RPSEA 2011 Draft Annual Plan

July 2010

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Table of Contents

Executive Summary

This document is the Research Partnership to Secure Energy for America (RPSEA) 2011 Draft Annual Plan (DAP) for the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Research and Development Program (Program) established pursuant to Title IX, Subtitle J, Section 999 (Section 999), of the Energy Policy Act of 2005 (EPAct). RPSEA administers three of the four program elements 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. Previously, RPSEA submitted DAPs for 2007 through 2010, and in their development gathered extensive input through industry workshops, road mapping sessions, and expert opinion, including input from two Federal Advisory Committees (FACA).

The 2011 DAP is an evolutionary document building upon the foundation of the 2007 through 2010 approved Annual Plans, all of which DOE has submitted to Congress and all of which incorporated RPSEA's earlier DAPs. The vision and plan laid out in these previous DAPs remains solidly in place as the program begins to produce results that will positively impact the nation's energy security, job development, and economy. While safety and environmental sensitivity have always been key components of the technologies developed under the program, the recent Deepwater Horizon incident in the Gulf of Mexico and ongoing concerns regarding the safety and environmental aspects of shale gas development has resulted in an increased emphasis on the evaluation of potential safety and environmental risks associated with the development of ultra-deepwater and unconventional resources, and approaches to reduce and mitigate those risks. While the original intent of the Section 999 was to "maximize the value of natural gas and other petroleum resources of the United States" none of that value will be realized if the targeted resources cannot be developed in a safe and environmentally sensitive manner. The Deepwater Horizon incident has caused the industry to reevaluate its approach to risk management as applied to all exploration and development operations. An important component of this plan is conducting the research necessary to ensure that the risks associated with the development of ultra-deepwater and unconventional resources are fully understood, and the means are available to fully mitigate those risks with respect to both prevention and recovery.

RPSEA's Mission is to provide a stewardship role in ensuring the focused research, development and deployment of safe and environmentally sensitive technology that can effectively deliver hydrocarbons from domestic resources to the citizens of the United States.

At this stage of the Program, RPSEA's objectives are: the continued aggressive engagement of the private sector and research communities to enhance the value of the public/private partnership; a focus on building, maintaining, and managing the optimal portfolio contemplated by the original DAPs; and the transition from planning to project execution and technology transfer. Focus is the operative word regarding portfolio composition, and RPSEA remains keenly focused on the objectives more fully described in the following chapters. The program chapters each include examples of projects that are having an impact on the operations of the participants and developing technology and information to transfer to the industry as a whole. Each of the three RPSEA program portfolios, ultra-deepwater, unconventional resources, and small producer, have developed according to plan. The 2011 DAP continues that evolution to build the foundation required for optimal portfolio composition.

RPSEA Model

The RPSEA model for technology development involves the active engagement of stakeholders across the entire community of energy producers, researchers, technology providers, regulators, and environmental groups. The best efforts of the research community will be required to develop the technology necessary to safely deliver hydrocarbons from the targeted resources; however, the knowledge residing with producers and service companies is crucial in providing effective direction for the needed research. Further, the rapid application of new ideas and results will be facilitated by the continuing involvement of producers and service companies in the planning and execution of the research program. The increased emphasis on safety and environmental sensitivity reflected in this plan will require more direct involvement and communication with the regulatory agencies and the environmental community, as represented by the Environmental Advisory Group (EAG). The chapters for the individual program elements describe the ways in which stakeholder groups are effectively engaged for each portion of the program.

The safe and environmentally sensitive delivery of secure domestic hydrocarbon resources to the citizens of the United States is not the only outcome of the research conducted under this program. While the United States is currently a leader in terms of the development of Ultra-deepwater and Unconventional Resources, other nations around the world are beginning to see these resources as an important component of a plan to move toward a lower-carbon, sustainable energy mix. While development of these resources in the U.S. directly yields thousands of high-paying domestic jobs, the research efforts funded by this program are helping to keep U.S. companies in the forefront of energy technology worldwide.

The portion of the Section 999 program covered by this plan includes an authorized expenditure of $100 million, subject to appropriation, in excess of the $50 million directed spending associated with the RPSEA administered program and the NETL Complementary program. During the first three years of the program, the RPSEA solicitation process has been able to generate qualified proposals for several times the amount of funding available. The model and process used for the program could thus readily support additional appropriated funds, with the associated increased impact on the

energy supply in the U.S. and the global competitiveness of the U.S. energy technology industry. With significant opportunities well in excess of available funds, RPSEA will continue to high-grade and prioritize funding needs and coordinate with the NETL complementary program.

2010 and 2011 Planning

The Ultra-deepwater Program 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 the 2009 solicitations, six need areas further defined the four field development scenarios:

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

The focus for UDW in 2010 continued to address the themes articulated for the four generic field types by addressing the six heretofore described needs areas.

In 2011 the UDW Program will prioritize technology needs and continue to develop and mature selected projects. In addressing the higher-level goal of accelerating the development of resources into reserves, the program will strategically begin combining previously developed technologies into cohesive and comprehensive systems that address the overall needs and lead toward field demonstrations, and ultimately to commercialization. As such, the UDW program will move generally to fewer and larger projects, emphasizing cross cutting projects where possible.

While the general focus remains the same, the UDW Program 2011 solicitations will center around the following themes:

- Emergency prevention, preparedness, response and recovery
- Next phase projects based on completed projects from the 2007 and 2008 program
- Specific project ideas to fill-in identified technical gaps
- Graduate Student and Innovative/Novel projects

An added emphasis on environmental and safety issues will be addressed through needs identified as a result of analysis of the Deepwater Horizon incident. These are likely to include analyses of systems integrity in ultra-deepwater environments, environmental

studies regarding the potential impact of ultra-deepwater operations, as well as specific technology developments aimed at increasing the safety of offshore operations.

The **Unconventional Resources Program** for 2007 through 2010 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). The 2010 program will see the continued population of the portfolio set forth in the early foundational years. For 2011, the focus on unconventional natural gas remains essentially unchanged, with integration and application of project results as a particular priority. While safety and environmental impact have been key elements of the program since its inception, the 2011 plan includes specific efforts to more fully define the risks associated with unconventional gas development and ensure that appropriate technologies are available to mitigate those risks. As with the UDW program, evaluating and ensuring systems integrity will be a key issue for the Unconventional Resources program. In addition, the 2011 DAP contemplates an emphasis on specific geographic areas to broadly incorporate the components of the existing portfolio and begin the transition to field scale demonstration projects.

The **Small Producer Program** for 2007 through 2010 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 solicitations under this program were 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. The 2010 solicitation will continue this building process. For 2011, 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 through 2010 programs by funding research that builds upon earlier results and expands their geographic application.

Chapter 1 Strategic Overview

RPSEA Mission, Goals and Objectives

The primary mission of RPSEA as applied to Section 999 of EPAct 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 fifth year plan is RPSEA's continuing effort toward meeting the more specific goal in EPAct 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."* As the Section 999 program has a sunset date of September 30, 2014, this plan will include provisions for managing the program in a way that will ensure that the funds allocated in the program's final years are effectively deployed to meet the specific goal above.

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).

Safety and Environmental Stewardship

The resources targeted by the Section 999 program have the potential to increase America's energy security and provide a stable and abundant supply of low-carbon natural gas that opens the possibility of significant near-term reductions in carbon emissions associated with transportation and power generation. This potential cannot be

realized unless these resources can be developed safely and with minimal risk to the environment. The Deepwater Horizon incident has called into question the risk management capability of the oil and gas development industry. It is essential that research be conducted to ensure that the risks associated with the development of ultra-deepwater and unconventional resources are fully understood and that reliable processes and procedures are in place to prevent incidents and mitigate the impact of any incidents that do occur. It is not enough that industry experts feel that operations can be conducted safely and with minimal environmental risk. In order to assure timely development of these important resources, the public and the regulatory bodies must be fully convinced of the capabilities of the oil and gas industry for safe development of these challenging resources.

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. This plan includes elements that focus specifically on understanding the risks associated with oil and gas development operations and developing technologies to mitigate those risks. 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.

There are currently a number of efforts under way to understand and evaluate the risks associated with ultra-deepwater operations and the development of shale gas through hydraulic fracturing. The sections of this DAP describing each program element include a commitment to research specifically directed toward relevant safety and environmental topics, and include sufficient flexibility to ensure coordination with other efforts that may be ongoing when this plan is executed.

Research Program Development Principles

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

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.

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 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. The active engagement of the research community ensures that the program is able to look-ahead toward future challenges as well as respond effectively to current needs. 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.

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.

RPSEA 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:

- 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 critical, also, to acknowledge the importance of a collaborative partnership with industry to the success of the mission; academic research, while absolutely necessary, is clearly not sufficient. Along with other research institutions, industry, as the ultimate enduser 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. This is particularly true as projects move to the development and demonstration phase.

A key goal for RPSEA is "improving safety and minimizing environmental impacts". The benefits of access to additional energy resources cannot be realized unless those resources can be reliably produced with minimal risk to the public, oil and gas development personnel, and the environment. Additionally, the risks associated with oil and gas development in the targeted resources must be transparent and understood not just by industry, but by the public and the regulatory bodies charged with ensuring the

safety of the public and the environment. Additional effort in the 2011 plan will be directed toward evaluating the risks associated with oil and gas development in ultra-deepwater and in unconventional gas resources and technology development to mitigate those risks. These efforts may include environmental studies to fully understand how technologies can preserve, protect, or restore natural resources. In addition to participation by industry and research organizations, active engagement with regulatory bodies, environmental organizations, and the public will be critical to the successful application of technologies that will enable the development of these resources. The status of RPSEA as a public-benefit organization with active engagement of industry and other stakeholders provides a unique opportunity for a significant near-term impact on the safety and potential environmental impact of oil and gas development operations.

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 providing 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, single-use 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 the 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 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 technology transfer, as well as commercialization.

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 1.1. This strategic triangle developed by the Strategic Advisory Committee (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 leapfrog the conventional development cycle.

For 2011, the RPSEA program has moved upward in the triangle depicted in Figure 1.1. As will be described in the individual program element chapters, there will likely be fewer projects selected in the 2011 program. In some cases, early feasibility studies have laid the groundwork for larger demonstration projects. In other areas, the results of successful projects from previous years will be integrated into larger efforts and applied in field tests or other activities that address the challenges associated with the development of the targeted resources. In addition, it is likely that some longer-term projects will be planned to be funded with 2012-2014 program year funds. Clear decision points will be established, beyond which funding will depend not only on successful preliminary results, but also the availability of funds in future program years. By the time the draft Annual Plans for the 2013 and 2014 program years are developed, it is likely that the bulk of those years’ funds will be committed to existing projects. Planning now for the effective use of 2012-2014 program year funds will allow the program to maximize its impact through the 2014 end date, as well as provide the means to plan and manage the larger scale projects that will be necessary as the program moves toward the integration and application of earlier results.

Finally, it should be noted that the program has been able to consistently attract high-quality proposals significantly in excess of the available funding. For example, the 2008 and 2009 Unconventional Resource solicitations resulted in the submission of proposals requesting over $167 million in funding. The technical reviewers and the PAC felt that approximately $85 million of requested funding represented relevant, well conceived proposals backed by strong research teams that could be expected to yield solid dividends in term of enabling additional reserves and production; however, only $27 million in funding was available for the two program years. The roughly $58 million in qualifying projects that were not funded represents a resource of work that could be initiated rapidly to have a near-term impact on the nation’s energy supply should additional funding become available.

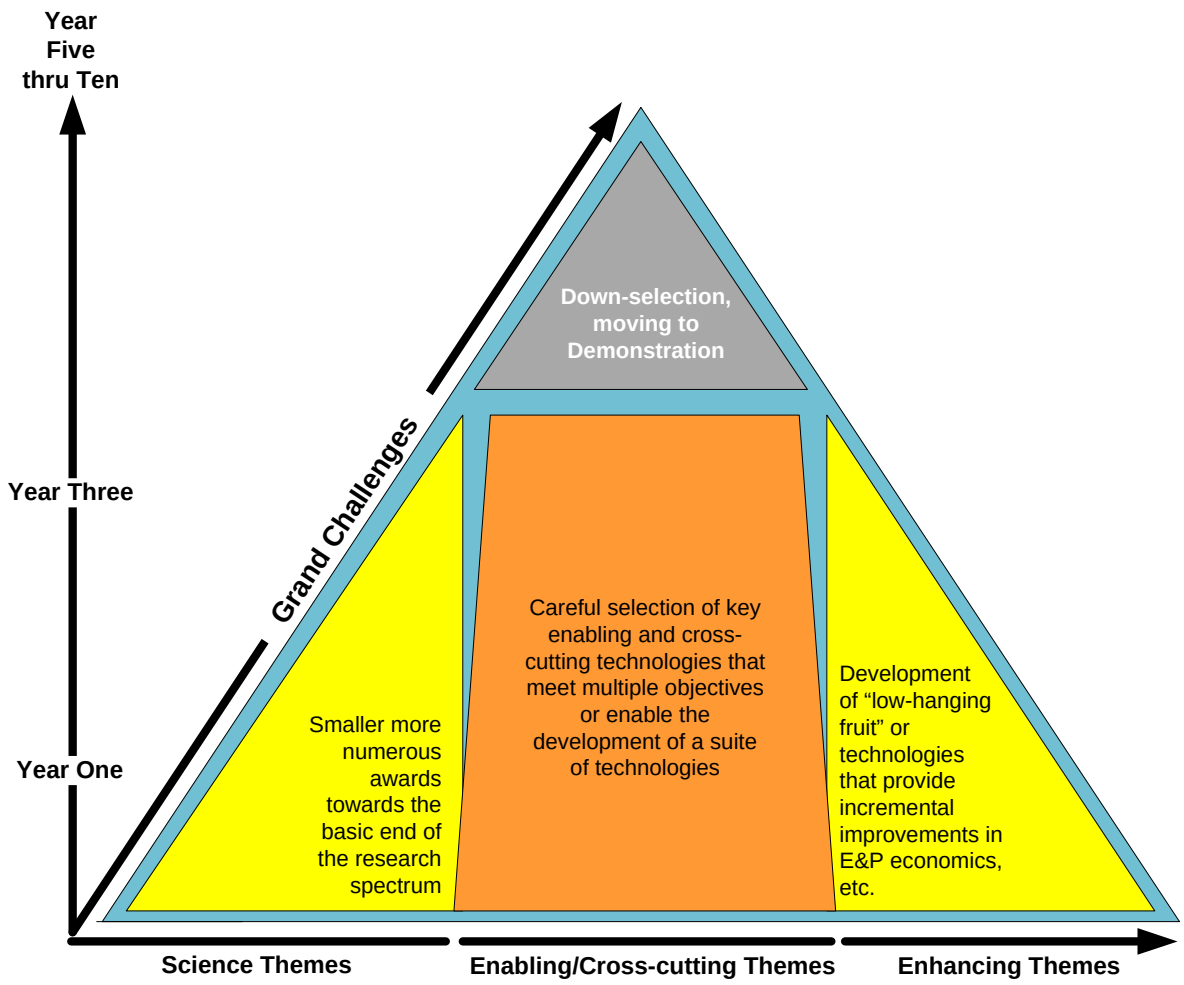


Figure 1.1: SAC Research Portfolio Guidance

Draft Annual Plan Organization

Following the structure of the strategic triangle in Figure 1.1, this fifth-year DAP builds upon the foundation laid by the 2007 through 2010 Annual Plans 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 years 2007 through 2010 Annual Plans as follows:

- Four ultra-deepwater field types have evolved to six industry needs
- Three unconventional 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. Table 1.1 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	• Relatively small number of industry players • Significant capital requirements • Consistent but evolving national regulatory environment • Some internal research capability • Very high-cost, high-risk working environment • Industry players operating in major UDW basins worldwide	• Focus on infrastructure/harsh environnemental 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 • Opportunity for synergy with other UDW research programs (DEMO, PROCAP etc) • Need to engage regulators, environmental organizations and other stakeholders in setting research priorities that address risk, response and clean-up technologies
Unconventional Resources Program	• 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	• 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	The number of small producers is more than 10,000 in diverse regions and resources with: • Limited access to capital • Multiple regulatory jurisdictions • No internal research capability • Limited or no capability to internalize new technology • Threats from technical, environmental, and market challenges	• 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

Table 1.1: 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 chapters that follow.

Chapter 2 Background

Energy Policy Act of 2005: Section 999

The Energy Policy Act of 2005 (EPAct), Title IX, Subtitle J, Section 999 (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 2.1 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 nonfederal lands, which although not directly providing federal royalties 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 needed technology is the 2008 Unconventional Resources Program selection on ***Coupled Flow-Geomechanical-Geophysical-Geochemical Analysis of Tight Gas Production***, led by Lawrence Berkeley National Laboratory. The emergence of extraordinary unconventional natural gas resources has in a very short time frame completely changed the domestic energy outlook. However, the flow mechanism for these huge resources is still not well understood: this critically important project seeks to advance the understanding of how all the factors are coupled to characterize and optimize gas flow from these relatively impermeable formations. While industry has done a remarkable job of iteratively advancing its operational processes to enable economic production, efficiency still needs to improve to reduce the overall costs and much still remains to be learned to further advance production with reduced environmental footprint. Overlaying the science from this work onto existing field operations is not something that market forces would normally incentivize and is the appropriate application for advancement through a public/private partnership.

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; it can only happen with effective public policy and leadership. Therefore, a fundamental objective of the Program is to generate collaborative projects that are not well suited or practical for industry to perform without an incentive. The Program will achieve this goal 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 our nation's oil, yet in general have little or no internal technology development capability. (www.ipaa.org/issues/testimony/IPAATestimony-HouseOversiteGovtReform10-31-2007.pdf).

Each program has specific examples of such collaboration. An example in the 2008 Unconventional Resources Program is the project selection of **the *Environmentally Friendly Drilling Systems Program***. While the potential for unconventional natural gas is now clearly demonstrated by investment and production increases, it still requires drilling wells to access the resource. This project seeks to optimize the drilling process to assess trade-offs and establish balance among various interests using the land. This is especially relevant to urban areas and to public lands in the West. This project has over 15 diverse participants bringing a variety of perspectives and expertise to address this critical issue. Another example is the 2008 UDW selection on ***Coil Tubing Drilling and Intervention System Using Cost Effective Vessels*** project. Recovery factors in the ultra-deepwater of the Gulf of Mexico (GOM) are directly related to intervention costs, and federal royalties are a function of recovery factors. By lowering the cost of intervention, producing fields can produce more hydrocarbons at lower costs from existing environmenal footprints, thereby increasing federal royalties and enhancing domestic energy security. Yet another example is the 2008 Small Producer selection on ***Electrical Power Generation from Produced Water*** project. This project advances the technology to capture thermal energy from existing waste streams and converting it to generate electricity, thereby lowering operating costs, which in turn prolongs well life and increases recovery. An added benefit lies in the fact that since the electrical energy is geothermally generated, it produces no greenhouse gas emissions.

A. Consortium Selection

NETL contracted with RPSEA, a 501(c)(3) nonprofit corporation, to administer the distribution of approximately $32 million per year in R&D contracts (Table 2.1). 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	1,750,000	14,875,000
Unconventional Resources	32.5%	16,250,000	812,500	1,625,000	13,812,500
Small Producer	7.5%	3,750,000	187,500	375,000	3,187,500
Consortium Total		37,500,000	1,875,000	3,750,000	**31,875,000**
Complementary	25%	12,500,000	0	0	12,500,000
Section 999 Total	100%	50,000,000	1,875,000	3,750,000	44,375,000

Table 2.1: Distribution of Section 999 Funds ($)

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. RPSEA is currently comprised of over 160 member firms. 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 21,600 hours of volunteer participation, the value of which cannot be over-emphasized and could not 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, nonprofits, and consumer and civic organizations. In addition, through

the Environmental Advisory Group, RPSEA has established a collaboration with prominent environmental organizations. This "network of networks" avoids reinventing the wheel by utilizing and leveraging the robust individual capabilities of the network components. Moreover, member company volunteers are subject matter experts in their lines of work who routinely collaborate to solve problems and fill the most important technology needs. The model, uniquely developed for the natural gas and oil sector, seeks to replicate the success of other models developed for other public and private sectors such as the National Aeronautical Space Administration and the Defense Advanced Research Projects Agency, which 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 2.1. RPSEA is the consortium competitively selected by the Department of Energy (DOE) to administer three programs of Section 999. Information on RPSEA and its members can be found at this link, RPSEA Members, 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.

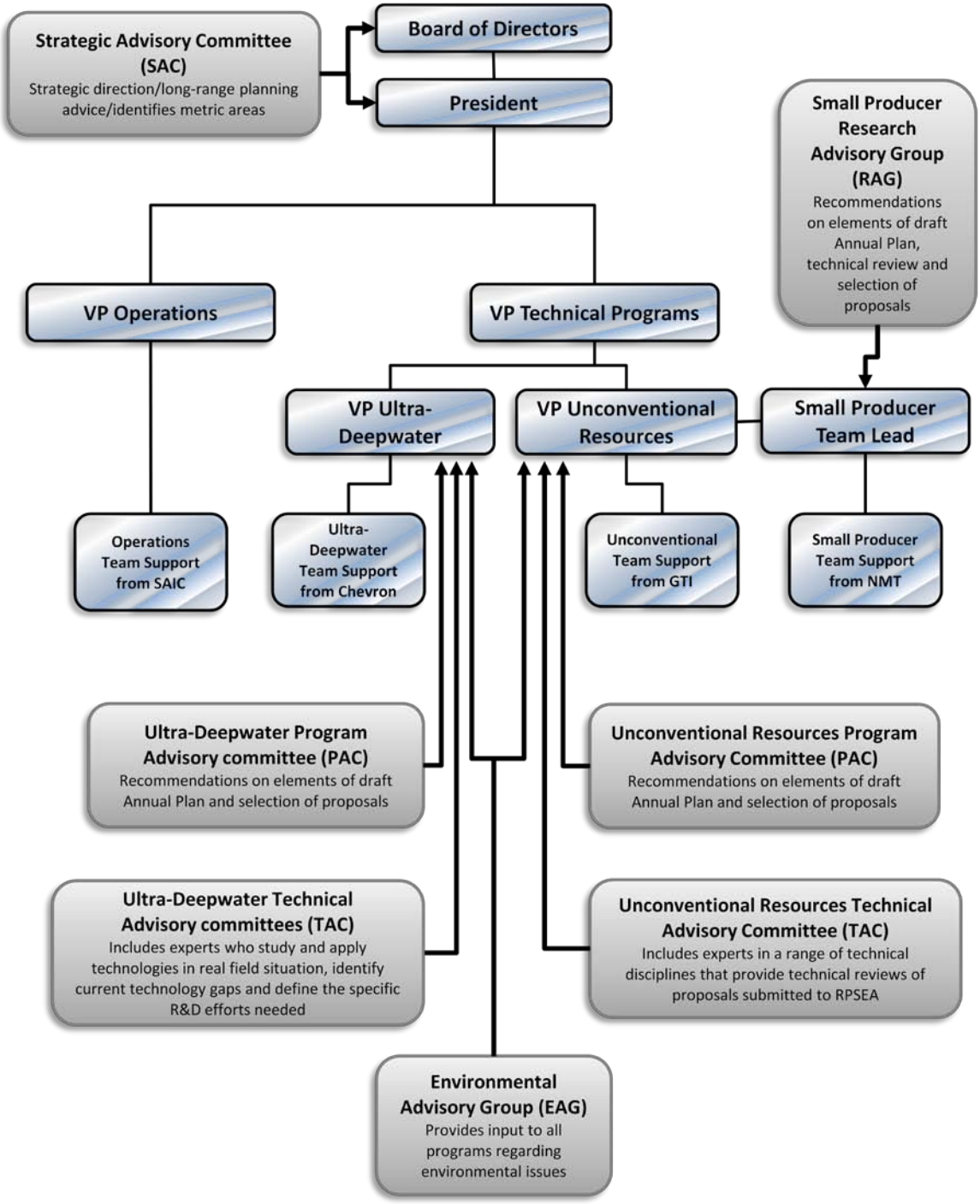


Figure 2.1: Organization of RPSEA and Advisory Committee Relationships

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 bylaws 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 nonmembers. 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, nongovernmental organizations, and industry for road mapping exercises to identify key regulatory barriers/issues. As requested, the EAG reviews programs, projects, and plans to ensure that environmental issues are appropriately addressed. The EAG also serves in a liaison capacity with various environmental programs and organizations across the United States. The role of the EAG will be expanded in the 2011 program to ensure that appropriate priorities are placed on relevant and needed environmental studies to fully understand how technologies can preserve, protect, or restore natural resources. In addition, operational safety will be a key element of the 2011 program, and advice will be sought through the EAG or other appropriate resources.

Program Advisory (PAC) and Technical Advisory (TAC) Committees - The roles of the PACs and TACs within each program are further defined in Chapters 5 through 7, 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 Producer 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 are reviewed by the RAG annually. While the RAG is responsible for directing the Small Producer Program, the Unconventional Resources Program PAC remains 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. In August 2008, RPSEA provided recommendations for the 2009 Annual Plan, and in July 2009 it did the same for the 2010 Annual Plan. RPSEA will continue to provide Annual Plan input each July on a regular cycle.

