Appendix: Department of Energy Program Summaries

This Appendix contains additional information about Department of Energy programs, many of which are discussed in the text. While not a comprehensive review of DOE programs and R&D, these summaries provide a clear illustration of the range and depth of energy efficiency, oil and gas, coal, nuclear and cross-cutting programs. The summaries denote which DOE challenge they address, as well as describe the program activity and related accomplishments and benefits. Contact information is also provided for additional information. More complete information about DOE's energy resources R&D portfolio can be found at www.osti.gov/portfolio.

Energy Efficiency

Vehicles

Partnership for a New Generation of Vehicles (PNGV)

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts

Program Activity: PNGV is a government-industry, cost-shared program initiated in 1993 to reduce the cost and time of automotive development, improve fuel efficiency and emission performance of conventional vehicles, and develop mid-size vehicles that achieve up to 80 miles per gallon (mpg) while maintaining or improving safety, performance, emissions, durability, comfort, and affordability.

PNGV identified three major milestones for the 10-year program. Prior to 1997, the objective was to rapidly advance specific component technologies for vehicle application. In late 1997, the first major PNGV milestone was to select the most promising of these technologies for integration into concept vehicles. The second PNGV milestone was the display of concept vehicles in the year 2000 that demonstrate the technical feasibility of 80 mpg family sedans. The 2004 milestone is to have advanced vehicle production prototypes that contain enhancements of these technologies.

Accomplishments:

- The National Academy of Sciences recognized program schedule performance and commended the progress made by the partnership; and
- Met concept vehicle year 2000 milestone demonstrating the technical feasibility of 80 mpg family sedans. Ford, General Motors and DaimlerChrysler displayed their PNGV concept vehicles this year. Each concept showcased unique and innovative approaches to combining advanced technologies in an appealing, functional vehicle that could achieve between 72 and 80 miles per gallon (gasoline equivalent.)

Benefits:

- By meeting PNGV's goals and objectives, the nation will reduce its dependence on oil and achieve energy savings as well as reduce carbon emissions;
- By 2010, the entry of advanced automotive technologies into the market will displace 1.2 quads of primary oil, increasing to 2.5 quads by 2020;
- Resulting energy cost savings total $8 billion in 2010 and over $20 billion by 2020;
- Carbon reductions are estimated at 16.1 and 37.2 million metric tons in 2010 and 2020, respectively; and
- Displaced oil consumption would have a positive impact on the US balance of payments deficit.

For More Information, Contact: Ed Wall, Office of Advanced Automotive Technologies, (202-586-0410) or go to: www.ott.doe.gov/oaat/pngv.html

Lightweight Vehicles

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts

Program Activity: The goal of the Lightweight Vehicles program is to reduce national petroleum dependency as well as local pollution and greenhouse gases emissions by developing lighter-weight autos, trucks and buses while maintaining or improving size, comfort, affordability/cost-effectiveness, safety and recyclability.

The DOE Lightweight Vehicles programs began in FY 1992 but have grown, especially for autos, since the advent of the Partnership for a New Generation of Vehicles (PNGV) in FY 1994. In FY 1996, efforts were formally split into two complementary programs, the larger on autos under the PNGV, the smaller on heavy-duty trucks. The majority of efforts to date have been on aluminum casting, aluminum sheet production and forming, and manufacturing of glass-fiber reinforced polymer-matrix composites (PMCs.) As those efforts have matured and have begun to be implemented by U.S. industry, the Lightweight Vehicle programs are focusing on development of carbon-fiber reinforced PMCs, magnesium casting, metal-matrix composites, titanium, crashworthiness and recycling/repair. All efforts are highly coordinated with, and cost-shared by, U.S. auto and truck manufacturers and their suppliers, notably the United States Automotive Materials Partnership. In addition, nine DOE National Laboratories participate.

Accomplishments:

- Demonstrated that a 40 percent reduction in the weight of the average mid-size family auto is technically feasible (though not yet economically competitive);
- Developed a cost-effective system for casting large, single-piece truck structures at rates required for high-volume production;
- Demonstrated that large, fiber-reinforced PMC components can be produced at typical auto production rates;
- Validated cost-effective technologies for producing dependable, high-quality, cast aluminum structural components at high production rates, and transferred the technology to Tier 1 auto suppliers; and
- Demonstrated technologies necessary to produce low-cost, continuously-cast, aluminum sheet and improved forming technology necessary to produce automotive components.

Benefits: Generally, lightweight materials technologies allow a 6 percent increase in fuel efficiency for every 10 percent decrease in vehicle weight, with corresponding decreases in tailpipe emissions. Light-weighting is viewed as the second most effective way of improving fuel efficiency, next to improvements in propulsion/drive train systems.

For More Information, Contact: Joseph A. Carpenter, Jr., Office of Advanced Automotive Technologies, (202-586-1022) and/or Sidney Diamond, Office of Fuels Development, (202-586-8032) or go to: www.ott.doe.gov/oaat/lw_materials.html

Advanced Combustion and Emission Control for Diesel Engines

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts

Program Activity: Addresses the future technology challenges faced by advanced diesel engines which the PNGV program identified as one of the most promising technologies for achieving the fuel economy goal of up to 80 miles per gallon. Today's diesel engines achieve impressive thermal efficiency; however, in order to meet future emissions standards, advancements in clean combustion, emission control technology, and fuels are necessary, including:

- Reducing and controlling unwanted nitrogen oxides (NOx) and particulate matter in the exhaust below current-technology diesel engine emissions; and
- Improving the durability and decreasing fuels sensitivity of emission control devices.

The Combustion and Emission Control program is a joint effort between industry and government. The program is focused on improving combustion processes and emission control technologies through basic and applied research in combustion modeling, materials research, and emission control system development.

Accomplishments:

- Demonstrated the potential of a new catalyst formulation to remove 95 percent of NOx emissions over a broad range of temperatures with ultra-low sulfur diesel fuel;
- Initiated programs with Cummins/Engelhard and Detroit Diesel/Johnson Matthey to develop and demonstrate emission control systems for passenger cars (PNGV) and light trucks that will enable compliance with future emissions standards;
- Received 1999 R&D 100 Award (R&D Magazine) for "Clean Diesel Technology"; and
- Tested DOE-sponsored microwave regenerative particulate trap technology successfully.

Benefits:

- Contribute to achieving 80 miles per gallon PNGV mid-size passenger vehicles, and significantly improved fuel economy for light trucks and sport utility vehicles, while meeting stringent Tier 2 tailpipe emission standards.

For More Information, Contact: Ken Howden and/or Kathi Epping, Office of Advanced Automotive Technologies, (202-586-3631) and/or (202-586-7425) or go to: www.ott.doe.gov/pdfs/Comb_ReportNew.pdf

Alternative Transportation Fuels

DOE Challenge: Enhancing Energy Security; Mitigating Environmental Impacts

Program Activity: To advance the Energy Policy Act of 1992 (EPACT) objective to increase the use of alternatives to petroleum in the transportation sector. EPACT seeks to achieve this goal via an increase in the use of alternative fuels and alternative fuel vehicles (AFVs) as well as through an expansion of the use of non-petroleum components (replacement fuels) in conventional petroleum-based fuels. EPACT section 502(b)(2) established goals of displacing 10 percent of motor fuel consumption in 2000 and 30 percent of motor fuel consumption in 2010 with alternative and replacement fuels.

Accomplishments:

- Implemented regulations governing the purchase of alternative fuels by State governments and fuel providers;
- Published an Interim Final Rule governing the availability of alternative fuel vehicle credits through the use of biodiesel fuel;
- Supported Executive Orders resulting in over 40,000 alternative fuel vehicles operating in the Federal Government fleet; and
- Induced a total population of around 160,000 alternative fuel vehicles in the fleets of the Federal Government, State governments, and fuel providers.

Benefits:

- Displaced around 140 million gallons of petroleum fuels since 1992;
- Helped increase the number of AFV models available from 7 in 1993 to 29 in 2000; and
- Helped increase the number of alternative fuel refueling stations to 6000 in 2000.

For More Information, Contact: David Rodgers, Director, Office of Technology Utilization, EE-34, (202-586-9118) or go to: www.afdc.doe.gov/

Clean Cities

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts

Program Activity: Provides the technical assistance needed to expand the use of alternative fuel vehicles (AFVs) and their supporting infrastructure throughout the nation by building community networks. The Clean Cities program takes a unique, voluntary approach to AFV market development, working with coalitions of local stakeholders to help develop the AFV industry and integrate this development into larger planning processes.

The Clean Cities program thrives on strong local initiatives and a flexible approach to the challenge of building alternative fuels markets, providing participants with options to address problems unique to their cities, and fostering partnerships as the mechanism to overcome these problems. Current and potential members of the Clean Cities network also help each other by sharing local innovations, by addressing and relaying obstacles they encounter in pursuing alternative fuels programs, and by exchanging "do's" and "don'ts," based on experiences in these programs.

Accomplishments:

- Around 170,000 alternative fuel vehicles in service in Clean Cities;
- 80 participating communities; more than 3500 stakeholders;
- Over 4000 alternative fuel refueling stations in service in Clean Cities;
- 10 domestic AFV corridors under development;
- Six national conferences held, the most recent of which attracted almost 1000 attendees;
- Creation and maintenance of Alternative Fuels Data Center and Clean Cities websites, providing wide dissemination of alternative fuels and Clean Cities information; and
- More than $10 million in grants to States for innovative projects.

Benefits:

- Over 600 million gallons of petroleum fuel displaced since 1993;
- Over 130,000 metric tons of criteria emissions displaced since 1993; and
- Over 300,000 metric tons of carbon emissions displaced since 1993.

For More Information, Contact: Shelley Launey, Office of Technology Utilization, (202-586-1573) or go to: www.ccities.doe.gov

International Clean Cities

DOE Challenge: Mitigating Environmental Impacts, Enhancing Energy Security, Increasing Competitiveness and Reliability

Program Activity: Extending the Clean Cities model of public-private partnerships to enable developing countries to make use of U.S. Alternative Fuel Vehicles technology to mitigate pollution problems and build sustainable transportation. The international projects in the Clean Cities program facilitate international exchange and government/industry partnerships to promote alternative fuel technologies that address shared energy and environmental issues. Technical assistance and expert support:

- Build and maintain partnerships through international information exchange;
- Advance economic opportunities for U.S. and in-country industries; and
- Enhance and maintain the technological and analytical knowledge of the international community.

Accomplishments:

- Enrolled Santiago, Chile, Juarez, Mexico, and Toronto, Canada, into the Clean Cities International program;
- Conducted a reverse trade mission from Chile to the U.S. in February, 1999;
- Co-sponsored a Climate Change Initiative Workshop in San Salvador, El Salvador in March, 2000;
- Conducted a successful trade mission to Monterrey, Mexico in April, 2000; and
- Sponsored a transit workshop in Santiago, Chile in May, 2000.

Benefits:

- Chile has adopted tough new emissions regulations for transit buses and a financial incentive program for purchase of natural gas buses; and
- U.S. industry has developed partnerships in Chile, Mexico, and Canada to promote natural gas and other alternative fuel vehicle products.

For More Information, Contact: Marcy Rood, Office of Technology Utilization, (202-586-8161) or go to: www.hemis-ccities.doe.gov

Electric Vehicle Batteries

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts

Program Activity: Develop advanced energy storage and related systems technologies that simultaneously meet competitive requirements such as high power demand, fast rechargeability, long life, safety, low heat and low cost. Address barriers including high cost, inadequate performance and life, reliability, system safety, and disposal through high-energy battery research. Focuses on advanced energy storage technologies will enable full-range electric vehicles to travel at least 200 miles on a single battery charge. Working closely with U.S. automakers as part of the U.S. Advanced Battery Consortium (USABC), the Electric Vehicle Battery program is developing the next generation of nickel-metal hydride (NiMH), lithium-ion and lithium-polymer battery technologies.

Accomplishments:

- Completed nickel-metal hydride battery research activities with the delivery of production modules from SAFT America to DaimlerChrysler for use in the EPIC Electric Minivan and from GM Ovonic to General Motors for use in the EV-1 and S-10 electric vehicles;
- Demonstrated life of more than 500 cycles in laboratory tests of a lithium-polymer electrochemical cell cohort group representing an entire EV battery pack; and
- Developed a comprehensive series of tests to characterize the abuse tolerance of advanced batteries developed under the USABC and PNGV programs. These test procedures were published in July 1999 and have been recognized and adopted by the Society of Automotive Engineers (SAE) as the industry standard (J2464.)

Benefits:

- By 2010, 700,000 electric vehicles on the road replacing inefficient urban vehicles.

For More Information, Contact: Dr. Kenneth L. Heitner, Office of Advanced Automotive Technologies, (202-586-2341) or go to: www.ott.doe.gov/oaat/ev_batt.html

Fuel Cell Development for Vehicles

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts, Providing Diverse Energy Technologies

Program Activity: A fuel cell is an electrochemical device that combines hydrogen and oxygen to produce electricity with zero emissions and high energy efficiency—either as a stationary means of producing electricity or a mobile propulsion system for vehicles. The DOE effort is designed to help industry develop effective, low-cost fuel cells, that move well beyond the costly fuel cells developed for the U.S. space program.

The U.S. Government owns and operates 30 fuel cell co-generation units, the world's largest fleet of fuel cells. Five cabinet-level Departments participate in fuel cell research and demonstration programs, investing more than $100 million per year. The U.S. Department of Energy spends about $50 million on research in molten carbonate and solid oxide fuel cells for stationary power and more than $30 million on transportation applications, primarily utilizing the Proton Exchange Membrane (PEM) technology.

