

# Petroleum Environmental Solutions Product Plan 2003



**October 2002**

**"America must have an energy policy that plans for the future, but meets the needs of today. I believe that we can develop our national resources and protect our environment."<sup>1</sup>**

**President George W. Bush**

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<sup>1</sup> Bush, George W, *National Energy Policy Document*, May 2001, page ix

## **Product Team Members**

The team consists of seven members and six ad hoc members. The members have a more direct role while the ad hoc members are advisory and provide assistance in special cases.

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## **EXECUTIVE SUMMARY**

The Petroleum Environmental Solutions (PES) Product Line is unique among product lines at the National Energy Technology Laboratory. PES is the result of careful planning to optimize the use of Government resources on environmental issues in the Fossil Energy Oil and Gas Programs. This product line addresses environmental issues related to:

- Gas exploration and production
- Oil exploration and production
- Oil processing

Our mission is to improve environmental performance in the oil and gas industry, and reduce the cost of effective environmental protection to maximize the recovery and processing of domestic resources.

The PES Product Line, formed in 2001, is designed to take advantage of synergies in environmental research while maintaining areas of specific focus from each of the areas listed above. For instance, all of the components have water related issues. Some of them are specific to oil or gas, upstream or downstream. However, many of the issues are interrelated. The new product line can be of maximum benefit in handling these common issues. They can be addressed effectively with a minimum of resources.

Because reliable domestic energy supplies are vital to the Nation's economy, this program is designed to enhance the efficiency and environmental performance of domestic oil and gas operations. It is conducted in partnership with industry, universities, National Laboratories, State and Local governments, and other organizations. Private sector participation is emphasized through industry cost-sharing with individual companies and consortia to ensure market relevance and to facilitate the transfer of technology to the private sector while leveraging Federal R&D investment.

### **Drivers**

- Our Nation needs a reliable domestic supply of affordable oil, natural gas, and petroleum products.
- Protecting the environment is vital to national and global prosperity.
- Environmental regulations have raised the cost of production and refining as well as limiting access to new resources.
- Future regulations will further increase costs.
- Rising costs of environmental compliance could accelerate the decline in U.S. oil production and limit the availability of natural gas.

## **Goals**

- Enable industry to reduce compliance costs and improve environmental performance.
- Expand the capabilities of State and Federal government to make more cost effective, risk based regulatory decisions - promoting sound science and common sense.
- Improve communication and technology transfer among industry, government, Tribes, and the public toward balancing national energy, economic, and environmental objectives.

## **Strategies**

- Develop new, lower cost technologies for refining heavier crudes.
- Develop new, lower cost environmental compliance technologies.
- Promote dialogue, education, collaboration, and innovative problem solving.
- Work with States and Federal agencies to streamline existing regulations and practices.
- Develop credible scientific and technical information to serve as the basis for risk-based regulation and compliance, including economic and energy impact analyses and tools for regulators to make risk-based decisions.
- Promote sound environmental practices through outreach and assistance to industry.
- Collaborate with State, Federal agencies, and industry to leverage efforts to accelerate progress toward reducing the costs of effective environmental protection.

## **Product Line Summary**

Working with industry, DOE's Office of Fossil Energy is helping to ensure that environmental protection approaches make technical, environmental, and economic sense. DOE is well positioned between industry and regulators to champion balanced, cost effective approaches to environmental protection. DOE's environmental program pursues improvements to the regulatory process, supports development of new technologies, and exercises key responsibilities for energy policies that encourage efficient recovery and ensure adequate, secure energy supplies.

To support more informed regulatory decision making, DOE facilitates dialogue among Federal officials, State regulators, industry personnel, and other stakeholders. Through its program activities, DOE can provide assessments of costs or risks, lending an independent voice to the debate. DOE also characterizes problems and possible alternative solutions, catalyzing and contributing to the process of achieving common sense approaches.

Many times, more cost-effective environmental approaches hinge on the development of new technologies. DOE supports such development, focusing on beneficial technology investments that could not be justified by a single company or small group of companies. Some of these technologies have longer-term payoffs or high risks; others may have

widely diffused benefits that a single company could not capture, but that will accrue to the Nation.

Working with industry, the Petroleum Environmental Solutions Product Team is helping to ensure that environmental protection approaches make technical, environmental, and economic sense. The Program is well positioned between industry and regulators to champion balanced, cost effective approaches to environmental protection. The program pursues improvements to the regulatory process, supports development of new technologies, and exercises key responsibilities for energy policies that encourage efficient recovery, increase domestic refining capacity, and ensure adequate, secure and affordable energy supplies.

The benefits for the U.S. public from the Petroleum Environmental Solutions Product Line are a more competitive, economically viable U.S. energy industry that can supply an adequate amount of energy while simultaneously reducing environmental risks associated with oil and gas production and processing. Lower costs and improved environmental protection technologies will result in more of America's oil being produced and lead to a better quality of life for America's citizens.

Funding for environmental research activities will bring credible scientific information and advanced technologies to address the environmental issues that have been identified as highest priority by industry and regulators. The program will primarily focus on air emissions, produced water treatment technologies, bio-processing, refining heavy crudes, access to Federal resources, and waste management. The program combines risk assessment, technology development, regulatory streamlining, impact analysis, and dialogue among affected parties to balance the Nation's need to develop its energy resources with its environmental values.

## 1.0 PRODUCT DESCRIPTION AND STATUS

### *Building Synergy in Oil and Gas Environmental Program*

The Petroleum Environmental Solutions (PES) product line is the result of careful planning to optimize the use of Government resources on environmental issues in the Fossil Energy Oil and Gas Programs. This product line addresses environmental issues related to:

- Gas exploration and production
- Oil exploration and production
- Oil processing

The PES Product Line, formed in 2001, is designed to take advantage of synergies in environmental research while maintaining areas of specific focus from each of the areas listed above. For instance, all three components have water related issues. Some of them are specific to oil or gas, upstream or downstream. However, many of the issues are interrelated. The new product line can be of maximum benefit in handling these common issues. They can be addressed effectively with a minimum of resources.

The PES Product line has the advantage of examining all oil and gas environmental issues, determining where funding can be optimized, and ensuring that issues are resolved. The whole is now more than the sum of the parts.

## 2.0 MISSION

***Our mission is to improve environmental performance in the oil and gas industry, and reduce the cost of effective environmental protection to maximize the recovery and processing of domestic resources.***

In the National Energy Policy, President Bush points out that energy development and environmental quality are compatible. He stated, “America must have an energy policy that plans for the future, but meets the needs of today. I believe we can develop our natural resources and protect our environment.”<sup>2</sup> The National Energy Policy stresses the importance of developing U.S. energy sources. It also provides guidance in areas that need to be emphasized.

Rita Bajura, Director of NETL, has noted that, “NETL’s primary mission is to assure that U.S. fossil energy resources can meet increasing demand for affordable energy without compromising the quality of life for future generations of Americans.”<sup>3</sup> The PES Product Line directly supports the need to maintain the environment for future generations while providing energy for today’s needs.

The PES Product Team combines the environmental programs for the oil and gas programs, both upstream and downstream, under one umbrella. This combined program assures a cost effective approach to common environmental issues. Representatives on the team from each program will help ensure that specific issues are also handled effectively.

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<sup>2</sup> Bush, George W, *National Energy Policy Document*, (May 2001), page ix.

<sup>3</sup> Bajura, Rita, *Welcome Statement on, National Energy Technology Laboratory website*, [www.netl.doe.gov](http://www.netl.doe.gov) (October 2002).

### **3.0 PRODUCT VISION**

The vision of the PES Product Team is a domestic oil and gas resource at its fullest potential, contributing to the Nation's energy security, economic growth, environmental quality, and scientific and technological leadership. A key contributing factor in the success of the Program is the customer-driven approach to public-private partnerships, which contribute to the development of technologies, regulatory streamlining, and policies that support increased oil supplies. The goals of the Program are designed to enhance the efficiency and environmental quality of domestic oil and gas operations. R&D efforts are conducted in partnership with universities, National Labs, industry, and State and Local governments. Private sector participation is emphasized through cost-sharing to ensure relevance and encourage technology transfer. In this way, the program leverages the Federal R&D investment.