Each year, the Annual Plan for the Program 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 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; that 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 Annual Plan is critical to effective results. Achieving these results within the finite 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. 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:

- Twenty-seven 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 1457 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 and an annual TAC Conference. Additional forums and meetings are continually planned in order to secure input to future plans and R&D solicitations.
- Multiple individual meetings and contacts with individual RPSEA members, who cover a broad spectrum of knowledge and expertise and provide the backbone of the program strengths
- RPSEA's PACs and the RAG for general guidance and project selection, the various TACs and the RAG for technical gap identification, and the SAC for high level direction
- Federal and state government agencies; non-oil and gas stakeholder groups including for example, the Nature Conservancy, the Groundwater Protection Council, and the National Resources Defense Council (NRDC) among others; state, regional, and national hydrocarbons organizations, and national and international technical societies
- Managers and vice presidents of all RPSEA Programs, to focus on cross-cutting technologies, opportunities to further integrate the knowledge base, and identifying key elements for further collaboration and study
- Key representatives from NETL in events and planning exercises to enhance complementary efforts, eliminate the likelihood of competing evaluations, ensure open lines of communication, and identify knowledge-based opportunities

- Multiple road-mapping exercises conducted by the DOE, RPSEA, and others prior to 2007

The process of integrating these inputs is illustrated in the schematic shown in Figure 2.2, 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, ensuring that no one interest can dominate. This holds true for project selection and portfolio development, where the open and robust process with multiple inputs overrides possible individual biases and provides invaluable credibility. This process is ongoing.

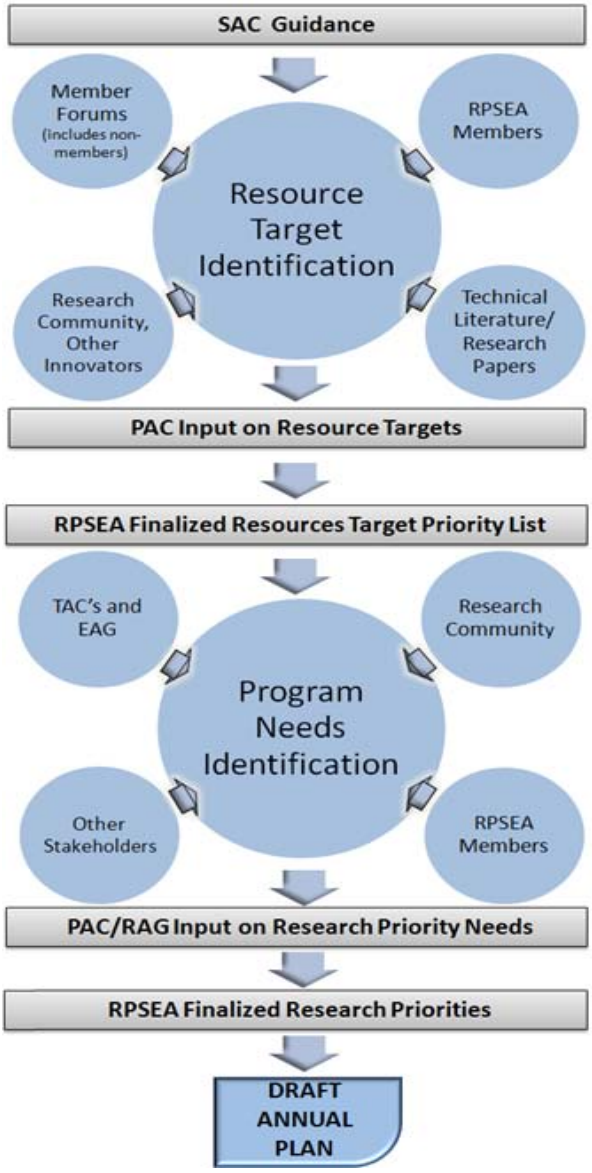


Figure 2.2: RPSEA DAP Development Process

Chapter 3 RPSEA Accomplishments

The primary accomplishment of the RPSEA program is the engagement of technical experts across the spectrum of disciplines and stakeholder organizations to form an active research program developing new technology to meet the program goals for each of the program elements. Information on the 70 projects that have been awarded and the 29 projects that have been recently selected is provided in the Chapters for each program element. RPSEA has also made significant organizational progress towards the overall, high-level goals of the Program. These accomplishments are listed below.

- Commenced a new, fully-functional management structure and developed compliant policies and procedures specifically for administering Section 999 for the Program
- Developed a federally compliant set of policies and procedures for a new revolutionary Program, including management and operating plans
- Obtained federal certification of RPSEA's Procurement System, thereby expediting the approval process for research awards
- Successfully completed independent third party and federal accounting system audits with no material weaknesses
- Launched a new, content-rich website to support strategic communications, technology transfer, and the solicitation process
- Established a comprehensive advisory committee network
- Built support among oil and gas research and industry constituencies
- Increased membership within the different oil and gas community stakeholder groups. RPSEA currently has 168 members.
- Promoted links to other associations and members and has utilized the RPSEA website as a "network of networks"
- Initiated discussions and continued a series of meetings on technology collaboration with Norway's Demo 2000, United Kingdom's Industry Technology Facilitator (ITF) and Canada's Petroleum Research Atlantic Canada (PRAC). The objective of this collaboration is the identification and commencement of joint leveraged research opportunities.
- Developed the 2007 through 2010 Draft Annual Plans, which were the bases for the approved Program Annual Plans transmitted to Congress.
- Developed and issued research solicitations for the 2007 Program
  - Received and reviewed 99 research proposals and made 43 project selections
  - Successfully negotiated and awarded 42 of the 43 project selections in 2007
- Developed and issued research solicitations for the 2008 Program

    - Received and reviewed 116 research proposals and made 29 project selections
    - Successfully negotiated and awarded 28 project selections in 2008
- Developed and issued research solicitations for the 2009 Program
    - Received and reviewed 97 research proposals and made 28 project selections
- 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
- Held the RPSEA Small Producer Project Review meeting for the Small Producer Program in February 2009 and the Unconventional Gas Project Review meeting for the Unconventional Resources Program in April 2009
- Hosted the Unconventional Gas Resource Conference 2010
- Hosted the Small Producer Program Technology Showcase 2010
- Held 27 nationwide member technology input forums
- Established RPSEA Lunch and Learn talks at member organizations
- Participated/exhibited and/or sponsored/supported multiple industry functions
- Chosen as the 2009 Offshore Technology Conference (OTC) Invited Organization
    - This recognition was based on RPSEA's outstanding contributions to the offshore industry and included a full afternoon panel of RPSEA members and researchers and provided a highlighted booth space to showcase research projects underway.
- Chosen as a 2010 Offshore Technology Conference (OTC) Supporting Organization
- Sponsored the Young Professionals in Energy (YPE) website
- Sponsored the development of the Oil & Gas Innovation Center
- Sponsored Oil & Gas Innovation Center Showcase
- 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 for 2008 and 2009

In order for RPSEA to effectively meet the overall, high-level goals of this Program as described in EPAct 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 more than doubled since January 2007, growing from 66 members to the current membership of 168 members (Figure 3.1). These members represent 25 states, the District of Columbia and the Province of Newfoundland, Canada. As previously stated, these members collectively have more than 650,000 employees worldwide and represent approximately 55 percent of U.S. natural gas and oil production. Thirty-five percent of RPSEA membership is U.S. small businesses.

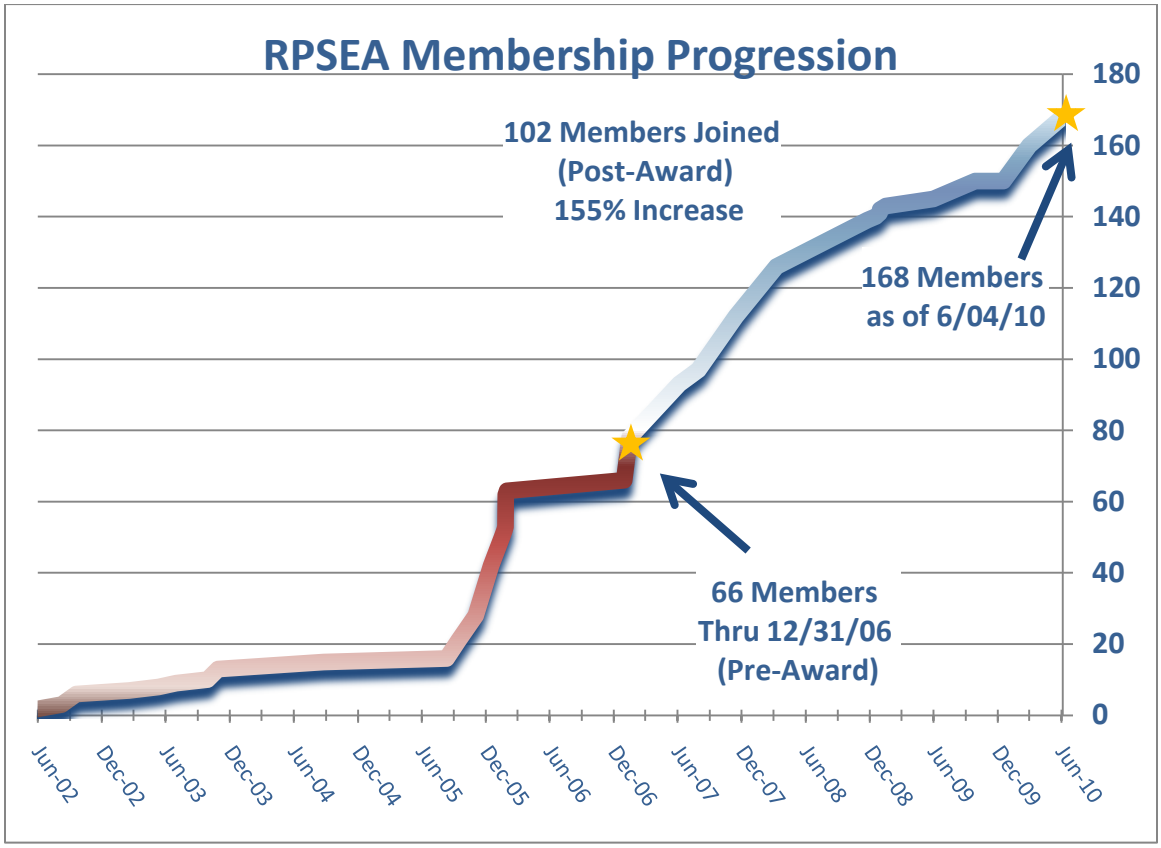


Figure 3.1: RPSEA Membership Progression

The overall RPSEA membership represents the diverse stakeholders in the oil and gas industry. The following graphic (Figure 3.2) depicts a percentage breakdown of RPSEA membership by industry group:

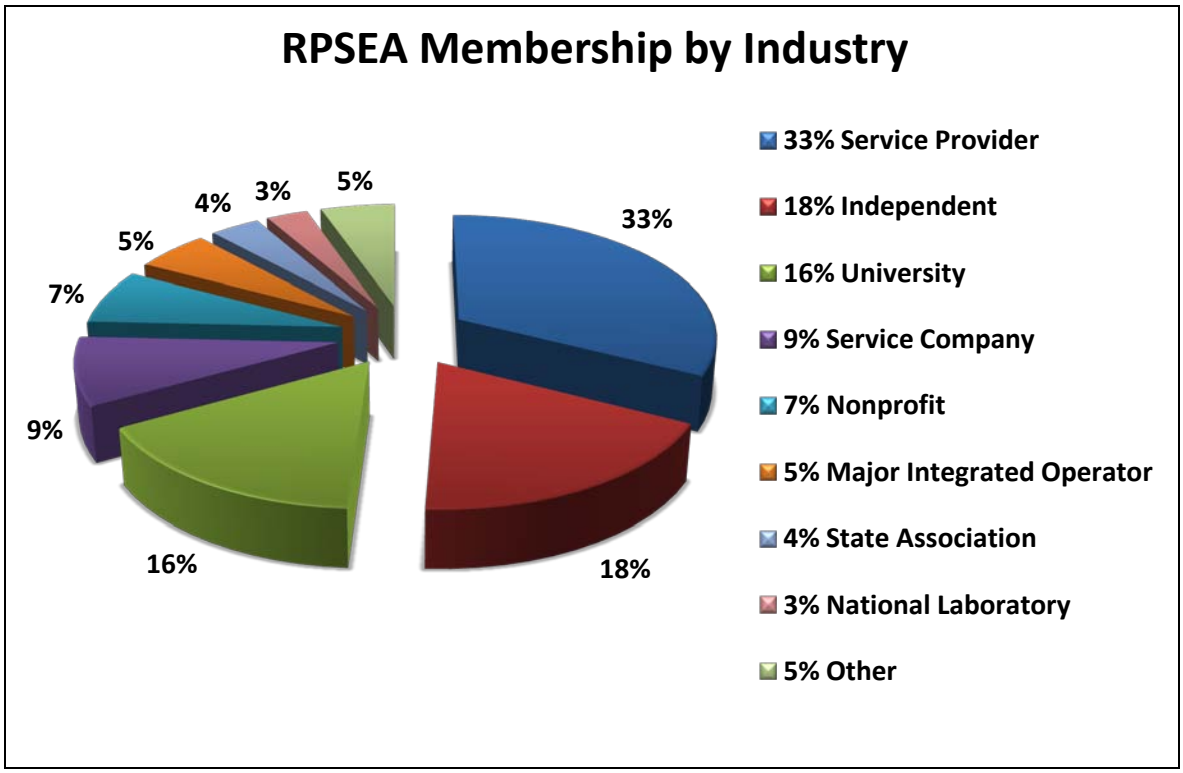


Figure 3.2: RPSEA Membership by Industry

Advisory Structure

RPSEA has developed a comprehensive advisory committee infrastructure from its diverse natural gas and oil constituency 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 meet multiple times a year to review overall Program goals, project ideas, and review and select projects. The PACs, TACs, and RAG have been the workhorse committees. In the overall process there have been 113 meetings with 2,372 participants who have volunteered approximately 9,100 hours of time and effort. As an example, the Ultra-Deepwater (UDW) PAC and TACs, combined, have met 79 times with 1,852 participants involving over 5,400 hours of time and effort. 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 27 forums hosted by member organizations (Table 3.1), in which 1,457 people participated (not including RPSEA, NETL, or the DOE personnel). This participation amounts to over 12,500 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 grouped by general themes and then sorted by date is as follows:

MEMBER FORUM	HOST	DATE
Ultra-Deepwater		
Technology Readiness Level Forum	Det Norske Veritas (USA)	2/23/2010
Long-Term Environmental Vision for Ultra-Deepwater Exploration and Production Research Forum	Houston Advanced Research Center	11/20/2008
Seafloor Engineering Forum	Texas A&M University	3/9/2007
Flow Assurance Forum	The University of Tulsa	2/8/2007
Vortex Induced Vibrations Forum	Massachusetts Institute of Technology	1/11/2007
Autonomous Intervention for Deepwater O&G Operations Forum	Massachusetts Institute of Technology	10/31/2006
Seismic E&P Forum	University of Houston	10/10/2006
Unconventional Resources – General		
Unconventional Gas Development in the Western Energy Corridor	Idaho National Laboratory	5/12/2009
Alaskan Unconventional Gas Resource Forum	The University of Alaska Fairbanks at the BP Energy Center	4/7/2008
Produced Water Forum	New Mexico Institute of Mining and Technology	12/14/2006
Unconventional Resources – Shales		
Coalbed & Shale Gas Forum 2010 (in conjunction with the International Coalbed & Shale Gas Symposium)	University of Alabama	5/19/2010
Mid-Continent Gas Shales Forum	Gas Technology Institute	6/3/2009
Coalbed & Shale Gas Forum 2009 (in conjunction with the International Coalbed & Shale Gas Symposium)	University of Alabama	5/18/2009

MEMBER FORUM	HOST	DATE
Coalbed & Shale Gas Forum 2008 (in conjunction with the International Coalbed & Shale Gas Symposium)	University of Alabama	5/21/2008
Fracture in Devonian Black Shale of the Appalachian Basin Workshop	West Virginia University	1/8/2008
Shale Plays Technology and Permian Basin Trends Symposium	Midland College	11/29/2007
Bakken Shale Forum	North Dakota Energy & Environmental Research Center	11/6/2007
Shale Gas Forum	The University of Oklahoma	12/5/2006
Tight Gas Shale Gas & Coalbed Methane Forum	Colorado School of Mines	11/14/2006
Environmental		
Low Impact O&G Operations in Environmentally Sensitive Areas Forum	Texas A&M University	5/30/2008
Technologies for Mitigation of Environmental Impact of Rocky Mountain Unconventional O&G Operations Forum	Colorado School of Mines	5/12/2008
CO_2		
CO_2 Operations and Opportunities to Advance Technology for Mature Fields Forum	The University of Texas at Austin	2/2/2009
CO_2 EOR & Carbon Sequestration Forum	The CO_2 Conference	4/23/2008
Small Producer		
Mid-Continent Small Producer Forum	Kansas Geological Survey (University of Kansas)	5/30/2009
Unconventional Plays & Research UDW needs for Appalachian Basin Small Producers Forum	West Virginia University	2/15/2007
Small Producer Forum	New Mexico Institute of Mining and Technology	12/15/2006
Problem Identification Forum	University of Southern California	11/29/2006

Table 3.1: RPSEA Forums

One of the unique aspects of the Program is a focusing of the specific challenges and technology needs for resource themes. RPSEA, in conjunction with other organizations or alone with our member institutions, has held these various forums 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 forum 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.

In addition to the theme-based member forums listed above which focus on the Unconventional Resources and Small Producer Programs, the UDW uses a series of TAC meetings that identify technology gaps and, eventually, define specific project themes which will serve as the basis for solicitations. These meetings allow RPSEA to take advantage of the extensive technical expertise of RPSEA members at critical stages during program development and execution.

Technology Transfer and Outreach

The RPSEA technology transfer plan is described in Chapter 4. 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:

American Association of Drilling Engineers Completions Group Meeting 2009

American Association of Drilling Engineers Emerging Completions 2009

American Association of Petroleum Geologists (AAPG) Annual Convention 2008 through 2010

American Association of Petroleum Geologists (AAPG) Rocky Mountain Section Meeting 2010

American Institute of Chemical Engineers (South Texas Section) 2008

American Rock Mechanics Association Workshop 2007

Annual Convention of the Gulf Coast Association of Geological Societies 2007

Annual Gas Shale Summit 2008

Barnett Shale Produced Water Conference 2007

BOMA Optimizing Mature Assets 2007

Center for International Energy and Environmental Policy 2009

Clean Technology Conference and Expo 2009

Colorado Oil & Gas Association (COGA) Conference 2006 through 2009

CO_2 Flooding Conference 2007 through 2009

Deep Offshore Technology (DOT) and Demo2000 Conference 2007

Developing Unconventional Gas (DUG) 2007through 2010

Disappearing Roads Competition 2008 and 2010

Drilling Engineering Association 2009

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

Gas Shales Summit 2008

Global New Energy Summit 2009

Global Technology Summit 2008

Greater Houston Partnership Energy Summit 2009

Greater Houston Partnership Marketing in the Oilfield Conference 2009

Hart's Research and Development in Exploration 2008

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 & 2009

Independent Petroleum Association of America (IPAA) Offshore Committee 2007 and 2009

Industry Technology Facilitator (ITF) Reservoir Imaging in Difficult Environments 2009

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 Association of Drilling Contractors (IADC) Drilling Onshore Conference 2009

International Coalbed & Shale Gas Symposium 2008 through 2010

International Petroleum and Biofuels Environmental Conference 2009

INTSOK 2007through 2009

Interstate Oil and Gas Compact Commission (IOGCC) Annual Meeting 2008

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

Louisiana Oil and Gas Association (LOGA) 2009

Marine Technical Society 2008

Massachusetts Institute of Technology Natural Gas Advisory Committee 2008 through 2010

Mid-America Regulatory Conference (MARK) 2008

More Bytes & More Barrels –Digital Energy Conference & Exhibition 2008 and 2009

New Mexico Oil and Gas Day 2009

North American Prospect Expo (NAPE) 2007through 2010

Offshore Technology Conference (OTC) 2007through 2010

Oil & Gas Innovation Center organizational sponsor

Oklahoma Independent Petroleum Association (OIPA) Annual Meeting 2008 and 2009

Oklahoma State University Energy Conference 2010

Pennwell Unconventional Gas Conference 2009

Residual Oil Workshop 2009

Rice Alliance Business Plan Competition 2008 and 2009

Rice Alliance Energy and Clean Technology Venture Forum 2007through 2009

Rice Nanotechnology Venture Forum 2008 and 2009

Rice University Congressional Field Hearing 2008

Rocky Mountain Energy Technology Conference 2008

Science Engineering Fair of Houston 2008 through 2010

Society of Exploration Geophysicists (SEG) Annual Meeting 2007 through 2009Society of Petroleum Engineers (SPE) Workshop on Delivering and Using Emerging Technology in the E&P Business 2009

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 2007 through 2009

Society of Petroleum Engineers (SPE) Digital Energy Conference 2009

Society of Petroleum Engineers (SPE) Tight Sands Workshop 2009

Southern Methodist University Geothermal Conference 2009

Subsea Tieback Forum 2010

Sustainable Opportunities Summit 2010

SW Petroleum Show 2008

Texas Alliance Expo and Annual Meeting 2008 through 2010

Texas Independent Producers and Royalty Owners Association Annual conference 2010

Texas Renewable Energy Industries Association 2008

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

The University of Tulsa Energy Management Program 2008 and 2009

University of Colorado at Boulder Renewable & Sustainable Energy Institute Conference 2009

U.S. – Mexico Border Energy Forum 2009

Washington Post Energy Conference 2007

World Energy Technology Summit 2010

Young Professionals in Energy (YPE) website sponsor 2008 and 2009

In addition to its responsibilities under EPAct, 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 Company, 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, The University of Oklahoma, and West Virginia University.

Chapter 4 Technology Transfer

In order to meet the RPSEA Program goal of maximizing the value of the nation's natural gas and oil resources, as well as increasing federal royalty receipts and enhancing America's energy security, it is essential that technology developed under this Program be rapidly and effectively applied by operators exploring for and developing new hydrocarbon 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.

The general approach that RPSEA uses for technology transfer, including coordination with NETL, is illustrated in Figure 4.1. Rather than being solely an activity that is initiated after a project is completed, technology transfer occurs within the timeframe and throughout the progress of any given research project. Through monthly reports, project updates and reviews, and presentations at public meetings, RPSEA investigators interact with members of advisory committees and other potential technology users at all stages of each project. These interactions not only serve to create interest and demand for the new results, but also to provide valuable feedback to investigators to ensure that their efforts are well aligned with anticipated needs. During this process, NETL includes interim project results in its various outreach activities. When a project does reach completion, successful examples and case studies generated during the course of the project are the basis for formal technology transfer efforts. These efforts include workshops and other means of dissemination as described below. Input from users and potential users of project results drive the benefits assessment conducted by NETL.

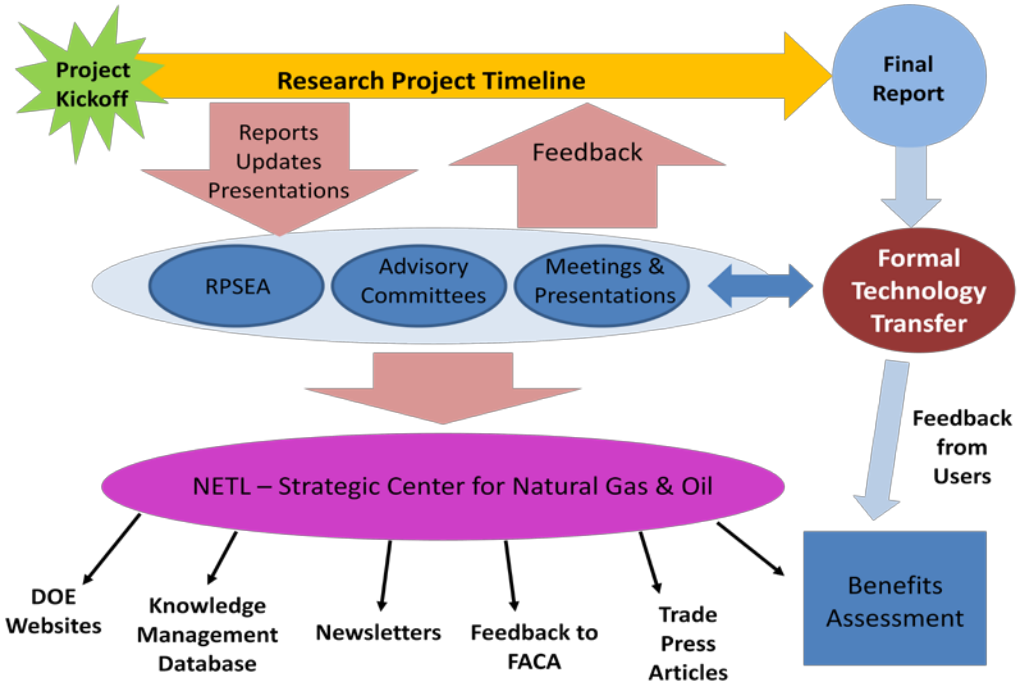


Figure 4.1: Flow Chart for Technology Transfer

Specific technology transfer approaches incorporated in the Program include:

1. The engagement of PAC and TAC committee members through involvement in needs assessment, project selection, and ongoing project review in order to promote ongoing interests in developing projects and facilitate field tests and demonstrations using operating company wells, data, and facilities. Operators and service companies represented on these committees represent the likely "early adopters" of Program technologies who will lead the way for wider industry adoption and provide the real-world examples that will facilitate meaningful technology transfer. While the law requires that 2.5 percent of the project funding be set aside for technology transfer, this industry engagement reflects a component of the technology transfer approach beyond the effort funded by the set-aside.
2. Active communication and coordination between RPSEA and NETL on a Knowledge Management Database (KMD) that will serve as a publically available archive of data and results associated with RPSEA projects.
3. Continuing commitment to enhance the functionality and value of the RPSEA website by adding relevant, value-added data and information regarding RPSEA's individual projects, as well as overall Program direction and impact.
4. Provisions in the project awards that require a minimum of 2.5 percent of the funding for each project to technology transfer activities. The solicitations incorporate language that require 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 (1 percent of the total project value) may be directed by RPSEA for program-level technology transfer. The model contract provides for the coordination of technology transfer across multiple related projects using the funding approach described above. Some of the activities to be funded at the program level are described in the Program-Level Activities section below.

