas where short-term metrics will be measured.

4. With the above information in hand, a projection of Program short-term results based on a \$50 million R&D budget per year for a specified number of years will be modeled.
5. Based on the results of Step 4, more precise and quantifiable Program objectives will be established.
6. The results will be reviewed with RPSEA advisory groups before finalization.
7. The process will be repeated on a yearly basis to quantify incremental project/RPSEA administered Program results and cumulative impacts.

The degree to which project milestones are completed on time, papers are delivered, patents are filed, companies contribute cost-share funds, and new technologies are determined to be successful and become commercialized are important indicators of the Program's success. The long-term success of the Program will ultimately be determined by the degree to which these short-term achievements are translated into the benefits outlined earlier.

B. Monitoring and Reporting Program Management Performance and Budget Metrics

In addition, as detailed within the RPSEA Management Plan, a monitoring process has been implemented for tracking budgeted versus actual financial information and other project schedule parameters. This monitoring process includes measurements of:

1. **Obligated/Uncosted Funding in Relation to Total Funds** – RPSEA will establish a database to track obligated funding, as well as uncosted amounts for the total Program (including administration) and each project. Funds will be tracked by year appropriated in order to determine the age of all funds in all categories.
2. **Earned Value Assessment for Each Research Project Including Individual Project Cost and Schedule Variation** – Earned value management metrics will measure the cost and schedule performance of each research project. These metrics will be based on three essential variables:
 - **Budgeted Cost of Work Scheduled** is extracted from the initial project plan. This variable lays down the baseline of planned expenditures at any given time.
 - **Budgeted Cost of Work Performed** is extracted from the initial plan and computed based on the reported work completed.
 - **Actual Cost of Work Performed** is extracted from a project's periodic reports and is the actual expenditure to complete a given task.

From these three variables, the RPSEA administrator will determine the cost and schedule variance for each project.

Cost and schedule data will be collected from researchers on a schedule negotiated with the provider during the contract finalization process. The nature and characteristics of projects funded under the Program will vary widely. The reporting frequency established for each project will consider these differences and vary as appropriate for individual projects and will balance the need for information required to effectively monitor project execution against project schedules, milestones, and magnitude.

3. **Project Completion Targets (within budget and project period)** – RPSEA will utilize the three variables identified above to compute and report the estimated time at completion and estimated cost at completion for each project.

In addition to the above, RPSEA is developing procedures to capture, monitor, and analyze data related to:

- Minimization of the amount of time from invoice to payment
- Processing time for project change requests
- Project report quality and adherence to set standards
- The number of small business, minority owned, and other disadvantaged category Program participants

Chapter 8 Solicitation Process

A. Eligibility

In accordance with Section 999 of EPAct, in order to receive an award an entity must either be:

1. a United States-owned entity organized under the laws of the United States or
2. an entity organized under the laws of the United States that has a parent entity organized under the laws of a country that affords:
 - a. to United States-owned entities opportunities comparable to those afforded to any other entity to participate in any cooperative research venture similar to those authorized under this subtitle,
 - b. to United States-owned entities local investment opportunities comparable to those afforded to any other entity, and
 - c. adequate and effective protection for the intellectual property rights of United States-owned entities.

RPSEA is not eligible to apply for an award under this Program.

B. Organizational/Personal Conflict of Interest

The approved RPSEA Organizational Conflict of Interest Plan (OCI) will govern all potential conflicts associated with the solicitation and award process.

RPSEA was required to submit an OCI, which in accordance with Section 999B(c)(3) of EPAct addressed the procedures, by which RPSEA will (1) ensure it's board members, officers, and employees in a decision-making capacity disclose to the DOE any financial interests in or financial relationships with applicants for or recipients of awards under the Program, and (2) require board members, officers, or employees with disclosed financial relationships or interests to recuse themselves from any oversight of awards made under the Program. The OCI was reviewed by the DOE. After the DOE's comments and questions were addressed, a final OCI was approved.

In addition, the contract between the DOE and RPSEA includes the following OCI clauses: H.22 *Organizational Conflict of Interest (Nov 2005)*; H.23 *Organizational Conflict of Interest (OCI) Annual Disclosure*; and, H.24 *Limitation of Future Contracting and Employment*.