Accomplishments:

- October, 1997. A government-industry team (Department of Energy, Ford Motor Company and International Fuel Cells) announced that for the first time, a PEM fuel cell system fueled by hydrogen, produced more than 50 kilowatts of electrical power without an air compressor;
- October, 1997. A breakthrough in "on-board" fuel processing demonstrated that ordinary gasoline and clean alternative fuels can be converted to power a fuel cell electric car; and
- January, 2000. PNGV effort produces 80-mpg concept cars by GM, Ford and DaimlerChrysler. One of the GM cars utilizes fuel cell/hybrid propulsion system and promises fuel efficiency of 108 miles per gallon (gasoline equivalent.)

Benefits:

- Fuel cells can provide major environmental, energy and economic benefits that advance critical national goals: clean air, increased national self-reliance for transportation fuels, and enhanced national security; and
- Continued aggressive development will help retain competitive advantage for U.S. fuel cell suppliers and automakers.

For More Information, Contact: Patrick Davis, Program Manager, EE-32, (202-586-8061)
or go to: www.ott.doe.gov/oaat/fuelcell_tech.html

Energy Efficiency

Electricity Generation

Gas Turbines

DOE Challenge Area: Mitigating Environmental Impacts; Increasing Competitiveness and Reliability

Program Activity: This program focuses on development and testing of advanced turbine systems to convert natural gas and other domestic fuels into electric power. These systems are ultra-efficient, near zero emissions, and affordable in today's power generation marketplace. The program includes research and development in critical research areas with U.S. DOE National Labs, 40 U.S. universities, and industry partners. The ATS program began in the year 1992 with the goals to achieve 60 percent net electrical efficient utility scale power plants, a 10 percent reduction in cost of electricity, and less than 10 ppm NOx emissions. The ATS program is a success with the General Electric 7H-ATS ready for demonstration at the Sithe Energy site near Scriba, NY and the Siemens-Westinghouse ATS currently being tested at Lakeland Municipal Utilities near Orlando, FL.

With environmental and energy security pressures continuing to grow in the U.S., the DOE is planning further development of ***next generation turbine systems*** for Vision 21 plants. By the year 2010, turbine based power systems developed will include turbine/fuel cell hybrids, flexible turbine systems, and revolutionary concepts such as the Ramgen and Clean Energy Systems concepts. By the year 2015, these systems will be enhanced and integrated into Vision 21 power plants.

Accomplishments:

- Development and testing of utility scale ATS which are 60 percent efficient, 10 percent lower in cost of electricity, and ultra-low emissions;
- 60 universities have contributed to the development of the ATS under the industry-university consortium; and
- DOE National Laboratories and industry have developed materials and combustion technology to achieve the cost and emissions goals of the ATS program.

Benefits: In the 2000 Annual Energy Outlook, the DOE EIA predicts that 300 gigawatts of new generating capacity will be required in the United States by 2020 to meet growing demand and to replace retiring units. Of the new capacity, 90 percent is projected to be combined-cycle or combustion turbine technology. Development of next generation turbine systems will provide the following savings to the U.S.:

- 4900 trillion btu of primary energy;
- $6,900 million fuel cost savings;
- 490 million metric tons of CO_2;
- 0.55 million metric tons of SOx; and
- 1.1 million metric tons of NOx.

In the near term, it is estimated that a **reduction of up to 165 million tons of CO_2 per year** could be achieved in the U.S. alone by displacing older, less efficient, intermediate coal, oil, and NG-fired steam plants with next generation technology.

In the long term, if turbine/fuel cell hybrid systems penetrate the U.S. market, these systems will produce less than 1 ppm NOx and virtually no SOx. They are at least 70 percent efficient, have a concentrated CO_2 stream, and no particulates even when utilized as electric generation modules for coal-fired power plants. With integration of the next generation technologies into Vision 21 plants,

public benefits will be further increased due to significant long-term emissions reduction and fuel savings to the U.S. economy.

Currently U.S. turbine manufacturers annually export more than $3 billion worth of power generation systems. Maintaining the U.S. technological lead in gas turbines power generation equipment will provide for increased exports and enhance our industrial competitiveness. The U. S. Department of Commerce estimates that every $1 billion of exports equates directly to 20,000 jobs. More than 60,000 jobs can be accredited to U.S. turbine manufacturers through the export of power generation systems.

For More Information, Contact: Vic Der, Director, Power Systems, Office of Coal and Power Systems, (301-903-2700) or go to: www.fe.doe.gov/coal_power/ats/ats_sum.html

Fuel Cells for Utility Sector

DOE Challenge Area: Mitigating Environmental Impacts

Program Activity: In the near term, the Fuel Cell Program is committed to creating environmentally friendly technology for the expanding distributed generation market that has gained impetus from the deregulating electric industry. The molten carbonate and solid oxide fuel cell technology products should enter the near-term distributed generation market by 2003. In the long term, the Program is committed to realizing the full potential of ultra-high efficiency with zero emissions fuel cell technology and to wider, deeper market applications of the technology. The greatest opportunities in the fuel cell program are expected to be achieved through the Solid State Energy Conversion Alliance (SECA.) SECA comprises government agencies, commercial developers, universities, and national laboratories committed to the development of low cost, high-power density solid state fuel cells for a broad range of stationary and transportation applications. SECA technology will ultimately lead to megawatt-size configurations for commercial/light industrial packages and Vision 21 central power station applications.

Accomplishments:

- Commercialization of the phosphoric acid fuel cell and deployment of over 200 units worldwide has created the first generation of ultra-clean, highly reliable power plants that produce high quality electricity and thermal energy;
- The next generation molten carbonate and solid oxide fuel cell technology is being demonstrated and scaled-up to 1 megawatt; and
- The world's first fuel cell turbine hybrid is being tested.

Benefits:

- By 2010, molten carbonate (MCFC) and solid oxide fuel cell (SOFC) developers will produce 5,000-10,000 new jobs, $400 million/year in potential wages and $1 billion in tax revenue;
- The SOFC and MCFC developers will capture 10-15 percent of the 10 gigawatt per year European and U.S. distributed generation (DG) market;
- By 2010, the DG market is expected to be 20-40 percent of the total new and replacement market worldwide. The DG market could be potentially 40 gigawatts per year worldwide;
- In terms of CO_2 emissions, with an average efficiency of 50-60 percent (LHV), almost twice that of conventional power plants, CO_2 emissions would be reduced by almost 40 percent on all power plants using fuel cells. This would reduce the growth in new CO_2 emissions by 40 percent. In addition, NOx and SOx emissions would virtually be eliminated;
- Grid reliability will be enhanced through the ancillary services benefits of fuel cells (including power quality, premium power, voltage control, etc.); and
- Longer term, SECA will produce the first demonstrations of even lower-costs, Vision 21-enabling fuel cell technology concepts, such as solid-state fuels cells, networks, multi-staged designs, etc., to enhance wider and deeper penetration of the mature, competitive distributed generation market. These revolutionary fuel cells systems will target efficien-

cies of over 80 percent at costs below $400 per kilowatt, while reducing carbon dioxide emissions by over 56 percent. This breakthrough will allow widespread penetration into high volume stationary and transportation markets, ultimately leading to "Vision 21" central station power application of advanced fuel cell technology. The inherently high 60-70 percent conversion efficiencies of these solid state fuel cells will provide significantly reduced CO_2 emissions, in addition to negligible emissions of pollutants when operating using fossil fuels.

For More Information, Contact: Vic Der, Director, Power Systems, Office of Coal and Power Systems, (301-903-2700) or go to: www.fe.doe.gov/coal_power/fuel_cells/fc_sum.html

Combined Heat and Power

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts, Increasing Competitiveness and Reliability

Program Activity: This program is intended to assist industry and state agencies in developing and deploying clean, reliable, and affordable clean energy generation options for the 21st century. It focuses on identifying and removing regulatory and institutional barriers for the use of Combined Heat and Power (CHP) systems. DOE efforts provide leveraging mechanisms for accelerating the deployment of research, development and deployment investments in turbines, engines, fuel cells, HVAC, and humidity control equipment.

This is the second year of the CHP program. Activities have focused on launching a national information and education campaign on the energy, economic, and environmental benefits of CHP systems. The primary audience is state energy and environmental policy officials, particularly state public utility commissioners and staff and environmental siting and permitting officials. The Department has formed an alliance with the U.S. EPA to develop new policy actions and to clarify existing air quality regulations for CHP. EPA has joined with the Department in the CHP Challenge Initiative, which was announced in December, 1998 and aims at doubling the amount of CHP capacity in the U.S. by 2010. This means adding approximately 46 gigawatts of new CHP capacity in this timeframe.

To achieve the CHP Challenge Initiative goal, the U.S. Combined Heat and Power Association has started a vision and roadmap process to identify the most productive pathways for achieving the CHP Challenge goal. A series of conferences, workshops, and seminars have been held with CHP developers and state regulatory officials to identify better approaches for the siting, permitting, and interconnection of CHP systems. Financial assistance has been provided to state agencies in California, Washington, New York, Indiana, and Vermont to explore the CHP potential in those states and identify barriers to CHP implementation. Outreach workshops have been held in Maine, New York, and New Mexico. Regional workshops have been held in the Northeast, Midwest, and Pacific Northwest.

There is also a focused effort targeting increased use of CHP in commercial buildings. As part of this effort, the BCHP Initiative, a series of workshops have been held involving the natural gas industry, CHP developers, and building designers to determine R&D needs to tailor the integration of CHP systems for use in buildings for heating, cooling, power, and humidity control needs.

Accomplishments:

- Developed and disseminated information on CHP systems and regulatory and institutional barriers to CHP to hundreds of state officials, which has led to local efforts in New York, New Jersey, Illinois, Michigan, Wisconsin, Washington, New Mexico, and Maine to eliminate the unnecessary barriers to the installation of CHP systems;
- Held national and international conferences on CHP involving senior level policy officials and business executives to raise awareness of CHP benefits. This has led to the DOE-EPA partnership on CHP and a review of air quality regulations and their effects on CHP development. These conferences have also led to international initiatives with the UK, EC, and Canada on CHP development and deployment; and
- Launched the CHP vision and roadmap process led by the U.S. Combined Heat and

Power Association involving hundreds of business executives representing equipment manufacturers, CHP developers, A&E firms, electric and gas utilities, energy services companies, and potential industrial and commercial CHP users.

Benefits: Doubling U.S. CHP capacity by 2010 will result in these net benefits:

- Net energy savings of 1276 trillion btus;
- Carbon reductions of 37 million metric tons;
- SO_2 reductions of 0.94 million tons;
- NOx reductions of 0.42 million tons; and
- Economic savings of $5.5 billion.

For More Information, Contact: Pat Hoffman, Team Lead, Distributed Energy Resources (202-586-2387) or go to: www.oit.doe.gov/chpchallenge/

Distributed Energy Resources

DOE Challenge: Enhancing Energy Security, Increasing Competitiveness and Reliability, Mitigating Environmental Impacts

Program Activity: In March 2000 a Distributed Energy Resources Task Force was established in the Office of Energy Efficiency and Renewable Energy (EERE), Office of Power Technologies. The Task Force consolidates the programs and staff from across EERE related to the development and deployment of distributed energy resources. The vision is for the U.S. to have the cleanest and most efficient and reliable energy system in the world through maximizing the use of affordable distributed energy resources. The focus is on technology development and the elimination of regulatory and institutional barriers to the use of distributed energy systems including interconnection to the utility grid and environmental siting and permitting.

The program directs and coordinates a diverse portfolio of research and development. Activities consist of investments in natural gas and renewable technologies including advanced turbines and microturbines, natural gas engines, fuels cells, and cooling, heating and power systems (CHP.) The program also conducts supporting research, development and deployment (RD&D) in enabling technologies such as advanced combustion systems, advanced materials, and sensors and controls. Additional efforts focus on energy generation and delivery systems and architectures for distributed energy resources to strengthen grid reliability in electricity transmission and distribution technologies, energy storage systems, grid interconnection technologies, power parks, mini grids, and district energy.

Outreach and implementation activities are also program priorities. These efforts are addressing infrastructure, institutional and regulatory needs in utility restructuring, environmental siting and permitting, uniform interconnection standards, tax provisions, state initiatives, and international recommendations of the Presidents Committee of Advisors on Advanced Science and Technology (PCAST.)

Accomplishments:

- Developed advanced turbine systems that achieve emissions (single digit NOx emissions), efficiency (40 percent LHV), and cost targets (competitive installation, O&M costs) for use in industry, commercial facilities, and district energy complexes for baseload power, backup power, and combined heat and power applications;
- Initiated RD&D for developing the next generation of microturbine and reciprocating engine systems for electric power and combined heat and power applications;
- Developed advanced engine driven heating, cooling, and humidity control equipment for use in commercial buildings that use natural gas, reduce electric power requirements, and are applicable to building cooling, heating, and power applications;
- Launched a transmission reliability R&D program aimed at understanding the technical requirements of competitive power markets and developing advanced systems for the interconnection of distributed power systems, real time systems control, and outage management;
- Developed advanced energy storage systems for use in utility applications for power quality and reliability; and

- Assisted state agencies in the development of utility restructuring concepts and plans to open electricity and natural gas markets to competitive market forces.

Benefits: Reduced air emissions, reduced fuel consumption, lower energy costs, greater power system reliability, better power quality, more customer choice, better customer energy services.