As we continue to develop the program, the PES Product Team envisions and will take actions to provide assurance that:

- Total Maximum Daily Load (TMDL) regulations are implemented in a way that accurately reflects the contributions of the oil and gas industry.
- Changes in permitting processes allow the domestic refining industry to increase capacity through design changes or building new refineries while continuing to protect the environment.
- The Program provides the basic scientific data needed to ensure that the NEPA process goes smoothly while ensuring environmental protection.
- Increased access to resources on Federal lands and improved environmental technologies that allow cost-effective development in sensitive environments, will contribute to meeting natural gas demand and to reducing the decline in domestic oil production.
- Improved technologies for produced water management have converted a waste stream into a resource in many areas and, the cost of managing produced water has been significantly reduced in all areas.
- Risk-based decision making will be the normal accepted method of operation by both regulators and industry so that the supply of energy can be maintained and the environment protected.

#### **4.0 GUIDING STRATEGIES AND MANDATES**

The PES Product Team conducts its activities in accordance with the following external mandates:

- Appropriations and authorizations by Congress to the Department of Energy.
- The Report of the National Petroleum Council (NPC) which identified major long-term issues impacting the Nation's ability to meet the growing energy demand.
- The PES Product Team supports the following recommendations from the National Energy Policy (NEP):
  - Promote enhanced oil and gas recovery from existing wells through new technology (Ch 5).
  - Improve oil and gas exploration technology through continued partnership with public and private entities (Ch 5).
  - Use technological advances to better protect our environment (Ch 4).
  - Rationalize permitting for energy production in an environmental sound manner (Ch 3).
  - Take steps to ensure that America has adequate refining capacity (Ch 7).
  - Review new source regulations on the impact on refinery capacity (Ch 7).
- The activities of the PES Product Team are performed in compliance with, and designed to help industry comply with the following environmental regulations:
  - The National Energy Policy Act (NEPA)
  - Resource Conservation and Recovery Act (RCRA)
  - Clean Water Act
  - Clean Air Act
  - Safe Drinking Water Act
  - National Historic Preservation Act
  - Emergency Planning and Community Right-to-Know Act (EPCRA)
  - Clean Skies Initiative

The PES Product Team recognizes its responsibility to track performance relative to stated goals in accordance with:

- Government Performance and Results Act (GPRA)
- Internal measurement programs including the OMB Score Card, The Joule Database, the Program Review and Analysis Technique (PART)
- NETL Institutional Plan
- NPTO Operations Plan.

## 5.0 PORTFOLIO MAPPING

A portfolio analysis was conducted in FY2002 to determine the nature of the current program. A key goal of the PES Product Team is to ensure that the projects that comprise the program reflect the program priorities established during Team planning sessions and to have a solid mix of projects of varying size, nature, and geography. In addition, the portfolio analysis addresses how well current activities are addressing the goals of the program. Key findings include:

- *Projects clearly reflect program priorities:* In planning sessions, issue areas were assigned a priority of 1, 2, or 3 (with 1 being the highest) based on a combination of industry input and programmatic factors. All of the priority 1 issues are being addressed, with 86% of the funding going toward priority 1 and 2 issues. Funding for priority 3 issues is limited to closing out issue areas where work is being completed on former high priority issues.
- *Projects are well distributed geographically:* Twenty states and the District of Columbia have PES projects. In terms of congressional districts, projects are being conducted in 42 of the 436 congressional districts. The largest number of projects has been awarded in Texas, and the most funding has been awarded in the state of California. Other states with relatively high levels of funding include Oklahoma and Montana.
- *Project size is well distributed:* Projects range in size from \$5K to \$915K per year with durations ranging from one to three years. The median project size is \$200K per year and the median project duration is two years.

## 6.0 SITUATION ANALYSIS

While environmental activities are an important part of all Product Lines within the Oil and Gas Programs, the PES team specifically focuses on environmental aspects of oil and gas E&P and processing. In particular, the exploration and production programs of each the oil and the gas programs devote considerable effort to integrating environmental protection into the technologies they develop. Both of these programs have developed situational analyses for their product plans. (See *Natural Gas Exploration, Production and Storage Fiscal Year 2003 Product Plan* and *Oil Exploration and Production Product Plan for FY 2003.*) Since the PES is integral to both areas, some of the information for both the Oil and the Gas programs will be included here for overall context. However, the PES analysis will focus on environmental aspects of the petroleum industry.

This situation analysis gives a snapshot of:

- Today's petroleum industry with an emphasis on trends in the environmental area
- Logical role of the PES product line
- What we are doing
- Stakeholders, both internal and external
- How we see the future

## **6.1 The U.S. Petroleum Industry—2002 Snapshot**

**6.1.1 Industry consolidation and its consequences.** The last decade has shown accelerated transformation in all business sectors of the U.S. petroleum industry. Historical major oil producers (majors) have merged to become super-majors, many now headquartered outside the U.S. Smaller producing companies have merged, purchased resources and become large independents.

**6.1.1.1 Upstream Oil and Gas.** Larger companies focus on prospects with larger potential, mostly outside the U.S. or in deep waters of the Gulf of Mexico. This has left opportunities for smaller companies with less economic resources, less technical expertise and a lower economic hurdle (minimum rate of return). Smaller exploration and production companies have picked up many leases previously operated by majors in the lower 48-states and shallow waters in the Gulf of Mexico. Many of these properties have declining production, dispersed rather than concentrated lease ownership, and they have environmental liabilities. Small producers often lack the investment capital and technology needed for technology development and enhanced resource recovery. The smaller producers also tend to have a different business plan; rather than extending resource life, they often ride out the field's normal decline curve.

**6.1.1.2 Downstream Oil.** In the last three years over half the U.S. refinery capacity has been traded, bought, or sold (both majors and independent refiners). Many small refineries (generally older and inland) have closed because they 1.) were not profitable and/or 2.) could not meet increasingly stringent environmental standards for fuel quality and reduced plant emissions. Still, refiners have kept up with demand through improved efficiency and the addition of new processing units at other refineries. Refineries are now operating at more than 92.6% capacity. This number changes monthly; and it has been above 95% within the last three years. This is really beyond design capacity when scheduled maintenance shut downs are considered. In the past two years, a critical point has been reached: small increases in efficiency can no longer be expected to keep up with demand as has been the case in prior years. The result is that the U. S. has been losing and is expected to lose even a greater amount of refining capacity.

The last new grass roots refinery in the U.S. was built 1978. In 1980, over 300 refineries were operating in the United States and in 2002 the number had declined to 141 with 6 of those up for sale. In introducing his energy policy, President Bush noted that, "We are not just short of oil, we're short of the refineries that turn oil into fuel. So while the rest of our economy is functioning at 82 percent of capacity, our refineries are gasping at 96 percent capacity."

The two major things that work against construction of new refineries are:

- Compliance with the environmental regulations and obtaining permits for new units has become increasingly expensive and complex , and
- ROI for refineries has traditionally been low; capital investment to meet environmental regulations is seldom recouped.

**6.1.2 Environmental regulations.** In recent decades, environmental concerns have led to numerous Federal and State regulations being imposed on oil and gas operations in the United States. While these regulations provided the framework for many environmental improvements by the industry, compliance has become costly and increasingly complex. Based on 1996 data, the petroleum industry, including refining, spends as much on environmental protection as it spends searching for new domestic supplies of oil and natural gas - 9 cents for each gallon of gasoline Americans buy. That amounts to \$10.6 billion a year, nearly twice the budget of the U.S. Environmental Protection Agency

**6.1.2.1 Upstream Oil and Gas** The higher cost of meeting environmental regulations places a substantial economic burden on industry. The burden is magnified by the economically marginal condition of a large percentage of domestic production and refining industry. Over two-thirds of domestic oil wells produce, on average, less than three barrels per day, making them highly sensitive to increasing costs. Modest increases in cost can cause marginal wells to be plugged and abandoned, permanently cutting off access to oil and gas resources left in the ground. Premature abandonment of wells and forgone exploration and production threaten to increase our Nation's reliance on oil imports, and to reduce the supply of natural gas at a time when its use is being promoted as a partial solution to such environmental concerns as acid rain and global warming.

**Downstream Oil.** The cost of environmental regulations is now undercutting the refining industry's leading edge in oil processing technology and its competitiveness in a world market. According to a recent study by the National Petroleum Council, environmental compliance costs are projected to exceed \$150 billion between 1991 and 2010, including more than \$36 billion for capital equipment to meet current regulations. Costs also include an estimated \$5 to \$12 billion to meet expected regulations for fine-size particulate matter (PM<sub>2.5</sub>), ozone, sulfur, and nitrogen. This will severely limit available funds to develop and demonstrate new technology and equipment. Since 1994, the refining industry has committed over \$20 billion to capital equipment for improving environmental performance. Such equipment has absorbed between 75 and 90 percent of total capital expenditures to meet environmental regulations, especially the Clean Air Act Amendments of 1990.