The approach to technology transfer is designed to address program-level goals through ongoing industry engagement, documentation of results on the RPSEA website and in a KMD, and 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.

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

Project-Level Activities

Project-level technology transfer activities are a key part of the project selection and management approach used by RPSEA in each of the programs.

- In the UDW program, ongoing projects are reviewed at TAC meetings, which are open to all interested parties. The relatively small size and regional concentration of the offshore community results in strong representation among potential technology adopters at the TAC meetings in which projects are reviewed. These meetings serve as an effective forum for introducing developing technology, ensuring that the resulting products are well aligned with industry requirements and identifying potential participants in field trials. While TAC events form a key part of project-level technology transfer, they are supplemented by presentations, publications, and other activities outlined in the technology transfer plans developed jointly by the contractors and RPSEA project management staff.
- While the unconventional gas community is similarly involved in the selection and review of projects under the Unconventional Resources Program, this numerically larger and more geographically dispersed community requires additional emphasis on approaches designed to reach the widest possible cross-section of potential adopters of program technology. In addition to providing funds for contractors to engage in project-level technology dissemination, RPSEA has organized program-level activities to provide opportunities for additional dissemination and cross-fertilization of program results.
- The Small Producer Program faces the challenge of connecting with the thousands of small producers operating across the nation. While engagement of service providers and others in the operation of the program will help ensure that new technologies are available to these small producers, a particular emphasis on program-level activities is required.
- The degree to which industry engagement by RPSEA results in awareness of technologies developed under the Program is illustrated by the appearance of articles such as the one in the January 2010 issue of *Hart's E&P* magazine explaining the goals of The Environmentally Friendly Drilling Systems Program project. A number of other articles have been published, and links are posted on the RPSEA website. This type of coverage in widely read trade and technical publications is a direct result of active industry participation in the planning, management, and execution of the Program and provides an effective context for the directed technology transfer efforts that are funded by the 2.5 percent set-aside.

Program-Level Activities

RPSEA will conduct the following program-level technology transfer activities as an intrinsic part of the program-management approach.

- RPSEA will continue to post on its website a list of projects and related information, such as abstracts, technical status assessments, results,

accomplishments, reports, and key personnel contact information. The information on the RPSEA website will be coordinated with the KMD, developed by NETL under the Section 999 complementary program, and appropriate links to information in the KMD will be provided.

- Periodic project reviews with the PACs, TACs, and the RAG (as appropriate) that are conducted as part of the RPSEA program-management process are designed to ensure that the results of related projects are presented to highlight their interconnection and allow the various advisory bodies to identify opportunities for the evaluation and application of project results. This coordinated methodology enhances the effectiveness of the entire technology transfer effort.
- In 2010, the UDW program hosted the first UDW TAC Conference. This event provided an outlet for every active UDW Program project to be reviewed by a project champion. Additionally, it included various question-and-answer opportunities for the audience, which was comprised of subject matter experts from the entire UDW community and other stakeholders. The event allowed for numerous opportunities to discuss issues, ongoing activities, and potential collaboration opportunities. Lessons learned from this immensely popular and productive first conference will be used to plan similar annual events.
- Like the UDW TAC Conference, the Unconventional Resources Program hosts an Annual Unconventional Gas Conference that aims to disseminate information and offer the opportunity for the unconventional gas community to hear the latest perspectives and exchange ideas on current RPSEA-sponsored collaborative research projects.
- The Small Producer Program has hosted a Small Producer Program Showcase in which members of the Small Producer community have the opportunity to network and exchange ideas with research providers and discuss potential collaboration opportunities. Similar events will be held around the country as the technologies being developed within the program mature to a point at which they are of interest to the small producer community in a given region.

In addition, RPSEA has implemented the following approach to maximize the impact of the 2.5 percent allocated to technology transfer:

- Each solicitation includes the requirement for a plan for technology transfer. The solicitation instructs offerors to propose an approach for technology transfer for their project, understanding that up to 40 percent of the 2.5 percent (or 1 percent of total project funding) designated for technology transfer may be designated by RPSEA for use in program-level technology transfer activities.
- RPSEA and each selected recipient will jointly develop a project-level technology transfer approach to be coordinated with program-level efforts.

Examples of program-level technology transfer activities include the following:

Website Enhancement
The RPSEA website will continue to be enhanced to assist technology transfer beyond the simple availability of reports. Developing suitable materials to support such an effort and providing a website with the required functionality to support interactive technology transfer will come from the programmatic funding through a designated portion of the 2.5 percent technology transfer allocation. Additional website capability will also be required to interface the RPSEA website with the KMD in order to provide an effective tool for current and archival access to data and information generated through the program. The shear amount of technology transfer materials generated through the projects necessitates the addition of website tools and adds to its complexity. This effort is meant to ease the burden of the public in searching for, finding, and utilizing technology transfer materials. It will not only result in a more streamlined product, but should also encourage faster adoption of technology.

Leveraging Via Participation and Coordination with Existing Conferences, Forums, and Workshops
There are an abundance of industry conferences, forums, and workshops. These events are produced and sponsored by a variety of entities, including for-profit companies, governmental/regulatory agencies, professional societies, and other non-governmental organizations (NGOs). Event objectives for organizers may range from simply earning a profit to transferring technology ; event quality and effectiveness at meeting desired goals can vary significantly. RPSEA, on a regular basis, will review existing industry events and on a prioritized basis work with the organizers to incorporate an effective RPSEA technology transfer component. Factors to be considered include:

- Quality and reputation of event
- Alignment between the event's existing delegate base and RPSEA's target audience for the technology to be disseminated
- Level and visibility of RPSEA's participation
- Cost, in terms of actual out-of-pocket registration/exhibit fees, transportation and logistics, as well as indirect costs such as staff's time and effort.

RPSEA has an established working relationship with OTC, PTTC, SPE, AAPG, SEG, Hart's, PennWell, Quest Offshore, and others. RPSEA will work with these groups by participating as session chairs, on planning and program committees, in speaking roles, and/or in other roles as appropriate to leverage RPSEA's limited resources. The objective of this participation will be the timely and cost effective dissemination of RPSEA-sponsored project results and targeting existing events with audiences that have specific needs for the technologies being presented.

RPSEA *GasTips*
The now-dormant *GasTips* publication was an excellent vehicle for providing wide exposure to research results. The relatively short articles and wide distribution list generated a lot of interest in new technology, which could be further pursued through in-depth references or discussions with subcontractors. RPSEA has initiated discussions with Hart's and potential industry sponsors regarding restarting this publication as a

vehicle for highlighting the results of the Section 999 Program. Even though *GasTips* has had a recent hiatus from publication, it is a recognized communication vehicle with established credibility in the industry.

Select/Focused RPSEA Workshops and Forums

In some technical areas, several contractors work on different aspects of a single key challenge. The most effective technology transfer occurs when these contractors each present their own results, but do so in a way that emphasizes their contribution to the solution of the larger problem. RPSEA will first investigate leveraging existing conferences and forums; however, there are situations where the volume of technology and the focus of the technology may best be accomplished as a standalone event. In these cases, RPSEA will organize focused workshops targeted on a particular technology or closely-related suite of technologies. While these workshops will be open to the public, RPSEA will encourage key stakeholders and technology adopters to attend. These workshops are designed to be interactive, involving a relatively small number of participants (target less than 50), along with experts from the technology developer or the operator participating in the initial field trials. In some cases, the workshops are presented multiple times in regions that benefit from the application of the subject technology. Depending on the nature of the technology, the workshop might involve simulations, training based on case studies, or exposure to the actual application of the technology in a field setting. The desired result is to enhance the capability of the operator/staff to make appropriate decisions regarding the application of new, commercially available technology that is developed through the program. Program-level technology transfer funding will be required to support a third-party organization capable of organizing, conducting, and securing appropriate participation in regional workshops.

In addition to the focused workshops as mentioned, RPSEA has sponsored a series of forums hosted by various RPSEA members across the country. These forums have served as excellent vehicles for identifying critical research needs and obtaining input for research program content that drives the future of each RPSEA program. As the RPSEA Program develops research results, these forums will shift to greater emphasis on Program results and the transfer of information, while maintaining a technical input component.

RPSEA Technical Conferences

Technical conferences held at a national or large regional scale can highlight a range of technologies applicable to a particular resource type or geographic area. Presentations will be made by RPSEA contractors, as well as operators or service companies that have experience in the testing or application of new technologies. The primary audience will be the operator community positioned to apply the results of the program to the development of new resources. R&D contractors and organizations offering commercial services based on Program technology or otherwise relevant to the conference topic may secure booth space. Such conferences can be very effective in creating visibility and credibility for the results of the program, but significant program-level technology transfer funding will be required to organize, publicize, and conduct thoroughly

professional, national-scale technical conferences. Some expenses will be recovered by charging for attendance, but a low cost of attendance is one way to distinguish RPSEA conferences from other topical meetings for which revenue generation for the sponsor is a primary goal.

Webcasts/Podcasts
Webcasts and podcasts have become a popular and effective medium for communication. Presentations by researchers and discussions among researchers, service companies, and producers regarding potential applications are among the types of material that might be appropriate for this medium.

Follow-on Projects and/or Unfunded Projects
Future phases of projects from 2007 through 2010 that may not be funded or promising project ideas not selected in the rigorous program development process are important to retain. Finding funding or a continuation vehicle for these projects to ensure that the research initiated by RPSEA is not lost is an activity worthy of emphasis in the technology transfer effort.

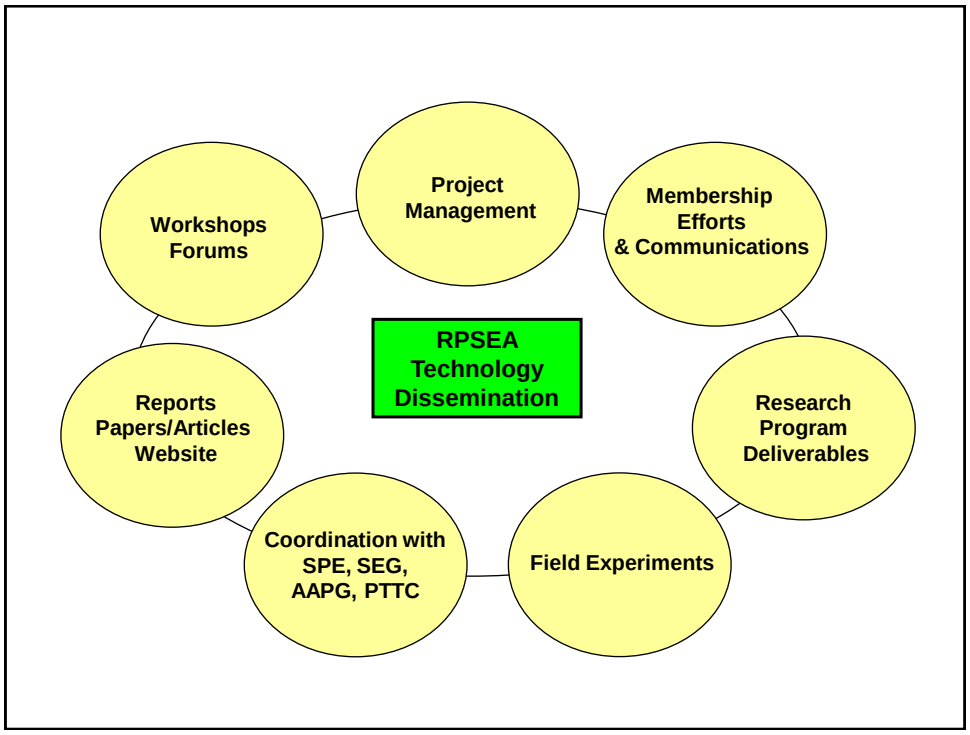


Figure 4.2: RPSEA Technology Dissemination Efforts

Technology Transfer Assistance
In an effort to more effectively cover the industry and disseminate technological progress and developments, RPSEA has subcontracted with PTTC. RPSEA also supported PTTC's larger technology transfer proposal directly to NETL, so the choice of PTTC as a technology transfer subcontractor ensures that RPSEA work is well coordinated in an

overarching technology transfer plan among all NETL related activities. The subcontractor will assist on several fronts, including:

- Working with investigators to collect and edit articles for publications associated with the RPSEA program.
- Working with publishers to assemble content.
- Organizing Technology Transfer/Project Review meetings during which investigators on RPSEA projects present their results and receive feedback from other investigators and RPSEA advisory groups.
    - Objectives include technology transfer, as well as enhancing communication among investigators and looking for opportunities for coordination and cooperation among investigators.
    - Specific duties would include working with RPSEA to schedule and select locations for the events, working with RPSEA and investigators to establish agendas and schedules, meeting logistics and finances, promotion, and on-site support, as directed by RPSEA.
- Additional technology transfer options that will be reviewed for assistance include:
    - Topical webinars
    - PTTC workshops incorporating RPSEA presentations as part of the offering
    - Topical short courses building on results from one or more RPSEA-funded projects
    - Special "Emerging Technology" cooperative events that may be developed with organizations such as NAPE, Rice Technology Alliance
    - Special sessions for AAPG Section or National meetings; SPE Section, Regional, or International events; OTC events; SEG events; other conferences such as University of Tulsa's Integrated Petroleum Environmental Conference, etc.
    - Various state oil and gas/ producer association meetings and events
- Work with RPSEA staff and website contractors to enhance the technology transfer capability of RPSEA's website.
    - Compensate vendors for making required upgrades to the website.
    - In particular, develop means for effectively coordinating the RPSEA website with the NETL KMD.
- Supporting technology dissemination through webcasts and podcasts.

Events

The schedule for RPSEA technology transfer events is dynamic, driven by progress on individual projects and coordination with other industry activities. The RPSEA Calendar of Events lists upcoming, as well as past, events. Recent events include participation as a Supporting Organization at OTC, where several offshore technologies being developed under the UDW were highlighted, and the 2010 RPSEA Unconventional Gas Conference

in Golden, CO. A more extensive list of technology transfer events and activities is given in Appendix C, Technology Transfer Accomplishments. As new events are scheduled, they will be included on the RPSEA Calendar of Events.

Chapter 5 Ultra-Deepwater (UDW) Program

The EPAct 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."*

A. Mission & Goals

The mission of the UDW program is to identify and develop technologies, architectures, and methods that ensure safe and environmentally responsible exploration and production of hydrocarbons from the ultra-deepwater (UDW) portion of the Outer Continental Shelf (OCS) in an economically viable (full life cycle) manner.

This mission of technology development encompasses:

- 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

As of this writing, a Presidential commission as well as other investigations are underway collecting and reviewing factors surrounding the Deepwater Horizon incident. As one of the largest nonprofit group of experts with over 160 member organizations, RPSEA will be closely monitoring the results as they are released and targeting high value research and development needs with a priority on safety and environmental stewardship and emergency prevention, preparedness, response and recovery.

Relevant EPAct definitions for the UDW program element include:

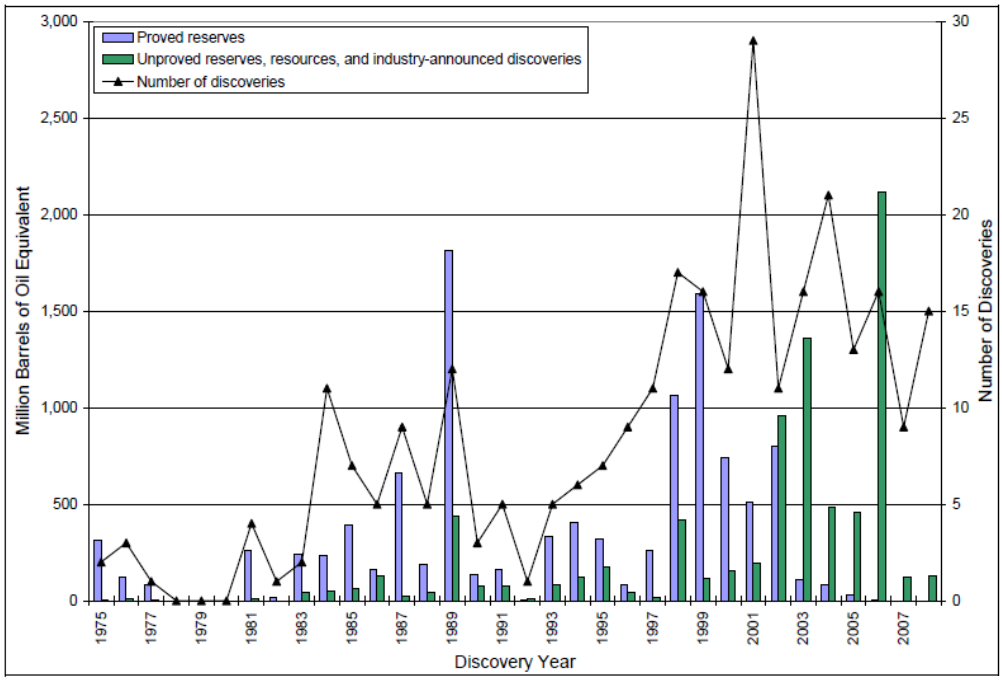
- **Ultra-Deepwater -** a water depth that is equal to or greater than 1,500 meters (~5,000 feet). The program also includes technologies applicable to formations in the OCS deeper than 15,000 subsurface
- **Ultra-Deepwater architecture -** the integration of technologies for the exploration for, or 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

The goal of the UDW is 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. This goal will be achieved by:

- Increasing the production of ultra-deepwater oil and gas resources
- Reducing the costs to find, develop, and produce such resources
- Increasing the efficiency of exploitation of such resources
- Increasing production efficiency and ultimate recovery of such resources
- Increasing safety and environmental awareness by addressing safety and environmental focus impacts associated with ultra-deepwater exploration and production, and technology development.

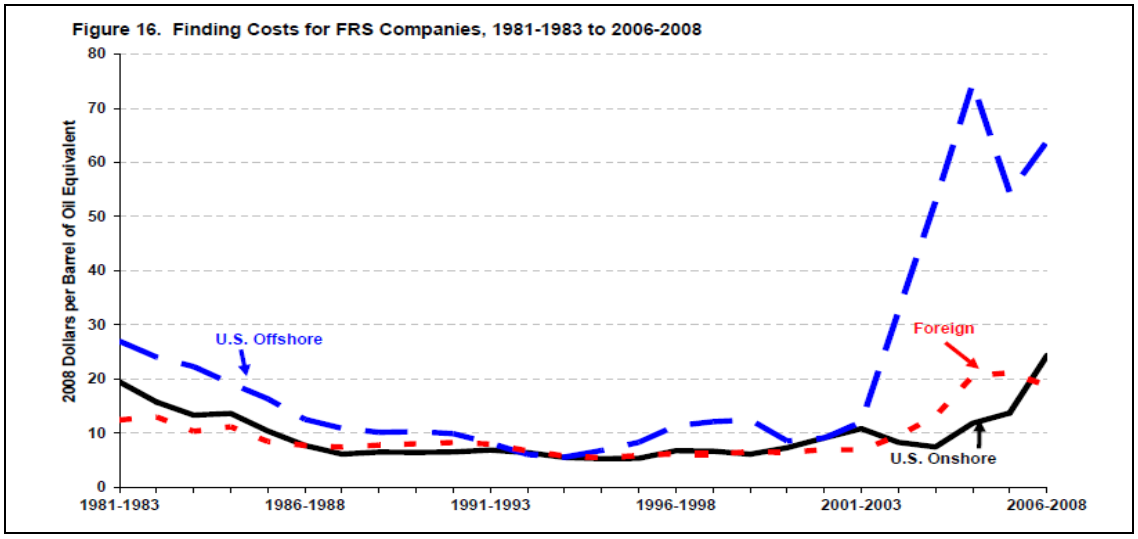
The significant importance of this goal is illustrated by Figure 5.1, which shows the difficulty the oil and gas industry has had since 2002 converting discovered resources into proven reserves (producing developments). Proven reserves add value to royalty revenues, consumers, and the oil and gas industry. Identified non-producing resources do not contribute to the supply base or generate royalties.



Latest Minerals Management Service (MMS) report 2009-016 shows an increasing lag between discovery and production in deepwater Gulf of Mexico – demonstrating the need to focus on development related technology development

Figure 5.1: Proven Reserves Add Value

Further evidence supporting UDW's goal to reduce cost can be found in Figures 5.2, 5.3, and 5.4 from the U.S. Department of Energy's Energy Information Administration (EIA). The data in Figure 5.2 vividly depict the much higher cost associated with UDW. To 'move' the resources depicted in the resource category in Figure 5.1 to proven reserves, cost must come out of the system.



Notes: Costs are the quotient of costs and reserve additions for each 3-year period. BOE = Barrels of oil equivalent. The above figures are 3-year weighted averages of exploration and development expenditures, excluding expenditures for proven acreage, divided by reserve additions, excluding net purchases of reserves. Natural gas is converted to equivalent barrels of oil at 0.178 barrels per thousand cubic feet. Sum of elements may not add to total due to independent rounding. Source: Energy Information Administration, Form EIA-28 (Financial Reporting System). http://www.eia.doe.gov/emeu/perfpro/0206(08).pdf

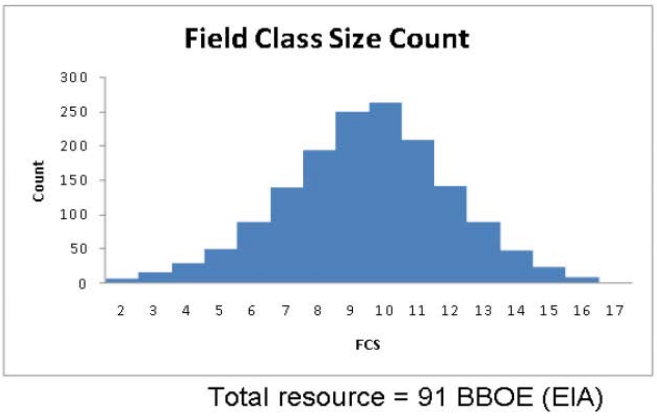
Figure 5.2: Need to Develop Technology to Control Finding Costs

Figure 5.3 from DOE's Energy Information Agency (EIA) shows that while 'small' fields are by definition small, the large number of small fields can contribute significantly to the overall resource base if they can be economically developed. The majority of UDW future fields are likely to be these smaller fields developed with extended sub-sea tie backs utilizing a 'hub and spoke' methodology with multiple small fields tied back to single surface hosts.

Undiscovered Resource Base

USGS Field Class Sizes

Pool Size Class	MMBO lower	MMBO upper	BCFG lower	BCFG upper
1	0.03125	0.0625	0.1875	0.375
2	0.0625	0.125	0.375	0.75
3	0.125	0.25	0.75	1.5
4	0.25	0.5	1.5	3
5	0.5	1	3	6
6	1	2	6	12
7	2	4	12	24
8	4	8	24	48
9	8	16	48	96
10	16	32	96	192
11	32	64	192	384
12	64	128	384	768
13	128	256	768	1,536
14	256	512	1,536	3,072
15	512	1,024	3,072	6,144
16	1,024	2,048	6,144	12,288
17	2,048	4,096	12,288	24,576
18	4,096	8,192	24,576	49,152
19	8,192	16,384	49,152	98,304
20	16,384	32,768	98,304	196,608



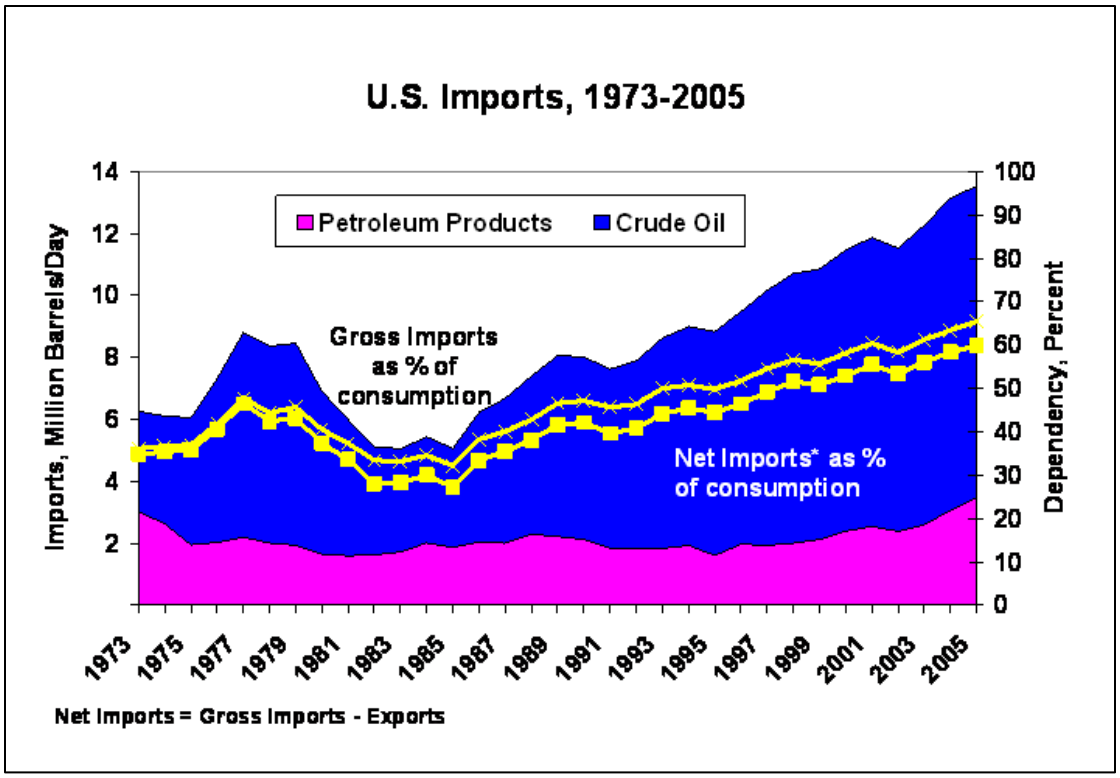
Total resource = 91 BBOE (EIA)

Data from the U.S. Department of Energy's EIA vividly shows that while 'small' fields are by definition small that the large numbers of them can contribute significantly to the overall resource base if they can be economically developed.