For More Information, Contact: Pat Hoffman, Team Lead, Distributed Energy Resources (202-586-6074) or go to: www.eren.doe.gov/der/

Vision 21

DOE Challenge: Mitigating Environmental Impacts

Program Activity: The mission of Vision 21 is to effectively remove environmental concerns associated with the use of fossil fuels for producing electricity and transportation fuels (at competitive cost.) Vision 21 is a long-range (~15 year), industry-driven, research and development program aimed at creating technology that will allow future energy plants to achieve almost double the efficiency of today's power plants while virtually eliminating all harmful emissions. Technology innovation is emphasized. Designs for technology modules (plant subsystems and major components) will be developed along with the systems integration capabilities necessary to configure the modules into Vision 21 energy plants. Other products of the Vision 21 program will be improved computer design and simulation tools, including virtual demonstration, and spin-off technologies, e.g., air separation membranes for producing low-cost oxygen. The approach allows for the inclusion of carbon sequestration at a later time. In a report issued in May, 2000, the National Research Council recommends that over time, Vision 21 become the primary focus of the Office of Fossil Energy's program in coal and power systems. Also, the President's Committee of Advisors on Science and Technology (PCAST), in their November, 1997 report, endorse Vision 21. Vision 21, along with other Fossil Energy programs, plays a prominent role in the Department's Energy Resources R&D portfolio.

Accomplishments:

- Vision 21 solicitation issued September 30, 1999. The solicitation requests proposals in three areas: enabling and supporting technologies, systems integration, and advanced plant design and visualization software. There are four proposal submission periods; selections are made every three months. Minimum cost-sharing is 20 percent; and
- Selection of the first six projects was announced on March 7, 2000 (see DOE Techline.) These projects involve development of hybrid power systems (Fuel Cell Energy), oxygen separation membranes for fuel cell applications (Siemens Westinghouse and Praxair), hydrogen separation membranes (Eltron Research), a novel steam generator design for a high-efficiency power cycle (Clean Energy Systems), systems integration (National Fuel Cell Research Center), and model development for a virtual demonstration (Fluent.)

Benefits: A successful Vision 21 program will help ensure that our nation continues to have a plentiful supply of clean, low-cost energy essential to robust economic growth. When coupled with sequestration, Vision 21 technology will remove environmental concerns, including climate change, associated with the use of fossil-based energy. New advances for the manufacture of hydrogen will make gasification an important technology in the transition to a hydrogen economy.

For More Information, Contact: Vic Der, Director, Power Systems, Office of Coal and Power Systems, (301-903-2700) or go to: www.fe.doe.gov/coal_power/vision21/vision21_sum.html

Innovations to Existing Power Plants

DOE Challenge: Mitigating Environmental Impacts

Program Activity: The program is directed at existing power plants and has two major focuses: (1) develop advanced environmental control technology and (2) provide high-quality scientific data and analysis for use in policy and regulatory determinations. The program portfolio includes research and development activities aimed at either preventing the generation of pollutants during fossil fuel conversion or capturing them from effluents before they are released to the environment. Research is being conducted in the areas of control of fine particulate matter; mercury/air toxics, nitrogen and sulfur oxides, and utilization coal combustion byproduct. The program covers the entire "life cycle" of emissions and technology, from source speciation through advanced emissions control technology development and testing. The program has targeted a 50 percent reduction in overall environmental compliance costs through the development of advanced technologies and integrated systems. The achievement of this target is expected to provide over $6.5 billion per year savings by 2010.

Accomplishments: The Innovations for Existing Plants program has a strong history of assisting in the development of useful commercial products. Low-NOx burners (LNBs), advanced SO_2 scrubbers, and other products have provided the United States with both billions of dollars of savings and a cleaner environment through lower-cost technology. For example, collaborative research with industry has lead to LNB technology capable of achieving 50 percent reductions in NOx emissions at an incremental cost of roughly 0.03 cents per kilowatt hour. In another example, advanced scrubbing technology developed under the program is lowering SO_2 emissions at one Pennsylvania utility while saving the company over one-half million dollars in annual operational costs. The program has also provided unbiased, high-quality scientific and technical data to EPA and other federal agencies in response to regulatory actions regarding mercury, CCBs, and TRI.

Benefits: The aggregate cost of environmental compliance for coal-fired generators in the United States was $1.9 billion in 1997. It is projected that the cost of environmental compliance will increase by seven-fold to over $13 billion per year by 2010. This growth will be driven by calls for more stringent environmental regulations to address mercury, ambient fine particulates, regional haze, acid gases, acidification, eutrophication, air toxics, and their potential impacts on human health and on terrestrial and aquatic ecosystems. This Program will enable major reductions in this $13 billion annual compliance cost.

In addition, roughly 71 percent of the byproducts of coal combustion (CCBs) continue to be disposed of in landfills, at a cost of roughly $1 billion per year. New applications for CCBs will be developed to substantially reduce the volume of CCBs landfilled each year.

The program will meet these challenges through continued partnership with industry and other key stakeholders in the development of cost-effective technology and by providing quality scientific data and analyses associated with the environmental performance of coal-fired power plants.

For More Information, Contact: Doug Carter, Director, Planning and Environmental Analysis, Office of Coal and Power Systems, (202-586-9684) or go to: www.fe.doe.gov/coal_power/environ/environ_sum.html

Power Plant Environmental Regulatory Analysis

DOE Challenge: Mitigating Environmental Impacts

Program Activity: DOE plays a significant role in the development of environmental regulation for the energy sector, particularly for fossil fuel-fired powerplants. Through one of the roles mandated DOE by Congress, to develop improved technologies to address environmental issues, DOE has amassed a large body of information on energy processes, energy conversion, the pollutants associated with such processes, and technologies to mitigate emissions. This knowledge base is provided to EPA, which has the final responsibility for regulations to protect the environment. This information has led to several positive outcomes, including the avoidance of unnecessary regulations, better approaches to address others, and development of altogether new technologies or technologies much less expensive than preceding technologies to reduce emissions.

Accomplishments:

- Development of information related to nitrogen oxides control technology to assist EPA in promulgating regulations for electric utilities. DOE participated in public meetings chaired by EPA, interagency regulatory review meetings chaired by OMB, and summarized information on the state of mitigation technology for the final EPA rule;
- Development of a database on toxic emissions from powerplants. The measured data demonstrated that emissions were much lower than previously estimated using less precise methods, and were used by EPA to avoid adoption of unnecessary regulations for several pollutants;
- Collection and analysis of data related to EPA's Toxic Release Inventory, and participation in interagency meetings influencing the final utility regulation by EPA; and
- Collection and analysis of data related to coal combustion wastes and participating in two cycles of interagency meetings leading to EPA decisions to regulate these wastes under State solid waste regulations, rather than more onerous Federal regulations.

Benefits: It is difficult to quantify the benefits of this activity because alternative outcomes are hypothetical. In just one of the rulemakings avoided, EPA cited costs up to one trillion dollars for the electric utility industry. In other rulemakings, development of advanced technologies enabled greater degrees of environmental protection than would otherwise have been possible.

For More Information, Contact: Doug Carter, Director, Planning and Environmental Analysis, Office of Coal and Power Systems, (202-586-9684)

Regulatory Oversight of Natural Gas Imports/Exports and Electricity Exports

DOE Challenge: Enhancing Energy Security

Program Activity: The Office of Fossil Energy (FE) is responsible for authorizing requests to import and export natural gas and electricity exports, as well as authorizing the construction of international electric transmission lines. Originally, the Federal Power Commission (FPC) exercised regulatory authority over cross-border natural gas and electricity trade; however, the Department of Energy Organization Act (1977) transferred this authority to the Secretary of Energy. This regulatory responsibility was given to the Secretary rather than to the Federal Energy Regulatory Commission (FERC), an independent regulatory body, because the DOE Act wanted all regulatory functions affecting international commerce to remain under the direct control of the President.

The principal objective of FE's regulatory oversight responsibilities is to maintain a program that promotes the freest possible international gas and electricity trade, with minimal government intervention. The regulatory program facilitates natural gas and electricity imports and exports which enhance the nation's energy security by minimizing our dependence on less secure supplies of oil; diversifying our energy sources; and reducing our vulnerability to the adverse impacts of supply disruptions. Further, the regulatory oversight promotes a level playing field that facilitates competition.

Accomplishments:

- Consistent with the Canada-United States Free Trade Agreement and the North American Free Trade Agreement, FE maintains a regulatory program that promotes market-sensitive natural gas and electricity trade, with minimal government interference;
- FE authorizes natural gas and electricity exports in a manner that encourages development of foreign markets for surplus natural gas and electricity supplies;
- FE determines the reliability and environmental impacts associated with installing international transmission lines and exporting electric energy;
- FE has extended the principles of non-discriminatory open access transmission service to international transmission lines; and
- FE monitors North American natural gas and electricity trade. It collects and publishes extensive data on cross-border natural gas trade in the Quarterly Report of Natural Gas Imports and Exports; the data are also used by the Energy Information Administration.

Benefits:

- DOE's light-handed regulatory policy regarding natural gas and electricity imports and exports has resulted in a more efficient, market-driven, and integrated North American energy market; and
- Natural gas imports have increasingly become a very important incremental source of supply to the growing gas demand in the United States. During 1999, natural gas imports from eight different countries (primarily Canada) supplied almost 16 percent of our country's total gas demand; this is compares with 4.2 percent in 1986.

For More Information, Contacts: Tony Como, Manager, Electricity Import Regulation, Office of Coal and Power Systems, (202-586-5935) or go to: www.fe.doe.gov/coal_power/elec_reg/elec_reg.htm
John Glynn, Manager, Natural Gas Import/Export Regulation, Office of Natural Gas and Petroleum Technology, (202-586-9454) or go to: www.fe.doe.gov/oil_gas/im_ex/gasimex.html

Energy Efficiency

Homes and Buildings

Low Income Weatherization Assistance Program

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts

Program Activity: DOE's Weatherization Assistance Program has served as the nation's core program for delivering energy conservation services to low-income Americans since it was created by Congress in 1976. Low-income households spend about 14.9 percent of their income for energy needs, as opposed to the 3.5 percent of income spent on energy needs by other households. The Weatherization Program reduces this disproportionate burden. The program's resources are focused particularly on the elderly, persons with disabilities, and families with children.

Accomplishments:

- Through local agencies, the program has retrofitted over 4.7 million homes since 1976;
- Most local programs now use the National Energy Audit (NEAT), a computer program developed by ORNL for DOE which identifies the most cost-effective energy conservation measures specifically for each house, significantly boosting achieved energy savings;
- Improving program practices resulted in average savings of 33.5 percent of natural gas space heating consumption in 1996, 80 percent higher average savings than in 1989. Assuming that this same level of improvement was achieved in homes heated by other fuels, the annual energy savings for a home weatherized in 1996 is estimated to be 32.2 million btu. Over the 20-year average life of weatherization measures, this represents an energy cost savings of more than $3000 per house; and
- Over the average 20-year life of weatherization measures, these homes will save 108 trillion btu of energy, their occupants will pay $550 million less in utility bills, and 1.63 million metric tons of carbon emissions will be averted.

Benefits:

- Weatherization of low-income homes directly and immediately improves the health and safety of inhabitants by reducing carbon monoxide emissions and eliminating fire hazards, in addition to lightening the financial burdens of those most in need;
- The program's longer-term impacts include community revitalization; and
- The Weatherization Program also creates about 8000 jobs nationwide; 52 jobs grow directly from every million dollars invested in the program.

For More Information, Contact: Gail McKinley, Director, Office of Building Technology Assistance, (202-586-4074) or go to: www.eren.doe.gov/buildings/weatherization_assistance/

Federal Energy Management Program

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts

Program Activity: The Federal Energy Management Program (FEMP) reduces the cost to government by advancing energy efficiency and water conservation, promoting the use of renewable energy, and managing utility costs of federal agencies. FEMP accomplishes its mission by leveraging both Federal and private resources to provide technical and financial assistance to other Federal agencies. The agencies make investments in projects that increase energy efficiency and renewable energy use, and reduce water consumption in their buildings, facilities and operations.

The President issued Executive Order 13123, "Greening the Government Through Efficient Energy Management," on June 3, 1999, providing new emphasis and commitment to improve the efficiency of Federal energy use. The Executive Order establishes new goals of improving efficiency in federal buildings by 35 percent by 2010 from the 1985 baseline, and reducing greenhouse gas emissions attributable to Federal buildings energy use by 30 percent from 1990 levels by 2010. FEMP helps agencies achieve their needs by providing alternative financing tools and guidance to use the tools, technical and design assistance for new construction and retrofit projects, training, technology transfer, procurement guidance, software tools, and reporting and evaluation of all agencies' programs.

Accomplishments:

- Between 1985 and 1999, the government achieved a 21.1 percent reduction in site based energy intensity (energy used per square foot of building floor space), meeting the 2000 goal one year early;
- Half of these savings is attributable to the FEMP program;
- FEMP trained over 13,000 Federal energy managers since 1992; and
- FEMP established 44 regional and technology energy savings performance contracts (ESPC.)

Benefits:

- FEMP helps agencies save energy and money;
- Agencies can potentially achieve an estimated $2 billion in cumulative investment in their facilities via FEMP Super ESPCs and utility energy service contracts over the 2002-2010 time frame (which averages to $240 million per year); and
- By the end of 2010, the Federal renewable energy use is estimated to increase by 7.5 percent relative to a 1990 baseline.