New transportation fuel requirements are forcing the industry to make expensive changes to existing refineries. At the same time, the crude oils coming into the refineries are heavier and more expensive to refine. On top of this, compliance with the environmental regulations that govern the operation of the refineries has become increasingly more expensive and complex. In some cases, refiners have difficulty getting the environmental

permits they need in order to modify plant to meet the new environmental requirements for the fuels that they produce.

**6.1.3 Access to Federal Lands.** Development of oil and gas resources on Federal Lands and development of coal bed methane in the West are the most promising approaches for significant near-term increases in domestic production. The technologies and the resources are fairly well known, but environmental concerns are restricting both.

Public support for environmental issues continues to grow: In the past year these concerns were expressed in:

- Opposition for drilling in ANWR,
- Public support for drilling bans offshore Florida, California, and the East Coast, and
- Renewed restrictions on seismic data acquisition in both the Gulf of Mexico and the Four Corners region

A sizable segment of society remains opposed to development of any kind, especially in environmentally sensitive locations. They provide a stiff challenge to anyone seeking further access to public lands. The public is not generally aware of advances in production technology that have resulted in significantly smaller drilling footprints and geologic knowledge of oil fields that require fewer wells to be drilled to produce the same amount of petroleum.

## **6.2 Internal Situation Analysis**

Recent political and organizational changes provide additional opportunities and challenges for the PES Product team:

- The PES program has had consistent political backing as evidenced by a relatively stable funding profile throughout the budgeting processes, while other parts of the program have experienced cuts or serious attempts at cuts.
- NPTO's merger into NETL has facilitated closer coordination with the Gas Exploration and Production (GEP) program.
- The PES team needs to continue communication with the Oil Exploration and Production product team and strengthen that with the GEPS team.
- The recent creation of the Environmental Product Manager position has resulted in combining the planning functions for the upstream and downstream environmental programs for oil and gas. This allows for closer coordination of efforts on environmental issues that impact oil and gas. Projects can be both more productive and cost efficient; repetitive research will be limited by this approach.
- The team has limited in-house R&D capabilities. However, the PES funds NETL's Office of Science and Technology (essentially in-house research) to conduct research at NETL that supports the team's goals. The PES team needs to ensure that their work is responsive to team goals and is held to the same high standards we expect of other projects.

- Support Contractors assist the PES team in the collection and analysis of data that support program planning and management.
- All parts of the organization have placed increased emphasis on metrics. Responding to the various metrics exercises has required large blocks of time. The team needs to look at this issue to make responses meaningful, but less time consuming.
- It is difficult to address new topics/concerns. There is a long lead-time in the budgetary process, and there are limited funds to work on issues that arise.
- Reporting of project results internally through the PROMIS has started. While this should ultimately prove to be a benefit, the implementation phase is not yet complete.

### 6.3 Stakeholder Analysis

The PES Product Team recognizes two groups of stakeholders: Internal Stakeholders and External Stakeholders.

Internal Stakeholders	External Stakeholders
<ul style="list-style-type: none"> <li>• PES Product Team</li> <li>• Oil Exploration and Production Program</li> <li>• Gas Exploration, Production and Storage Program</li> <li>• DOE Senior Management</li> <li>• NETL Management</li> <li>• Other NETL Divisions</li> <li>• Site Support Contractors</li> </ul>	<ul style="list-style-type: none"> <li>• Public</li> <li>• Industry</li> <li>• Academia</li> <li>• Associations</li> <li>• Government</li> </ul>

#### 6.3.1 Internal Stakeholders

The PES Team is responsible for the direction of the environmental programs in Fossil Energy’s Oil and Gas Programs. In order to be effective, they need to:

- Be in close contact with the teams representing other NETL programs. At present, good communication exists on an informal basis, and some of the PES Team members are on other Product Teams. Ties are closest with the Oil Exploration and Production Product Team.
- Follow the direction of DOE and NETL management.
- Help make DOE and NETL management as effective as possible by being responsive to their needs and pointing out issues of importance.
- Use site support contractors productively.

#### 6.3.2 External Stakeholders

**The Public:** The Public is the primary stakeholder for the PES program. It is their money that is being spent, and all efforts are designed to produce effects for the common good. The public expects the Product Team to invest their tax dollars wisely in an effort to ensure future energy security at acceptable prices, while maintaining and/or improving environmental quality. These stakeholders require safe, environmentally friendly projects and enough information about the product line to make fair and educated

judgments about the associated benefits. All work within the Product Team must ultimately serve the needs of these stakeholders.

**Industry:** The PES program enjoyed strong industry support during FY2002. Industry participation included direct involvement in research, participation in roadmapping sessions, cooperative funding, evaluation of projects (NGOTP), and workshop attendance.

**Academia:** Academic stakeholders primarily perform research. They are often leading experts in a particular field of study. Most academic efforts are small-scale and cost-effective. They have positive political benefits, increase the pool of available talent, and generally result in publications/presentations that can assist in developing new business and function as positive press for the Program.

**Associations:** The PES team works with organizations and professional societies to make sure that the research in the environmental area is productive and applicable. These organizations include the Interstate Oil and Gas Conservation Commission (IOGCC), the American Petroleum Association (API), the Society for Petroleum Engineers (SPE), the Gas Technology Institute (GTI), the Petroleum Environmental Research Forum (PERF), the National Petroleum Refiners Association (NPRA), and the Groundwater Protection Council (GWPC). They provide publications and conferences that are a major outlet for communication of R&D results, general program outreach, and networking.

**Government:** The U.S. Congress and the Office of Management and Budget (executive branch) are the major decision-makers with control over the size, focus and content of the team's budgets. These stakeholders need assurance that the PES program is well managed, addresses national priorities, and is achieving intended and quantifiable results. The PES Product Team works with several State and Federal Government entities environmental issues. Agencies where there are collaborative efforts include the Minerals Management Service (MMS), the Bureau of Land Management (BLM), the United States Geological Survey (USGS), the Energy Information Administration (EIA), the Environmental Protection Agency (EPA), and the Forest Service.

**DOE's National Laboratories** are significant participants in PES-funded R&D. The labs work with industry through the Natural Gas and Oil Technology Partnership (NGOTP). The Partnership is an excellent way to work with the labs and ensures industry participation and direction. The PES team will continue to build the success of this partnership.

## **7.0 PLANNING ASSUMPTIONS**

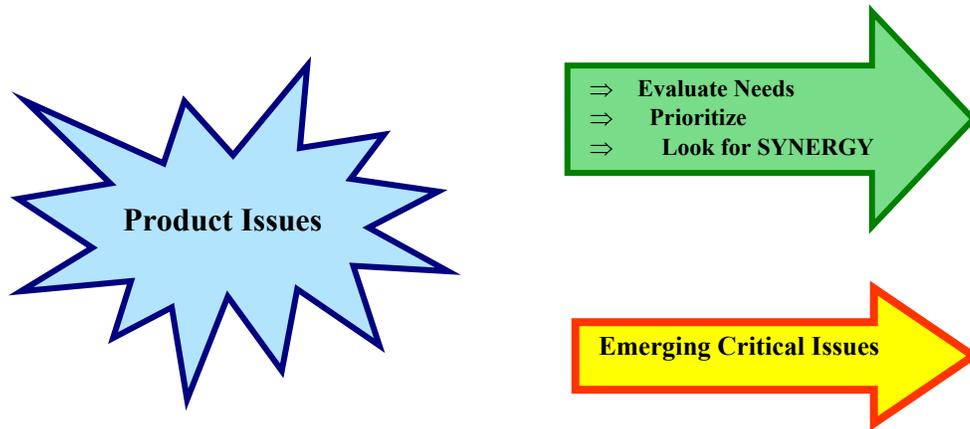
- Oil, gas and fuel prices will continue to be volatile, but within defined ranges.
- There will not be any significant legislative actions that increase environmental requirements. There will, however, continue to be a general tightening of environmental regulations and enforcement at the state and Federal level.
- Domestic production will continue to be more and more dependent upon smaller independent operators. These smaller companies will not have the resources to pursue technology development or to purchase research that is necessary to fully develop the resources.
- Demand for natural gas, oil, and gasoline will continue to increase. Development of new technologies and alternate fuels will continue but will not significantly reduce demand of conventional petroleum.
- The push for increased domestic production will require a significant increase in production from Federal lands.
- Coal Bed Methane production will be a key component of meeting the nation's demand for natural gas.
- Domestic crude oil will continue to be increasingly difficult to refine, requiring new processing technologies to make these heavier, higher sulfur crudes economic and a part of our energy supply.
- Tensions in the Middle East will continue, making domestic production and refining of Western Hemisphere crude oil more important to our Nation's energy security.