Figure 5.3: Undiscovered Resource Base by Field Class Size

Figure 5.4 depicts the continuing and growing US dependency on imports. The UDW program will focus on reducing overall development costs so that this resource base can safely and in an environmentally appropriate manner be utilized to:

- improve US energy security
- economically developed and resources produced for America's energy consumers
- promote American jobs and tax base
- improve America's trade balance



Data from the U.S. Department of Energy's EIA vividly shows the continuing increased US dependence on imports. http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/trade_image_us_imports.htm

Figure 5.4: Imports and GoM UDW Production

B. Objectives

To meet the goal of converting the UDW resource base to economically recoverable resources, the UDW program intends to fund activities to build new planning and analytical models; design and manufacture new equipment; develop new exploration and production technologies as well as integrated systems technologies; demonstrate that the equipment and technologies are dependable and reliable; and ultimately manufacture and deploy the technologies in commercial quantities. The UDW program established a series of objectives, first outlined in the 2007 Annual Plan, on which it continues to build.

Objective 1: Technology Needs Assessment – The 2007 - 2010 Annual Plans capitalized on DeepStar Systems Engineering Studies which identified the specific technology gaps that hinder ultra-deepwater development. Proposals were then solicited to address the identified gaps. These gaps have been and will continue to be periodically revisited throughout the Program duration utilizing UDW Technical Advisory Committees (TAC) input.

Objective 2: Technology Research & Development, and Applied Science – The early years of the UDW are forming a base of the technology development triangle (Figure 5.5). Subsequent years will fund additional technical development, demonstration, and potential commercialization of promising technologies. UDW has administered multiple rounds of solicitations for R&D contracts designed to meet the stated goal and identified "Needs" of the UDW. While many of these projects will be of interest and would no doubt generate value for the program and the American consumer, current limits on funding will dictate the need to prioritize and select only those that are deemed likely to result in the most significant increases in value through cost reduction, efficiency improvement, and effectiveness. Concurrently over the life of the UDW program, funding will be directed to innovative and novel projects as well as graduate study proposals that meet the needs and goal of the UDW program.

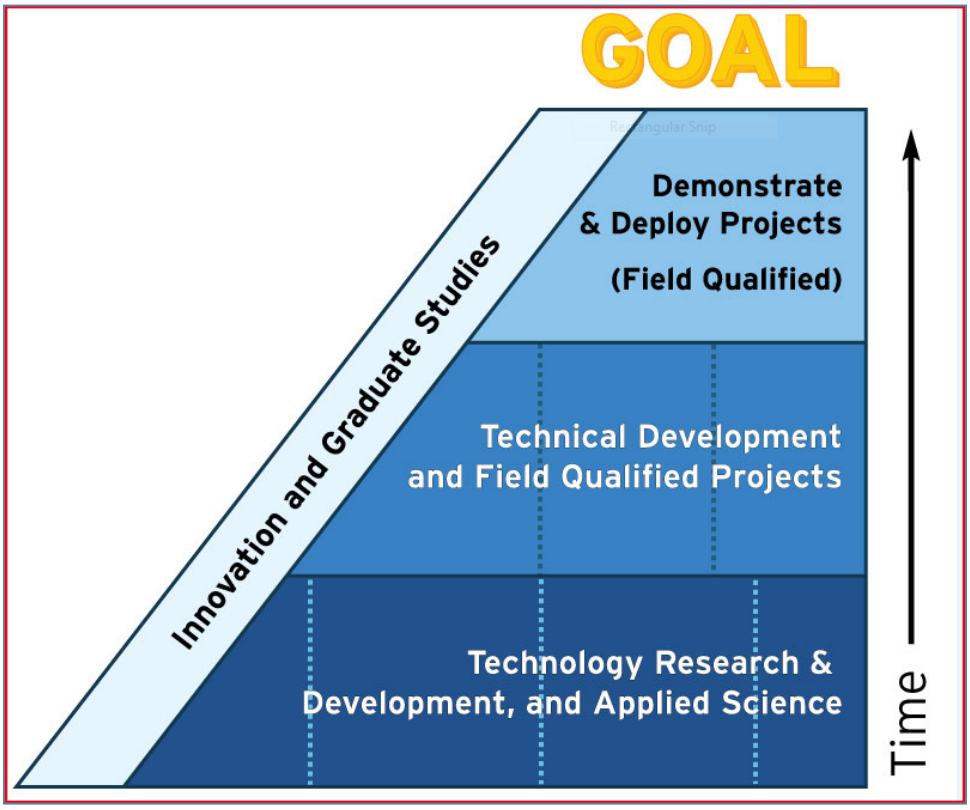


Figure 5.5: UDW Development Triangle

Objective 3: Awareness and Cost-Share Development – The UDW program 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.

Objective 4: Technical Development and Field Qualified Projects – Through assessment of project results and additional solicitations (as needed), the UDW program will continue the development and maturation of the most promising technologies with a strong focus on field qualifying projects that carry the greatest potential for meeting the UDW goal.

Objective 5: Environmental and Safety Technology Development and Deployment – The UDW program will assess the environmental and safety impact of all 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 program 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: Emergency Prevention, Preparedness, Response and Recovery – The UDW program will work with appropriate regulatory agencies, industry and other key stakeholders to identify technology needs arising from the Deepwater Horizon incident.

C. Implementation Plan

DeepStar and Advisory Committee Roles in the UDW Program Element

The UDW program is managed by Chevron, through a subcontract with RPSEA, utilizing the Chevron administered DeepStar consortium. DeepStar, with ten deepwater operating companies and 60+ contributing member companies, is the world's largest ultra-deepwater stakeholder group and has a 20 year history of managing collaborative research. Through this arrangement, the UDW program accesses 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 program with significant pro bono expertise, as well as potentially significant cost share funds to further accelerate the development of ultra-deepwater technologies.

The UDW program utilizes a PAC and TAC in an advisory role. The 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.

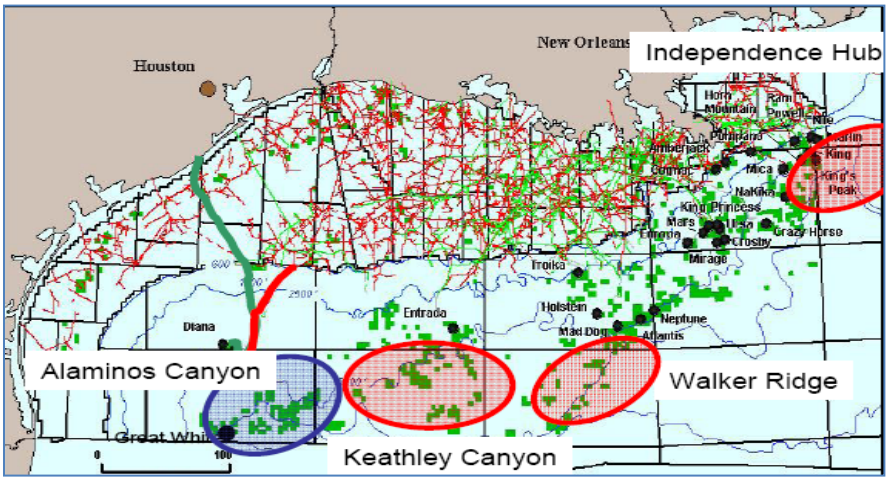
Supporting the PAC are nine TACs, each of which is focused on a particular ultra-deepwater technology area (see Table 5.1). The role of the TACs, with representation from Subject Matter Experts (SME) who study and apply ultra-deepwater technologies in real field situations, is to identify current technology 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 and In-well Interventions	Environmental, Safety & Regulatory	Floating Facilities
Flow Assurance	Geoscience	Met-Ocean
Reservoir	Subsea Facilities	Systems Engineering

Table 5.1: UDW Technical Advisory Committees

Identification of Focus Areas for New Technology Development

The UDW focus areas for the initial solicitations (2007 and 2008) were developed using a DeepStar Systems Engineering study that was based on industry UDW 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 5.6). Collectively these areas of activity represent a very large resource base as portrayed earlier in Figure 5.1. The initial 2007 & 2008 project selections and portfolio was developed based on these generic field types, with the UDW goal to develop new technologies to help convert these resources to proven reserves.



Walker Ridge/Keathley Canyon
- subsalt
- deeper wells
- tight formations

Alaminos Canyon
- viscous crude
- lacking infrastructure

Eastern Gulf – Gas Independence Hub
- higher pressure & temperature
- CO_2/H_2S

Overall
- higher drilling costs
- challenging economics

Figure 5.6: Technical Challenges for Identified Basins

Each of the above areas is characterized by challenges currently hindering technical and economic development which have been organized into a grouping of six technology UDW needs. Within each area of UDW need, various initiatives have been identified.

UDW projects are chosen based on their potential to address and satisfy the UDW needs and therefore meet the goal of converting UDW resources to proven reserves as shown in Figure 5.7.

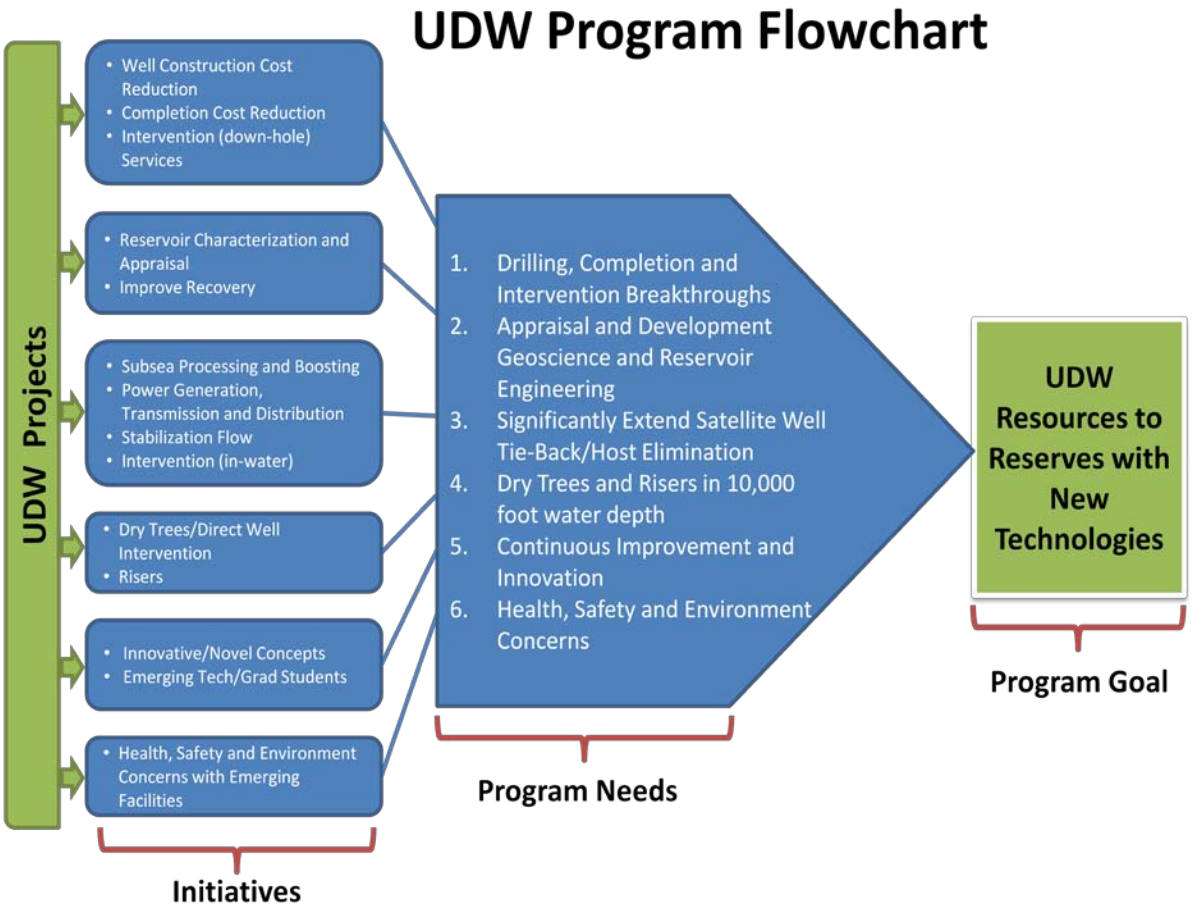


Figure 5.7: UDW Program Flowchart

2011 Solicitations

Upon transmittal of the 2011 Annual Plan to Congress, the 2011 requests for proposals (RFPs) will be developed and released. The primary focus of these RFPs is to fill-in technology gaps not addressed by the prior years' projects and solicitations. Solicitations for 2011 can be categorized into the following types:

- Emergency prevention, preparedness, response and recovery
- Next phase projects based on completed projects from the 2007 and 2008 program
- Specific project ideas to fill identified technical gaps
- Graduate Student and Innovative/Novel projects

Anticipated 2011 UDW RFPs will be crafted to meet the program goal by addressing the Needs and Initiatives as shown in Figure 5.7 and summarized below. The actual 2011 UDW RFPs may differ from the anticipated portfolio listed below and will be driven by further guidance from the UDW PAC, the timing associated with 2011 program funding, and other relevant factors such as results from the President's commission on the Deepwater Horizon incident.

Need 1: Drilling, Completion, and Intervention Breakthroughs

Proposals may be requested identifying novel ideas to reduce well construction and completion costs and funding follow-on recommendations from 2007 and 2008 projects.

Need 2: Appraisal and Development Geoscience and Reservoir Engineering

Proposals will be requested in the area of formation and reservoir characterization and/or surveillance. The goal of this effort is to improve recovery and reduce the amount of unproduced hydrocarbons upon well or field abandonment.

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

Proposals may be requested addressing follow-on recommendations from 2007 and 2008 projects. New 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. Next Phase proposals may be requested addressing recommendations from the 2007 and 2008 projects.

Need 5: Continuous Improvement and Innovation

Proposals in this need area may include:

- Advancing industry understanding of phenomena and science impacting ultra-deepwater operations
- Improvements in integrity management and reliability
- Additional graduate student and project funding
- Innovative technology high risk, high reward "long-shot "opportunities

Need 6: Associated Safety and Environmental Concerns

The UDW program will work with appropriate regulatory agencies, industry, and other key stakeholders to identify emergency prevention, preparedness, response and recovery technology needs suitable for UDW operations, which may include findings arising from the Deepwater Horizon incident.

Additionally, RPSEA will continue to focus on ensuring that technology development takes environmental impact and safety considerations into account. To accomplish this overarching task, RPSEA will seek to leverage ongoing research efforts and collaborate within existing forums and venues. RPSEA will integrate with ongoing UDW projects wherever feasible.

Anticipated Awards for 2011

Due to carry-over from earlier years, approximately $21 million is available for 2011 project awards. Cost sharing beyond the minimum is encouraged in all solicitations. In 2011, the UDW program will target the award of three to five large projects with a value of $1 to $5 million per project. Additionally, a number of smaller awards averaging $150,000 - $300,000 each will be funded under Need #5, "Continuous Improvement and Innovation." Each project will have duration of one to three years. The projects will be aligned with the six UDW needs. Project integration and cross-cutting approaches across multiple disciplines will be encouraged.

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. This approach will take on additional significance as RPSEA approaches Section 999 program close-out.

D. Ongoing Activities

As implementation of the program continues, activities include administration of current contracts, solicitation of new proposals, and planning for the following year. In addition to developing and releasing RFPs, selecting, negotiating and awarding subcontracts, the Program Consortium will perform project management functions for the current contracts and for future awards throughout the year. Special emphasis is placed on the combination of ongoing research and development efforts, which are increasing in number and size, and their fit, in terms of both timing and funding, with planned future efforts and direction. As alluded to above, the ultimate goal is to efficiently and effectively develop an improved toolkit that will be available for use, and that will result in a more robust overall system, in terms of safety, environmental impact, and resource utilization.

A listing of all projects can be found in Tables 5.2, 5.3, and 5.4. Abstracts and additional project status information for each of the projects can be found on the RPSEA website at www.rpsea.org.

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1201: Wax Control	The 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/Neftemer Axept, Intertek, BP, Southwest Research Institute, ENI, Anadarko, Devon, Schlumberger, Weatherford
DW1302: Ultra-High Conductivity Umbilicals	NanoRidge Materials	12 months $448,000	Engineering prototype of a working ultra-high conductivity 'wire' (conductor) utilizing nanotube technology and test and analytical data	Technip, Rice University, Duco
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 WP riser service in 10,000 fsw	Stress Engineering
DW1402A: Ultra-Deepwater Dry Tree System for Drilling and Production	Floatech	Complete $234,000	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
DW1402B: Ultra-Deepwater Dry Tree System for Drilling and Production	Houston Offshore Engineering	Complete $812,042	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
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	
DW1603-A: Graduate Student Design Project. Hydrate Plug Charaterization and Dissociation Strategies	The University of Tulsa	24 months $150,000	Project will contribute to the goals of the stabilized flow initiative	BP
DW1603-B: Graduate Student Design Project. Flow Phenomena in Jumpers	The University of Tulsa	24 months $150,000	Project will contribute to the goals of the stabilized flow initiative	Chevron
DW1603-C: 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	

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1603-D: 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
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	18 months $1,200,000	Process simulator for a subsea production system	GE/VetcoGray
DW1902: Deep Sea Hybrid Power System	Houston Advanced Research Center	24 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 5.2: 2007 UDW Selections

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW1502: Coil Tubing Drilling and Intervention System Using Cost Effective Vessel	Nautilus International LLC	12 months $820,000	Provide the basis for detailed design of a cost-effective deep water Coil Tubing (CT) system for down-hole work in deep water Gulf of Mexico (GOM) satellite wells without need for a Mobile Offshore Drilling Unit (MODU).	GE Oil & Gas; NOV CTES; INTECSEA; Tidewater Marine, LLC; The University of Tulsa; Texas A&M University; General Marine Contractors; Huisman Equipment BV
DW2101: New Safety Barrier Testing Methods	Southwest Research Institute	12 months $128,000	Develop more efficient and effective means of evaluating safety barriers, such as valves and blow-out preventers.	
DW2301: Riserless Intervention System	DTC International, Inc	27 months $3,382,000	Develop a Deepwater Riserless Intervention System (RIS) capable of conducting typical wireline interventions in water depths up to 10,000 feet.	Superior Energy Services; NOV Texas Oil Tools; Deepwater Research, Inc.; Det Norske Veritas (USA)

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW2502: Advanced Steady-State and Transient, Three-Dimensional, Single and Multi-phase, non-Newtonian Simulation System for Managed	Stratamagnetic Software, LLC	18 months $360,000	Provide an integrated suite of simulation tools capable of modeling the complete gamut of fluid flow problems encountered in managed pressure drilling.	
DW2902-02: Technologies of the Future for Pipeline Monitoring and Inspection	The University of Tulsa	24 months $120,000	Provide a system for monitoring and maintaining deepwater pipelines which would predict and allow proactive measures to be taken to avoid the problems associated with pipeline fouling or plugging or other deleterious conditions in the pipeline.	T.D. Williamson, Inc.
DW2902-03: Wireless Subsea Communications Systems	GE Global Research	12 months $120,000	Explore the limits and capacity of wireless communications for Subsea operations using RF conduction.	Northeastern University
DW2902-04: Replacing Chemical Biocides with Targeted Bacteriophages in Deepwater Pipelines and Reservoirs	Phage Biocontrol, LLC	25 months $120,000	Evaluate the use of bacteriophage in a focused approach to reduce the agents of microbiologically induced corrosion.	Texas A&M University; Shell International Exploration & Production; ConocoPhillips Company; Petrobras America, Inc.; Halliburton; Nalco Company; Multi-Chem Corporation; BJ Services Company; Champion Technologies, Inc.; Intertek Group plc; INTECSEA; Livermore Instruments, Inc.
DW2902-06: Enumerating Bacteria in Deepwater Pipelines in Real-Time and at a Negligible Marginal Cost Per Analysis: A Proof of Concept Study	Livermore Instruments Inc.	9 months $120,000	Utilize BioAerosol Mass Spectrometry (BAMS) technology to provide real time bioassays for flood water that will allow the design of an effective biocide regimen..	Phage Biocontrol, LLC; Texas A&M University; ConocoPhillips Company; Shell International Exploration & Production; Petrobras America, Inc.; Halliburton; Nalco Company; Multi-Chem Corporation; BJ Services Company; Champion Technologies, Inc.; Intertek Group plc; INTECSEA
DW2902-07: Fiber Containing Sweep Fluids for Ultra Deepwater Drilling Applications	The University of Oklahoma	24 months $120,000	Develop fiber sweep systems that improve hole cleaning in UDW drilling operations, reduce drilling costs and improve operational safety, and minimize the impacts of drilling on the natural environment.	M-I SWACO
DW2201: Heavy Viscous Oil PVT for Ultra Deepwater Proposal	Schlumberger Limited	30 months $458,000	Development and recommendation of best practices for sample handing and laboratory measurement methods for heavy viscous oil PVT measurement.	
DW1501: Early Reservoir Appraisal, Utilizing A Well Testing System	Nautilus International LLC	13 months $820,000	Design a low-cost and rapid response well testing and intervention system for ultra-deepwater wells.	Knowledge Reservoir, LLC; Expro International Group Ltd.; General Marine Contractors LLC; INTECSEA; Louisiana State University; The University of Tulsa; Texas A&M University; GE Oil & Gas; Tidewater Marine, LLC
DW2701: Ultra-Deepwater Resources To Reserves Development And Acceleration Through Appraisal	The University of Texas at Austin	18 months $200,000	Develop methodology and tools to estimate connectivity and properties of typical deepwater reservoirs based on a statistical treatment of geologic models.	Marathon Oil Corporation; Quantitative Clastics Laboratory (QCL); Center for Petroleum Asset Risk Management (CPARM)

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING	DESCRIPTION	PARTICIPANTS
DW2801: GOMEX 3-D Operational Ocean Forecast System Pilot Project	Portland State University	30 months $1,248,000	Demonstrate, evaluate, and establish an operational forecast system for ocean currents in the Gulf of Mexico.	Chevron Corporation; BP America, Inc.; Jet Propulsion Laboratory; UCLA; North Carolina State University; Princeton University; Naval Research Laboratory; Texas A&M University; Coast Survey Development Lab (CSDL); National Ocean Service (NOS); National Centers for Environmental Prediction (NCEP); National Weather Service (NWS); National Oceanic and Atmospheric Administration (NOAA)
DW2901: Ultra-reliable deepwater electrical power distribution system and power components	GE Global Research	36 months $5,000,000	Design an electrical power transmission and distribution system to enable subsea oil and gas production for a deepwater field development scenario, and design, build, and qualify critical components in a system demonstration to advance technology readiness level.	Texas A&M University; Rensselaer Polytechnic Institute; GE Oil & Gas