For More Information, Contact: Beth Shearer, Director, Federal Energy Management (202-586-5772) or go to: www.eren.doe.gov/femp

Whole Buildings Approach

DOE Challenge: Mitigating Environmental Impacts

Program Activity: We have found that an effective way to optimize energy performance in buildings is to integrate efficiency components, accounting for all interactive effects, including non-energy effects. In addition to improved energy performance, the resulting improvements in indoor environmental quality, comfort, productivity (in workplaces and schools) and affordability will bolster support for improved building energy efficiency at all levels. However, the building industry encompasses literally thousands of different businesses and millions of individual decision makers. The resulting fragmentation separates developers, designers, builders, utilities, engineers, and occupants from one another as they pursue objectives which often are at cross-purposes. Fragmentation also results in lower-than-average profit margins for many firms, often making it difficult for these firms to invest in efficiency strategies that add to up-front construction costs.

The DOE Building America program is the flagship program of the whole building approach. The Building America program brings together architects, engineers, builders, equipment manufacturers, material suppliers, community planners, mortgage lenders, and contractor trades. These teams use a systems engineering approach to identify highly energy efficient building designs with little or no additional net up-front costs. Up-front cost savings can occur, for example, when improved insulation and duct systems allow the size of the heating and cooling systems to be reduced. Currently, there are five teams comprised of more than 50 different companies. Team members agree to evaluate their design, business, and construction practices to identify cost savings and re-invest cost savings in improved energy performance and product quality. Everyone benefits from the improved knowledge of which whole building strategies typically work best.

Concurrent DOE work on building performance design tools also contributes to the whole building approach, by helping builders take full consideration of energy efficiency options and their interactions in their building designs. The whole building approach is being extended to address efficiency improvement in existing homes (where the Weatherization Assistance Program already makes widespread use of similar building design tools), and new and existing commercial buildings. The lessons learned through these innovative research and engineering activities will be transferred to broader markets through state grants, community-based partnerships, and information and outreach efforts that catalyze rapid market adoption of the whole building approach.

Accomplishments:

- Building America partnerships have produced several hundred homes, and plans are in place to build several thousand more. Dissemination of results continues;
- Since its launching in 1998, Building America has led the energy efficiency efforts of the Presidential Initiative “Partnership for Advancing Technology in Housing”; and
- DOE-developed design tools are used by a wide spectrum of interests, from technology researchers, code developers, local officials, building designers, owners and developers.

Investments:

- Building America and related programs have averaged $7 million dollars in appropriated funding for technical assistance since 1996. No DOE funds are used for capital expenditures.

Benefits:

- The goal of the Building America program is to produce homes that: use 30 percent to 50 percent less energy; reduce construction time and waste by as much as 50 percent; improve builder productivity, provide new product opportunities to manufacturers and suppliers; and implement innovative energy- and material-saving technologies, all at little or no incremental cost to the builder or the consumer.

For More Information, Contact: John Talbott, Office of Buildings Systems, (202-586-9455) or go to: www.eren.doe.gov/buildings/building_america/

Appliance and Equipment Standards

DOE Challenge: Enhancing Energy Security, Increasing Competitiveness and Reliability, Mitigating Environmental Impacts

Program Activity: During its lifetime, the operating costs of an appliance may exceed its initial purchase price several times over. U.S. homeowners spend $1,329 per household each year to operate such home appliances as refrigerators, freezers, clothes washers, clothes dryers, water heaters, furnaces, air conditioners, and lights.

Recognizing the great potential for energy savings, many states began prescribing minimum energy efficiencies for appliances during the late 1970s and early 1980s. Anticipating differing state standards, manufacturers supported developing federal standards. These were enacted as the National Appliance Energy Conservation Act (NAECA) of 1987. There are now national efficiency standards for most home appliances and equipment. DOE periodically reviews and updates these efficiency standards for most household appliances. Although efficiency measures may add a small cost to products, the efficiency standards are set at levels where the extra costs are rapidly offset by energy savings.

Accomplishments:

- Final appliance standards have been issued for small gas furnaces and refrigerator products (1989), clothes washers, dishwashers and clothes dryers (1991), refrigerator products (1997), room air conditioners (1997), electric cooking products (1998), and for electric motors (1999) and plumbing products (1998) used in a range of applications;
- New standards are under development for fluorescent lamp ballasts, water heaters and residential central air conditioners and upgraded standards are under development for clothes washers and certain commercial heating, air conditioning and water heating equipment as contained in the American society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE) and Illuminating Engineering Society of North American (IES) 90.1-1999; and
- Appliance energy costs have dropped significantly as a result. For example, the new standard for refrigerators which will become effective July 1, 2001 will reduce the energy consumption of the typical top-mount automatic defrost refrigerator-freezer to about 500 kilowatthours of electricity per year. (Similar models in use consume between 700-972 kilowatthours a year.)

Benefits:

- Since the enactment of the National Appliance Energy Conservation Act of 1987, the Department has issued eight appliance energy efficiency standards final rules. In 2000, these standards, including those set by law, are expected to save consumers $4.7 billion in reduced energy costs, or an average annual savings of $44 per U.S. household;
- Based on these forecasts, each federal dollar spent on the appliance standards program will result in consumer savings of about $1,000; and
- More efficient products are more competitive internationally and have environmental benefits from reduced atmospheric emissions.

For More Information, Contact: Ed Pollock, Office of Building Systems, (202-586-5778) or go to: www.eren.doe.gov/buildings/codes_standards/index.htm

Energy Efficiency

Industry

Industries of the Future

DOE Challenges: Economic Security, Competitive Restructuring, Environmental Improvement

Program Activity: DOE partners with the most energy intense domestic industries to identify and pursue common technology needs through public-private sector partnerships. The industry visions process enables and encourages industries to work together to: create broad industry wide goals for the future that incorporate the DOE challenges and industry objectives; identify specific needs and their priorities through a system design modeling process called roadmapping and, to form cooperative alliances to help attain those goals cost effectively through diverse technology partnerships; take advantage of departmentally-developed crosscutting technical assistance.

Accomplishments:

Vision Title:	Vision Date:	Roadmap Date:	Major Successes:
Forest Products	Nov-94	Mar-99	Launched gasification initiative, selected for funding the first demonstration project. Have funded over 90 research and development projects. DOE has funded over 90 projects supporting the industry vision and roadmap. Partners include 20 universities, 11 national laboratories, 10 suppliers, 2 research institutes and about 30 forest product companies.
Steel	May-95	Aug-97	Twelve commercial successes including furnace sensors, models and controls, and new alloy (nickel aluminide) applications multiplying service life. Six process developments in the waste oxide recovery, recycling, steelmaking, furnace heating and coating. Two important steel technology showcases were held.
Aluminum	Mar-96	May-97	New energy efficient technologies developed include: A filtration system for primary aluminum, a novel grain refining system, a vertical floatation melter and scrap dryer, and vitrification technology to produce glass fiber from spent aluminum potliners. Three inert anode materials and cell designs have been developed and are being tested. Developed, tested and demonstrated improved wettable cathodes that could reduce energy intensity of primary production by 10+ percent.

Vision Title:	Vision Date:	Roadmap Date:	Major Successes:
Metal Casting	Sep-95	Mar-98	Broad partnership with industry involving 250 partners in 32 states. Commercialized a 3–sensor "air gauging system" for maintaining the dimensional accuracy of the advanced lost foam casting process. Commercialized a PC-based modeling program for die casting flow simulation to reduce development lead time and scrap from die try-outs. Developed a clean cast steel technology resulting in significant time and material savings, fewer defects and reduced weld repairs.
Glass	Jan-96	Jan-98	Commercialized oxy-fuel firing technology now in place in over 30 percent of all glass plants. Technology improved productivity, and reduces energy and environmental emissions. Helped to organize the Glass Manufacturing Industry Council (GMIC) representing over 72 percent of U.S. glass production. Commercialized oxygen enriched air-staging which dramatically reduces NOx emissions.
Chemicals	Dec-96	Nov-98	Formed Computational Fluid Dynamics consortium whose tools are now used by chemical companies to shorten energy efficient production process technology development time. Commercialized Super critical CO_2, Nylon Carpet Recycling process technology, Membrane technology to recover chemicals, and Silicone manufacturing waste recovery process. Developed a total cost assessment tool and sustainability metric methodologies to assess chemical plant impact on the environment.
Mining	Sep-98	Feb-99	Completed two mining roadmaps: crosscutting technologies and processing. Awarded 26 projects. Several technologies are nearing commercialization.

Vision Title:	Vision Date:	Roadmap Date:	Major Successes:
Agriculture	Apr-98	Feb-99	Established industry executive steering group to oversee implementation of vision and roadmap. Issued three solicitations since program inception with 16 project awards. In partnership with Cargill-Dow's joint venture, accelerated commercialization of technology for turning plant-derived matter into industrial chemicals at the first global-scale factory in Blair, Nebraska.
Petroleum	Feb-00	In process	A first round of procurements has been initiated to address key technology areas identified in the vision and roadmap. Vision signed in February, 2000.

Benefits:

- Enables industry cooperation and sharing of technology and resources;
- Encourages research, development and deployment (RD&D) that would not otherwise happen;
- The nation, its industries and consumers receive energy, environmental and cost savings years earlier;
- Through cooperative cost-shared RD&D programs industry and government pool resources and share risks; and
- Preserves and improves U.S. industry competitiveness.

For More Information, Contact: Douglas Kaempf, Program Manager, (202-586-5264) or go to: www.oit.doe.gov/industries.html

Oil and Gas

Oil Supply Research and Development

DOE Challenge: Enhancing Energy Security

Program Activity: The Oil R&D Program focuses on the development of technology needed to sustain domestic oil production in an environmentally responsible manner. The program focuses on high-risk or underutilized technologies that private industry alone will not undertake.

Historical data demonstrate that technology advances are key to keeping energy prices low for consumers and maintaining the profitability and long-term survival of the domestic oil and gas industry.

Accomplishments:

- Oil Reservoir Class Program includes 32 projects with a total DOE investment of $118 million and industry co-funding of $150 million. In one project, reservoir characterization and process analysis of an idle lease in Midway-Sunset field, California found 4.5 million barrels of new recoverable reserves in new and previously abandoned reservoirs on the 40-acre property. The technology has already been transferred to other field areas;
- Petroleum Technology Transfer Council (PTTC), formed in 1994, to provide independent oil operators easy and timely access to new technology, includes 10 regional resource centers, workshops, websites, outreach activities, publications and software;
- Coiled Tubing Horizontal Drilling Systems models developed by the program increase coiled-tubing drilling efficiency and reliability. Coiled tubing drilling systems have a 50 percent smaller footprint and reduce drilling costs by almost 40 percent; and
- Four-Dimensional Seismic, which integrates multiple 3-D seismic surveys, has been commercially applied to 21 Gulf of Mexico fields after it was developed by the program in 1994.

Benefits

- Oil R&D Program projects are expected to add over 1 million barrels of oil per day in 2010.

For More Information, Contact: Edith Allison, Program Manager for Exploration, Office of Natural Gas and Petroleum Technology, (202-586-1023) or go to: www.fe.doe.gov/programs_oilgas.html

Natural Gas Supply Research and Development

DOE Challenge: Mitigating Environmental Impacts, Providing Diverse Energy Technologies

Program Activity: Natural Gas Research & Development Program focuses on the development of technology needed to supply the growing demand for natural gas. The program focuses on high-risk or underutilized technologies that private industry alone will not undertake.

Historical data demonstrate that technology advances are key to keeping energy prices low for consumers and maintaining the profitability and long-term survival of the domestic oil and gas industry.

Accomplishments:

- 3-D Seismic advances for fracture imaging and advanced drilling technologies developed by the Energy Department and the Gas Research Institute, led to record breaking horizontal well in the Greater Green River Basin in southwestern Wyoming. The additional drilling using this technology could generate almost $10 million in Federal and State royalties; and
- Horizontal Drilling research led to air motors now being used for most new wells drilled in eastern gas formations. Horizontal drilling techniques, that use air in place of mud to drive and cool the downhole bit motor and remove drilling debris, have vastly improved the efficiency of drilling in Appalachian reservoirs, where mud use causes formation swelling and fracture blockage.

Benefits: It is estimated that in 2010, almost 2 trillion cubic feet of gas per year will be produced as a result of projects funded within the Gas R&D Program.

For More Information, Contact: Edith Allison, Program Manager for Exploration, Office of Natural Gas and Petroleum Technology, (202-586-1023) or go to: www.fe.doe.gov/programs_oilgas.html

Ultra-Clean Transportation Fuels

DOE Challenge: Enhancing Energy Security

Program Activity: The Ultra-Clean Transportation Fuels Program is a joint effort of the Office of Energy Efficiency and Renewable Energy and the Office of Fossil Energy. The goal of the Program is to promote, in partnership with all sectors of the refining and transportation industries, the development and deployment of advanced fuels, refinery processes and vehicle technologies. The advanced fuels technology will produce ultra-clean burning, high performance transportation fuels for the 21st century from a diversity of resources in addition to conventional petroleum. These will support the introduction of advanced, highly efficient fuel/engine combinations that meet EPA Tier II emission standards and possible future, more stringent standards. Promotion of resource diversity will result in other feedstocks in addition to petroleum (e.g. natural gas, petcoke, biomass, coal, etc.) being used to produce ultra-clean fuels, thereby reducing our dependence on imported petroleum. These ultra-clean liquid fuels will use the nation's existing transportation infrastructure.

Accomplishments:

- Determined diesel fuel formulation could reduce particulate emissions by up to 50 percent, and NOx emissions by up to 10 percent, without any changes to the engine;
- Demonstrated a light-duty diesel vehicle with prototype emission control devices that met the fleet average Tier 2 emissions for particulates and NOx for limited durability with ultra low sulfur diesel;
- Identified a group of 8 oxygenates that could reduce particulate emissions from diesel fuel and potentially increase its renewable content;
- Identified several new classes of ceramic membrane and seal materials that are necessary to reduce the capital cost of gas to liquids technology by 25-30 percent;
- Awarded several Early Entrance Coproduction Plant feasibility. These plants would co-produce ultra-clean transportation fuels, chemicals and electricity from a variety of feedstocks; and
- Received proposals for projects to be implemented under Ultra Clean Fuels Transportation Solicitation, 1st Round.