## 8.0 GOALS, STRATEGIES, AND OBJECTIVES

### 8.1 Strategy Overview.

Environmental issues and their relative importance can change fairly quickly. There are some long-term issues, those that arise suddenly, and those that become less urgent. The PES Product Team will optimize efforts on the long-term issues while maintaining the flexibility to work on some issues as the need arises. Issue areas will be periodically examined to ensure that the level of effort is appropriate and on-track.

#### Two Paths for Handling Product Issues



Program adjustments are a critical part of spending the Government's money effectively. In some cases, program focus will need to be redirected. Some areas will require additional attention and resources. Other areas will be terminated because work is complete, becomes obsolete, or is off-track. A periodic examination of priorities is planned to ensure that environmental programs are adequately addressing the most important issues.

#### 8.1.1 Strategic Planning Process

Environmental issues are generally driven by legislative and regulatory bodies (both State and Federal) and, as such, can be extremely volatile. To accommodate this volatility, a major review of program priorities is conducted each year with an ongoing stakeholder in-put process to identify issues that may arise suddenly during the year.

During the annual review, the PES Product Team will use the following process to determine high priority issues and how to handle them effectively.

► **Determine Priorities.** Throughout the year, the PES product Team actively solicits input from stakeholders, including various industry segments, State and Federal oil and gas regulators, EPA, and environmental groups. This input is used to identify emerging issues and to get a sense of the relative priority that both on-going and emerging issues have for the various stakeholders.

These stakeholder priorities are then examined to determine program priorities based on a number of programmatic factors. Programmatic factors include but are not limited to:

- Existence of a clear Federal role in resolving the problem
- “Window of Opportunity” Can the PES program react in the time frame needed to address the issue
- Ability to impact – does the PES program have the resources (or time to try to acquire the resources) needed to address the problem in the time available.
- Impact of the issues – what is the benefit, in terms of environmental protection, additional reserves, additional capacity, or reduced cost, of resolving the issue.

► **Examine Existing Program.** Once the program priorities have been established, the current program is examined to determine what issues are already being addressed and to determine what issues should be added or removed based on priorities and available funding. If new issues have higher priorities than some of the existing issues, then the issues are examined to determine whether existing issues should be terminated or delayed in favor of addressing the new, higher priority items.

► **Road-maps**

For all issues to be pursued under the program, road-maps for addressing the issue will be developed by the PES Product Team. In developing the road-map, the Team will examine any current research being done on the issue and consult with stakeholders. The road map lays out the sequence of steps that need to be taken to address an issue, who is expected to do them (DOE, industry, or other) and when.

► **Off-Ramps**

Off-ramps are built into the planning for each issue area. Each issue area has clearly defined goals and a road-map that lays out the steps to achieve those objectives. When those goals are achieved, work on that issue area is terminated. Where appropriate, off-ramps are built into each project, with decision points that provide an opportunity to evaluate whether to continue a project based on progress or probability of success.

During the annual review, progress on each issue area is examined against the original objectives and the road-map. If work is off track the cause is analyzed and adjustments are made to bring it back on track or, if necessary, to terminate work on specific projects or the entire issue area.

Changes in priorities may occur that indicate that resources should be shifted to another issue. When that occurs, the existing issues will be re-examined to determine whether the work should be terminated, delayed, or reduced for the short-term.

### **8.1.2 Emerging Critical Issues**

Because of the volatile nature of environmental issues, the PES Product Team maintains an on-going stakeholder in-put process to identify emerging issues through out the year. Some of these issues are critical and require a more rapid response than the annual review cycle allows.

When these issues arise, they are evaluated against the programmatic factors discussed above. The PES team strives to maintain some flexibility in funding so that these emerging critical issues can be addressed without waiting for the three-year Federal budget cycle or even the Team's annual review process.

Usually, the funding required to address these emerging critical issues in mid-year is small and the project or projects are short-term. These issues are then considered in the next annual review along with other issues.

## **8.2 Current Topics of Interest for PES Team**

The PES team is now centering their attention on several issues that are highlighted in the following text. In order to handle these issue more effectively, one of the team's priorities is an organizational change that will take advantage of synergies in research.

### **8.2.1 Organizational Change**

**Organizational Change Goal:** To fully integrate the Oil E&P, Gas Supply, and Oil Processing components of the program into a unified whole that fully supports our mission, the mission of the other oil and gas product lines and of the Department.

#### **Organizational Change Objectives:**

- By 2004: Develop a programmatic strategy to identify crosscutting issues and address them in a way that creates and takes advantage of synergies.
- By 2004: Develop a communications strategy and tools to inform stakeholders of the PES program goals and accomplishments.
- By 2006: Implement a revised Key Activity structure that better supports the mission and function of the PES Product Team.

#### **Organizational Change Issues/Barriers:**

The environmental programs for Oil and Gas have been driven by Key Activities. These include:

- Program Planning and Analysis
- Streamlining
- Risk Assessment
- Technology Development
- Outreach and Technology Transfer (Gas)

All of these key activities are important, but the titles and structure of the program no longer provide the most effective approach to achieve the goals of the program. Many issues areas addressed by the program are intertwined and cut across multiple Key Activities. This can lead to problems in making sure that program activities are clearly defined and focused. In addition, the current structure can be difficult to describe to stakeholders, especially when trying to tie program activities to the budget.

#### **Organizational Change Strategies:**

The PES Product Team will hold a planning session in 2003 to:

- Devise a communication plan and to identify the tools needed to implement it.
- Identify crosscutting issues and develop synergistic approaches to address them.

The Team will work within the NETL budget and administrative processes to revise our Key Activity structure. A better description of where we are, and where we are headed will help stakeholders understand what we do. It will also help clarify areas of synergy and areas where programs need to be focused on a single area. One proposed structure might look like the following:

<b>Proposed Key Activity</b>	Air, Water, and Soil Issues	Technology Development	Emerging Issues Regulatory Streamlining
<b>Examples of what we do in this area</b>	PM2.5	Compliance Technology	Regulatory Impact Analysis
	Total Maximum Daily Load	Pollution Prevention Technology	Permit Process Streamlining
<b>Where we are going</b>	⇒ Maintain specific programs as needed (Oil, Gas, Upstream, and Processing)		
	⇒ Look for Program Synergy		
	⇒ Technology Transfer as part of all our programs		

## **8.2.2 Air, Water and Soil Issues**

### **8.2.2.1 Air Emissions**

#### **Air Emissions Goal:**

By 2012, develop and demonstrate air chemistry and dispersion models that accurately reflect the effect of E&P and processing operations on regional air quality and visibility.

#### **Air Emissions Objectives:**

By 2007: Develop scientific data to more accurately predict particulate matter precursor formation in SW Wyoming.

By 2010: Develop dispersion models that accurately reflect E&P contributions in non-attainment areas.

By 2012: Develop more accurate and robust air chemistry models and integrate them with the dispersion models.

#### **Air Emissions Issues/Barriers:**

- Visibility science and measures are being developed and are apt to change significantly in the near future.
- Acceptance and implementation of new model may be slow because use of current models is sometime written into state law or regulation.
- More robust models will require greater computing power that may not be available or affordable for all regulatory agencies.

#### **Air Emissions Strategy:**

Work with BLM, Forest Service and Park service to provide accurate scientific information during the development of visibility requirements.

Conduct an uncertainty analysis of current air quality models and provide the results to EPA and other regulators.

Complete a feasibility study of using miniaturized gas-chromatography (a.k.a. “GC on a chip”) to allow for lower cost air monitoring to detect specific compounds.

Complete development of model adjustments to allow for treatment of E&P operations as multiple, spatially dispersed point sources instead of inappropriately aggregating them into a single point source.