Table 5.3: 2008 UDW Selections

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING*	DESCRIPTION	PARTICIPANTS
UDW Seabed Discharge of Produced Water and/or Solids	Fluor Enterprises, Inc.	12 months $450,000	Evaluate the technical, environmental and regulatory factors associated with seabed discharge of produced water and solids in an ultra-deepwater environment.	The University of Tulsa; Colorado School of Mines; University of Houston; Rice University; Texas A&M University; Louisiana State University; Cameron; FMC Corporation; NATCO Group Inc.; GE Oil & Gas; Schlumberger Limited; Halliburton; Baker Petrolite; Coastal Chemical Company; Oceaneering International, Inc.; Subsea 7 Limited; Framo Engineering; Roxar
Displacement & Mixing in Subsea Jumpers Experimental Data and CFD Simulations	The University of Tulsa	24 months $255,000	Conduct an experimental and computational study of the mixing and displacement phenomena that take place during hydrate inhibition of jumper type configurations using MEG and methanol.	Anadarko Petroleum Corporation; BG Group; BP America, Inc.; BHP Billiton; Calsep International Consultants; Champion Technologies, Inc.; Chevron Corporation; Eni S.p.A.; Statoil; ONDEO; Nalco Company; Marathon Oil Corporation; Petrobras America, Inc.; TOTAL E&P USA, Inc.
Autonomous Inspection of Subsea Facilities	Lockheed Martin	12 months $994,000	Develop, integrate and test technology for autonomously conducting a pre/post hurricane inspection of a facility.	Florida Atlantic University; Seanic Ocean Systems
High Resolution 3D Laser Imaging for Inspection, Maintenance, Repair, and Operations	3D at Depth, LLC	13 months $499,000	Improve the accuracy and efficiency of the inspection, maintenance, and repair of ultra deepwater assets by designing and testing in a lake environment a 3-D laser scanning system.	UTEC Survey Inc.; CDL Inc.
Sensors & Processing for Pipe, Riser, Structure, & Equipment Inspection to Provide Detailed Measurements, Corrosion Detection, Leak	Blueview Technologies Inc	12 months $468,000	Apply advanced acoustic sensing technology developed with DOD funding to inspection of equipment in an UDW environment.	
Development of Carbon Nanotube Composite cables for udw Oil and Gas Fields	Los Alamos National Laboratory	36 months $2,000,000	Develop a new technology for electrical power cables, using a composite of carbon nanotubes (CNT) and copper. The composite cable should have twice the conductivity of an equivalent size pure copper cable and should also be lighter and stronger.	Chevron Energy Technology Company
Intelligent Production System for udw with Short Hop Wireless Power & Wireless Data Transfer for Lateral Production Control & Optimization	Tubel LLC	24 months $1,103,000	Develop and test a prototype system specifically for deployment in Ultra Deepwater horizontal wells and the lateral sections in multilateral wells to control and monitor hydrocarbon production.	University of Houston
Fatigue Testing Of Shrink-Fit Riser Connection For High Pressure Ultra Deepwater Risers	Subsea Riser Products	12 months $350,000	Conduct resonant fatigue testing of a Shrink-Fit connection which, as an alternative to welding, facilitates the fabrication of riser joints from high and ultra-high strength steel (80>130ksi)	BP America, Inc.; Chevron Corporation

PROJECT	AWARDEE	DURATION/ RPSEA FUNDING*	DESCRIPTION	PARTICIPANTS
Deepwater Subsea Test Tree and Intervention Riser System	DTC International, Inc.	19 months $1,551,000	Develop a Deepwater Subsea Test Tree and Intervention Riser System that are capable of conducting Riser–Based intervention operations on subsea completed wells with wellhead shut-in pressures up to 20,000 psi and wellhead flowing temperatures up to 350 °F in water depths up to 12,000 feet.	Stress Engineering Services, Inc.; Titanium Company; Det Norske Veritas
Gyroscope Guidance Sensor for Ultra-Deepwater Applications	Laserlith Corporation	12 months $489,000	Development of an inertial guidance system for directional drilling, based on MEMS gyroscope technology.	Colorado School of Mines; MicroAssembly Technologies, Inc.; Ideal Aerosmith, LLC; X-FAB Silicon Foundries Group
A 1,000 level Drill Pipe Deployed Fiber Optic 3C Receiver Array for Deep Boreholes	Paulsson, Inc.	24 months $1,994,000	Develop a 1,000 level drill pipe deployed borehole seismic receiver array system using fiber optic sensor technology and build a 100 level demonstration system operational to 30,000 ft in a GOM UDW well.	US Sensor Systems, Inc.; Premier Drill Pipe, LTD; Kemlon Products, Inc.; Optiphase, Inc.; NORSAR

***** Note that duration and award amounts on 2009 projects have not been finalized

Table 5.4: 2009 UDW Selections

E. Metrics

Overall metrics for RPSEA in general are discussed in Chapter 8. Shorter-term metrics specific to the UDW program include the completion of annual milestones that show progress toward meeting the program element objectives. As a minimum, short term metrics to be completed before the end of FY 2011 include:

- Issue five solicitations for 2011
- Finalize portfolio, prepare and issue 2010 RFPs
- Select and award three to five large projects for 2010
- Establish FY 2011 R&D priorities based on results of 2007 - 2010 contracts, project selections, solicitations, and inputs from the TACs, PAC, and UDAC
- Prepare the 2012 Draft Annual Plan

Chapter 6 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 resources are defined in Section 999G of EPAct 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 EIA and others as important supply sources during a minimum of the next 20 years (2008 Update to the National Petroleum Council Report: *Hard Truths: A Comprehensive View to 2030 of Global Oil and Natural Gas).* 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 (TCF). A 2008 report prepared by ICF International for the INGAA Foundation estimates these gas resources to be 624 TCF. In their 2009 report, the Potential Gas Committee estimates the lower 48 shale gas resource alone to be 616 TCF. Unconventional gas is clearly an important component of the U.S. energy portfolio and a valuable U.S. endowment. It is a goal of this program to provide the technology to both grow the resource base and convert technical resource into economic gas production. The primary beneficiary is the U.S. gas consumer who will have a more secure and fairly priced gas supply.

Due to their potential significance and in view of the limited resources available to the research program, gas shales and tight gas sands are the primary focus for the program. Novel technologies for coalbed methane development are also included, but at a secondary level. 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

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 is 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.

Consistent with an increased emphasis on the safety and environmental sensitivity of onshore operations, RPSEA will be expanding the role of the EAG and other stakeholders to ensure that appropriate priorities are placed on developing technologies and performing environmental studies that lead to a more complete understanding of the potential safety and environmental consequences of onshore gas development activities. This will likely lead to an increased effort on factors such as wellbore integrity, blowout prevention and control in onshore gas wells, safe hydraulic fracturing practices, and effective response and clean-up of spills and other incidents.

C. Objectives

Objectives for the Unconventional Resources Program were developed with input from the Unconventional Resources PAC. This input has been combined with information gathered during an ongoing series of efforts to identify and prioritize the technology challenges associated with the development of unconventional resources.

Recent efforts include: (1) 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, (2) input provided to the 2010 Annual Plan by the URTAC, (3) input provided by PAC and TAC members involved with the selection process for the 2009 program, and (4) discussions at events such as the 2010 RPSEA Unconventional Gas Conference in Golden, CO and the 2010 RPSEA Coalbed and Shale Gas Forum in Tuscaloosa, AL.

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 2010 program.

The objectives are tied to the three resources described above (shales, tight sands, and coalbed methane). All three resources are important, but gas shales, the most difficult to economically extract and least developed of the three, was initially identified 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. As the current portfolio reflects a strong emphasis on shale gas, the 2011 solicitations will emphasize both shales and tight sands. The desired balance among the three development categories has not changed significantly as the program has evolved:

- Existing - Active development drilling and production (~45%)

- Emerging - Formations, depth intervals, or geographic areas from which there has been limited commercial development activity and very large areas remain undeveloped (~45%)
- Frontier Area - Formations, depth intervals, or geographic areas from which there has been no prior commercial development (~10%)

The intended relative balance of the program's focus among these three categories from prior year Annual Plans is indicated above. In practice, the number of projects that apply to all three development categories has given the Frontier category a weight of approximately 15% in the 2007 through 2009 programs. No significant change in emphasis is planned for 2011.

Specifically, the objectives of the Unconventional Resources Program are:

Near Term

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

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

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 exploration and production 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.

In order to accomplish this integration, projects will continue to be focused on two or three specific unconventional gas development areas. While the results of the program

will be applicable across a wide range of resources and basins, synergy among individual projects will best be achieved when there is an opportunity for multiple projects to share common datasets and coordinate their efforts to apply a range of technologies to the solution of common problems.

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 objectives, technology targets, field projects, and technology dissemination components utilize an approach illustrated within Figure 6.1. The program components are prioritized for a particular resource target that has been identified as having significant potential. The highest ranking technology needs are identified and form the basis for the R&D solicitations. The projects are not implemented individually but are linked and coordinated one to another wherever possible. All projects are focused on a particular region(s) and coupled to program technology dissemination efforts. A coordinated program as opposed to individual projects is a primary implementation goal.

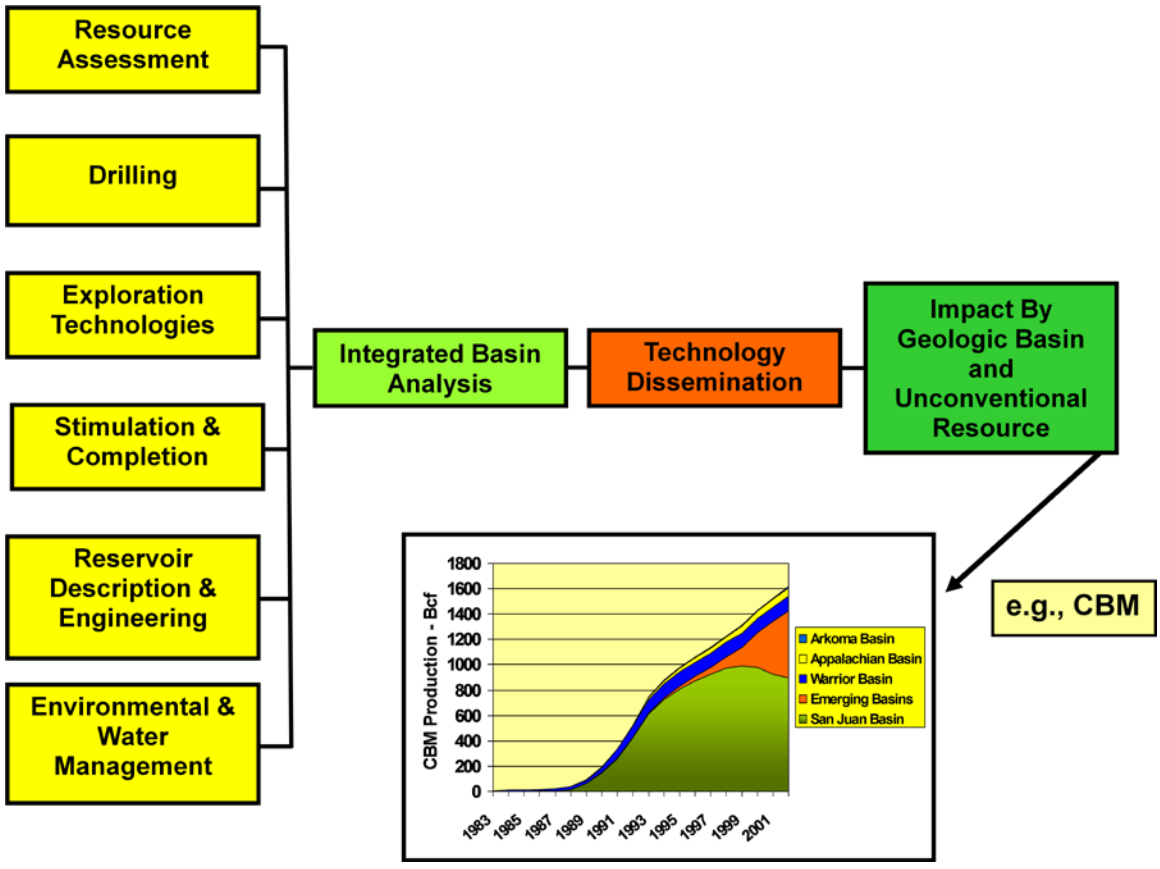


Figure 6.1: Program Development Component and Implementation Approach

The following section outlines the major steps in the implementation plan.

Development of Solicitations to Address Prioritized Technology Challenges
The 2007 and 2008 solicitations were broad in scope in order to allow consideration of a broad range of technical solutions, but they placed particular emphasis on addressing key technical or resource gaps within the current portfolio of projects. The 2009 program solicitations encouraged the development of integrated programs targeting specific resources with a focus on technology or resource gaps that remain in the program after the 2007 and 2008 selections. The 2010 solicitation is aligned with specific key resource targets and technology needs that emerged from the portfolio of projects chosen for the 2007 through 2009 program years. The 2011 solicitation will be particularly focused on the integration of results from earlier projects and their application to specific unconventional resource development challenges.

Two Integrated Basin Analysis projects were funded during the 2007 program year, focusing on the New Albany Shale in the Illinois Basin and tight sands in the Piceance Basin. A Marcellus Shale project was funded in the 2009 program. Another Integrated Basin Analysis project targeting an additional shale or tight gas resource is being sought through the 2010 program year solicitation. The PAC has recommended that these projects serve as anchor projects to focus program efforts on these specific resources. While it is intended that the technologies developed through the program will be applicable to a wide range of shale and tight sand resources, the recommended approach will allow individual researchers to develop coordinated efforts addressing the key challenges associated with specific targeted resources. In addition to the synergies that will arise from having teams of researchers work with common datasets on related problems, more effective workflows will be developed as a result of combining the best practitioners and researchers from multiple disciplines in a coordinated approach to development of the targeted resources.

Description of Planned Solicitations
The solicitations issued during the 2011 program year will be designed to integrate and build on the portfolio of projects developed during the 2007-2010 program years. They will be designed to ensure a coordinated program that addresses the technology challenges of resource development in at least three specific unconventional gas resources. While it will be important to confirm that the solicitations fill any program gaps remaining after the 2010 projects are chosen, a crucial need will be the integration of the results of individual projects and project application to the technical challenges associated with the development of specific unconventional gas resources. Thus, in addition to addressing specific technical needs, the 2011 solicitations may seek resources to plan and manage field-scale projects that result from the application of technology developed in previous program years. In order to successfully integrate the results of projects funded in previous years and bring appropriate technologies to the field trial stage, active technical management, with an emphasis on supervision of field experiments at the well site, will be required. The 2011 solicitations will likely seek proposals to provide such technical management and integration.

At least one, but no more than three, solicitations are anticipated to be issued during the 2011 program year, depending upon the evolving needs of the program. As proposals

involving the coordination of field trials or the integration of the results of multiple technologies are likely to be larger than early-stage technology development projects, it is anticipated that fewer and larger awards will result from the 2011 solicitation.

Safety and environmental impact have been key elements of the program since its inception. While a number of previous projects address the development of technologies that promise to decrease the environmental impact of unconventional gas development, some assessment of the vulnerabilities of existing technologies may be appropriate to ensure that any risks are fully understood and effectively mitigated. While there is no intent to duplicate work being done by other institutions and agencies, the 2011 program may include specific efforts to more fully define any risks associated with unconventional gas development, and ensure that appropriate technologies are available to mitigate those risks. In addition, priorities may include developing technologies and performing environmental studies concerning response, clean-up and the value of ecosystem services that may be impacted if an emergency situation should arise during exploration and production activities.

Some or all of the areas below may be covered by solicitations during the 2011 program year.

Solicitations will be directed toward the development and application of tools, techniques, and methods to substantially increase in an environmentally sound manner, commercial production, ultimate recovery from established unconventional gas resources, and accelerate the development of gas from emerging and frontier unconventional plays. For technologies that have reached the appropriate stage of development, field demonstrations may be encouraged. 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 2011 solicitations are issued.

Solicitations may be issued addressing the highest level goals below (1, 2, 3…) or targeting specific technology areas (a, b, c…), depending on program needs.

1. 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.
    a. Plan and manage field trials of previously developed technologies applied to the development of unconventional gas resources. Field trials will have as a focus the testing of developing technologies in the field at producer well sites and/or areas of field activity.
    b. Provide technical management services that integrate the results of existing projects and ensure that appropriate contractors work together to apply the most effective new technologies to the development of targeted unconventional gas resources.

c. Plan with RPSEA the dissemination of these results to the appropriate producer communities.

2. 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

      ii. Link the research program to national assessment efforts for gas resources (e.g. Potential Gas Committee (PGC), Energy Information Administration (EIA)) to enable the program research results to be reflected as soon as practical on the annual assessments of the U.S. natural gas endowment.

   b. Geosciences

      i. Characterize geological, geochemical, and geophysical framework of unconventional resource plays

      ii. Develop surface-based and borehole-based technologies that identify drilling sweet spots

      iii. Develop real-time downhole techniques for evaluation of the source potential of hydrocarbon bearing shales

      iv. Characterize fracture attributes (orientation, intensity, openness, fluid saturation)

      v. Develop methods to optimize the position and orientation of vertical and horizontal wellbores

      vi. Determine stress fields

      vii. Apply geosciences to improve the design and implementation of hydraulic fracturing

   c. Basin Analysis and Resource Exploitation

      i. Characterize geological, geochemical, geophysical, and operational parameters that differentiate high-performing wells, areas and/or fields

      ii. Develop and demonstrate techniques to analyze large volumes of data in real-time for application during unconventional resource development

   d. Drilling

i. Progress the use 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. Utilize multi-zone completion and stimulation methods

ii. Cultivate steerable hydraulic fractures as appropriate

iii. Develop "domain stimulation" methods that impact a larger volume of reservoir volume

iv. Advance suitable low-cost fracturing fluids and proppant materials, e.g. non-damaging fluids and/or high strength, low density proppant materials

v. Develop techniques for zonal-isolation

vi. Develop methods for re-stimulation and identification of candidate wells for re-stimulation

vii. Mature stimulation methods that require less water and other fluids to be injected into the subsurface

viii. Identify more environmentally benign stimulation fluids

ix. Utilize stimulation methods that result in a lower volume of treatment fluids produced to the surface

x. Develop approaches for improved treatment, handling, reuse and, disposal of fluids produced and/or used in field operations, including reuse of recovered waters

xi. Improve fracturing and stimulation techniques for gas shales

f. Water Management

i. Advance comprehensive approaches for the conservation and management of water resources used and produced during all aspects of unconventional gas development

ii. Extend 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 and fracturing fluids with intermediate and high total dissolved solids in order to minimize the potential impact on natural water resources

iv. Develop methods for the sustainable beneficial use of produced water

v. Improve methods to control fines production

vi. Widen techniques to minimize the volume of water produced to the surface

g. Reservoir Description and Management
    i. Mature methods to accurately assess the potential for shale gas production from common industry petrophysical methods
    ii. Expound on 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. Progress methods to manage production in order to maintain the permeability generated through stimulation operations and minimize formation damage over time
    v. Exploit methods to manage reservoirs to ensure maximum efficient recovery
h. Reservoir Engineering
    i. Elaborate on methods to plan, model, and predict the results of gas production operations
    ii. Develop real-time simulation and modeling of reservoirs
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. Build on advanced drilling approaches that minimize the surface impact of well construction associated with the targeted unconventional gas resource
    iii. Advance completion, stimulation and/or reservoir management approaches that minimize the environmental impact associated with the development of the targeted resource
    iv. Cultivate methods to plan and select sites that minimize the surface footprint and the impact of drilling and production operations
    v. Develop surface mitigation methods applicable to all environments
    vi. Improve technologies to recycle water
    vii. Upgrade technologies to detect and capture emissions from unconventional oil and gas operations

3. Conduct early-stage research on novel concepts that may be applied to the development of unconventional gas resources. Such methods may include biological enhancement of gas production from unconventional resources.
4. Evaluate the environmental and safety aspects of current approaches to unconventional gas development. Identify any vulnerability and provide guidance on approaches to reduce and mitigate any risks. Specific topics may include, but are not limited to the following.

a. Conduct a comprehensive evaluation of the environmental risks associated with unconventional gas development and production operations associated with any general or specific unconventional gas resource.

b. Develop technologies to advance the science of warning systems to mitigate or prevent any safety or environmental accidents at any onshore oil and gas operation

c. Develop technologies to advance the science of damage control regarding safety and environmental accidents at any onshore oil and gas operations

d. Develop methods to further minimize the environmental impact of any onshore oil and gas operations

e. Develop methods to further improve safety procedures impacting personnel involved with onshore oil and gas operations

f. Perform environmental studies concerning the value of ecosystem services that may be impacted if an emergency would arise during exploration and production activities.

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 expertise to bring new products to the stage of field application and commercial availability. For this reason, number one (1) 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 may not be 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 evaluations 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 $13.7 million available for funding the Unconventional Resources Program during each fiscal year. Approximately four to eight awards are anticipated to be awarded in 2011.

The typical award is expected to have duration of one to three years, although shorter or longer awards will be considered if warranted by the nature of the proposed project. The solicitation will specify a maximum award duration that is consistent with the authorized ending date for the program.

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 the 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

Twenty-eight projects have been awarded and eleven projects are pending contract execution based on selections from the 162 proposals submitted in response to the 2007 through 2009 solicitations for the Unconventional Resources Program. Table 6.1 below illustrates the breakdown of the current projects by technology area and primary resource target.

	Gas Shales	Tight Sands	Coalbed Methane
Integrated Basin Analysis	New Albany (GTI) $3.4 *Marcellus (GTI) $3.2* *Mancos (UTGS) $1.1*	Piceance (CSM) $2.9	
Stimulation and Completion	Cutters (Carter) $.09 Frac (UT Austin) $.69 Refrac (UT Austin) $.95 Frac Cond (TEES) $1.6 *Stimulation Domains (Higgs-Palmer) $0.39* *Fault Reactiviation (WVU) $0.85*	Gel Damage (TEES) $1.05 Frac Damage (Tulsa) $.22 *Foam Flow (Tulsa) $0.57* *Fracture Complexity (TerraTek) $0.83*	Microwave CBM (Penn) $.08
Reservoir Description & Management	Hi Res. Imag. (LBNL) $1.1 Gas Isotope (Caltech) $1.2 Marcellus Nat. Frac./Stress (BEG) $1.0 *Frac-Matrix Interaction (UT-Arl) $0.46* *Marcellus Geomechanics (PSU) $3.1*	Tight Gas Exp. System (LBNL) $1.7 Strat. Controls on Perm. (CSM) $0.1 *Fluid Flow in Tight Fms. (MUST) $1.2*	
Reservoir Engineering	Decision Model (TEES) $.31 Coupled Analysis (LBNL) $2.9 *Shale Simulation (OU) $1.05*	Wamsutter (Tulsa) $.44 Forecasting (Utah) $1.1 Condensate (Stanford) $.52	
Exploration Technologies	Multi-Azimuth Seismic (BEG) $1.1		Coal & Bugs (CSM) $.86
Drilling	*Drilling Fluids for Shale (UT Austin) $0.6*		
Water Management	Barnett & Appalachian (GTI) $2.5 Integrated Treatment Framework (CSM) $1.56	Frac Water Reuse (GE) $1.1	
Environmental	Environmentally Friendly Drilling (HARC)* $2.2	*	*
Resource Assessment	Alabama Shales (AL GS) $.5 Manning Shales (UT GS) $.43	Rockies Gas Comp. (CSM) $.67	

2007 Projects

2008 Projects

2009 Projects

Table 6.1: 2007, 2008, 2009 Project Selections Classified by Primary Resource Target and Technology Area

Table 6.1 also illustrates the way in which the projects selected for the 2008 and 2009 programs addressed some of the technology gaps left in the program after previous years' selections. The 2010 solicitation was designed to strengthen the integrated approach to the technology challenges associated with specific unconventional gas resources and identify an additional Integrated Basin Analysis project to serve as an anchor project for the program.

Figure 6.2 shows how the existing projects are beginning to achieve a program focus on specific resource areas anchored by Integrated Basin Analysis projects and supported by projects with a regional focus and projects that cross-cut the various geographic areas. The 2010 solicitation is designed to strengthen the program focus so that the maximum value is derived from the coordination and interaction of the funded projects.

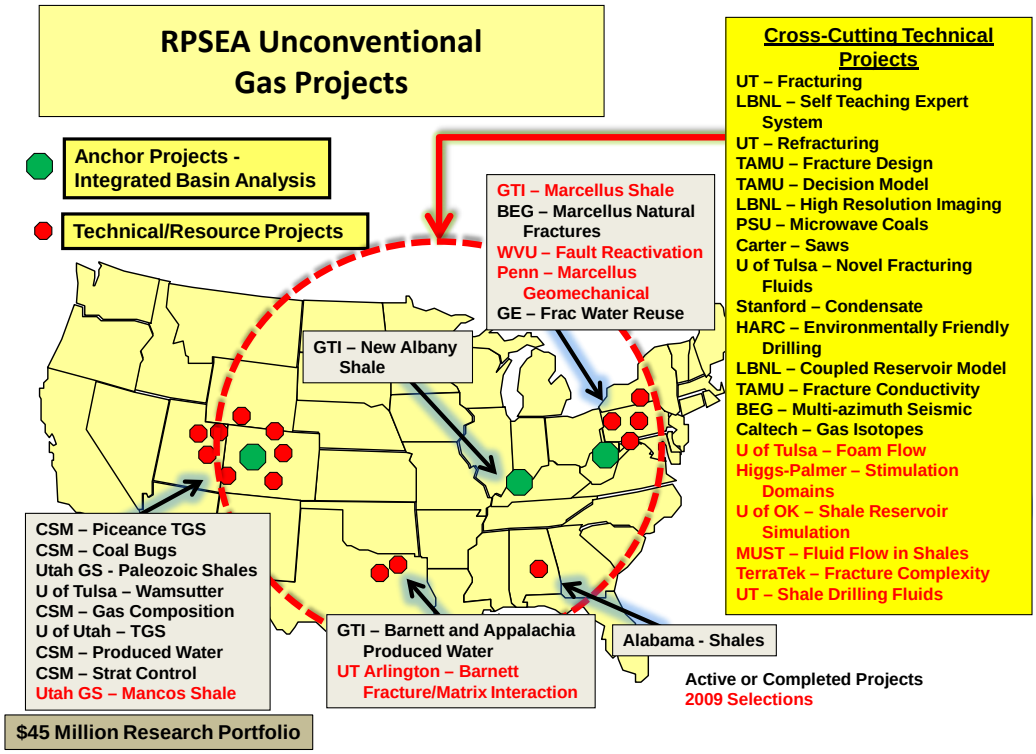


Figure 6.2: 2007, 2008 and 2009 Project Focus Areas

Project Highlights

Two projects from the 2007 program have been completed. These two projects are representative of those whose purposes are to progress innovations of new technologies not being applied today.