These contract clauses and the approved OCI will govern potential conflicts associated with the solicitation and award process.

C. Solicitation Approval and Project Selection Process

The overall structure of the solicitation approval and project selection process is illustrated in Figure 8.1. Project selection will be through a fully open and competitive process. A pre-proposal process may be used where a brief description of a research concept is submitted prior to submission of a full proposal in order that feedback may be given regarding the alignment of the proposed work with Program goals and the advisability of submitting a full proposal. Within the RPSEA project proposal review and selection process, advisory committees composed of subject matter experts and industry representatives will be responsible for providing technical reviews of proposals and for the selection of proposals to recommend to the RPSEA president for negotiation toward award. NETL will be responsible for the final review and approval of recommended projects.

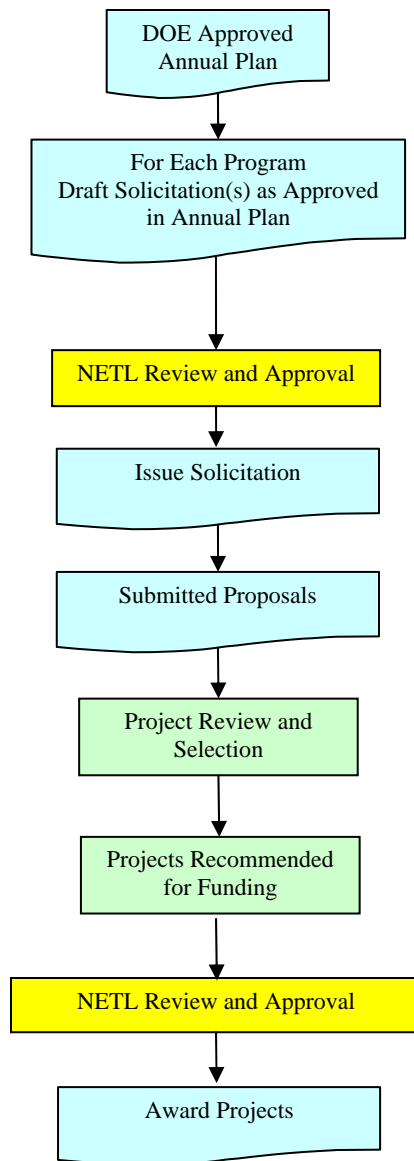


Figure 8.1: Project Solicitation Process

D. Selection Criteria

The following general criteria (which will be more defined in the individual solicitations) will be used to evaluate proposals submitted under the Program. The details of the selection criteria and the weighting factors will vary depending on the specific technology area and will be clearly identified in each solicitation.

- Technical merit and applicable production or reserve impact
- Statement of project objectives
- Personnel qualifications, project management capabilities, facilities and equipment, and readiness
- Technology transfer approach
- Cost for the proposed work
- Cost share
- Environmental impact (including an assessment of the impacts, both positive and negative, that would result from the application of a developed technology)
- Health and safety quality assurance/quality control

A bidder may be required to meet with the review committee to present their proposal and to answer any outstanding questions.

In the Small Producer Program, the following criteria will be used to evaluate proposals in addition to those stated above: approach to application of the results, involvement of small producers, and the overall strength of the Program.

E. Schedule and Timing

The 2009 solicitation(s) will be conducted after approval and posting of the 2009 Annual Plan and will remain open for a minimum of 60 days. Additional activities for RPSEA shown on the timeline below will be the active administration of all R&D awards, planning and development of the Program for 2010, and holding program level technology transfer workshops.

2009 RPSEA Program Timeline		<i>Aug 08</i>	<i>Sept 08</i>	<i>Oct 08</i>	<i>Nov 08</i>	<i>Dec 08</i>	<i>Jan 09</i>	<i>Feb 09</i>	<i>Mar 09</i>	<i>Apr 09</i>	<i>May 09</i>	<i>Jun 09</i>	<i>Jul 09</i>	<i>Aug 09</i>	<i>Sept 09</i>
<i>Month</i>		-2	-1	1	2	3	4	5	6	7	8	9	10	11	12
2009 Draft Plan Submitted (July 31, 2008)	◆														
Plan Published		◆													
Plan Approved						◆									
Obtain DOE Approval of Solicitation							◆								
Solicitation Open Period															
Proposal Evaluation and Selection															
DOE Approval															
Contract Negotiation and Award															
Administer 2009 Awards															
Administer 2007 & 2008 Awards															
Report Program Deliverables															
Conduct Technology Transfer Workshops & Activities															
Establish 2010 R&D Priorities & Annual Plan															

Table 8.1: 2009 RPSEA Program Timeline

F. Proposal Specifications

The structure and required elements of proposals submitted in response to each of the solicitations, as well as the specific details regarding format and delivery, will be developed in consultation with the DOE and will be provided in each solicitation.