### **8.2.2.2 Environmental Issues of Coal Bed Methane (CBM)**

#### **Environmental Issues of CBM Goal:**

By 2010, provide the solutions to current environmental issues and questions that will allow a 25% increase in natural gas produced from coal seams.

#### **Environmental Issues of CBM Objectives:**

By 2005: Resolve questions surrounding the environmental effects of hydraulic fracturing.

By 2006: Provide data on the term effects of coal bed methane production on coal seam aquifers.

By 2006: Provide fate and transport data to determine the environmental impacts of infiltration ponds in the Powder and Tongue River basins.

By 2007: Develop best management practices for treating and/or discharging coal bed methane water to the surface.

By 2009: Provide impact analyses of coal bed methane production on wildlife species of concern (such as threatened and endangered species) and, where necessary, develop mitigation strategies that will allow development to proceed while protecting the environment.

**Environmental Issues of CBM Issues/Barriers:**

- Coal bed methane development, especially in the West, is a fairly recent phenomenon and new issues may arise as current issues are being resolved.
- Water issues surrounding coal bed methane development, especially in the West, have become an emotionally charged. Some of the barriers to production cannot be resolved through science or technology.
- Hydraulic fracturing continues to be a contentious issue despite strong evidence, endorsed by EPA, that hydraulic fracturing does not cause contamination of underground sources of drinking water.
- The NEPA process in Montana is moving slowly and once it is completed, litigation may cause further delays in CBM development.

**Environmental Issues of CBM Strategy:**

Work with BLM, FS, and EPA, through the Federal Leadership Forum, to remain abreast of the issues that may impede CBM development and to provide an energy policy perspective to land use considerations.

Provide the scientific information needed to allow BLM and the State of Montana to resolve issues in the NEPA process.

Work with IOGCC, GWPC, and EPA to resolve hydraulic fracturing issues.

**8.2.2.3 Remediation:**

**Remediation Goal:**

By 2010 Reduce the cost of remediating soils contaminated with crude or refined product by 15% compared to 1990 approaches.

**8.3.3.2 Objectives:**

By 2005: In conjunction with the Petroleum Environmental Research Forum (PERF), establish the scientific basis for clean-up parameters.

By 2010: Provide the tools for States to expand the use of Risk-Based Corrective Action by 25%.

**Remediation Issues/Barriers:**

DOE cannot set the clean-up standards for remediation; we can only provide regulators with the scientific information to appropriate standards.

Clean-up technologies are fairly mature and the likelihood of a break-through that would significantly reduce cost is small.

**Remediation Strategy:**

The overall strategy for this area is to reduce clean-up costs by demonstrating the viability of intrinsic remediation and by establishing ecologically based clean-up targets rather than cleaning to non-detectable levels in every case.

Work with PERF and regulators to determine environmentally acceptable end-points for clean-up targets.

Work with PERF and regulators to develop protocols for ecological risk-assessments.

Further develop and demonstrate tools and protocols to optimize bio-remediation strategies.

### **8.2.3 Technology Development**

#### **8.2.3.1 Bio-Processing**

**Bio-Processing Goal:**

Biodegradation of chemical bonds or selective removal of heteroatoms (Sulfur, Nitrogen) from crude oil (upgrade crudes) or refinery cuts offers potential to revolutionize refining with the possibility of reducing processing cost.

Develop bio-technologies to economically upgrade crudes or remove sulfur from naphtha boiling-range refinery cuts.

**Bio-Processing Objectives:**

By 2005: Survey currently available bio-processing methods.

By 2010: Develop biological tools that can be used for bio-processing of crude oil and crude oil products.

By 2015: perform pilot-scale bio-processing of heavy crudes during the transport from production well to the refinery.

By 2015: perform bench-scale study designed to replace one refinery unit operation with a biological process

**Bio-Processing Issues/Barriers:**

- The efficiency of bio-processing to upgrade crude oil products has to improve by more than  $10^8$  to become competitive with current chemical processing.
- The volume of water used for processing must be reduced by more than  $10^5$  over current laboratory volumes to be cost competitive. This is long-term, high-risk research.

**Bio-Processing Strategy:**

Work through multiple research groups pursuing bioprocessing for petroleum and petroleum products.

**8.2.3.2 Produced Water Management**

**Produced Water Management Goal:**

By 2015, reduce the cost of produced water management for oil and gas operations by 15%.

**Produced Water Management Objectives:**

By 2005: Develop low-maintenance, laboratory scale processes to treat produce water at lower cost.

By 2007: Develop technologies and strategies beneficial reuse or sale of produced water.

By 2010: Develop pilot-scale low-maintenance, lower-cost produced water treatment unit.

**Produced Water Management Issues/Barriers:**

- Produced water characteristics vary significantly both between regions and within regions. It is unlikely that a given treatment technology will work for all applications.
- Current produced water treatment technologies are either too expensive or are not robust enough for oilfield applications or both.
- The economics of produced water treatment vary significantly from region to region.
- Laws and regulations governing surface discharge and water rights may inhibit some beneficial use applications.

**Produced Water Management Strategy:**

Work with industry groups to identify the regions where significant progress is most likely.

Work with industry groups to develop a suite of technologies and practices that, taken together, can reduce treatment costs in a variety of regions.

Work with industry, regulators, and other industries to identify potential beneficial use applications and the water quality parameters for each.

Develop region-specific treatment technologies and practices where feasible.

**8.2.3.3 Processing Heavy Crudes****Processing Heavy Crudes Goal:**

By 2015, improve the efficiency and yield of processing plentiful Western Hemisphere crudes by 10%.

**Processing Heavy Crudes Objectives:**

By 2005: Select candidate heavy oils and match to U.S. domestic refinery

By 2007: Complete initial characterize of selected heavy oils from the Western Hemisphere.

By 2010: Develop alternative processing technologies to reduce heavy oil processing costs .

**Processing Heavy Crudes Issues/Barriers:**

- The Western hemisphere has huge volumes of heavy crudes that are high in sulfur, nitrogen, and heavy metals.
- Heavy oil is 12% of the total U.S. production and the U.S. imports increasing volumes of heavy crudes from Canada, Columbia, Mexico, and Venezuela.

**Processing Heavy Crudes Strategy:**

Obtain the chemical and physical properties of heavy crudes (on a molecular level) to improve process configuration and efficiency.

Advance the technology of coking heavy crudes to increase the yield of high value products.

## **8.2.4 Emerging Issues/Regulatory Streamlining**

### **8.2.4.1 Regulatory Impact Analysis**

This is an on-going effort in response to the regulations that are issued by Federal and State agencies. As such, its objectives and duration are dependent upon the response needed to maintain the energy supply within environmental requirements.

#### **Regulatory Impact Analysis Goal:**

Ensure that Federal agencies have the complete, accurate information they need to craft appropriate environmental regulations for the oil and gas E&P and processing industries.

#### **Regulatory Impact Analysis Objectives:**

Provide an objective analysis of the economic impact of any proposed Federal environmental regulations on oil and gas E&P and processing operations.

Provide an objective analysis of the environmental benefits of any proposed Federal environmental regulations on oil and gas E&P and processing operations.

Provide an objective analysis of the energy policy impact of any proposed State and Federal environmental regulations on oil and gas E&P and processing operations.

Provide appropriate comments to proposed regulations suggesting changes that would minimize the adverse impacts to the oil and gas E&P and processing industries while meeting the environmental protection goals of the proposed regulation.

#### **Regulatory Impact Analysis Issues/Barriers:**

- Proposed regulations can appear without warning and their application to the oil and gas industry is not always apparent.
- Comment periods for proposed regulations are often short and may not allow adequate time for analysis.
- Research or data provided to DOE by industry may not be fully considered by regulatory agencies because it is viewed as biased.
- The Federal procurement process is not conducive to acquiring competitive bids for such analysis work on short notice.

#### **Regulatory Impact Analysis Strategy:**

Systematically peruse the Federal Register for proposed environmental regulations that may affect the oil and gas industry.

Review the EPA Regulatory Agenda on a regular basis.

Develop and maintain contacts with regulatory agencies to become aware of proposed regulations before they are published.

Make use of the Fossil Energy HQ Office of Planning and Analysis capabilities for regulatory analysis work.

#### **8.2.4.2 Removing Environmental Barriers to Increased Access to Federal Lands**

**Federal Lands Goal:** By 2015, provide the environmental solutions needed to increase access to oil and gas resources on Federal lands by 25%.

##### **Federal Lands Objectives:**

By 2004: Expand the current MOU with BLM to include the Forest Service in the Federal Lands Technology Partnership.