Novel Concepts for Unconventional Gas Development in Shales, Tight Sands and Coalbeds *(Project # 07122-07)* was performed by Carter Technologies along with The University of Oklahoma, University of Houston, and M-I L.L.C. The project objective was to define and provide a conceptual evaluation of an alternative method of formation stimulation to increase the net production of gas from shale while reducing the environmental impact due to the amount of water required.

The project has met the objective of defining and evaluating a new method of formation stimulation that may be able to connect hundreds of thousands of square feet of the formation face directly to the well bore. The preferred method uses a downhole cable saw to cut a pathway or "slot" into the formation all along the length of a horizontal lateral well bore within a shale formation. Estimates are that the method could cut 100-foot deep slots all along a 2500-foot long horizontal well.

Theory indicates that these slots may also reduce production decline, reduce the effects of formation damage, and allow a larger percentage of the in-place gas to be recovered

compared to conventional completions. The method appears to have a low capital cost and be sufficiently robust to withstand the rigors of the downhole drilling environment.

The computer model developed during the work indicates that the deep longitudinal slots can produce 50 to 100 times as much surface area as a horizontal well alone. These slots may be thought of as steerable oriented fractures. They are over an inch wide, and thus are more resistant to plugging than a hydro-fracture. They can be left open or packed with sand or pea gravel. Since their size and position are controlled rather than random, they can be placed in a grid or pattern to maximize production from a given zone, well, or lease acreage.Inventions and improvements to concepts have been made as a result of the project, and a provisional patent application has been filed with intension to file for U.S. and foreign patents.

Collaborative associates for the project have included M-I L.L.C., a Smith/Schlumberger Company, Smith International, and professors Peter Valco from Texas A&M University, and Younane Abousleiman from the University of Oklahoma.

The second completed project is entitled ***Enhancing Appalachian Coalbed Methane Extraction by Microwave-Induced Fractures*** *(Project # 07122-27),* performed by The Pennsylvania State University along with Nottingham University. The project objective was to perform preliminary laboratory evaluation of the use of short-bursts of microwaves for developing new fractures and enhancement of cleat apertures in bituminous coal (exposed with and without application of simulated hydrostatic stress). It was confirmed that the exposure of microwaves to a coal core can generate new fractures and increase the existing cleat apertures for an un-stressed core. Similar observations were found in the coal core under simulated hydrostatic stress during microwave exposure, indicating there is potential to use microwave exposure to improve connectivity between a horizontal wellbore and coal seam. Cleat/fracture volume, determined from micro-focused X-ray computed tomography, following microwave exposure increased from 1.8% to 16.1% of the unconfined core volume. The cleat/fracture volume increased from 0.5% to 5.5% for the core exposed while under simulated hydrostatic stress. Induced fractures were often horizontal and terminated at the existing cleat system. Cleat aperture enhancements were also noted.

Two other projects, still in progress, have been recognized by industry and are highlighted below:

The ***New Albany Shale Gas*** *(Project # 07122-16)* is one of the Integrated Basin Analysis projects that serve as an anchor for that geographical area. This project integrates geologic, geochemical, reservoir engineering, and production stimulation studies to bring together cross cutting technologies to allow for comprehensive study of the New Albany Shale. This project represents an integrated, scientific look at the factors controlling production in a marginally economic shale resource, with an objective of developing methods that will improve the economics of the New Albany shale, while also generating a level of fundamental understanding of shale resources that will guide the development of similar shales with currently marginal economics. The project is coming to a close as this plan is being prepared and operators are currently applying the results of the study.

When preliminary results were presented at the 24th World Gas Conference in Buenos Aires, Argentina the project received a best project award in recognition of its interdisciplinary, scientific approach to the development of a marginal shale resource..

Another award winning project is ***Environmentally Friendly Drilling*** *(Project #08122-35).* The goal of the Environmentally Friendly Drilling Systems (EFD) Program is to further advance to knowledge and development of environmentally friendly oil and gas activities with the objective of identifying, developing and demonstrating low-impact technologies/systems that can be used in environmentally sensitive areas that are currently off-limits. The EFD Program was selected by the Interstate Oil and Gas Compact Commission's Stewardship Award Subcommittee as the winner in the Environmental Partnership category. The award was presented at the Commission's annual meeting in Biloxi, Mississippi on October 5, 2009, where it was noted that "The program has become a clearing house of knowledge on reducing the impact of oil and gas operations through presentation, publications and the Web site."

Table 6.2 below provides a listing of the ongoing projects. Table 6.3 lists the projects that have been selected for the 2009 program year and their contracts are currently being finalized. Included for each selection is the project title, the recipient, project duration, the primary project deliverable, and other participants. Additional information can be found at www.rpsea.org and on the NETL/Strategic Center for Natural Gas and Oil webpage at www.netl.doe.gov/technologies/oil-gas/EPAct2005.

PROJECT	RECIPIENT	RPSEA FUNDING/ COMPLETION DATE	DELIVERABLE	OTHER PARTICIPANTS
A Self-Teaching Expert System for the Analysis, Design and Prediction of Gas Production from Shales	Lawrence Berkeley National Laboratory	$1,700,000 Oct 2010	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	$1,000,000 Sep 2011	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	$1,600,000 Mar 2011	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	$670,000 Aug 2011	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

PROJECT	RECIPIENT	RPSEA FUNDING/ COMPLETION DATE	DELIVERABLE	OTHER PARTICIPANTS
Comprehensive Investigation of the Biogeochemical Factors Enhancing Microbially Generated Methane in Coal Beds	Colorado School of Mines	$860,000 Dec 2011	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
Enhancing Appalachian Coalbed Methane Extraction by Microwave-Induced Fractures	The Pennsylvania State University	$79,000 Complete	Fundamentals of efficacy of using microwaves as a CBM stimulation technique	Nottingham University
Gas Condensate Productivity in Tight Gas Sands	Stanford University	$520,000 Dec 2011	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	The University of Utah	$1,100,000 Sep 2011	Best Practices for development of Utah gas shales integrating natural and hydraulic fracture interaction	Utah Geological Survey; Golder Associates; Utah State University; HCItasca; Anadarko; Wind River Resources Corp
Geological Foundation for Production of Natural Gas from Diverse Shale Formations	Geologic Survey of Alabama	$500,000 Jul 2011	Geologic characterization of diverse shales in Alabama	
Improved Reservoir Access through Refracture Treatments in Tight Gas Sands and Gas Shales	The University of Texas at Austin	$950,000 Aug 2011	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	The University of Texas at Austin	$690,000 Apr 2012	Design and field test of lightweight proppant materials in the Barnett shale	Daneshy Consultants; BJ Services
New Albany Shale Gas	Gas Technology Institute	$3,400,000 Jul 2010	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	$91,680 Complete	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 L.L.C.
Novel Fluids for Gas Productivity Enhancement in Tight Formations	The University of Tulsa	$220,000 Sep 2011	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	The University of Tulsa	$440,000 Jan 2011	Simulation technique for high-grading 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	$310,000 Aug 2011	Reservoir and decision model incorporating uncertainties	Unconventional Gas Resources Canada Operating Inc.; Pioneer Natural Resources

PROJECT	RECIPIENT	RPSEA FUNDING/ COMPLETION DATE	DELIVERABLE	OTHER PARTICIPANTS
Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities	Utah Geologic Survey	$430,000 Aug 2011	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	$1,100,000 Oct 2011	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	$2,900,000 Sep 2010	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
Barnett and Appalachian Shale Water Management and Reuse Technologies	Gas Technology Institute	$2,500,000 Aug 2011	Water management methods and technologies that reduce demands for freshwater, reduce environmental impact of brine disposal, and ensure supplies of water for well drilling and completion for shale gas development	The Bureau of Economic Geology/The University of Texas at Austin; Texerra; Geopure Water Technologies/Texas A&M University; Texas Oil and Gas Association; Chesapeake Energy Corporation; ConocoPhillips; Devon Energy Corporation; EnCana; EOG; Pittls Oil Company; Quicksilver; Range Resources; XTO; Barnett Shale Water Conservation and Management Committee; Appalachian Shale Water Conservation and Management Committee
Novel Gas Isotope Interpretation Tools to Optimize Gas Shale Production	California Institute of Technology	$1,190,000 Aug 2012	Novel diagnostic tools for predicting, monitoring and optimizing shale gas production	Devon Energy Corporation; BJ Services Company; GeoIsoChem Inc.
The Environmentally Friendly Drilling Systems Program	Houston Advanced Research Center	$2,200,000 Jul 2012	Identification and evaluation of critical technologies for low-impact drilling, transfer of technology to industry, and tools for selecting low-impact technologies appropriate for a given site	BP; CSI Technologies; Devon Energy Corporation; Gulf Coast Green Energy; Halliburton; Huisman; Jacarilla Apache Nation; KatchKan U.S.A.; M-I SWACO; Newpark Mats & Integrated Services; Weatherford; TerraPlatforms, LLC; Texas A&M University; Sam Houston State University; University of Arkansas; University of Colorado; Utah State University; University of Wyoming; West Virginia University; Argonne National Laboratory; Los Alamos National Laboratory; TerraPlatforms, LLC; Environmentally Friendly Drilling Joint Industry Partnership; The Nature Conservancy; Natural Resources Defense Council; New York State Energy Research and Development Authority
Pretreatment and Water Management for Frac Water Reuse and Salt Production	GE Global Research	$1,105,000 Aug 2011	Technology that enables recycle of nearly all fracturing flowback water as well as production of a salable salt by-product	STW Resources, Inc.
Stratigraphic Controls on Higher-Than-Average Permeability Zones in Tight-Gas Sands in the Piceance Basin	Colorado School of Mines	$110,000 Jul 2011	Evaluation of the stratigraphic controls on the distribution and quality of tight-gas reservoirs in the Piceance Basin	

PROJECT	RECIPIENT	RPSEA FUNDING/ COMPLETION DATE	DELIVERABLE	OTHER PARTICIPANTS
Coupled Flow-Geomechanical-Geophysical-Geochemical (F3G) Analysis of Tight Gas Production	Lawrence Berkeley National Laboratory	$2,900,000 Mar 2013	Knowledge regarding long-term behavior of fractured tight gas reservoirs	Texas A&M University; Stanford University; Baker Hughes Inc.; Unconventional Gas Resources, Inc.
Sustaining Fracture Area and Conductivity of Gas Shale Reservoirs for Enhancing Long-Term Production and Recovery	Texas A & M University	$1,615,000 Sep 2012	A methodology for reservoir typing and selection of fracture stimulations for preventing loss of productive fracture area and loss of fracture conductivity	TerraTek a Schlumberger Company; Devon Energy Corporation; EnCana Oil & Gas USA; Pennsylvania General Energy Co.
Multiazimuth Seismic Diffraction Imaging for Fracture Characterization in Low-Permeability Gas Formations	Bureau of Economic Geology, The University of Texas at Austin	$1,105,000 Oct 2012	Techniques for predicting fracture occurrence and attributes by combining seismic tools, fracture modeling, and fracture characterization based on wireline sampling techniques	The University of Texas at Austin; Bill Barrett Corporation
Evaluation of Fracture Systems and Stress Fields Within the Marcellus Shale and Utica Shale and Characterization of Associated Water-Disposal Reservoirs: Appalachian Basin	Bureau of Economic Geology, The University of Texas at Austin	$1,020,000 Sep 2012	Demonstration of how multicomponent seismic data can be used to evaluate fracture systems that control production of shale gas systems, quantify stress fields and elastic moduli that influence hydrofrac performance in shale reservoirs, and measure the capacity of porous sandstone units to accept flow-back water produced during hydrofrac operations.	University of Pittsburgh; Chesapeake Energy Corporation; Jeter Field Service; RARE Technology; AscendGeo; AOA Geophysics, Inc.; Austin Powder Company; Seismic Source

Table 6.2: Status Update on Awarded R&D Projects

PROJECT	RECIPIENT	DURATION/ RPSEA FUNDING*	DELIVERABLE	OTHER PARTICIPANTS
Gas Well Pressure Drop Prediction under Foam Flow Conditions	The University of Tulsa	$580,000 34 months	Correlation to calculate the pressure drop under foam flow for deep gas wells with small amounts of water production	Marathon; Chevron
Characterizing Stimulation Domains, for Improved Well Completions in Gas Shales	Higgs-Palmer Technologies	$390,000 19 months	A method and a prototype screening software tool to characterize how flow properties change within the domain of a well stimulation, both during and after the stimulation. Permeability-based stimulation diagnostics, and relate these to fracture treatment parameters. A guide to improvements in well stimulations. Demonstration the prototype tool by application to field data.	Aetman Engineering; PCM Technical; Southwestern Energy Company
Marcellus Gas Shale Project	Gas Technology Institute	$3,220,000 18 months	Develop technologies to overcome the technical and environmental challenges preventing the expansion of Marcellus production through a field-based project.	Pennsylvania State University; West Virginia University; Bureau of Economic Geology; Pinnacle Technologies; Restech
Prediction of Fault Reactivation in Hydraulic Fracturing of Horizontal Wells in Shale Gas Reservoirs	West Virginia University Research Corporation	$850,000 36 months	Develop an advanced method to predict fault reactivation and improve effectiveness of hydraulic fracturing stimulation of horizontal gas shale wells.	Range Resources; Appalachian, LLC
Cretaceous Mancos Shale Uinta Basin, Utah: Resource Potential and Best Practices for an Emerging Shale Gas Play	Utah Geological Survey	$1,080,000 36 months	This project will produce a GIS-based integrated geologic characterization of the Mancos Shale along with drilling, completion, and stimulation method recommendations.	University of Utah; Halliburton Energy Services
Simulation of Shale Gas Reservoirs Incorporating Appropriate Pore Geometry and the Correct Physics of Capillarity and Fluid Transport	Board of Regents of the University of Oklahoma	$1,050,000 36 months	Production of a reservoir simulator that provides for the appropriate pore geometry complexity, and models the processes with valid physical assumptions.	BP; Chesapeake Energy Corporation; Exco; Newfield; Total; Computer Modeling Group, Inc.
Integrated Experimental and Modeling Approaches to Studying the Fracture-Matrix Interaction in Gas Recovery from Barnett Shale	The University of Texas at Arlington	$460,000 24 months	The outcomes of this proposal will bridge the knowledge gaps in the pore connectivity effect on diffusive gas transport and gas recovery in fractured shale system.	Carrizo Oil and Gas, Inc.
Using Single-molecule Imaging System Combined with Nano-fluidic Chips to Understand Fluid Flow in Tight and Shale Gas Formation	Missouri University of Science and Technology	$1,210,000 36 months	The project will improve the understanding of the flow behavior of natural gas and introduced fluids (water, surfactant solutions and polymers) in nano-darcy range of tight gas and shale formations by using advanced single-molecule imaging system combined with nano-fluidic chips and pore-scale numerical simulation techniques.	Colorado School of Mines; BJ Services; HESS Corporation

PROJECT	RECIPIENT	DURATION/ RPSEA FUNDING*	DELIVERABLE	OTHER PARTICIPANTS
Improving Reservoir Contact for Increased Production and Recovery of Gas Shale Reservoirs (Achieving Management of Fracture Complexity)	TerraTek, A Schlumberger Company	$830,000 25 months	The main objective of this theoretical and experimental project is to understand the operational drivers of fracture complexity (pumping rate, fluid viscosity, and proppant) and provide guidance for maximizing this opportunity.	New Ventures; Encana Oil and Gas; Unconventional Gas Completion Research; Shell; William Duncan; Cimarex Energy Company; Devon Energy
A Geomechanical Model for Gas Shales Based on the Integration of Stress Measurements and Petrophysical Data from the greater Marcellus Gas System	The Pennsylvania State University	$3,140,000 36 months	Development of an integrated, predictive geomechanical model that integrates rock stress and petrophysical properties for the Marcellus gas system. The model can be generalized for application in other shale plays.	Chesapeake Energy Corporation; Schlumberger; Range Resources
Improved Drilling and Fracturing Fluids for Shale Gas Reservoirs	The University of Texas at Austin	$600,000 36 months	Develop nano-particle based water-based drilling fluids that are compatible with reactive gas shales and cost a lot less than the oil-based fluids being used today.	Conoco Phillips; Chevron Energy Technology Company; Mi SWACO

***** Note that duration and award amounts on 2009 projects have not been finalized

Table 6.3: Status Update on 2009 R&D Project Selections

F. Metrics

Overall metrics for the Program in general are discussed in Chapter 8. Shorter-term metrics specific to the Unconventional Resources Program include the completion of annual milestones that show progress towards meeting the program objectives. Short-term metrics to be completed before the end of FY 2011 include:

- Issue and complete at least one solicitation
- Engage the PAC to review that the solicitation reflects sufficient breadth and depth of industry experience
- Select and award 4 - 8 projects
- Establish FY2012 R&D priorities based on results of 2007-11 solicitations and other inputs from stakeholders, including the program advisory committees and the URTAC

Chapter 7 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 it 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 2007, the EIA reported that these 13,121 operators produced 186 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 technology 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 PAC through the RPSEA Unconventional Resources Program Vice President and through its chairman, who will hold a seat on the Unconventional Resources 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 6, part C), as well as specific events aimed at small producers. The overarching theme expressed by small producer representatives at these events and through feedback from the RAG in regular conference calls was the need for technology, which allows small producers to maximize the value of the assets they currently hold primarily in mature fields.

Accordingly, solicitations under this program are 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 2011 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 2007-2010 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 is highly encouraged.

The 2011 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 and 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 and 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, and 4)
- Creative capture and reuse of industrial waste products (produced water, excess heat) to reduce operating costs or improve recovery (Objectives 1, 2, and 3)
- Leverage of existing wellbores and surface footprint to maximize recovery of additional hydrocarbons (Objective 2)
- Addressing novel concepts that may be applied to increase production from mature fields (Objective 4)

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. The RAG consists 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, 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 $3.17 million will be available for the Small Producer Program during fiscal year 2011.

Approximately four to seven awards are anticipated to be awarded under solicitations in 2011. 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. 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 and 2008 solicitations focused on application of available technologies for oil and gas recovery, water management issues, and minimizing the environmental impact on the surface. Seven projects were selected from the 2007 solicitation and six from the 2008 solicitation. These are listed in Table 7.1. Several projects built upon the theme of improving recovery from mature reservoirs, while others expanded into new theme areas of improved reservoir characterization and utilization of waste industrial products. 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 2009 solicitation was issued in October of 2009 and had the same general focus as that for the previous two years as consultation with advisory group members and information from participants in industry forums had indicated that the focus established by the initial solicitation is still the most important for small producers. Six projects were selected from the 2009 solicitation and these are listed in Table 7.1. The 2010 solicitation will again focus on application of available technologies for oil and gas recovery, water management issues, and minimizing the environmental impact on the surface as was outlined in the 2010 Annual Plan.

Figure 7.1 provides a summary of the type and a general geographic location of the projects awarded thus far. Additional information can be found at www.rpsea.org and on the NETL/SCNGO webpage at www.netl.doe.gov/technologies/oil-gas/EPAct2005.

Several of the 2007 projects are near completion; two are highlighted below.

Reducing Impacts of New Pit Rules on Small Producers *(Project 07123-07)* performed by New Mexico Institute of Mining and Technology in cooperation with the Independent Petroleum Association of New Mexico (IPANM) and the New Mexico Oil Conservation Division (NMOCD). The primary objective of this project was to make available a variety of data that New Mexico oil and gas producers would need to present when they file a pit closure plan (C-144 form). New rules in the state required operators to provide a significant amount of data; obtaining this data can be costly and time-consuming and is a particular burden on smaller companies. Other objectives included making the data available in useful formats that would be accepted by the NMOCD, and creating an

interactive version of the C-144 form that could be easily and automatically populated with some of the data obtained from the various databases accessed by this project.

The results of this project can be seen at http://ford.nmt.edu/react/pitrules_index.html. The real importance of the work is the mapping portal, which takes users to an online GIS system. Users can select pit locations, move locations, and query a great number of map layers for pertinent information, such as distances to water, residences, depths to groundwater, topography, etc. Although the OCD still requires operators to perform a site analysis, this tool provides a quick look for operators, enabling them to get an idea of issues they may face at a particular location. In addition, the web site also allows users to create maps and diagrams of locations, and provides checklists and warnings of issues that may need attention as the forms are completed. The impact of this project has already been proven; the OCD has received and approved a number of forms that contain maps printed from this web site, and several operators have reported using it for a variety of purposes – not just the initial intent of completion the C-144 form.

A second project, ***Near Miscible CO_2 Application to Improve Oil Recovery for Small Producers*** *(Project #07123-03)*, performed by the University of Kansas in partnership with Carmen Schmitt is also near completion. The primary object of this project was to investigate the feasibility of using CO_2 displacement at near miscible conditions to improve oil recovery in Arbuckle reservoirs in Kansas. CO_2 injection for enhanced oil recovery is normally carried out at a pressure above the minimum miscibility pressure (MMP), which is determined by crude oil composition and reservoir conditions. Many mature reservoirs are not considered for CO_2 miscible flooding because the maximum reservoir pressure that can be attained is less than the MMP. There is a significant resource that could be tapped if these lower pressure reservoirs could be recovered by CO_2 recovery processes operating near the miscibility pressure.

The MMP defined by the slim-tube experiment was 1350 psig at reservoir temperature of 110 F. Phase behavior studies indicate that extraction is the primary mechanism for mass transfer between CO_2 and crude oil to recover oil during CO_2 displacement at near miscible conditions. Core flooding tests conducted at the current average reservoir pressure, 1150 psig with three groups of rock samples, Berea sandstone, Baker dolomite and Arbuckle core, have found that at least 50% of the remaining oil can be recovered from this process. Detailed results of core flooding experiment and phase behavior study can be found on paper SPE 129710 and SPE 129728 or from http://www.torp.ku.edu/research/Near-MiscibleProject_Overview.html. Progress on this project was sufficient that the same organization received a second RPSEA Small Producers award to continue the work by expansion into collection of accurate field data to improve reservoir models.

The 2009 projects are listed below, categorized into three theme areas:

Oil and Gas Recovery

Field Testing and Diagnostics of Radial-Jet Well Stimulation for Enhanced Oil Recovery from Marginal Reserves *(Project # 09123-03)*

The objective of this research is field demonstration of radial jet technology for production enhancement from low-permeability reserves. Diagnostic techniques for monitoring lateral direction and placement will be developed and field tested. It is expected that successful completion of this project will answer the following questions: control and diagnosis of placement and direction of laterals during a radial jet enhancement, cost effectiveness of lateral jet enhancement, and determining preferred reservoir conditions and lateral patterns for deployment of radial jet technology from an existing wellbore.

Creating Fractures Past Damage More Effectively With Less Environmental Damage *(Project # 09123-20)*

The goal of this project is develop a more cost effective and environmentally friendly fracturing fluid to support a novel fracturing process. The process utilizes substantially less fluid volume than conventional treatments, and the frac fluid to be studied is comprised of a biodegradable polymer that will hydrolyze in an aqueous environment to monomeric forms of organic materials, eliminating the need for transition metal cross-linkers, breakers and other commonly used chemicals required with traditional cross-linked frac fluids.

Enhanced Oil Recovery from the Bakken Shale Using Surfactant Imbibition Coupled with Gravity Drainage *(Project # 09123-09)*

The objective of this project is to determine whether surfactant solutions can alter the wettability of the Bakken shale in North Dakota's Williston Basin to enhance oil recovery via gravity drainage. The research will investigate the ability of various surfactant solutions to alter the wettability of the formation without causing formation damage.

Characterization of Potential Sites for Near Miscible CO_2 Applications to Improve Oil Recovery in Arbuckle Reservoirs *(Project # 09123-18)*

This project will collect field data regarding reservoir pressure, residual oil saturation, reservoir properties and the nature of the flow from well to well in a Arbuckle reservoir. Single well transient pressure tests, multiple well interference tests, single well tracer tests, and interwell tracer tests will be conducted to determine the nature of the flow paths and average properties in the reservoir, to assess the effect of geology on process performance, to calibrate a reservoir simulation model, and to identify operational issues and concerns for future near miscible CO_2 applications.

Produced Water Management

Treatment and Beneficial Reuse of Produced Waters Using A Novel Pervaporation-Based Irrigation Technology *(Project # 09123-11)*

This project will explore and evaluate the application of a novel pervaporation (PV) based irrigation technology for treating and reusing oil and natural gas produced water.

Objectives for this research project are evaluation of the performance of the PV irrigation technology for treating oil/gas produced waters;, assessment of critical process design and operation issues associated with the PV irrigation technology through bench and pilot-scale tests, development of engineering and design information for implementing the PV irrigation technology in full-scale installations; and finally, development of a user friendly model for the PV irrigation technology to facilitate its implementation as a produced water management alternative.