G. Funding Estimates

It is anticipated that for fiscal year 2009, \$14.87 million per year will be available for the UDW with approximately five to 10 awards and \$13.81 million per year for the Unconventional Resources Program with approximately five to 15 awards. The typical award is expected to have duration of one to three years, although shorter or longer awards may be considered if warranted by the nature of the proposed project. Under the stage/gate approach, all projects will be fully funded to the completion of the appropriate decision point identified in each contract, which may include multiple stages. Once a decision is made to move to the next stage or decision point, additional funding will be provided from available funds.

It is anticipated that \$3.19 million per year will be available for the Small Producer Program. Approximately four to 12 awards are anticipated during fiscal year 2009. The

typical award is expected to have a duration of two years, although shorter or longer awards may be considered if warranted by the nature of the proposed project.

H. Advertising of Solicitations

Advertising of each solicitation will be implemented in a manner that insures wide distribution to the specific audience targeted by each solicitation.

The vehicles used will include but not be limited to:

- Publication on the NETL website, supported by DOE press releases
- Publication on the RPSEA website, supported by RPSEA press releases and newsletters
- Announcements distributed via e-mail to targeted lists (e.g., small producer solicitation to members of state producer organizations and IPAA)

Other vehicles that may be used include:

- Advertising in recognized industry publications (e.g., *Oil and Gas Journal*, *Hart's E&P*, *Offshore*, *American Oil and Gas Reporter*, etc.)
- Presentations at industry meetings by both RPSEA and NETL representatives, as appropriate given the timing of the solicitations
- Subscribing to funding-alert organizations that send e-mails once a week about funding opportunities to members in their specific areas of expertise
- Working with the various professional, industry, state, and national organizations to utilize their established networks

Chapter 9 Technology Transfer

In order to meet the Program goal of maximizing the value of the nation's natural gas and oil resources, as well as increasing federal royalty receipts, it is essential that technology developed under this Program be rapidly and effectively applied by operators exploring for and developing new resources. The goal for technology transfer under this Program is to assure the engagement of participants all along the technology value chain, from conceptual development to commercial application, in order to maximize the impact of Program technology. Technology transfer will be coordinated with NETL/DOE.

A proactive communication approach to technology transfer must include the initial articulation of technology needs by the ultimate users of the technology, involve the various stakeholders in the technology development continuum, and have continuous feedback loops from each stage in the process to either validate or calibrate research or technologies. The technology transfer objectives for the early years of the Program focus on developing and implementing a set of processes designed to ensure coordinated transfer of technology across the anticipated wide spectrum of technology investors, developers, deployers, and end users likely to be associated with the Program. Examples of technology transfer include workshops, conferences, websites, and flyers, along with newer techniques such as webcasting, podcasting, or online video conferencing.

The specific technology transfer objectives for the Program include:

1. Incorporate provisions in the solicitations that provide for the allocation of 2.5 percent of the funding for each project to technology transfer activities. Develop and incorporate language that requires each applicant for an award to propose a technology transfer approach, with the understanding that up to 40 percent of the 2.5 percent designated may be directed by RPSEA for program-level technology transfer. Develop and incorporate language in the model contract that provides for the coordination of technology transfer across multiple related projects, as specified above.
2. Engage the PAC and TAC members through involvement in needs assessment, project selection, and ongoing project review in order to promote ongoing interest in developing projects and facilitate field tests and demonstrations using operator wells, data, and facilities.
3. Each project will participate in at least one project review meeting for RPSEA members and the public.

The approach to technology transfer is designed to address program-level goals through a coordinated process that combines the technology transfer efforts associated with related projects, while honoring the contractual commitment to fund technology transfer through the allocation of 2.5 percent of Program funding for this purpose.