By 2004: Complete on-going efforts with BLM to create maps overlaying environmental restrictions with the five major rocky mountain basins identified in EPCRA.

By 2005: Develop a prioritized list (incorporating industry, BLM, FS and EPA input) of the primary environmental concerns that prevent or delay access to Federal lands.

By 2005: Develop a road-map, in coordination with industry, BLM, FS and EPA to remove or minimize those environmental barriers.

By 2009: Complete environmental baseline studies with BLM and USGS to support oil and gas development in NPR-A.

By 2009: Create maps overlaying environmental restrictions with the all of the major rocky mountain basins.

##### **Federal Lands Issues/Barriers:**

- DOE cannot directly control access to Federal lands. We can only provide the tools and information that will allow Federal land management agencies to do so.
- Some non-government interest groups view oil and gas development as incompatible with environmental protection and/or with other uses of the land.
- Some individuals within BLM/FS view oil and gas development as incompatible with environmental protection.
- BLM and Forest Service have complicated planning and permitting processes that are time consuming and man-power intensive.
- Most BLM and Forest Service offices do not have the human resources to keep pace with oil and gas permitting and leasing activities using current practices.
- Many permit stipulations concerning wildlife are not based on sound scientific studies and/or do not account for modern industry practices.

##### **Federal Lands Strategy:**

Work collaboratively with BLM, FS and EPA to provide sound scientific answers to environmental questions concerning oil and gas development.

Provide Federal lands managers with the technology tools to overcome administrative barriers created by environmental regulations.

Work with the Gas Supply Program and the Oil E&P Program to identify and develop minimal-impact E&P technologies that will allow development in sensitive or pristine environments.

#### **8..2.4.3 Streamline Permitting Processes**

##### **Streamline Permitting Processes Goal:**

By 2017, reduce E&P permitting time for non-Federal lands by 20% and reduce permitting time for refinery upgrades by 10%.

##### **Permitting Objectives:**

By 2004: Identify the most likely targets for refinery permit streamlining and develop strategies for addressing them.

By 2005: Provide the tools for States to reduce permit review time by 20%.

By 2007: Provide the tools to make on-line permitting a cost-effective option in 10 States.

By 2012: Provide the tools to make on-line permitting a cost-effective option in 20 States.

##### **Streamline Permitting Processes Issues/Barriers:**

- DOE cannot control permitting times; we can only provide the tools for EPA and the States to streamline their processes.
- The PES Product Team does not have a fully developed working relationship with the EPA and State agencies responsible for refinery permitting.

##### **Streamline Permitting Processes Strategy:**

Work with State-based organizations such as IOGCC and GWPC to develop tools for States and to help States implement those tools.

Work with GWPC to implement RBDMS in at least one of the top five producing States.

Work with regional industry organizations to develop contacts for working with EPA and State refinery permitting agencies.

## 9.0 MULTI-YEAR PLAN

A major purpose of this Product Plan is to present the multi-year aspects of the Oil and Gas Environmental Program. To present this aspect, the targets for both FY03 and FY04 are shown. Other actions that illustrate the multi-year aspect of the program are found throughout this document.

### Annual Strategic Goals in the Petroleum Environmental Solutions Program

FY 2003 Targets	FY 2004 Proposed Target
<p>- Award projects under the Environmental section in the Broad Funding Announcement from 2002 selections. Organize and hold an interagency coordination meeting. The solicitation, selection, and awarding of contracts follows a private and public derived roadmap for identifying and executing research needed to protect the environment and reduce compliance costs. (ER5-5)</p> <p>- Analyze results of bench-scale reverse osmosis in produced water treatment equipment. Develop kinetics for model compounds to be used in enzymatic and biomimetic catalysts for upgrading heavy crude oils. Construct greenhouse prototype for phytoremediation for methane (natural gas) from coal beds (CBM) water. Collect data on fine particulate matter emission factors. These studies will provide the scientific basis for lower-cost commercial-scale environmental technologies. (E505)</p> <p>- Complete field test for control system for oil field centrifuge using fuzzy logic. This project will help reduce the cost of disposing of oil-field wastes using an environmentally sound approach. (ER505)</p> <p>- Issue topical newsletters highlighting various technologies, issue 4 project reports on environmental clean-up and pollution prevention technology and sponsor International Petroleum Environmental Conference (IPEC). These tasks will provide refiners and independent producers with the information on environmental science and technology developments that they need to protect the environment and reduce costs. (ER505)</p>	<p>- Issue Broad Agency Announcement for 2004, make selections and award projects under the Environmental section in the Broad Funding Announcement from 2003. The solicitation, selection, and awarding of contracts follows a private and public derived roadmap for identifying and executing research needed to protect the environment and reduce compliance costs. (ER5-5)</p> <p>- Determine maximum number of cycles that solid acid catalysts can be regenerated with supercritical liquids. Develop feasibility study to produce a process design for a petroleum refinery on the Jicarilla Apache Reservation. These studies will provide the basic information needed to develop lower-cost refinery processes that protect the environment and develop additional refinery capacity. (ER5-5)</p> <p>- Conduct data acquisition studies for solid catalyst alkylation process project. Prepare baseline characterization of impacts of Wyoming and Montana coal bed methane (gas from coal seams) production on ground-water systems. Conduct outdoor test of laser-coupled line-scanner technology to identify leaks in natural gas distribution systems (pipelines.) These projects will help to ensure that refining and gas production and use are safe for the environment and the public. (ER5-5)</p> <p>- Issue topical newsletters highlighting various technologies, issue 3 project reports on environmental clean-up and pollution prevention technology and sponsor International Petroleum Environmental Conference (IPEC). These tasks will provide independent producers with the information on environmental science and technology developments that they need to protect the environment and reduce costs while expanding the available resource base. (ER5-5)</p>

## 10.0 MEASURES

The Oil and the Gas Exploration and Production Programs have developed a unique suite of oil, natural gas, and programmatic models to make estimates of potential economic recoveries of domestic oil and gas resources under a wide range of conditions. These models allow for the optimal management of complex research program, evaluation of policy options, and focus on areas of most benefit to stakeholders.

The Petroleum Technology Program collects and evaluates metrics on the effectiveness of the program annually. The approach used is a combination of capturing estimates of the impact of DOE technology and specifically modeling the impact of the technology. The Total Oil Recovery Information System (TORIS) modeling provides an analytical method of measuring programmatic impact/benefits, and assists in future program planning. There is also a refinery model that is used to determine the benefits of adjustments and modifications to refinery processes.

The majority of projects that are funded are selected competitively in a procurement process. Most of the projects are cost-shared with industry or other partners. The program development process has always required that selected research projects have demonstrated technical competence, a clear federal role, and demonstrated application if research is successful. More recently, there has been a push to estimate the likely outcomes and value of research.

The probabilistic weighted scenario method of determining the merits of efforts includes an additional factor of cost-avoidance. The conventional methods of modeling are based on the effectiveness of processes or equipment, while the Oil and Gas Environmental Program has to determine a method of the worth of streamlining or regulatory work, which do not have a hardware product that yields tangible results. However, the three metrics methods for the Oil and Gas Environmental Program can cause confusion and make it difficult to fully appreciate the value of the Program.

One of the efforts to help resolve this confusion is to determine a new metrics system for the Oil and Gas Environmental Program. This will necessitate redefining the parameters for the Program including establishing the state-of-the-art for each of the processes and methods that are a part of the Program. Then, the existing models will be used to determine the effect of the Program. The result will be evaluated against the current models and a resolution of any differences will be made.

The 1993 GPRA legislation requires that program administrators define specific program goals and track their progress in meeting these goals. In order to meet GPRA requirements, the DOE developed a strategic plan that listed specific goals (e.g. – reduce the decline of domestic oil production). Program administrators are now required to develop annual performance plans, describing intermediate goals, specific accomplishments and forecasts of Oil Program research results.

A representative selection of completed projects (40 to date) have been reviewed in detail by a contractor who did not take part in the development of their performance in order to determine the accuracy of the metrics forecast and technology transfer methods.

DOE has implemented a new graphic metrics tool, “Joule” to provide overall metrics for project performance. It has Strategic Goals, Program Strategic Performance Goals, Performance Indicators, and Standards for each element and sub-element in the research area. The goal is to increase accountability and focus resources on mission targets. In addition to Joule, the OMB has instituted a “Scorecard” to evaluate program management. The Program Review and Analysis Technique (PART) looks at measuring a program from an overall perspective. An operations plan has also been developed for the National Petroleum Technology Office that established measures of performance for several functions that represent the efficiency of the NPTO. These measures mirror and directly support those of the National Energy Technology Office.