Utilizing Waste Industrial Products

Green Oil™ CO_2-Enhanced Oil Recovery for America's Small Oil Producers *(Project # 09123-14)*

The objective of this project is to develop truck-portable equipment for generating CO_2 on-site at small producer fields on a scale of operation of approximately 1 million cubic feet per day. The system uses steam to reform biomass into CO_2 and hydrogen, following which the gases are separated, with the CO_2 used for enhanced oil recovery and the hydrogen used to generate several megawatts of electricity, which can be used locally or sold to the local grid. The study will also examine mature oil fields that are typical of small producer holdings to determine optimum locations for application of this technology.

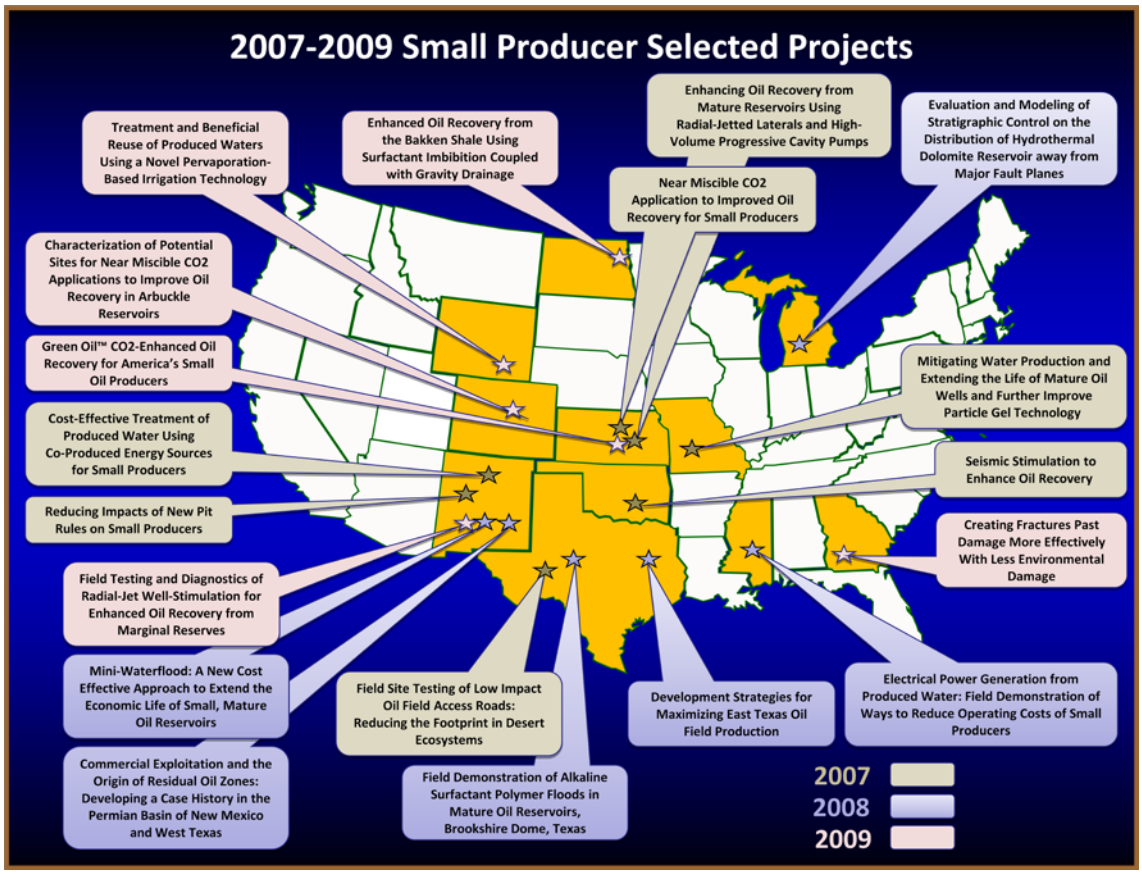


Figure 7.1: Small Producer Project Selections

2007 PROJECTS	AWARDEE	DURATION/ RPSEA FUNDING	DELIVERABLE	OTHER PARTICIPANTS
Cost-Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers	New Mexico Institute of Mining and Technology	36 months $457,253	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	The University of Kansas	24 months $248,385	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 $284,839	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	The University of Kansas	24 months $274,171	Define the potential for CO2 recovery or sequestration in near-miscible reservoirs	Carmen Schmitt
Preformed Particle Gel for Conformance Control	Missouri University of Science and Technology	24 months $520,212	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	24 months $509,185	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 GeoImaging Resources
2008 PROJECTS	**AWARDEE**	**DURATION/ RPSEA FUNDING**	**DELIVERABLE**	**OTHER PARTICIPANTS**
Commercial Exploitation and the Origin of Residual Oil Zones: Developing a Case History in the Permian Basin of New Mexico and West Texas	The University of Texas of the Permian Basin	24 months $631,001	Examination of regional data to clarify extents, locations, and origins of residual oil zones in Permian Basin	Chevron Corporation; Legado Resources; Yates Petroleum; Petroleum Technology Transfer Council; Midland College; Applied Petroleum Technology Academy
Evaluation and Modeling of Stratigraphic Control on the Distribution of Hydrothermal Dolomite Reservoir Away from Major Fault Planes	Western Michigan University	24 months $393,369	Study of lateral variability of reservoir quality hydrothermal dolomites to improve prediction of laterally persistent reservoir zones in the Albion-Scipio trend of southern Michigan.	Polaris Energy Company
Development Strategies for Maximizing East Texas Oil Field Production	Bureau of Economic Geology, The University of Texas at Austin,	36 months $984,985	Exploration of short to midterm strategies for maximizing recovery from East Texas Oil Field.	Danmark Energy LP; John Linder Operating Co. LLC

2007 PROJECTS	AWARDEE	DURATION/ RPSEA FUNDING	DELIVERABLE	OTHER PARTICIPANTS
Mini-Waterflood: A New Cost Effective Approach to Extend the Economic Life of Small, Mature Oil Reservoirs	New Mexico Institute of Mining and Technology	24 months $318,943	Demonstrate the feasibility of waterflooding small oil reservoirs that are not conducive to a fully-developed, patterned waterflood.	Armstrong Energy Corporation; Keltic Wall Services
Field Demonstration of Alkaline Surfactant Polymer Floods in Mature Oil Reservoirs Brookshire Dome, Texas	Layline Petroleum 1, LLC	24 months $597,936	Conduct a pilot study in Brookshire Dome field demonstrate applicability of alkaline surfactant polymer flooding to improve incremental oil production.	Tiorco LLC; The University of Texas at Austin
Electrical Power Genergation from Produced Water: Field Demonstration of Ways to Reduce Operating Costs of Small Producers	Gulf Coast Green Energy	12 months $229, 796	Demonstrate a relatively small low cost heat exhange device that converts heat from produced water to electricity.	Denbury Resources; ElectraTherm Inc.; Dry Coolers Inc.; Southern Methodist University; Texas A&M University
2009 PROJECTS	**AWARDEE**	**DURATION/ RPSEA FUNDING**	**DELIVERABLE**	**OTHER PARTICIPANTS**
Field Testing and Diagnostics of Radial-Jet Well-Stimulation for Enhanced Oil Recovery from Marginal Reserves Enhanced Oil	New Mexico Institute of Mining and Technology	24 months $656,537	Field evaluation of radial jet technology for pro-duction enhancement to determine effectiveness, directional control and placement of jets	Well Enhancement Services LLC; Harvard Petroleum Company LLC
Recovery from the Bakken Shale Using Surfactant Imbibition Coupled with Gravity Drainage	University of North Dakota	36 months $573,834	Investigate the ability of certain surfactant solutions to alter the wettability of the Bakken formation, without causing formation damage	North Dakota Industrial Commission; Tiorco – Stepan; Champion Technologies; Hess Corporation
Treatment and Beneficial Reuse of Produced Waters Using A Novel Pervaporation-Based Irrigation Technology	University of Wyoming	36 months $413,230	Evaluate the application of a novel pervaporation (PV) based irrigation technology for treating and reusing oil and natural gas produced water	Imperial College London; WyoTex Ventures LLC; DTI Group
Green Oil™ CO_2-Enhanced Oil Recovery For America's Small Oil Producers	Pioneer Astronautics, Inc.	24 months $550,000	Develompment and testing of truck-portable equipment for generating CO2 on-site at small producer fields	J & L Allen Inc.; American Pioneer Ventures; New Mexico Institute of Mining and Technology
Characterization of Potential Sites for Near Miscible CO2 Applications to Improve Oil Recovery in Arbuckle Reservoirs	University of Kansas Center for Research, Inc.	24 months $607,704	Collection of field data needed to help model Arbuckle reservoirs to predict recovery in a future near-miscible CO2 flood	Tertiary Oil Recovery Project; University of Kansas; Kansas Geological Survey; Carmen Schmitt, Inc.
Creating Fractures Past Damage More Effectively With Less Environmental Damage	DaniMer Scientific, LLC	12 months $455,000	Development of a more environmentally-friendly fracture fluid and technique for mature reservoirs	CSI Technologies LLC; Texas A&M University

***** All awards made to consortia with prime listed as awardee and other members listed as participants
****** Note that duration and award amounts on 2009 projects have not been finalized

Table 7.1: Small Producer Program Selected Projects

F. Metrics

Overall metrics for the Program in general are discussed in Chapter 8. Shorter-term metrics specific to the Small Producer Program include the completion of annual milestones that show progress towards meeting the program objectives. Short-term metrics to be completed before the end of FY 2010 include:

- Issue and complete at least one solicitation
- Engage the RAG to review that the solicitation reflects sufficient breadth and depth of industry experience
- Select and award 4 - 7 projects
- Establish FY2011 R&D priorities based on results of 2007-10 solicitations and other inputs from stakeholders, including the program advisory committees and the URTAC

Chapter 8 Program Benefits and Performance Benchmarking

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. 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. Some specific short-term metrics include:

- Number of solicitations issued
- Number of compliant proposals received
- Number of selections made
- Percent of selections resulting in contracts
- Time from selection to contracting
- Research award adherence to budget and schedule
- Amount of cost share in excess of the minimum requirement
- Milestone performance

B. Monitoring and Reporting Program Management Performance and Budget Metrics

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. **Research Project Performance Data Collection** - RPSEA utilizes research project monthly reports to efficiently collect project performance data. Each research project is required to submit a monthly report containing the following information:

    - Actual Expenditures by Month
    - Highlights and Accomplishments
    - Issues or Concerns
    - Corrective Actions

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
- The number of small business, minority owned, and other disadvantaged category Program participants

Appendix A: RPSEA Membership and Committee Lists

RPSEA Members

Acute Technological Services, LLC
Advanced Resources International, Inc.
Advantek International, Corp.
AeroVironment, Inc.
Altira Group LLC
Alcoa Oil and Gas
American Gas Association
Anadarko Petroleum Corporation
Apache Corporation
APS Technology, Inc.
At Balance Americas LLC
Baker Hughes Incorporated
Big Cat Energy Corp.
Bill Barrett Corporation
BJ Services Company
BlueView Technologies Inc.
BP America, Inc.
Brownstein Hyatt Farber Schreck, LLP
Cameron/Curtiss-Wright EMD
Campbell Applied Physics
Capstone Turbine Corporation
CARBO Ceramics, Inc.
Chesapeake Energy Corporation
Chevron Corporation
City of Sugar Land
Colorado School of Mines
Colorado Oil & Gas Association
ConocoPhillips Company
Conservation Committee of California Oil & Gas Producers
Consortium for Ocean Leadership
Consumer Energy Alliance
Correlations Company Inc.
CSI Technologies, Inc.
DCP Midstream, LLC
Cubility AS
DeepFlex Inc.
Deepwater Structures, Inc.
Deepwater XLP Technology, LLC
Det Norske Veritas (USA)
Devon Energy Corporation

Drilling & Production Company
EnCana Corporation
EnerCrest, Inc.
Energy Corporation of America
Energy Valley, Inc.
ExxonMobil Corporation
Gas Techology Institute
GE Oil & Gas
Granherne, Inc.
Greater Fort Bend Economic Development Council
Greensburg Oil, LLC
GSI Environmental, Inc.
Gunnison Energy Corporation
Halliburton
Harvard Petroleum Corporation
HIMA Americas, Inc.
Houston Advanced Research Center
Houston Offshore Engineering, LLC
Houston Technology Center
HW Process Technologies, Inc.
Idaho National Laboratory
Independent Petroleum Association of America
Independent Petroleum Association of Mountain States
Independent Petroleum Association of New Mexico
Integrated Ocean Drilling Program
Intelligent Agent Corporation
Interstate Oil and Gas Compact Commission
Jackson State University
Kongsberg Oil & Gas Technologies, Inc.
Knowledge Reservoir, LLC
Lawrence Berkeley National Laboratory
Lawrence Livermore National Laboratory
Leede Operating Company, LLC
Letton-Hall Group
Lockheed Martin Corporation
Los Alamos National Laboratory
Louisiana State University
MAP Royalty Inc.
Marathon Oil Corporation
Massachusetts Institute of Technology
Merrick Systems, Inc.
Mississippi State University
M&H Energy Services
Nalco Company
Nance Resources Inc.
NanoRidge Materials, Inc.

National Oilwell Varco, Inc
Natural Carbon, LLC
Nautilus International, LLC
Neptec USA
New England Research, Inc.
New Mexico Institute of Mining and Technology
Nexen Petroleum USA Inc.
NGAS Resources, Inc.
NGO Development Corporation
NiCo Resources
Noble Energy, Inc
Novatek, LLC
Oceaneering International, Inc.
Oklahoma Independent Petroleum Association
OTM Consulting Ltd.
Oxane Materials, Inc.
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Petris Technology, Inc.
Petrobras America, Inc.
Petroleum Technology Transfer Council
Pioneer Natural Resources Company
Propel, Inc.
Q O, Inc.
Quanelle, LLC
Quest Integrated, Inc.
Quest Offshore Resources, Inc.
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Robert L. Bayless, Producer LLC
Rock Solid Images
RTI Energy Systems
Sandia National Laboratories
Schlumberger Limited
Shell International Exploration & Production
Simmons & Company International
SiteLark, LLC
Southern Methodist University
Southwest Research Institute
Spatial Energy
Stanford University
Statoil
Strata Production Company
Stress Engineering Services, Inc.
Subsea Riser Products
Technip USA Inc.
Technology International Inc.

Tejas Research & Engineering, LP
Tenaris Global Services (USA) Corp.
Texas A&M University
Texas Energy Center
Texas Independent Producers and Royalty Owners Association
Texas Tech University
The Discovery Group, Inc.
The Fleischaker Companies
The Ohio State University
The Pennsylvania State University
The University of Kansas
The University of Oklahoma
The University of Texas at Austin
The University of Tulsa
The University of Utah
Titanium Engineers, Inc.
Total E&P USA, Inc.
Tubel Energy LLC
University of Alaska Fairbanks
University of Colorado at Boulder
University of Houston
University of Southern California
U.S. Geothermal Inc. (pending)
Vista Resources, Inc.
Versa Marine Engineering, LLC
Watt Mineral Holdings, LLC
Weatherford International Ltd.
WellDog
Western Standard Energy Corp.
West Virginia University
WFS Energy & Environment
The Williams Companies, Inc.
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Wright State University
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Brian Rovelli	TOTAL Exploration Production USA
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Dr. Charles Newell	Groundwater Services, Inc.
Øyvind Strøm	StatoilHydro
Dr. Mason Tomson	Rice University
Heidi VanGenderen	Worldwatch Institute

Appendix B: 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 (OCI) Plan will govern all potential conflicts associated with the solicitation and award process.

RPSEA was required to submit an OCI Plan, 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 Plan was reviewed by the DOE. After the DOE's comments and questions were addressed, a final OCI Plan was approved.

In addition, the contract between 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 Appendix B.1. Project selection will be through a fully open and competitive process. A two-step proposal process may be used where a technical volume

and cost summary is submitted prior to submission of a full-cost proposal and other associated detailed information. This two-step process eliminates unnecessary detailed cost development for proposals that are not selected after step one. 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.

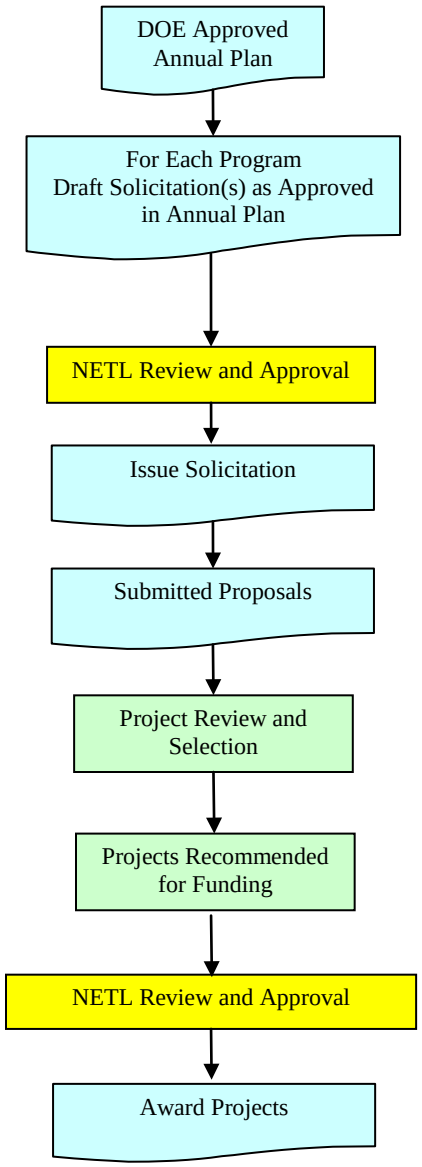

Figure Appendix B.1: Project Solicitation Process

D. Selection Criteria

The following general criteria (which will be more defined in the individual solicitations) will be used, as applicable, 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

Bidders 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 2011 solicitation(s) will be conducted after approval and posting of the 2011 Annual Plan and will remain open for a minimum of 60 days. Additional activities for RPSEA shown on the timeline in Table Appendix B.1 will be the active administration of all R&D awards, planning and development of the Program for 2012, and holding program-level technology transfer workshops.

2011 RPSEA Program Timeline		Aug 10	Sept 10	Oct 10	Nov 10	Dec 10	Jan 11	Feb 11	Mar 11	Apr 11	May 11	Jun 11	Jul 11	Aug 11	Sept 11
Month		*-2*	*-1*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
2011 Draft Plan Submitted (July 15, 2010)	♦														
Plan Published		♦													
Plan Approved						♦									
Obtain DOE Approval of Solicitation							♦								
Solicitation Open Period															
Proposal Evaluation and Selection															
DOE Approval												♦			
Contract Negotiation and Award															
Administer 2011Awards															
Administer 2007, 2008, 2009 & 2010 Awards															
Report Program Deliverables															
Conduct Technology Transfer Workshops & Activities															
Establish 2012 R&D Priorities & Annual Plan															

Table Appendix B.1: 2011 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 2011, $14.79 million per year will be available for the UDW, with approximately five to ten awards, and $13.73 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 $3.17 million per year will be available for the Small Producer Program. Approximately four to 12 awards are anticipated during fiscal year 2011. The

typical award is expected to have 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 the 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 Engineer, American Oil and Gas Reporter, World Oil, JPT*, etc.)
- Presentations at industry meetings by both RPSEA and NETL representatives, as appropriate given the timing of the solicitations
- Working with the various professional, industry, state, and national organizations to utilize their established networks

Appendix C: Technology Transfer Accomplishments

Technology transfer is foremost in the mission of RPSEA and its Section 999 Program. The ***Technology Transfer Policy*** states that RPSEA shall designate at least 2.5% of the amount of each award made under Section 999, EPAct 2005 for technology transfer and outreach activities. As interpreted by DOE, the amount of each award is the sum of the amount provided by RPSEA and the amount contributed as cost share. A portion of the 2.5% may be retained by RPSEA from each award for programmatic level technology transfer and outreach activities

The solicitations for all RPSEA program elements specify that some fraction of the 2.5% of contract funds designated for technology transfer will be set-aside for technology transfer activities as directed by RPSEA. This fraction is nominally 40% of the required 2.5% Technology Transfer reserve, or 1% of the total project value, but the exact amount may vary as specified in each contract. The intent is to ensure that some portion of the contract R&D funds designated for technology transfer are available for activities that cover the results of multiple R&D contracts in a coordinated fashion.

It is accomplished by several modes, including:

- Website enhancements and database population
- Workshops and forums
- RPSEA technical conferences
- Organization and facilitation of presentations and publications by multiple subcontractors
- Technical support
- Exhibition costs when supporting technology transfer
- Other technology transfer methods and opportunities

Many of these technology transfer mechanisms have become active as results have been generated by the Program. Other events, such as the workshops/forums and poster presentation opportunities at exhibitions or technical conferences, are ongoing and are anticipated to continue through the contractual period of the Program. Some of these events, such as a RPSEA Technical Conference, will require significant advance planning.

Below is a partial, though by no means exhaustive, list of technology transfer to date:

Date	Description	Program/ Contract No.	Event Title
Mar-09	Program Presentation	Overall Program	***Global New Energy Summit***, Santa Fe, NM
Apr-09	Program Presentation	Overall Program	***Center for International Energy & Policy Meeting***, Austin, TX
Apr-09	Program Presentation	Overall Program	***Small Producer Forum (mid-continent area needs)***, Wichita KS
Apr-09	Program Presentation	Overall Program	***Hart's Developing Unconventional Gas (DUG) Conference)***, Fort Worth, TX
Apr-09	Program Presentation	Overall Program	***Society of Petroleum Engineers Digital Energy Conference)***, Houston, TX
May-09	Clean Tech Panel Discussion Presentation: "*Traditional Energy – Natural Gas: A Bridge, Enabler and a Destination"*	Overall Program	***Clean Tech 2009 Conference***, George R. Brown Convention Center, Houston, TX
May-09	Session co-chair and Presentation: "*Delivering and Using Emerging Technology to Make Money in Exploration & Production"*	Overall Program	***Society of Petroleum Engineers Emerging Technology Workshop***, Houston, TX
Jun-09	Keynote presentation, Program	Overall Program	***Nalco Laboratories Open House***, Houston, TX
Jun-09	Program Presentation	Overall Program	***Independent Petroleum Association of America Mid-year Meeting***, Denver, CO
Jul-09	Environmental Panel discussion	Overall Program	***Colorado Oil and Gas Association Annual Meeting***, Denver, CO
Aug-09	Program Presentation	Overall Program	***Colorado School of Mines Produced Water Project Advisor/Stakeholders' Meeting***, Golden, CO
Sep-09	Lecture	Overall Program	***Energy Management Program***, Tulsa University, Tulsa, OK
Oct-09	Panel discussion	Overall Program	***Renewable & Sustainable Energy Institute***, University of Colorado at Boulder, Boulder, CO
Oct-09	Plenary presentation	Overall Program	***Society of Exploration Geophysicists 2009 Forum***, ?
Oct-09	Presentation	Overall Program	***Innovation Showcase***, Rice University, Houston, TX

Date	Description	Program/ Contract No.	Event Title
Oct-09	Panel discussion and presentation: ***"The Confluence of Drilling and Digital Energy"***	Overall Program	***Society of Petroleum Engineers Annual Technical Conference & Exhibition, Digital Energy Session***, New Orleans, LA
Nov-09	Presentation: "***Overview of RPSEA Onshore***	Overall Program	***Drilling Engineering Association Quarterly Meeting,*** Houston, TX
Nov-09	Presentation: ***"Natural Gas – An Unconventional Future with Efficiency & Renewables"***	Overall Program	***Oklahoma Wind Conference***, Oklahoma City, OK
Mar-10	Presentation: ***"Natural Gas – An Unconventional Future with Efficiency & Renewables"***	Overall Program	***Sustainable Opportunities Summit***, Denver, CO
Feb-09	Project progress presentations and discussion	Small Producer Program	***CO2 Forum***, Austin, TX
Jan-09	Project progress presentations and discussion	UDW Program	***UDW Met-ocean Technical Advisory Meeting, Bellaire, TX***
Jan-09	Project progress presentations and discussion	UDW Program	***UDW Drilling and Completions Technical Advisory Meeting, Bellaire, TX***
Jan-09	Project progress presentations and discussion	UDW Program	***UDW Geoscience – Reservoir Engineering Integrated Technical Advisory Meeting, The Woodlands, TX***
Mar-09	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting, Bellaire, TX***
Mar-09	Project progress presentations and discussion	UDW Program	***UDW Flow Assurance Technical Advisory Meeting, Bellaire, TX***
Mar-09	Project progress presentations and discussion	UDW Program	***UDW Subsea Systems Technical Advisory Meeting, Bellaire, TX***
May-09	Various (6) UDW Project progress poster presentations at RPSEA booth	UDW Program	***Offshore Technology Conference***, Houston, TX
May-09	OTC Panel Discussion Presentation: "*RPSEA: Ultra-Deepwater Program"*	UDW Program	***Offshore Technology Conference***, Houston, TX
May-09	OTC Panel Discussion Presentation: "*Technology Transfer and the Small Producer"*	UDW Program	***Offshore Technology Conference***, Houston, TX
May-09	Project progress presentations and discussion	UDW Program	***UDW Geoscience Technical Advisory Meeting, Bellaire, TX***
Jun-09	Project progress presentations and discussion	UDW Program	***UDW Reservoir Engineering Technical Advisory Meeting, Bellaire, TX***
Jun-09	Project progress presentations and discussion	UDW Program	***UDW Drilling & Completions Technical Advisory Meeting, Houston, TX***
Aug-09	Organized and Participated	UDW Program	***Composite Reinforced Drilling Risers Workshop***, Houston, TX