Benefits:

- Provides ultra clean fuels needed for advanced engines used to power automobiles (PNGV), light- and heavy-trucks while meeting Tier 2 emission standards.

For More Information, Contact: Lowell Miller, Director, Coal Fuels and Industrial Systems, Office of Coal and Power Systems, (301-903-9451), and Stephen Goguen, Team Leader, Office of Transportation Technologies, (202-586-8044) or go to: www.fe.doe.gov/techline/tl_ultrafuel1.html

Royalty Rates on Federal Lands

DOE Challenges: Enhancing Energy Security

Program Activity: DOE has worked with the Department of Interior, the Bureau of Land Management (BLM), and the Minerals Management Service (MMS) for the last 10 years to find cost-effective incentive royalty rates to promote development of petroleum resources on Federal lands.

Accomplishments:

BLM

- Worked closely with the BLM to develop royalty relief programs for stripper oil wells and heavy oil wells on onshore (BLM) Federal lands; and
- Provided expertise and modeling support for these initiatives. This work includes supporting the original development of these royalty relief programs in the last 7 years, and also the 5-year reviews of each program.

MMS

- Assessed and commented on royalty relief proposals by the Federal offshore (OCS) program. This includes the deepwater royalty relief program that was passed in 1995, and will expire in November, 2000.

Benefits:

- All of the current royalty relief programs were determined to be cost-effective for the government in terms of not losing (or adding) royalty revenues for the Federal Treasury;
- These programs have also benefitted the industry by supporting marginal operations or promoting new development in high-cost frontier areas; and
- The added supplies of oil and natural gas help supply the nation's demand for these products, and reduce imports.

For More Information, Contact: John Pyrdol, Chief Economist, Upstream Natural Gas and Petroleum, Office of Natural Gas and Petroleum Technology (301-903-2773) or go to: www.fe.doe.gov/oil_gas/modeling/oilgas_modeling.html

Market Access and Emergency Oil and Gas Loan Guarantee Programs

DOE Challenge: Enhancing Energy Security

Program Activity: The energy marketplace is undergoing profound changes. Small, independent oil and gas producers (the backbone of the domestic oil and gas industry) are finding it harder to obtain the capital needed to maintain and/or enhance production from marginal wells. Deregulation of the gas and electric industries is changing how these products are marketed and is creating numerous opportunities—and challenges—for small and disadvantaged businesses.

The Market Access Program works to provide opportunities for small, disadvantaged businesses, women and minority-owned businesses, small independent oil and gas producers, and oil field service companies, in this new energy marketplace. Begun in 1996, the Program works to remove or circumvent obstacles blocking small business access to oil and gas markets, identifies opportunities for small businesses in this market, and develops procedures to assist small businesses take advantage of these opportunities.

The Market Access Program is currently: working with the Emergency Oil and Gas Loan Guarantee Board to re-shape the Emergency Oil and Gas Loan Guarantee Program in a way that makes federal loan guarantees accessible to small, independent oil and gas producers and oil field service companies; developing workshops on opportunities for minority businesses in the natural gas industry; assisting small and disadvantaged businesses qualify for, purchase, and resell the royalty-in-kind natural gas being sold by the Minerals Management Service; and, identifying federal and state economic development funds for which small, independent oil and gas producers might qualify.

Accomplishments:

- Created the DOE Natural Market Access Program for Small and Disadvantaged Businesses. The Program, in turn, created a Roundtable that serves to coordinate DOE support to small and disadvantaged businesses competing in the natural gas marketplace;
- Took a credit instrument developed by a small business (the Funds Transfer Agent Agreement) and convinced the Gas Industry Standards Board (GISB) to incorporate this financial instrument in the GISB Base Contract for Short-Term Purchase or Sale of Natural Gas;
- Persuaded the Office of the Comptroller of the Currency to award Community Reinvestment Act (CRA) credit to banks that serve as a Funds Transfer Agent for small and disadvantaged businesses. Several banks are now using this instrument to provide financing to small and disadvantaged businesses marketing natural gas;
- Worked with the General Services Administration, Office of Public Utilities, to qualify small and disadvantaged businesses to market offshore royalty-in-kind natural gas to federal facilities;
- Signed an Memorandum of Understanding with the Small Business Administration under which SBA agreed to work with DOE to assist small, independent oil and gas producers qualify for SBA 7(a) loan guarantees;
- Assisted the Emergency Oil and Gas Loan Guarantee Board to develop Emergency Oil and Gas Loan Guarantee Program implementing regulations. Also, conducted a series of 10 workshops around the country designed to educate stakeholders in the domestic oil and gas industry about SBA and USDA loan guarantee programs and also the Emergency Oil and Gas Loan Guarantee Program; and

- With DOE encouragement, the National Association of Regulatory Utility Commissioners (NARUC) approved a Resolution, ***In Support of States Adopting Efforts to Increase Participation of Small and Disadvantaged Business and Women and Minority-Owned Business in the Natural Gas Industry***. NARUC and DOE are collaborating on efforts to encourage state regulated utilities to diversify their supplier base.

Benefits:

- Preserve domestic oil and natural gas productive capacity;
- Increase (or slow the decline of) domestically produced oil and natural gas;
- Promote natural gas utilization;
- Increase competition, and thereby reduce prices, for natural gas; and
- Support DOE Diversity Initiative.

For More Information, Contact: Peter Lagiovane, Analyst, Planning and Environmental Analysis, Office of Natural Gas and Oil Technology, (202-586-8116) or go to: www.fe.doe.gov/oil_gas/americaoil/loanprog_main.html

Public Lands Access

DOE Challenges: Enhancing Energy Security

Program Activity: DOE has worked with other agencies since 1994, to increase access to oil and gas resources on public lands for environmentally responsible and protective exploration and production. DOE funds research projects cooperatively with the Bureau of Land Management (BLM) and the Minerals Management Service (MMS) to understand the impacts of oil and gas activities on Federal lands and to improve environmental performance. Other parts of DOE's oil and gas research program improve access by developing technologies and practices that reduce footprint, reduce wastes, and improve environmental protection.

DOE also works with other agencies on regulatory and land management policy, making sure that the energy policy perspective is represented in their decisions, that regulations and processes are streamlined, and that credible data, sound science and technology advancements are incorporated in land use planning, NEPA decisions, and permit reviews.

Accomplishments:

- Worked closely with BLM on their Oil and Gas Performance Review to streamline and improve their leasing and permitting system;
- Contributed data and expertise to the Federal land access analysis section of the recent National Petroleum Council Natural Gas Study. Broadening that analysis in cooperation with BLM, the Forest Service, and USGS;
- Established an Interagency Work Group on Natural Gas within the White House National Economic Council to respond to the recommendations of the National Petroleum Council Natural Gas Study;
- Performed analysis of air quality modeling issues for assessing the impacts of oil and gas activities on Federal lands on air quality in the Rocky Mountain region;
- Submitted comments to BLM supporting environmentally responsible leasing of the NPR-A. Successful lease sale held in May, 1999. Three wells drilled during the 1999-2000 drilling season;
- Facilitated EPA's accelerated rulemaking for use of synthetic based, environmentally friendly muds for offshore drilling;
- Developed a Safety and Environmental Management Program template, cooperatively with MMS, for independent operators working in the OCS;
- Funding nine projects under the Public Lands Technology Partnership with BLM to improve access;
- Conducted modeling analysis for BLM of the impact of accelerated leasing on oil and gas production and reserve additions;
- Participating in the Federal Leadership Forum, an interagency group that is streamlining the NEPA process for oil and gas development on Federal lands in four western states; and
- Participating in the Wyoming Oil and Gas Assessment, a Federal-State effort to establish agreed-upon resource estimates and future oil and gas development scenarios for Wyoming, as a basis for resource management planning and environmental analysis.

Benefits:

- Promotes environmentally-sensitive development of oil and natural gas resources on Federal lands to meet the nation's needs for these products, reduce imports, and improve the environment; and
- The new development also generates additional royalty revenues for the Federal Treasury.

For More Information, Contact: Bill Hochheiser, Manager, Oil and Gas Environmental Research, Office of Natural Gas and Petroleum Technology, (202-586-5614)

Alaska North Slope Oil Exports

DOE Challenges: Enhancing Energy Security

Program Activity: In 1995, Congress removed the ban on the exports of oil from the Alaska North Slope (ANS.) Recently, there have been proposals to reinstate the ban because of a concern about high gasoline prices in California.

DOE has assessed the situation, and concluded that allowing the export of ANS oil has benefitted the nation, and has not resulted in higher gasoline (or other product) prices to consumers.

Accomplishments:

- In 1995, DOE provided much of the analysis that supported the legislation to lift the export ban, forecasting benefits for domestic producers;
- In May 2000, DOE assessed the impacts of having the ban removed for the last 5 years; and
- Congressional staff have been advised that DOE has found the removal of the ban to be beneficial to producers, and has not resulted in higher prices for consumers. This conclusion is supported by GAO (in a 1999 study required by the 1995 law), and the Commerce Department.

Benefits:

- ANS producers, as well as California producers of oil with similar qualities, have benefitted from higher crude oil prices (about $1/bbl.) This will provide them an incentive for further exploration which could result in a more domestic oil and natural gas production to meet the nation's needs. This would also reduce imports;
- ANS producers have benefitted with more options to sell their crude oil;
- Alaska has benefitted with higher tax revenues associated with the higher ANS oil prices; and
- Consumers have benefitted because the prices they pay for petroleum products were not affected by lifting the ban.

For More Information, Contact: John Pyrdol, Chief Economist, Upstream Natural Gas and Petroleum, Office of Natural Gas and Petroleum Technology, (301-903-2773)

Regulatory Streamlining in Oil and Natural Gas Supply

DOE Challenge: Enhancing Energy Security

Program Activity: The Department of Energy works cooperatively with States and other Federal agencies to streamline regulations and enhance the efficiency and effectiveness of government programs that affect U.S. oil and gas supply. These activities enable other agencies to make use of the Department's unique expertise in oil and gas supply issues and technology. DOE actively participates in advisory committees and interagency work groups to provide a national energy perspective and to promote cost-effective approaches for protecting the environment.

Accomplishments: Consistent with recommendations of the National Petroleum Council, an advisory body to the Secretary of Energy, on *Future Issues – A View of U.S. Oil and Natural Gas in 2020* and *Meeting the Challenges of the Nation's Growing Natural Gas Demand*, DOE has worked with other agencies to address policy and regulatory issues related to oil and gas supply ranging from the regulation of consumer fuel choice to achieve national air quality objectives, Clean Water Act permitting, Federal land management, tax policy, royalty relief, conflicts on pipeline siting, safety and environmental management planning, and electronic permitting.

Highlights include:

- Work by DOE and other Executive Branch agencies on more than 14 priority *Issues for Interagency Consideration* identified by the National Petroleum Council in 1996;
- Efforts undertaken by DOE and other Executive Branch agencies to preserve the production capacity of the domestic oil and gas industry during the low oil price situation of 1998 and 1999 which included initiatives to lower the costs of oil and gas production;
- Grants from DOE that have enabled more than 14 States to adopt improved data management techniques to facilitate risk-based decisions for protecting ground water resources and more cost-effective implementation of oil and gas regulatory programs;
- The successful demonstration of an innovative on-line permitting system by the Railroad Commission of Texas, with support from DOE, that could save Texas oil and gas producers $3 million to $6 million per year;
- Efforts by DOE to increase awareness of the *Environmental Benefits of Advanced Oil and Gas Exploration and Production Technology*;
- Participation in the Federal Leadership Forum, an interagency group that is streamlining the NEPA process for oil and gas development on Federal lands in four western states; and
- Collaborative efforts undertaken by DOE and industry, in coordination with the Environmental Protection Agency, to ensure the availability of ultra-clean fuels.

Benefits: Potential outcomes of regulatory streamlining and improved government coordination include improved, more cost-effective regulatory and policy decisions, reduced delays, cost savings for industry and government, and related opportunities for more efficient recovery and utilization of our Nation's valuable oil and gas resources, increased Federal and State revenues, jobs and economic activity.

For More Information, Contact: Bill Hochheiser, Manager, Oil and Gas Environmental Research, Office of Natural Gas and Petroleum Technology, (202-586-5614) or go to: www.fe.doe.gov/oil_gas/modeling/oilgas_modeling.html

Natural Gas Infrastructure Reliability

DOE Challenge: Increasing Competitiveness and Reliability, Mitigating Environmental Impacts

Program Activity: Natural Gas Infrastructure Reliability program assists industry to ensure the integrity and efficiency of the Nation's natural gas infrastructure and storage system. The reliability of the natural gas distribution and transmission systems across the United States is essential to ensure the availability of clean, affordable energy for our homes, businesses and industries. The Natural Gas Infrastructure program includes the Gas Storage Technology program initiated in FY 1993, and a new program initiated for FY 2001—Enhancing Infrastructure Reliability. Efforts are being directed to enhance energy system reliability with the Nation's natural gas pipelines and gas storage facilities.

The goal of the natural gas infrastructure reliability program is to develop and promote, in partnership with the gas storage, transmission, and utility distribution segments of the gas industry, technologies to enhance and expand the gas system infrastructure to meet a 30 Tcf market by 2015.