## **11.0 ACRONYMS AND ABBREVIATIONS**

This alphabetical list defines acronyms and abbreviations used in the report.

BLM – Bureau of Land Management  
DOE – Department of Energy  
E&P – Exploration and Production  
EPA – Environmental Protection Agency  
GEPS – Gas Exploration and Production Solutions  
NEP – National Energy Policy  
NEPA – National Environmental Policy Act  
NETL – National Energy Technology Laboratory  
NPTO – National Petroleum Technology Office  
PERF – Petroleum Environmental Research Forum  
PES – Petroleum Environmental Solutions

## **12.0 GLOSSARY**

**FY03 Product Plan:** A plan developed during FY02 for purposes of identifying/updating product strategies for FY03 and beyond.

**Goal:** A target level or state expressed in tangible, measurable terms against which actual achievement can be assessed.

**Measure:** Numerical information that quantifies input, output, and performance dimensions of processes, products, and services.

**Mission:** A statement of purpose.

**Objective:** Planned achievements that define steps toward a goal.

**Opportunity:** Important avenue for growth (new markets or segments, broadened range of stakeholder needs, complacency among competitors, etc.).

**Partner:** An individual or organization that joins with NETL by providing resources that allows the accomplishment of a shared goal.

**Portfolio Mapping:** An analytical process that considers qualitative and quantitative information in determining and displaying the relative position and strength of the products within a Team's portfolio.

**Product Line:** Collection of similar products/services organized as a Product Office headed by an Associate Director.

**Product Plan:** An internal document prepared annually by each NETL product team.

**Product Publication:** Any product outreach tool inclusive of brochures, fact sheets, videos, virtual CD ROM, WEB site information, etc., intended to externally communicate product plan information and strategies to stakeholders.

**Stakeholder:** Anyone who is affected by, has an interest in, or influences the activities of the Oil and Gas Environmental Program.

**Strategy:** The theory or thought-process directing a set of activities or deployment of resources.

**Strength:** An asset or characteristic (skill, competence, resource, etc.) that imparts an important capability to a product/service, or an achievement (superior technology, stakeholder service, visibility, etc.).

**Threat:** Factors (entry of new competitors, introduction of lower-cost technology, infrastructure overhaul, etc.) adversely affecting the Team's goals.

**Vision:** A description of a desirable future situation, intelligent foresight.

**Weakness:** A liability, or desirable characteristic lacking in a product, or a condition that places it at a disadvantage.

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Tulsa Educational Outreach Program

# Appendix

# Report On Impact Of The Program

Our Nation has come to expect both the benefits of petroleum-based fuels and products and a clean environment. Advances in exploration, production and refining technologies are key to helping meet projected growth in demand. With each step up in performance and efficiency, the petroleum industry can recover more resources with fewer wells drilled, resulting in smaller volumes of cuttings, drilling muds and fluids and produced waters. Technologies such as slimhole, directional, and multilateral drilling reduce the footprint of drilling rigs and minimize surface impact. Other benefits of advanced technology include reduced energy consumption, reduced noise from operations, decreased visibility of facilities, reduced emissions of greenhouse gases, better protection of water resources, preservation of habitats and wildlife, and enhanced worker safety.

## **Environmental Solutions – Upstream – Exploration and Production**

Environmental Solutions promotes petroleum technology development that mitigates environmental risk posed by petroleum exploration, production and refining while allowing optimum recovery and use of our nation's resources. Goals are to:

- Promote environmental best management practices to enable industry to reduce compliance costs and improve environmental performance
- Assist federal and state governments in making sound regulatory decisions based on scientific understanding
- Facilitate communication and technology transfer among industry, government agencies, states, and Native American Tribes
- Raise public awareness and bring an energy policy perspective to oil and gas environmental issues.
- Increase access to public lands where over half the Nation's petroleum resource is located

Environmental Solutions generates improvements in the regulatory process by conducting regulatory impact analysis; developing regulatory streamlining technologies such as electronic filing systems and online expert environmental compliance systems; developing risk-based database management systems; and developing new technologies to minimize and dispose of drilling and production waste, monitor air emissions, and remediate petroleum-impacted areas. The program also facilitates dialogue among federal officials, state regulators, industry personnel, and other stakeholders to support more informed regulatory decision-making.

The benefits from Petroleum Environmental Solutions occur in all program areas. These benefits accrue as technologies are developed to lower barriers to the permitting process, to enable scientifically sound environmental regulations to be promulgated, and to foster risk-based decisions for cleanup end-points. Petroleum Environmental Solutions has saved \$9 billion in environmental costs by improving permitting and risk-based decision-making. The expected future benefits of current activities are another \$7 billion. (National Energy Policy, Report of the National Energy Policy Development Group, May

2001) Other benefits of DOE's studies allow policy makers to make sound regulations based on scientific merit. Reducing the environmental footprint of exploration and production increases opportunities to produce oil from Federal resources, thereby decreasing U.S. reliance on imported oil.

Environmental benefits derived from the program include:

- **Fewer wells to add same level of reserves.** Today, twice as much oil and gas is added to our reserve base per well drilled than in the 1980's, meaning we can drill half as many wells to add the same level of reserves.
- **Reduced volumes of drilling waste.** In the early 1980's, approximately 7.5 barrels of drilling waste were generated per 100 barrels of oil equivalent of reserves added. Today, that same level of reserves additions is achieved with less than half the waste.
- **Reduced volumes of produced water.** The USGS estimates that up to 30 billion barrels of water are generated from domestic production annually ([http://toxics.usgs.gov/sites/ph20\\_page.html](http://toxics.usgs.gov/sites/ph20_page.html)) – or 6 barrels of water per barrel of oil. In some field tests, better reservoir management and well placement have resulted in reduction of produced water volumes by as much as 96%, often with an associated increase in production, a substantial reduction in production costs and reduced environmental impact.

Pumping oil and gas out of the ground also produces large volumes of water with undesirable quality known as produced water. Produced water commonly contains large amounts of dissolved salts, hydrocarbons, trace metals, and radionuclides. The United States produces 20 to 30 billion barrels of produced water every year. Much of the produced water is recycled by injecting it into the subsurface to maintain the pressure of oil reservoirs, which enhances oil recovery. An estimated 35 percent of produced water requires disposal because it cannot be recycled. The most common methods of disposal are injecting it into the subsurface and evaporating it in disposal ponds. Prior to environmental regulations in the 1970s, produced water was disposed of by whatever was the most economical method. This sometimes included intentionally discharging the water on the ground, which could cause salt scars and surface- and ground-water contamination. These past practices and current accidental releases of produced water are national issues that concern managers of Native American, Federal, and State lands, as well as oil and gas producers, mineral rights and lease owners, State and Federal regulators, and land owners. A growing concern facing land managers is the potential use of land for farming, housing, or other uses where oil and gas production is no longer active but may have left a legacy of undesirable environmental effects. Scientific studies are needed to evaluate the long-term and short-term effects of the disposal of produced water on soil, ground water, and streams, and the natural processes that may mitigate the effects. ([http://toxics.usgs.gov/sites/ph20\\_page.html](http://toxics.usgs.gov/sites/ph20_page.html))

- **Smaller facility footprints.** Substantial gains have been made in reducing the amount of area required by oil and gas exploration and production operations. At Alpine field, the newest discovery on the Alaska North Slope, surface facilities

will account for less than two-tenths of one percent of the total area of the 40,000-acre field. If Prudhoe Bay, our Nation's largest oil field, was developed with today's technology:

- Its footprint would be 64% smaller
- The drilling impact area would be 75% smaller
- Roads would cover 58% less surface area
- Separation facilities would occupy 50% less space
- **Greater protection of sensitive environments.** Resources underlying arctic regions, coastal and offshore areas, sensitive wetlands, public lands, and even cities and airports can now be developed and produced with minimal disruption to the surface.

### Upstream Environmental Solutions: Example Successes

Environmental Solutions has a broad petroleum upstream and downstream impact, everything from remediation of salt water contaminated production site (shown in the before and after photos of a DOE funded remediation project of a salt water spill in Osage County, Oklahoma) to reduction of the impact of drilling operations (North Slope, Alaska) in an environmentally sensitive area, to technology for reduction of emissions from a refinery or tanker loading terminal.