Date	Description	Program/ Contract No.	Event Title
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting, Bellaire, TX***
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Subsea Systems Technical Advisory Meeting, Bellaire, TX***
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Flow Assurance Technical Advisory Meeting, Bellaire, TX***
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Drilling & Completions Engineering Technical Advisory Meeting, The Woodlands, TX***
Sep-09	Project progress presentations and discussion	UDW Program	***UDW Systems Engineering Technical Advisory Meeting, Bellaire, TX***
Oct-09	Presentation: ***"Potential and Emerging Deepwater Completion and Intervention Technologies"***	UDW Program	***American Association of Drilling Engineers Emerging Completions Group Meeting***, Houston, TX
Oct-09	Project progress presentations and discussion	UDW Program	***UDW Met-ocean Systems Technical Advisory Meeting, Houston, TX***
Nov-09	Project progress presentations and discussion	UDW Program	***UDW Geoscience Technical Advisory Meeting, Houston, TX***
Oct-09	Project progress presentations and discussion	UDW Program	***Chevron Technology Showcase Meeting***, Houston, TX
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Drilling & Completions Engineering Technical Advisory Meeting, Bellaire, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Systems Engineering Technical Advisory Meeting, Bellaire, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Reservoir Engineering Technical Advisory Meeting, The Woodlands, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting, Bellaire, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Subsea Systems Technical Advisory Meeting, Bellaire, TX***
Dec-09	Project progress presentations and discussion	UDW Program	***UDW Flow Assurance Technical Advisory Meeting, Bellaire, TX***
Jan-10	Project progress presentations and discussion	UDW Program	***UDW Met-ocean Technical Advisory Meeting, Houston, TX***
Mar-10	Presentation: ***"A Different Approach to Oilpatch and R&D Technology Development"***	UDW Program	***PennWell Subsea Tieback Forum***, Moody Gardens Hotel, Galveston, TX
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Flow Assurance Technical Advisory Meeting, Bellaire, TX***
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Subsea Systems Technical Advisory Meeting, Bellaire, TX***

Date	Description	Program/ Contract No.	Event Title
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Floating Systems Technical Advisory Meeting, Bellaire, TX***
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Drilling & Completions Engineering Technical Advisory Meeting, Bellaire, TX***
Mar-10	Project progress presentations and discussion	UDW Program	***UDW Systems Engineering Technical Advisory Meeting, Bellaire, TX***
Apr-09	Project progress presentations and discussion	Unconventional Resources Program	***Unconventional Resources Annual Project Review Meeting***, Golden, CO
May-09	Presentation: "*Unconventional Gas Development in the Western Energy Corridor"*	Unconventional Resources Program	***RPSEA Forum***, Boise ID
May-09	Program Presentation	Unconventional Resources Program	***International Shale Gas Symposium***, Tuscaloosa, AL
Jun-09	Presentations on "*New Albany Shale"*	Unconventional Resources Program	***RPSEA Mid-continent Gas Shales Forum***, Chicago, IL
Jun-09	Session chair	Unconventional Resources Program	***Society of Petroleum Engineers Tight Sands Applied Technology Workshop***, San Antonio, TX
Sep-09	Session co-chair and panel discussion	Unconventional Resources Program	***PennWell Unconventional Gas Conference***, Fort Worth, TX
Oct-09	Presentation: ***"Reservoir Imaging in Difficult Environments"***	Unconventional Resources Program	***Industry Technology Facilitator Theme Day***, ?
Nov-09	Presentation	Unconventional Resources Program	***Geothermal Conference***, Southern Methodist University, Dallas, TX
Nov-09	Presentation	Unconventional Resources Program	***Oklahoma Independent Petroleum Association Unconventional Gas Forum***, Tulsa, OK
Nov-09	Presentation	Unconventional Resources Program	***EDGER Seismic Forum***, University of Texas at Austin, Austin, TX
Dec-09	Nano-Umbilical Workshop, Rice University, Houston, TX	07121-1302	***Ultra-high Conductivity Umbilicals***
Sep-09	Minerals Management Service Technical Review, New Orleans, LA	07121-1402a & b	***Ultra Deepwater Dry Tree System for Drilling and Production***
Sep-09	U. S. Coast Guard Technical Review, New Orleans, LA	07121-1402a & b	***Ultra Deepwater Dry Tree System for Drilling and Production***
Jan-10	Rigless Intervention with Coiled Tubing Workshop, Houston, TX	07121-1502	***Coil Tubing Drilling and Intervention System Using Cost Effective Vessel***

Date	Description	Program/ Contract No.	Event Title
Mar-10	Presentation: ***"Development of a Research Report and Characterization Database of Deepwater and Ultra-Deepwater Assets in the Gulf of Mexico, including Technical Focus Direction, Incentives, Needs Assessment Analysis and Concepts Identification for Improved Recovery Technology," 12th Annual US-Norway Technology Partnership Workshop, Houston, TX***	07121-1701	***Development of a Research Report and Characterization Database of Deepwater and Ultra-Deepwater Assets in the Gulf of Mexico, including Technical Focus Direction, Incentives, Needs Assessment Analysis and Concepts Identification for Improved Recovery Technology***
Sep-09	Functional Requirements – Basis of Design document (<5kW, 1 – 10 MW, 10 – 30 MW, and 30 – 200MW cases)	07121-1902	***Deep Sea Hybrid Power Systems***
Oct-09	Poster Session presentation: ***Society of Exploration Geophysicists Annual Meeting,*** Houston, TX	07121-2001	***Geophysical Modeling Methods***
Oct-09	Presentation: ***Society of Exploration Geophysicists Annual Meeting,*** Houston, TX	07121-2001	***Geophysical Modeling for Studying Acquisition and Processing Methods in the Deepwater Gulf of Mexico***
Mar-09	Final Report- feasibility of slot-cutting mechanisms for low perm formation stimulations	07122-07	***Novel Concepts for Unconventional Gas Development of Gas Resources in Gas Shales, Tight Sands, and Coalbeds***
Mar-09	Constructed website with gas sample information and protocols for Jonah and Piceance Basin fields	07122-09	***Application of Natural Gas Composition to Modeling Communication Within and Filling of Large Tight-Gas-Sand Reservoirs, Rocky Mountains***
Dec-09	Article: ***"New Albany Shale Gas Project; A Joint Industry Project Sponsored by Research***	07122-16	***New Albany Shale Gas Project***
Dec-09	Article: ***"Identification of microbial and thermogenic gas components from Upper Devonian black shale cores, Illinois and Michigan basins"***, **The American Association of Petroleum Geologists. (AAPG) Bulletin**, v. 92, no. 3 (Paper), Anna M. Martini, Lynn M. Walter, and Jennifer C. McIntosh – GTI.	07122-16	***New Albany Shale Gas Project***
Dec-09	Article: ***"New Albany Shale Gas Project; A Joint Industry Project Sponsored by Research Partnership to Secure Energy for America (RPSEA)"***, **International Oil and Gas Review**, 2009, volume 7, Salehi, Iraj and Angelica Chiriboga.	07122-16	***New Albany Shale Gas Project***

Date	Description	Program/ Contract No.	Event Title
Dec-09	Presentation: ***"Natural fractures in the New Albany Shale and their importance for shale gas production",*** **2009 International Coalbed and Shale Gas Symposium**, Tuscaloosa, Alabama, Gale, Julia F. W. and Stephen E. Laubach."	07122-16	***New Albany Shale Gas Project***
Dec-09	Presentation: ***"Economic Impact of Reservoir Properties and Horizontal Well Length and Orientation on Production from Shale Formations, Application to New Albany Shale"***, **2009 SPE Eastern Regional Meeting**, Charleston, West Virginia, USA, 23–25 September 2009, Dahaghi, A. Kalantari and S. D. Mohaghegh."	07122-16	***New Albany Shale Gas Project***
Sep-09	Presentation: ***"Top-Down Intelligent Reservoir Modeling of New Albany Shale"***, **2009 SPE Eastern Regional Meeting**, Charleston, West Virginia, USA, 23–25 September 2009, Dahaghi, A. Kalantari and S. D. Mohaghegh.	07122-16	***New Albany Shale Gas Project***
Dec-09	Presentation: ***"New Albany Shale Gas Research Project",*** **Annual AAPG Meeting**, Perry, Kent and Iraj Salehi.	07122-16	***New Albany Shale Gas Project***
Dec-09	Article: ***"New Albany Shale Gas Project; A Joint Industry Project Sponsored by Research Partnership to Secure Energy for America (RPSEA)"***, **International Oil and Gas Review**, 2009, volume 7, Salehi, Iraj and Angelica Chiriboga.	07122-16	***New Albany Shale Gas Project***
Mar-09	Presentation: ***"New Albany Shale Gas Project; A Joint Industry Project Sponsored by Research Partnership to Secure Energy for America (RPSEA)"***, **Spring Tropical Conference,** Philadelphia, PA, March 2009, Luffel, Don and Jim Lorenzen.	07122-16	***New Albany Shale Gas Project***
Apr-09	Presentation: ***"New Albany Shale Gas Project Update",*** **RPSEA Unconventional Resources Annual Progress Review Meeting**, Denver, CO, 2009, 14 Apr., Salehi, Iraj.	07122-16	***New Albany Shale Gas Project***

Date	Description	Program/ Contract No.	Event Title
Mar-09	Presentation: ***"New Albany Shale Gas Project, An Industry-RPSEA-GTI Cooperative Project",*** presented at **Society of Professional Well Log Analysts (SPWLA) 2009 Spring Topical Conference**, 2009, 17 Mar., Iraj Salehi, GTI, presentation slides.	07122-16	***New Albany Shale Gas Project***
Feb-09	Participation in **EDGERS conference**, UT Austin, Iraj Salehi discussed NEW Albany Shale project with graduate students. No formal presentation.	07122-16	***New Albany Shale Gas Project***
Sep-09	Discussion with New Albany shale geologist during the **Regional AAPG Conference**, Evansville, IN	07122-16	***New Albany Shale Gas Project***
Feb-10	Poster presentation: ***"New Albany Shale Gas Project",*** **NAPE Conference**, Houston, TX	07122-16	***New Albany Shale Gas Project***
Mar-09	Presentation: ***"New Albany Shale Gas Research Project",*** **World Gas Conference 2009**, Amsterdam, The Netherlands, Perry, Kent, and Iraj Saleji	07122-16	***New Albany Shale Gas Project***
Mar-09	Presentation: ***"New Albany Shale Gas Research Project",*** **World Gas Conference 2009**, Amsterdam, The Netherlands, Perry, Kent, and Iraj Saleji	07122-16	***New Albany Shale Gas Project***
Oct-09	Presentation: ***World Gas Conference***, Buenos Aires, Argentina (Best Project Award)	07122-16	***New Albany Shale Gas***
Mar-09	Constructed website with Conasauga area (AL) shale gas sample information	07122-17	***Geological Foundation for Production of Natural Gas from Diverse Shale Formations***
Oct-09	Poster Session presentation: ***Geological Society of America Annual Meeting***, Portland, OR	07122-17	***Geological Foundation for Production of Natural Gas from Diverse Shale Formations***
Oct-09	SPE ATCE 2009 124974 Predicting Relative-Permeability Curves Directly From Rock Images, New Orleans, LA	07122-22	***Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-22	***Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging***
Mar-10	A presentation at the Goldschmidt 2010 Conference has been accepted, http://www.goldschmidt2010.org/	07122-22	***Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging***

Date	Description	Program/ Contract No.	Event Title
1–3 March 2010	A paper authored by the team members has been submitted to the 2010 International Workshop on X-Ray CT for Geomaterials, New Orleans, LA	07122-22	***Petrophysical studies of unconventional gas reservoirs using high-resolution rock imaging***
Oct-09	Poster Session presentation: ***Society of Petroleum Engineers Annual Technical Conference & Exhibition,*** New Orleans, LA	07122-22	***Petrophysical Studies of Unconventional Gas Reservoirs Using High-resolution Rock Imaging***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-23	***A Self-Teaching Expert System for the Analysis, Design, and Prediction of Gas Production from Unconventional Gas Resources***
Sep-09	Presented papers SPE 124961-"A Numerical Study of Performance for Tight Gas and Shale Gas Reservoir Systems", New Orleans, LA	07122-23	***A Self-Teaching Expert System for the Analysis, Design, and Prediction of Gas Production from Unconventional Gas Resources***
Sep-09	Presented paper at the TOUGH Symposium 2009 in Berkeley, CA	07122-23	***A Self-Teaching Expert System for the Analysis, Design, and Prediction of Gas Production from Unconventional Gas Resources***
Sep-09	Presented papers SPE 124961-"A Numerical Study of Performance for Tight Gas and Shale Gas Reservoir Systems", New Orleans, LA	07122-23	***A Self-Teaching Expert System for the Analysis, Design, and Prediction of Gas Production from Unconventional Gas Resources***
Oct-09	Poster Session presentation: ***Society of Petroleum Engineers Annual Technical Conference & Exhibition,*** New Orleans, LA	07122-23	***A Self-Teaching Expert System For The Analysis, Design And Prediction Of Gas Production From Shales***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-29	***Gas Condensate Productivity in Tight Gas Sands***
Oct-09	A website has been created for the project for technology transfer: http://pangea.stanford.edu/ERE/research/suprid/projects/RPSEA/Gas_condensate_website2.htm	07122-29	***Gas Condensate Productivity in Tight Gas Sands***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-33	***Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs***
Oct-09	Poster Session presentation: ***Society of Petroleum Engineers Annual Technical Conference & Exhibition,*** New Orleans, LA	07122-33	***Advanced Hydraulic Fracturing Technology for Unconventional Tight Gas Reservoirs***

Date	Description	Program/ Contract No.	Event Title
Oct-09	Poster Session presentation: ***Society of Exploration Geophysicists Annual Meeting***	07122-33	***Advanced Hydraulic Fracturing Technology For Unconventional Tight Gas Reservoirs***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-35	***Optimizing Development Strategies to Increase Reserves in Unconventional Gas Reservoirs***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-38	***Improvement of Fracturing in Gas Shales***
Oct-09	A website has been created for the project for technology transfer: http://www.cpge.utexas.edu/ifgs/	07122-38	***Improvement of Fracturing in Gas Shales***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-41	***Improved Reservoir Access Through Refracture Treatments In Tight Gas Sands And Gas Shales***
Apr-10	Published a paper in SPE journal: "Quantifying transient effects in altered-stress refracturing of vertical wells"	07122-41	***Improved Reservoir Access Through Refracture Treatments In Tight Gas Sands And Gas Shales***
Feb-10	Presented a paper at the Formation Damage Control Symposium SPE 127986: "Optimizing Fracture Spacing and Sequencing in Horizontal Well Fracturing ", Lafayette, LA	07122-41	***Improved Reservoir Access Through Refracture Treatments In Tight Gas Sands And Gas Shales***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-44	***Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures***
Feb-10	SPE 127888: "Modeling Fluid Invasion and Hydraulic Fracture Propagation in a Naturally Fractured Rock, a Three Dimensional Approach", Lafayette, LA	07122-44	***Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures***
Feb-10	Display project material at AAPG 2010 Annual Convention in New Orleans, Louisiana, April 11-14	07122-44	***Gas Production Forecasting From Tight Gas Reservoirs: Integrating Natural Fracture Networks and Hydraulic Fractures***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	07122-45	***Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities***
Dec-08	The Utah Geological Survey created and is maintaining a Web site (http://geology.utah.gov/emp/shalegas/index.htm	07122-45	***Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration***

Date	Description	Program/ Contract No.	Event Title
			Opportunities
Apr-10	Presentation of AAPG Paper: "Manning Canyon Shale: Utah's Newest Shale Gas Resource", New Orleans, LA	07122-45	***Paleozoic Shale-Gas Resources of the Colorado Plateau and Eastern Great Basin, Utah: Multiple Frontier Exploration Opportunities***
Mar-09	Presentation:***"Is Reverse Osmosis Effective for Produced Water Purification: Viability and Economic Analysis,"*** SPE 115952, Muraleedaaran S., X. Li, L. Li, and R. Lee, prepared for Presentation at the 2009 SPE Western Regional Meeting Held in San Jose, USA, 24-26, March 2009.	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Dec-09	***"Purification of Produced Water by Ceramic Membranes: Material Screening,"*** Li L. and R. Lee, **Process Design and Economics, Separation Science and Technology**, 44: 3455-3484, 2009	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Feb-10	Technology Transfer – Presentation: "***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers"***, RPSEA Small Producer Technology Transfer Meeting, Midland, TX	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Apr-10	Article: ***"A Humidification Dehumidification Process for Produced Water Purification"***, X. Li, S. Muraleedaaran, L. Li, and R. Lee, **Desalination and Water Treatment**, in press – 2010.	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Mar-09	Presentation: ***"Reverse Osmosis Effective for Produced Water Purification: Viability and Economic Analysis"***, S. Muraleedaaran, X. Li, L. Li, and R. Lee, SPE 115952, **SPE Western Regional Meeting**, San Jose, CA, USA, 24-26, March 2009.	07123-05	***Cost Effective Treatment of Produced Water Using Co-Produced Energy Sources for Small Producers***
Sep-08	Technology Transfer - build website	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Mar-10	Technology Transfer - Semi-annual website updates	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-08	Presentation: "***Reducing Impacts of New Pit Rules on Small Producers"***, Independent Petroleum Association of New Mexico Annual Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***

Date	Description	Program/ Contract No.	Event Title
Feb-10	Presentation: "***Reducing Impacts of New Pit Rules on Small Producers"***, **RPSEA Small Producers' Conference**, Midland, TX	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-09	Article: "***Reducing Impacts of New Pit Rules on Small Producers"***, PRRC Review	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-08	Direct Contacts, Assessment: Independent Petroleum Association of New Mexico Annual Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-08	Data Presentation and Feedback: Independent Petroleum Association of New Mexico Annual Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Sep-08	Data Presentation and Feedback: New Mexico Oil Conservation Division	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Sep-08	Presentation: "***Reducing Impacts of New Pit Rules on Small Producers"***, **SPE Roswell Section Meeting**, Roswell, NM	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Oct-08	Data Presentation and Feedback: New Mexico Oil & Gas Association Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Nov-08	Second Data Presentation and Feedback: Project discussion, New Mexico Oil Conservation Division	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Oct-09	Second Data Presentation and Feedback: New Mexico Oil & Gas Association Annual Meeting	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Oct-08	Data Presentation and Feedback: Meeting with producers; Roswell, NM, and Artesia, NM	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Nov-08	Data Presentation and Feedback: Meeting with producers; Farmington, NM	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Jan-10	Presentation: "***Reducing Impacts of New Pit Rules on Small Producers"***, **SPE Four Corners Section Meeting**, Farmington, NM	07123-07	***Reducing Impacts of New Pit Rules on Small Producers***
Aug-09	Web page www.efdsystems.com	08122-35	***The Environmentally Friendly Drilling Systems Program***
Jan-10	Publication in Hart's E&P: "Cooperative Efforts Lead to Safer Operations"	08122-35	***The Environmentally Friendly Drilling Systems Program***

Date	Description	Program/ Contract No.	Event Title
Dec-09	"Drilling Advances: Is Green Drilling on the Horizon?" World Oil, December 2009,	08122-35	***The Environmentally Friendly Drilling Systems Program***
Dec-09	"Prevention Technology Can Help Drilling, Service Rigs to Minimize Environmental Footprint at the Source," Drilling Contractor, November/December 2009	08122-35	***The Environmentally Friendly Drilling Systems Program***
Mar-09	Systems Approach and Quantitative Decision Tools for Technology Selection in Environmentally-Friendly Drilling SPE-120848-PP 2009 SPE Americas E&P Environmental & Safety Conference, March, 2009, San Antonio, TX.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Dec-09	"Local Leaders' Perceptions of Energy Development in the Barnett Shale." *Southern Rural Sociology*24(1): 113-129.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Dec-09	"Public Perception of Desalinated Water from Oil and Gas Field Operations: Data from Texas." *Society and Natural Resources* 22(7): 674-885.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Apr-10	Presentation at RPSEA Unconventional Gas Conference 2010: Technological Keys to Unlocking Additional Reserves, Golden, CO	08122-35	***The Environmentally Friendly Drilling Systems Program***
Apr-10	Luncheon keynote address at the annual AADE Wednesday April 7th (Low Impact drilling talk titled Environmentally Friendly Drilling is not an Oxymoron).	08122-35	***The Environmentally Friendly Drilling Systems Program***
Mar-10	Presentation to Houston Association of Professional Landmen.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Dec-09	Best Practices Website is http://www.oilandgasbmps.org/	08122-35	***The Environmentally Friendly Drilling Systems Program***
Nov-09	Presented a paper titled "Public Opinion on Exploration and Production of Oil and Natural Gas in Environmentally Sensitive Areas" at the 16th International Petroleum & Biofuels Environmental Conference.	08122-35	***The Environmentally Friendly Drilling Systems Program***
Oct-09	Poster Session presentation: ***Society of Petroleum Engineers Annual Technical Conference & Exhibition,*** New Orleans, LA	08122-35	***The Environmentally Friendly Drilling Systems Program***

Date	Description	Program/ Contract No.	Event Title
Oct-09	Poster Session presentation: ***Geological Society of America Annual Meeting***, Portland, OR	08122-40	***Stratigraphic Controls On Higher-Than-Average Permeability Zones In Tight-Gas Sands, Piceance Basin***
Feb-10	Created a project webpage http://www.beg.utexas.edu/frac/geophysics.php	08122-53	***Multiazimuth Seismic Diffraction Imaging for Fracture Characterization in Low-Permeability Gas Formations***
Oct-09	Poster Session presentation: ***Society of Exploration Geophysicists Annual Meeting***	08122-53	***Multi-azimuth Seismic Diffraction Imaging for Fracture Characterization in Low-Permeability Gas Formations***
Oct-09	Poster Session presentation: ***Society of Exploration Geophysicists Annual Meeting***	08122-55	***Evaluation of Fracture Systems and Stress Fields Within the Marcellus Shale and Utica Shale and Characterization of Associated Water-Disposal Reservoirs: Appalachian Basin***
Oct-09	Residual Oil Zone Workshop, Midland, TX	08123-19	***Commercial Exploitation and the Origin of Residual Oil Zones: Developing a Case History in the Permian***

Table Appendix C.1: Technology Transfer

Acronyms

AAPG	American Association of Petroleum Geologists
AUV	Autonomous Underwater Vehicles
BOD	Board of Directors
BOEPD	Barrels Oil Equivalent Per Day
COGA	Colorado Oil & Gas Association
DAP	Draft Annual Plan
DEA	Drilling Engineering Association
DEEPSTAR	DeepStar Consortium
DOE	Department of Energy
DOT	Deep Offshore Technology
DUG	Developing Unconventional Gas
E&P	Exploration and Production
EAG	Environmental Advisory Group
EFD	Environmentally Friendly Drilling
EIA	Energy Information Administration
EOS	Equations of State
EPAct	Energy Policy Act 2005
FA	Flow Assurance
FACA	Federal Advisory Committees
FLIPPA	Florida Independent Petroleum Producers Association
GOM	Gulf of Mexico
GTI	Gas Technology Institute
HPHT	High Pressure/High Temperature
HTC	Houston Technology Center
IADC	International Association of Drilling Contractors
IOGCC	Interstate Oil and Gas Compact Commission
INGAA	Interstate Natural Gas Association of America
IPAA	Independent Petroleum Association of America
IPAMS	Independent Petroleum Association of Mountain States
IPANM	Independent Petroleum Association of New Mexico
ITF	United Kingdom's Industry Technology Facilitator
KMD	Knowledge Management Database
LOGA	Louisiana Oil & Gas Association
MARK	Mid-America Regulatory Conference
MMBOE	Million Barrels Oil Equivalent
MMP	Minimum Miscibility Pressure
MMS	Minerals Management Service
MODU	Mobile Offshore Drilling Unit
MPD	Managed Pressure Drilling

NAPE	North American Prospect Expo
NETL	National Energy Technology Laboratory
NGO	Non-Governmental Organization
NMOCD	New Mexico Oil Conservation Division
NMT	New Mexico Institute of Mining and Technology
NPC	National Petroleum Council
NRDC	National Resources Defense Council
O&G	Oil and Gas
OCI	Organizational Conflict of Interest
OCS	Outer Continental Shelf
OTC	Offshore Technology Conference
OIPA	Oklahoma Independent Petroleum Association
PAC	Program Advisory Committee
PGC	Potential Gas Committee
PRAC	Canada's Petroleum Research Atlantic Canada
PTTC	Petroleum Technology Transfer Council
PVT	Pressure, Volume and Temperature
R&D	Research and Development
RAG	Research Advisory Group
RFP	Request for Proposal
RPSEA	Research Partnership to Secure Energy for America
SAC	Strategic Advisory Committee
SAIC	Science Applications International Corporation
SCNGO	Strategic Center for Natural Gas and Oil
SEG	Society of Exploration Geophysicists
SOE	Secretary of Energy
SPE	Society of Petroleum Engineers
TAC	Technical Advisory Committee
TCF	Trillion Cubic Feet
TRL6	Technology Readiness Level 6
UDAC	Ultra-Deepwater Advisory Committee
UDW	Ultra-Deepwater Program
URTAC	Unconventional Resources Technology Advisory Committee
xHPHT	Extreme High Pressure/High Temperature
YPE	Young Professionals in Energy