As part of the administration of the Program, RPSEA will conduct the following program-level technology transfer activities.

- RPSEA will post on its public website a list of projects, including goals, objectives, technical status assessments, results and accomplishments, reports, best practices, and key personnel contact information. This effort will be coordinated with the knowledge management database being developed by NETL under the Section 999 complementary program that will provide a repository for Program results.
- Periodic project reviews with the PACs and the RAG (and the TACs as required) will be designed to ensure that the results of related projects are presented in a way that highlights their interconnection and allows the advisory bodies to identify opportunities for the evaluation and application of project results.

In order to maximize the impact of the 2.5 percent allocated to technology transfer, RPSEA is implementing the following approach:

- Each solicitation included the requirement for a plan for technology transfer. The solicitation will instruct offerors to propose an approach for technology transfer for their project, understanding that up to 40 percent of the 2.5 percent designated for technology transfer may be designated by RPSEA for use in program-level technology transfer activities, such as third-party services to coordinate program-level technology transfer for a number of projects.
- RPSEA is developing a program-level technology transfer approach for the portfolio of projects to be funded. This plan will be based on maximizing the impact of the entire project portfolio, including new and ongoing projects, and will consider the input associated with the technology transfer plans submitted in successful proposals.
- RPSEA and the selected awardee will jointly develop a project-level technology transfer approach.

The R&D contracts awarded will include requirements for the expenditure of funds allocated to technology transfer in accordance with the portfolio level plan. In some cases, especially with large projects with few deliverables, the technology transfer may be handled entirely by the awardee in accordance with an approved plan. In other cases, especially smaller projects, technology transfer efforts may be more effective if coordinated with other projects.

A portion of the 2.5 percent funding will be allocated to support a knowledge management database. RPSEA database efforts will be coordinated with the knowledge management database being developed by NETL under the Section 999 complementary program. The preservation of data from the R&D projects and technology transfer program must be retained in a database for maximum dissemination (both near and longer term) to the end users. Elements of a successful database resource should include:

- A knowledge management database populated with R&D results to serve as a resource of technology for industry
- A knowledge management database with the following aspects: require user registration, but be free of charge and open to the public; have a standard template format for input; allow for subject matter review process before information is published; and, incorporate a knowledge push and/or community notification system to stimulate and maintain interest
- Use of the existing petroleum technology transfer databases and databases that are under development by NETL to the maximum extent possible, to reduce development and maintenance costs

The objective of this approach is to ensure a coordinated technology transfer effort that maximizes the impact of the entire Program. Options will be explored for leveraging resources to ensure a most robust technology transfer program. The DOE will continue to engage RPSEA to develop a coordinated program. As a result of project commencements in 2008, it is expected that a combination of RPSEA member meetings, program specific meetings, joint efforts with professional associations, and/or other regional events will be held beginning in the last half of 2009. Notices of these meetings will be posted to the RPSEA and NETL websites as they are developed.

Appendix A: RPSEA Membership and Committee Lists

RPSEA Members

Acergy US Inc.
Acute Technological Services, LLC
Advanced Resources International, Inc.
AeroVironment, Inc.
Altira Group
American Gas Association
Anadarko Petroleum Corporation
Apache Corporation
Apex Spectral Technology
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Gas Technology Institute

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Independent Petroleum Association of Mountain States
Integrated Ocean Drilling Program
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New Mexico Oil & Gas Association
NGAS Resources, Inc.
NiCo Resources
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Oklahoma Independent Petroleum Association
Oxane Materials, Inc.
The Pennsylvania State University
Petris Technology, Inc.
Petrobras America Inc.
Petroleum Technology Transfer Council

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Quanelle, LLC
Rice University
Robert L. Bayless, Producer LLC
Rock Solid Images
RTI Texas
Sandia National Laboratories
Schlumberger Limited
Shell Exploration & Production
Simmons & Company International
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Stanford University
StatoilHydro
Strata Production Company
Stress Engineering Services Inc.
Technip
Technology International
Tejas Research & Engineering, LP
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Texas Engineering Experiment Station/Texas A&M University
Texas Independent Producers and Royalty Owners Association
Texas Tech University
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TOTAL Exploration Production USA
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The University of Oklahoma
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