The gas industry and its suppliers face significant regulatory, technology, and market challenges to reach the 30 Tcf market. Regulatory constraints in the expansion of transportation and distribution pipeline systems and storage facilities could impede industry progress, harm the economy, and weaken the environment. Technology constraints could lead to increased fugitive emission methane leaks from the aging gas transmission and distribution system. Market constraints could lead to higher gas prices for consumers and the power generation sector. Industry mergers and increased competition have reduced private sector incentives for long-term R&D. Many utility managers, in their efforts to reduce shareholder risk, have abandoned long-term resource planning and resisted making capital investments in pipeline operations and gas storage system development. Government funding of "public benefit" R&D has become essential and more critical to ensure the integrity of the gas delivery and storage infrastructures in maintaining system throughput and in meeting future gas demands as R&D funding by private firms and the Gas Research Institute (GRI) declines.

To achieve the DOE challenge, the Department and the National Energy Technology Laboratory (NETL), have started a process to develop a vision and roadmap to enhance infrastructure reliability. NETL held a series of meetings and workshops with business executives representing transmission and utility distribution companies, equipment manufacturers, energy service companies, gas storage operators, national laboratories, and Federal agencies and state government to identify the most productive areas of infrastructure research to ensure the integrity and efficiency of the natural gas delivery system.

Accomplishments:

- Launched natural gas infrastructure reliability program vision and roadmap process, led by NETL, which involved business executives representing transmission and utility distribution companies, equipment manufacturers, energy service companies, gas storage operators, national laboratories, and Federal agencies;
- Initiated advanced high-deliverability gas storage research in non-reservoir rock formations to serve peak power customers in the Northeast. Developed conceptual designs to demonstrate the feasibility and commercialization potential of Lined Rock Cavern Storage; and
- Initiated research on direct energy meters, capable of measuring gas volume flow, gas composition, and energy content.

Benefits:

- $200 million savings to consumers by 2010 from gas storage facilities using ultrasonic and direct energy meters;
- 255 Bcf/year of additional storage deliverability by 2010;
- Advanced storage well revitalization technologies will increase storage well deliverability (projected at 28 percent or 800 MMcf/day by 2010 for applicable sites) and lower utility storage costs;
- Salt cavern storage capacity will be increased (17 Bcf potential by 2010 with 10 percent reduction of minimum working gas pressure) without impact to environment and without increasing pipeline infrastructure;
- Supports use of technologies to detect and mitigate fugitive gas emissions to reduce greenhouse gas concentrations; and
- Supports distributed power systems and natural gas micro turbines and fuel cells.

For More Information, Contact: Christopher Freitas, Manager for Natural Gas Storage and Infrastructure, Office of Natural Gas and Petroleum Technology, (202-586-1657) or go to: www.fe.doe.gov/oil_gas/gasstorage/gas_storage.html

International Oil and Gas Forums

DOE Challenge: Enhancing Energy Security

Program Activity: The Forums, through structured discussions with foreign governments and companies, seek to promote the adoption of open-market principles and level playing field operations. These activities were developed through candid and open discussions between foreign government officials and petroleum companies and U.S. government and petroleum companies. The Forum format has proven successful in developing trust between parties in a low pressure environment that none the less has the benefit of government level assurances.

The program, begun in 1998, has as its focus developing trust between governments and petroleum companies in the development of policies, laws, regulations, and market operating systems that are open to all parties. The first Forum was conducted in 1998 in Beijing, China. Several U.S. government agencies and U.S. petroleum companies cooperated in the Forum which had participation of all the major Chinese government agencies related to petroleum production and all Chinese petroleum companies. A second Forum session was conducted in Houston, Texas in 1999.

Additional Forum sessions are planned for the future as well as ancillary meetings on specific topics such as natural gas regulation in the U.S. Other Forum structures with other governments are under consideration.

Accomplishments:

- Conducted Forums in China and the U.S. Expanded Forum activities to encompass Experts Working Groups of U.S. and Chinese government and industry participants.

Benefits:

- World-wide acceptance of open market principles protected by laws and regulations will facilitate the most efficient development of world petroleum resources, as well as provide opportunities for U.S. companies who are the leaders in petroleum technology development.

For More Information, Contact: Don Juckett, Director, Natural Gas and Petroleum Import and Export Activities, Office of Natural Gas and Petroleum Technology, (202-586-8830) or go to: www.fe.doe.gov/oil_gas/china_forum/

International Oil Data Transparency

DOE Challenge: Enhancing Energy Security

Program Activity: Secretary Bill Richardson initiated a series of roundtable discussions regarding worldwide oil data to assess what could be done to provide better information regarding world crude oil supplies. The first roundtable was held on January 26, 2000. The U.S. Department of Energy and the University of Houston's Energy Institute co-hosted the event. The second roundtable was held in Madrid, Spain on July 14-15, 2000. The U.S. Department of Energy and the Government of Spain co-hosted the event.

The objectives were to promote a formal industry and government dialogue on what role, if any, data on international oil markets have played in recent oil price volatility, and whether improvements in data quality and collection will enhance market stability: and also to establish priority follow-up activities, including the need for additional discussion sessions.

Accomplishments:

- Drew audiences and panels from the best and most knowledgeable people in the oil data business, both domestically and internationally;
- Agreed that further discussions will be initiated and that they will have the support of the Secretary's office as well as other offices and organizations within DOE;
- An APEC initiative will begin action on production and consumption in the APEC economies beginning in October, 2000; and
- The International Energy Agency will host a continuation of the Madrid activity in the fourth quarter of 2000 to continue working on process related actions related to transparency in the producing and consuming nations.

Benefits:

- Assembling the best informed parties to discuss an issue that has great importance to large segments of the oil and gas industry is expected to bring about improvement in petroleum data gathering and analysis. This, in turn, will help stabilize the world oil marketplace and increase energy security for the U.S.

For More Information, Contact: Don Juckett, Director, Natural Gas and Petroleum Import and Export Activities, Office of Natural Gas and Petroleum Technology, (202-586-8830)

International Oil Spill Workshops

DOE Challenge: Enhancing Energy Security

Program Activity: The workshops seek, through interaction with foreign governments and international organizations, using coordination and information sharing workshops, to improve the ability to respond to oil spills world wide. They will allow nations to better respond to oil spills within their borders and in international waters. Many American companies are preeminent in the field of oil spill containment and clean up and thus US industry should benefit from an increased international preparedness for oil spills.

The program, begun in 1999, has as its focus developing the ability of governments to respond to serious environmental threats brought about by oil spills. The first such workshop was conducted in 1999 for the Black Sea region. Many U.S. government and private organizations cooperated in the workshop, which had participation of all the Black Sea littoral states. A follow up workshop is planned for 2000.

Similar workshops are planned for the Caspian Sea, the Gulf of Guinea and Brazil.

Accomplishments:

- Conducted workshop on Black Sea, scheduled workshop for Cameroon, October 17-18, 2000.

Benefits:

- The existence of regional oil spill response organizations will lessen the chance of significant environmental degradation from oil spills. The ability to respond efficiently to oil spills will lessen the concern of environmental groups to development of world petroleum resources and thus provide for additional petroleum supplies available to the U.S. and others.

For More Information, Contact: Don Juckett, Director, Natural Gas and Petroleum Import and Export Activities, Office of Natural Gas and Petroleum Technology, (202-586-8830)

International Production Sharing Agreement (PSA)

DOE Challenge: Enhancing Energy Security

Program Activity: Through interaction with executive and legislative branches of foreign governments, this activity seeks to improve the ability of the foreign government to offer PSAs and other appropriate contractual vehicles for oil and natural gas exploration and production. Such actions will allow those nations to better develop their petroleum resources, facilitate American company's participation in the host country's petroleum industry, and increase the availability of worldwide petroleum supplies.

The program, begun in 1998, has had its major focus in developing the legal system of Ukraine to permit the initiation of PSAs. 1999 saw the passage of the key legislation necessary for initiating PSAs in Ukraine, and in July, 2000, Ukraine legislature passed conforming legislative amendments to complete Ukraine's ability to offer competitive PSAs that conform to world standards. These actions allow US petroleum and other private companies to successfully participate in Ukraine's petroleum industry.

Similar, though less direct, activities will be carried out through the actions within the U.S./China Oil & Gas Industry Forum, through Asian-Pacific Economic Cooperation, and through cooperative activities with emerging economies where AID operates.

Accomplishments:

- Conducted several workshops in Ukraine;
- Provided assistance in Drafting PSA legislation;
- PSA legislation passed by Ukraine legislature;
- Provided assistance in Drafting conforming legislation; and
- Conforming legislation passed by Ukraine legislature.

Benefits:

- Several U.S. companies are participating in the initial activities relating to Ukraine's offering of PSAs for the development of domestic petroleum resources. This will increase the production of petroleum available to Ukraine and the worldwide oil market; and
- An expanded program will draw on the Ukrainian experiences to support better private investment access to emerging oil and natural gas economies.

For More Information, Contact: Don Juckett, Director, Natural Gas and Petroleum Import and Export Activities, Office of Natural Gas and Petroleum Technology, (202-586-8830)

Strategic Petroleum Reserve Fill—Royalty-In Kind

DOE Challenge: Enhancing Energy Security

Program Activity: On February 11, 1999, Secretary Richardson announced plans to resume fill of the Strategic Petroleum Reserve (SPR) using federal royalty oil from production in the Central Gulf of Mexico. The initiative was designed to replace approximately 28 million barrels of oil sold from the Reserve in FY 1996 and 1997 largely for deficit reduction purposes. The first contracts for the oil transfer were signed on March 31, 2000. Initially the oil was scheduled to arrive in batches continuously through November 2000. Some delivery schedules were renegotiated due to tight supplies and high oil prices, and deliveries initially scheduled from March through June were delayed. The delivery of oil is currently scheduled to continue until December 2001.

Accomplishments:

- DOE completed writing contracts for exchange and delivery of the oil to the SPR sites;
- The vast majority of the 28 million barrels have been delivered and are in SPR caverns, and all deliveries should be completed before the end of the year; and
- DOE gained over 600,000 extra barrels of oil as a result of the renegotiated schedules.

Benefits:

- Allows the U.S. to pursue long term energy security;
- Helps the United States to reassert international leadership among other energy consuming and stockpiling countries;
- Filling the SPR with royalty oil costs the Treasury revenues but does not require appropriations and allows the Government to retain a valuable asset; and
- Resuming fill of the Reserve increases the days of net import protection provided by the SPR and increases national energy security.

For More Information, Contact: John Shages, Director, Finance and Policy, Office of Petroleum Reserves, (202-586-1533) or go to: www.fe.doe.gov/spr/spr_rik.html

Strategic Petroleum Reserve Life Extension

DOE Challenge: Enhancing Energy Security

Program Activity: On April 20, 2000, Secretary Richardson announced the completion of a 7-year, $328 million refurbishment of the Strategic Petroleum Reserve. The Life Extension Program was initiated in 1994 to upgrade or replace major systems by 2000, and ensure mission readiness through 2025. The program uses new technologies to increase reliability and reduce operating and maintenance costs.

Accomplishments:

- The Life Extension Program was completed ahead of schedule and nearly $42 million below its original cost estimate;
- Pumps have been upgraded, oil handling equipment streamlined and many of the control systems automated, making maintenance and inventory control more efficient and lower cost; and
- Close to half of the pumps, motors and valves have been eliminated from the physical infrastructure.

Benefits:

- Annual operating costs will be reduced by $12-$15 million per year over the next 25 years;
- The expected life of the four storage sites will be 25 years, essentially doubling the original design life and extending it to the year 2025;
- The critical systems reliability during a drawdown is greatly increased; and
- The number of employees has been reduced in compliance with the goals of the National Productivity Review.

For More Information, Contact: John Shages, Director, Finance and Policy, Office of Petroleum Reserves, (202-586-1533) or go to: www.fe.doe.gov/spr/spr.html

Home Heating Oil Reserve

DOE Challenge: Enhancing Energy Security

Program Activity: Last winter heating oil prices spiked to all time record highs. On March 18, 2000, the President proposed the creation of a 2 million barrel home heating oil reserve in the Northeast to supply additional heating oil to the market in the event of a future shortage. On July 10, 2000, the President directed the Secretary to use existing authority to establish an interim home heating oil reserve in the Northeast to help protect Americans from possible fuel shortages this winter. On July 19, 2000, the Defense Energy Support Center, acting as an agent for the Department of Energy, issued a solicitation requesting that companies submit offers to receive Strategic Petroleum Reserve crude oil in exchange for up to two million barrels of heating oil and storage capacity in the New England and New York/New Jersey areas. The Heating Oil Reserve will be in place by October 1, 2000.

Congress must enact legislation to provide specific authority for use of the Home Heating Oil Reserve. The House passed H.R. 2448 which extends the Energy Policy and Conservation Act and creates a heating oil reserve in the Northeast. The Senate amendments include set two conditions under which the President can release oil from the Home Heating Oil Reserve—a severe disruption in supply or an increase in the differential between crude oil and heating oil prices which is over 60 percent above the five year average.

Accomplishments:

- On July 10, 2000, Plan Amendment No. 6 was transmitted to Congress to establish a permanent Northeast heating oil reserve. The Plan Amendment becomes effective if Congress does not disapprove it in 60 days after submission;
- The FY 2001 Interior and Related Agencies Appropriations Bill included $4 million for the Home Heating Oil Reserve; and
- The Defense Energy Support Center awarded three contracts for two million barrels of storage—two contracts each for 500,000 barrels in New England (New Haven, Connecticut) and one contract for 1 million barrels in coastal New York Harbor (Woodbridge, New Jersey).