**Saltwater Spill on Soil**



**Spill Site After Remediation**



**Winter Drilling Location**  
(Photo courtesy Phillips Alaska)

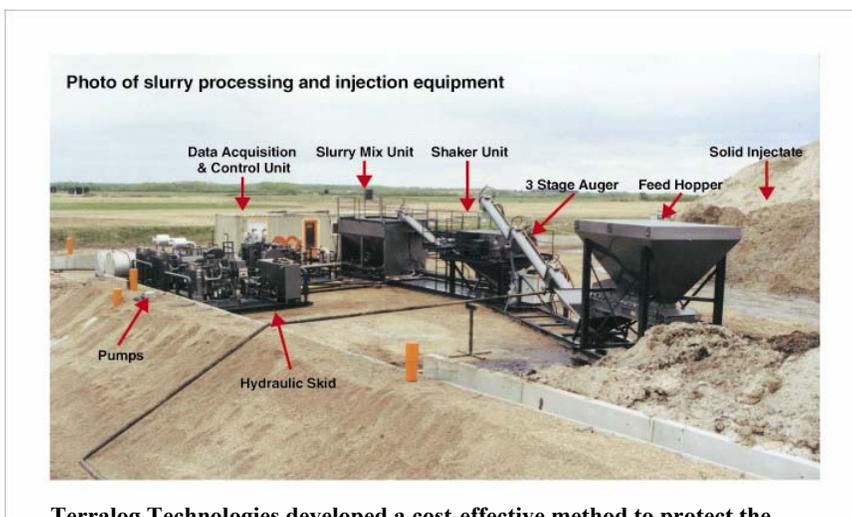


**Summer Same Location After Well Completion**  
(Photo courtesy Phillips Alaska)

**Texas Electronic Compliance And Approval Process (ECAP) and Environmental Compliance Assistance System (ECAS).** Development of ECAP and ECAS are examples of a DOE funding product to streamline compliance with environmental oil and gas regulations. The ECAP system eliminates the need for the operator to supply information the Texas Railroad Commission (TRRC) already has on file in its databases. It includes a streamlined application process that can be completed on-line, the electronic payment of permit fees and the capability to submit plat information in digital or scanned formats. This eliminates much of the editing required and reduces the need for filing corrected reports. An operator with an Internet connection can file anytime from any place, and costs of filing are greatly reduced. The processing and approvals are completed in less than half the time of mailed applications. The costs for each permit filing have been reduced by over \$200. If Texas operators use the completed online process for only 25 percent of the State's oil and gas permits, the economic benefits of ECAP in Texas could be \$17 million annually.

The on-line Environmental Compliance Assistance System (ECAS) helps operators and managers of small oil and gas exploration and production companies understand their environmental compliance responsibilities. The ECAS website is designed for easy navigation and provides guidance through direct links to federal and state regulatory agencies; help with water management plans, records management, emergency response, and remediation methods; and information on the latest federal environmental requirements.

Improved Oilfield Waste Injection Techniques (Terralog Technologies) Disposal of large volumes of produced wastes from oil production operations is a major cost and a potential environment hazard. Oilfield wastes include: produced sand, drilling muds, tank bottoms, and sludge remaining after oil has been produced, stored and transported. Forming these wastes into a slurry and injecting this fluid mixture into formations has become an acceptable environmentally approved method of disposal.



**Terralog Technologies developed a cost-effective method to protect the environment while injecting oilfield waste into deep subsurface formations.**

Operating guidelines and best practices for disposal of large volumes of oilfield waste and effective monitoring of injection volumes were established. Louisiana has incorporated these guidelines into state environmental regulation with EPA approval. The California Division of Oil, Gas and Geothermal Energy has informally adopted the guidelines for use in California slurry injection projects. Establishment of universal guidelines across the U.S. would decrease costs of disposal for the petroleum industry and improve environmental compliance.

#### BLM – DOE Memorandum of Understanding

The BLM and DOE are working together to protect the environment while supporting the President’s goal of increasing domestic oil and gas production. As the primary manager of Federal lands, BLM has the responsibility to balance the many public uses of the land, including oil and gas production, with environmental protection. Because of the need to protect varying interests, a cumbersome system of stipulations, NEPA findings, and permitting requirements has evolved that hinder oil and gas development.

This project focuses on resolving those environmental issues that currently limit oil and gas development on Federal Lands. NETL is funding 11 projects to address concerns ranging from air quality in Alaska, erosion problems in the San Juan Basin of New Mexico, coalbed methane produced water disposal in Wyoming and Montana, to wildlife protection in Wyoming and Montana.



**Agricultural Use of Produced Water from Coalbed Methane Wells, Wyoming**

The benefits of this program are expected to be far reaching. DOE’s contribution will ensure that energy needs are given consideration along with environmental protection of Federal Lands. Ultimate goals of both agencies are to promote protection of environmental resources (air, water, land wildlife) and to maintain the economic uses of the Federal Lands.

#### **Environmental Solutions - Downstream – Petroleum Processing**

The Downstream component of the Environmental Solutions program provides a science and technology base to assist the U.S. refinery industry in maintaining its technology edge, environmental leadership, and competitiveness in the global marketplace.

Challenges that face the domestic refining industry:

- Environmental regulations are forcing refineries to devote substantially more of their capital budgets to environmental compliance at the expense of technology development.
- Crude oil supplied to refineries is becoming heavier, with more sulfur, nitrogen, and heavy metals, while the market requires a product that is lighter, with less sulfur and nitrogen and more oxygenates. Processing of heavy crude with current technology is expensive and yields high levels of low-value residual oils, coke by-products, and wastes.



Downstream Environmental Solutions promotes improved regulation, and fundamental scientific data to facilitate the development of effective refining technologies while preventing pollution. It also supports chemical and bio-upgrading research for effective upgrading of heavy crudes.

Goals are to:

- Identify and evaluate means to effectively permit new refinery units (upgrades in technology) in a timely and cost effective manner
- Develop cost-effective and environmentally acceptable heavy oil and residual oil upgrading and refining technologies
- Reduce environmental impacts and wastes from crude especially heavy crude oil processing
- Develop scientific information on the environmental and health risks of pollutants emitted by the petroleum industry

The University of Tulsa is leading a joint industry project to reduce the environmental impact of coking processes. This study is modeling the coking process to enable optimization not possible before. Optimization is also a focus for Oak Ridge National Laboratory's study of the fundamental chemistry of heavy oils. Accurate data can lead to decreases in operating temperatures and pressures. Oak Ridge is also studying the use of inorganic membranes to purify and recycle hydrogen in hydroprocessing units, thus lowering unwanted side reactions, reducing energy consumption, and lowering emissions. The Idaho National Engineering & Environmental Laboratory is working on a project to develop an economical solid acid alkylation process that would improve safety and reduce environmental impact of alkylation.

Several ongoing research activities involve analysis and modeling air emissions, particularly PM<sub>2.5</sub> derived from fuel use and from industrial complexes such as petroleum refineries. DOE is partnering with several states to fund research at GE Energy and Environmental Research Corporation to provide sound, science-based data for realistic fine particulates compliance standards. They are developing new sampling, analysis and measurement technologies to determine potentially significant sources of emissions subject to the new federal PM<sub>2.5</sub> fine particulate air quality regulations. Several National Laboratories in partnership with industry are conducting work on advanced crude oil

upgrading processes. Crude oils can be biochemically converted to lighter oils, thus reducing sulfur, trace metals, and nitrogen content. There are problems to be overcome before crude oil bioprocessing can be used commercially. Oak Ridge, Argonne and Lawrence Berkeley National Laboratories are working together to solve these problems.

The National Research Council (NRC, 2001) commended DOE for "...playing a very significant role in developing thermodynamic databases needed for the design and operation of petroleum and petrochemical plants." The NRC acknowledged the significant contributions to the knowledge base serving as the foundation for fuels chemistry, process fundamentals, thermodynamics and other areas that have been important to commercial chemical and refinery process designs.

The Oak Ridge National Laboratory was responsible for development of thermodynamic data on classes of compounds that can represent fractions in a refinery allow engineers to understand the physics, chemistry, kinetics and thermodynamics to develop (optimize yield and economics) or modify existing chemical separation, chemical modification or blending of refinery cuts to produce fuels that meet or exceed EPA specifications.