Benefits:

- A heating oil reserve would serve as an interim source of supplies to the region until other supplies can be transported either from other commercial sources or the Strategic Petroleum Reserve during a winter disruption preventing shortages and excessive prices;
- According to a 1998 DOE study, the expected benefits of a smaller 2 million barrels regional petroleum product reserve located in leased terminals in the Northeast would approximate or exceed its costs, provided that those costs could be reduced by trading Strategic Petroleum Reserve crude oil for distillate fill; and
- The distillate oil stored in the Northeast can be released in conjunction with Strategic Petroleum Reserve crude oil in the event of general oil disruption.

For More Information, Contact: John Shages, Director, Finance and Policy, Office of Petroleum Reserves, (202-586-1533) or go to: www.fe.doe.gov/programs_reserves.html

Coal

Coal-Related Activities

DOE Challenge: Mitigating Environmental Impacts

Program Activity: DOE/Office of Fossil Energy is the lead Federal agency for conducting research on coal use technologies, such as advanced coal-fired powerplants. This work includes policy and environmental regulatory analysis, as well as pure R&D.

Accomplishments:

- Coal use for generation of electricity in the U.S. has increased 17 percent over the past 10 years;
- 56 percent of U.S. electric power comes from coal;
- The price of electricity in the U.S. is among the lowest of any market economy, giving U.S. manufacturers a competitive edge in the global economy;
- A continuous stream of advanced technologies, developed through government/private sector partnerships, have enabled electric utilities to meet environmental standards which have become significantly more stringent over time;
- Advanced technologies are under development to provide near-zero emission coal-fired powerplants to meet future electricity needs; and
- Data and expertise have been provided to EPA to provide for more informed environmental regulations.

Benefits:

- Clean, low-cost power meeting more than one-half of U.S. needs;
- Pollution control technologies which have reduced environmental compliance costs by about one-half—with savings totaling several billion dollars per year; and
- Sound scientific technical data on which to base environmental regulations.

For More Information, Contact: Doug Carter, Director, Planning and Environmental Analysis, Office of Coal and Power Systems, (202-586-9684) or go to: www.fe.doe.gov/programs_coalpwr.html

Clean Coal Technology Program

DOE Challenge: Mitigating Environmental Impacts

Program Activity: The Clean Coal Technology Program (CCT) began in 1985 as a joint effort between government and industry to demonstrate innovative coal-based technologies that addressed environmental and operational concerns in a competitive economic manner. A total of five competitive solicitations were conducted with the final project award occurring in 1996. Technologies demonstrated in the CCT Program include advanced electric power generation systems, environmental control devices, industrial applications, and coal processing for clean fuels. The program has a total of 38 projects and 26 have completed operational testing. Of the remaining 12 projects, five are in design, two are in construction, and five are in operation. Government participation is limited to 50 percent of the total project costs. However, industry has exceeded this requirement by funding over 65 percent of the total project costs for the 38 projects.

Accomplishments:

- Demonstrated a variety of NOx control technologies that provide a portfolio of cost-effective compliance options for the full range of boiler types;
- Demonstrated a variety of innovative flue gas desulfurization systems that have reduced capital and operating costs, can produce dry disposable wastes or valuable byproducts, and are capable of capturing multiple air pollutants;
- Provided valuable design and operational data for advanced combustion technologies including fluidized-bed combustion and integrated gasification combined cycle; and
- Reduced emissions and improved economic competitiveness of U.S. industry in energy-intensive applications through new combustion technologies, new fuel forms, and environmental equipment.

Benefits: The CCT Program has demonstrated the technology necessary to take advantage of the nation's coal resources while significantly reducing environmental impacts. Based on the performance demonstrated in the CCT Program, nearly one-half of the U.S. coal-fired generating capacity has installed low-NOx burners. Many of the flue gas desulfurization systems demonstrated in the CCT Program continue in operation today and hold significant promise for application in emerging markets. The advanced power generation projects are providing the basis for increased efficiency resulting in reduced greenhouse gases and very low pollutant emissions.

For More Information, Contact: Gene Kight, Financial and Procurement Director, Office of Coal and Power Systems, (301-903-2624) or go to: www.fe.doe.gov/coal_power/cct/cct_ipo/cct_ipo00.html

Sequestration

DOE Challenge: Mitigating Environmental Impacts

Program Activity: This Program focuses on development of technology to reduce net emissions by sequestering carbon, either through enhancing natural sinks (e.g., forestation) or by capturing the CO_2 emitted from fossil-based energy systems and storing it in geologic formations of the deep ocean or converting it to benign (potentially reusable) form.

The primary goal of this research program is to be able to deploy sequestration technologies after 2015 which could offset all future growth in U.S. GHG emissions under a "business as usual" scenario, which amounts to hundreds of millions of tons of carbon per year by 2030, and increasing amounts thereafter. A secondary goal is to accomplish such reductions for less than $10 per ton of carbon—90+ percent below today's commercially available sequestration technologies. At $10 per ton, carbon reduction would be inexpensive enough that traditional market mechanisms, such as the vendors' desire to market "green power," could be sufficient to drive deployment of this technology.

Accomplishments: This long-term program is in its infancy, but several small-scale sequestration development projects are underway that were selected in the FY 1998 Novel Concepts solicitation, and feasibility studies have been initiated for projects selected under the Office of Fossil Energy's August and September 1999 solicitations.

Benefits: Sequestration is an essential tool, along with higher energy efficiencies and less carbon intensive energy sources, for long-term stabilization of atmospheric concentrations of GHGs at levels that protect the environment. Benefits include:

- Dramatically lower GHG emissions—potentially over 500 million ton per year carbon (2030);
- Substantially lower costs than other options with comparable reduction potentials; and
- Expanded policy options for managing climate change.

For More Information, Contact: Bob Kane, Manager, Climate Change Activities, Office of Coal and Power Systems, (202-586-4753) or go to: www.fe.doe.gov/coal_power/sequestration/index.html

Nuclear

Advanced Light Water Reactor Program

DOE Challenge: Providing Diverse Energy Technologies for the Future

Program Activity: In the 1980s and 1990s the Department funded nuclear research that was cost shared with industry to develop the advanced light water reactors, a program established to ensure the viability of nuclear energy and to advance energy security and diversity in this century. This program was completed in 1997.

Accomplishments: Today, three vendors have brought their "evolutionary" designs to commercialization, with the first two boiling water reactors in operation today overseas. For example, the Kashiwazaki Kariwa Nuclear Power Station in Japan—the world's largest nuclear power station, supplying about 23 percent of Tokyo Electric's total capacity—is the site of the first operating General Electric Advanced Boiling Water Reactors. This past March, the U.S. Nuclear Regulatory Commission completed and issued the Standard Design Certification for the last of the advanced light water reactors funded under this program—the AP600, a Westinghouse passive-design, Pressurized Water Reactor. With this accomplishment, three designs are now available to be built and operated under a single license, significantly reducing the time needed to license a new plant in the U.S.

Benefits: Improved performance and safety of future nuclear power plants.

For More Information, Contact: Gail Marcus, Deputy Director of the Office of Nuclear Energy, Science and Technology, (202-586-2240) or go to: www.nuclear.gov

Nuclear Energy Research Initiative (NERI)

DOE Challenge: Providing Diverse Energy Technologies for the Future

Program Activity: Started in FY 1999 in response to the recommendations of the President's Committee of Advisors on Advanced Science and Technology, the NERI provides for innovative investigator-initiated, peer reviewed research and development at universities, laboratories, and industry to advance nuclear power technology, thus paving the way for expanded use of nuclear energy in the future and rebuilding U.S. leadership in nuclear technology. NERI research focuses on proliferation-resistant reactor and fuel technologies, high performance/efficient reactor technology, advanced nuclear fuels, new technologies for the minimization and management of nuclear waste, and fundamental nuclear science.

Accomplishments: In FY 1999, with $19 million, the initial NERI procurement resulted in the award of 46 one to three-year R&D projects involving research participants from 45 U.S. and 11 foreign universities, laboratories and industrial organizations. NERI is finding considerable success in helping place the U.S. once again in a key leadership role in the international exploration of nuclear technology, prompting interest, support, and collaborations from many other nations. Additionally, NERI has re-energized research in U.S. laboratories, universities and industry, and has begun to show the way towards solving some of the key obstacles to future expansion of nuclear energy.

In FY 2000, with $22.5 million, the Department will continue the research begun in 1999 and will award 8-10 new R&D projects, and complete 3 of the R&D projects awarded in FY 1999. While the NERI research was initially launched less than a year ago, progress has been made on all 46 projects. Some of the projects showing promise include using advanced ceramic materials in nuclear fuel, developing radiation-resistant alloys, automating future nuclear power plants, developing new proliferation-resistant nuclear fuels, exploring direct energy conversion technologies for nuclear power, and designing a low-cost proliferation-resistant reactor.

Benefits: NERI supports our nation's ability to apply nuclear technology to our energy, environmental, and economic goals. The objectives of NERI are to develop revolutionary advanced concepts and scientific breakthroughs in nuclear fission and reactor technology to address scientific and technical barriers to long-term use of nuclear energy; advance the state of nuclear technology to maintain a competitive position in overseas and future domestic markets; and promote and maintain the nuclear science and engineering infrastructure to meet future technical challenges.

For More Information, Contact: Shane Johnson, Acting Director, Office of Technology and International Cooperation, Office of Nuclear Energy, Science and Technology, (301-903-3860) or go to: nepo.ne.doe.gov

Generation IV Nuclear Power Systems

DOE Challenge: Providing Diverse Energy Technologies for the Future

Program Activity: The Gen IV program identifies and coordinates the R&D necessary to support development of next-generation reactors, specifically reactors that may be deployed in the next 20 years. The program began in FY 2000. In its initial stages, the program aims at working with other governments who may be embarked on similar R&D with an eye to eliminating duplicative research, establishing R&D collaborations and, to the extent possible, pooling research results. Countries include Argentina, Brazil, Canada, France, Japan, South Africa, South Korea, and the United Kingdom. Other countries have expressed interest in participating as well. FY 2000 accomplishments and benefits/beneficiaries are noted below. In FY 2001, the program expects to produce a Gen IV Technology Roadmap to define the path forward internationally.

Accomplishments:

- January 2000 meeting of the nine-country steering group:
  - Determined that the countries involved wanted to continue to pursue discussions of attributes and criteria associated with next generation reactor technologies; and
  - Recommended a subsequent meeting of senior technical experts to discuss opportunities for bilateral and multilateral research.
- April 2000 meeting of senior technical experts:
  - Identified nuclear R&D priorities of each participating country; and
  - Began identifying opportunities for collaborative research; and
- May 2000 International Generation IV Workshop identified characteristics and attributes of the next-generation reactors with respect to economics, safety, proliferation-resistance and waste, drawing on input from industry, universities and public interest groups. A report will be issued late spring 2000.

Benefits: The potential beneficiaries are countries that now or may in the future use nuclear power, as a successful Gen IV program will result in better-coordinated and more cost-effective R&D, in reactors that are safe, proliferation-resistant, less waste-producing and more economical than the current generation of plants. In addition, the Gen IV program puts a premium on developing reactors with the customer's concerns in mind, enhancing both their domestic and export value.

For More Information, Contact: Gail Marcus, Deputy Director of the Office of Nuclear Energy, Science and Technology, (202-586-2240) or go to: www.nuclear.gov

Nuclear Energy Plant Optimization

DOE Challenge: Increasing the Competitiveness and Reliability of U.S. Energy Systems

Program Activity: This past year was in many ways a banner year for nuclear power in the U.S., with nuclear plants generating a record amount of electricity and performing at the highest average capacity factor, 85.5 percent, ever achieved.

Recognizing the important role that these plants will continue to serve over the next several decades in meeting demand for electricity in an environmentally sound manner, this fiscal year the Department launched the *Nuclear Energy Plant Optimization Program* (NEPO) as part of the President's Climate Change Technology Initiative in cost-shared cooperation with the Electric Power Research Institute, the research arm of the electric power industry. This program, recommended by PCAST and initially funded at $5 million, represents a Federal investment in intermediate-term, higher risk research that is needed to increase the pace of innovation for developing new technologies that enhance operation, reliability and safety of the nation's nuclear plants and addressing critical issues associated with aging and extended operation of these plants.

Accomplishments: Thus far, the Department and EPRI have established the Joint DOE-EPRI Strategic R&D Plan to Optimize U.S. Nuclear Power Plants. This plan is being used to prioritize the R&D that will be conducted. Additionally, the Department expects to complete the preparation of and sign a Cooperative Agreement with EPRI in May, 2000 that will provide for the solicitation and award of research contracts.

Benefits: Contrasting industry's $85 million annual investment—focused on a short term horizon that funds "just in time" solutions to problems for the existing plants—NEPO's investment leverages Federal dollars with industry's matching funds in order to expedite and conduct intermediate term research needed by all of the nuclear utility industry to address critical aging issues and issues associated with long-term safe, economic and reliable operation of the Nation's nuclear power plants.

For More Information, Contact: Shane Johnson, Acting Director, Office of Technology and International Cooperation, Office of Nuclear Energy, Science and Technology, (301-903-3860) or go to: nepo.ne.doe.gov

Nuclear Power Plant Relicensing

DOE Challenge: Increasing the Competitiveness and Reliability of U.S. Energy Systems

Program Activity: Three years ago, with electricity restructuring looming and concerns over regulatory relicensing uncertainty, the prediction was that some existing nuclear plants would be shut down prematurely and few if any nuclear plants would receive a renewed license for 20 years of additional operation. With the Department contributing as appropriate, the nuclear industry and the Nuclear Regulatory Commission took bold steps to resolve outstanding issues and to move the process forward. As a result, the NRC has now issued renewed licenses to two utilities for five reactors. Furthermore, three additional utilities have submitted license renewal applications and several other utilities have announced their intention to seek license extensions.

Accomplishments:

- March 23, 2000. The Nuclear Regulatory Commission approved the renewal of operating licenses for two reactors at the Calvert Cliffs plant. The Baltimore Gas and Electric Company, which owns and operates the Calvert Cliffs plant, was the first utility to seek NRC approval for a 20 year license renewal. During the 22 months that the NRC reviewed the Calvert Cliffs submittal, license renewal applications for another six of the nation's 103 reactors were filed with the agency, and utilities owning another 22 reactors informed the NRC of their plans to apply by the year 2003. (Original nuclear plant licenses are issued for a 40-year operating period); and
- May 23, 2000. The U.S. Nuclear Regulatory Commission (NRC) approved the renewal of operating licenses for Duke Power's three-unit Oconee nuclear power plant in western South Carolina. The approval made Oconee the second nuclear power plant in the country to have its operating licenses renewed.

Benefits: Nuclear power is the single greatest source of clean electricity in the U.S. and around the world. Continuing operation of our nation's safe and economic nuclear power plants can contribute significantly to achieving our goals for affordable and environmentally responsible power.

For More Information, Contact: Gail Marcus, Deputy Director of the Office of Nuclear Energy, Science and Technology, (202-586-2240) or go to: www.nuclear.gov

Renewable Energy

Wind Energy Cost Reduction

DOE Challenge: Mitigating Environmental Impacts

Program Activity: Under the rapidly emerging U.S. restructured electricity generation environment, the competitive threshold for new supply technologies has been reduced dramatically in most regions of the country. The Wind Program has helped U.S. industry to significantly reduce the cost of wind energy, enabling wind to become a major new source for clean electricity. Today, wind technology can produce power for as low as 4 cents per kilowatthour, and the Program is working to achieve a goal of 2.5 cents per kilowatthour commercial technology by the end of the decade. This supports the Department's Comprehensive National Energy Strategy goal of achieving 25,000 megawatts of non-hydroelectric renewable generating capacity by 2010.

The Wind Program focuses on completing the research, testing and field verification needed by U.S. industry to fully develop advanced wind energy technologies, and on coordinating with partners and stakeholders to overcome barriers to wind energy use. Key activities include: Applied Research, which develops cutting edge tools and concepts for wind energy system design efforts, technologies to expand wind energy applications, and strategies to assure cost-effective wind plant operation; Turbine Research, which provides an opportunity for U.S. industry to apply the technology breakthroughs and design tools from Applied Research in developing advanced wind technology wind turbines; and Cooperative Research and Testing, which supports turbine certification and other activities for the domestic and international competitiveness of wind energy equipment and services offered by U.S. firms.

Accomplishments:

- R&D by the Department's Wind Program has helped lower the cost of wind generated electricity by 80 percent in the last 20 years. Wind electricity costs have dropped from over 30 cents per kilowatthour in 1980 to about 4 cents per kilowatthour in 2000;
- An example of the type of advancement accomplished by the DOE Wind Program are improved wind turbine airfoils, which have increased efficiency by up to 30 percent and have been adopted in most commercial U.S. wind turbines;
- Next generation wind turbines from U.S. companies are expected to reduce the cost of energy to about 2.5 cents per kilowatthour at 15 miles per hour average wind speed sites by 2003; and
- Wind Powering America was launched in 1999 to accelerate domestic use of wind.

Benefits:

- In 1999 about 5 billion kilowatthours of electricity was produced by wind turbines in the United States, enough to meet the needs of over 500,000 average U.S. households;
- In a recent 18 month period, over 900 megawatts of wind capacity was installed in the U.S., bringing the nationwide total to 2,500 megawatts in 2000. About $1 billion of private sector capital was invested in wind power plants in the U.S. over this period;
- 5,000 megawatts of domestic wind capacity is anticipated by 2005, and 10,000 by 2010; and
- By 2010 wind energy is expected to provide about 0.6 quads of primary energy and reduce carbon emissions by over 10 million metric tons of carbon equivalent.

For More Information, Contact: Peter Goldman, Director, Office of Geothermal and Wind Technologies, (202-586-1995) or go to: www.eren.doe.gov/wind/

Photovoltaic Cost Reductions

DOE Challenge: Mitigating Environmental Impacts; Providing Diverse Energy Technologies

Program Activity: The technology revolution in the power generation sector has led to drastic decreases in the price of power from new sources of generation. For example, natural gas-fired combustion turbine technology produces electricity for about $0.03 per kilowatthour. Given the low domestic market prices of fossil fuels, market penetration of renewable energy technologies is occurring more quickly in remote locations domestically and overseas where the cost of electricity is generally much higher than in the U.S. Recent trends in the growth rate of global PV sales, especially in Japan and Germany, indicate that this rapidly accelerating market will more than double in the next two years.

The program conducts a balanced R&D effort in fundamental and applied research, materials and device development, advanced manufacturing R&D, module reliability, and system testing and evaluation. The strategy is to concentrate on areas of high-risk, high-payoff R&D, an area where private sector companies traditionally under invest, and where a national research program tapping the unique capabilities of our national laboratories can make a significant impact. As a result of efforts to date, the U.S. is the unquestioned world leader in the development of new advanced PV technologies such as thin films and high efficiency devices. The successful transition of these potentially low cost technologies to large-scale manufacturing is the foremost technical challenge for the Program and is critical to the ongoing viability of the domestic PV industry. The Photovoltaics Program, in partnership with the U.S. PV industry, universities and national laboratories, has established aggressive technical goals as measures of success in order to meet this challenge.

Accomplishments:

- In FY 2000, PV systems are delivering electricity for as low as $0.12 - $0.20 per kilowatthour—depending upon the specific technology—making clean, reliable PV systems competitive in many remote and on-grid sites here in the U.S. and around the globe. This compares with a cost of more than $1.00 per kilowatthour in the early 1980s; and
- R&D in crystalline silicon and thin film cells that have enabled a multi billion dollar industry.

Benefits:

- Reduces the dependency on fossil fuels;
- Provides increased reliability of energy service;
- Reduces the emission of greenhouse gases; and
- Establishes a $22.5 billion industry by 2020.

For More Information, Contact: Richard King, Office of Photovoltaics and Wind Technology, (202-586-1693) or go to: www.eren.doe.gov/pv/

Geothermal Energy Cost Reduction

DOE Challenge: Mitigating Environmental Impacts

Program Activity: The Geothermal Program has worked closely with U.S. industry to reduce the cost of geothermal energy, providing technology that has resulted in the installation of 2800 megawatts of domestic geothermal power. Today, geothermal technology can produce reliable power in the range of 5-8 cents per kilowatthour at average geothermal sites, and the Program is working to achieve a goal of 3-5 cents per kilowatthour by 2007. Geothermal energy will contribute as much as 6,000 megawatts to the Department's Comprehensive National Energy Strategy goal of achieving 25,000 megawatts of non-hydroelectric renewable generating capacity by 2010.

The Geothermal Program conducts the research, testing and field verification needed by U.S. industry to fully develop advanced geothermal energy technologies. This is accomplished in large part through cost-shared partnerships with industry. Key activities include: Geoscience and Support Research which investigates problems associated with finding and producing geothermal resources; Drilling Research directed at developing advanced drilling technology to reduce the cost of drilling geothermal wells; and Energy Systems Research and Testing which improves the efficiency of converting geothermal energy into electricity and tests new technology with the potential of reducing overall system costs.

Accomplishments:

- The Department's Geothermal Program has contributed to a 50 percent decline in the cost of geothermal electricity in the past 20 years. Costs at the best geothermal sites have dropped from an average of about 10 cents per kilowatthour in 1980 to about 5 cents per kilowatthour in 2000;
- An award-winning, advanced direct contact condenser resulted in a 17 percent increase in generation capacity at a geothermal power plant in 1999;
- Development of a high-speed, diagnostics-while-drilling system will reduce well costs by more than 20 percent, resulting in a reduction in geothermal development costs by as much as 10 percent by 2005; and
- In early 2000, the Department announced a new initiative, GeoPowering the West, to encourage the use of geothermal energy in 19 western states.

Benefits:

- Over 14 billion kilowatthours of electricity was generated by geothermal facilities in four states last year, meeting the needs of about 1.4 million homes;
- GeoPowering the West is expected to result in geothermal energy being used by 7 million homes or the equivalent of about 10,000 megawatts;
- Capital investment in geothermal facilities will total $50 billion over the next 20 years; and
- By 2020, geothermal energy will displace 20 million metric tons of carbon equivalent.

For More Information, Contact: Allan Jelacic, Office of Geothermal and Wind Technologies, (202-586-6054) or go to: www.eren.doe.gov/geothermal/

Biobased Products and Bioenergy Initiative

DOE Challenge: Enhancing Energy Security, Mitigating Environmental Impacts,

Program Activity: As we move into the 21st century, a number of key issues challenge our nation's rural economy, energy security, and environment. Recent scientific advances in bioenergy and biobased products have created enormous potential to develop new economic opportunities for rural America, enhance U.S. energy security, help manage carbon emissions, and protect the environment. *"The Bioenergy Vision: Achieving Integrated Development and Use of Our Nation's Biologically Derived Renewable Resources"* developed by industry, challenges industry and government alike to develop a sustainable energy future founded on science, domestic resources, and the protection of the natural environment.

A 1999 Executive Order on Biobased Products and Bioenergy provides for coordinated Federal efforts to accelerate the development of 21st century biobased industries that use trees, crops, agricultural, forest, and aquatic resources to make an array of commercial products including fuels, electricity, chemicals, adhesives, lubricants, and building materials. Legislation in support of the principles established in the Executive Order has been introduced. The Agricultural Risk Protection Act of 2000 has received bipartisan support. The U.S. Department of Agriculture, EPA and others have joined DOE in focusing efforts toward integrated R&D that will support a strong industrial and agricultural participation.

The cornerstone of the initiative is a concept called "the biorefinery," similar to the refineries of the oil industry. These biorefineries will use biomass from today's farms and forests to create an array of products. Additional focus areas include outreach and analysis, combined with the integrated R&D to lead to cost-shared demonstrations. Future efforts will follow the new strategic plan that will be developed under the Executive Order and roadmaps identified under the Bioenergy/ Bioproducts Initiative that utilizes biomass to advance both an integrated bioenergy industry, as well as its renewable bioproducts industry sector. It is anticipated that new partnerships will come together for the first time in an integrated fashion, leading to new business opportunities. Innovative approaches will be encouraged through a multi-agency, industry peer review project selection process.

Accomplishments: The initiative depends on the integration of the existing programs within DOE, including the EEREs Offices of Transportation Technologies, Power Technologies, and Industrial Technologies. These programs have been developing the core technologies needed to support the goals of the integrated Bioenergy/Bioproducts Initiative.

Benefits:

- The initiative goal is a tripling of U.S. use of biobased products and bioenergy by 2010;
- Reduced oil dependence; and
- Increased economic opportunities, especially in rural areas.

For More Information, Contact: Richard Moorer, Office of Transportation Technologies, (202-586-5350) or go to: www.eren.doe.gov/bioenergy_initiative/

Million Solar Roofs Initiative

DOE Challenge: Mitigating Environmental Impacts

Program Activity: Million Solar Roofs is an initiative to install solar energy systems on one million U.S. buildings by 2010. Announced by President Clinton on June 26, 1997 in his speech before the United Nations Session on Environment and Development, this effort includes two types of solar technology—photovoltaics that produce electricity from sunlight and solar thermal panels that produce heat for domestic hot water, space heating or heating swimming pools.

The U.S. Department of Energy is working with partners in the building industry, other Federal agencies, local and state governments, utilities, the solar energy industry, financial institutions and non-governmental organizations to remove market barriers to solar energy use and develop and strengthen local demand for solar energy products and applications. The Initiative works in a "bottom-up" fashion by attracting partners building by building, community by community, state by state and business by business. It also works in a "top-down" fashion by developing financing, leveraging resources, coordinating Federal agency support and sharing information. Any person or organization who installs the minimum size solar electric or solar thermal energy system on a residential, commercial, institutional or government building is able to register with the Million Solar Roofs Registry. President Clinton has committed the Federal government to install solar electric and solar thermal energy systems on 20,000 federal buildings by 2010. The U.S. Department of Energy's Federal Energy Management Program will assist Federal agencies to meet that commitment.

Accomplishments:

- The original Initiative Action Plan was developed with input from members of the solar energy community and was first introduced in April, 1998. Since then, it has been updated annually to set goals and prioritize actions. The 2000-2001 Action Plan will continue to build on that work;
- In April 2000, Secretary Richardson announced that the total number of preliminary pledges made by the Initiative's Partners has reached over one million solar energy systems. With the addition of seven new State and Local Partnerships this Spring, the total number of Partnerships has grown to 47 and the number of preliminary pledges to install solar energy systems has reached 1,000,440;
- As an example, the City of Chicago and ComEd will install $4 million worth of solar panels atop Chicago's nine major museums and Lincoln Park Zoo. Each installation will generate approximately 50,000 kilowatthours of electricity per year from the sun. In total, the solar panels will provide more than 600,000 kilowatthours per year, enough to power 60 average households;
- Photovoltaics were invented approximately 40 years ago at AT&T's Bell Laboratories and later developed as a means to power satellites and space vehicles. In the past two decades, research and development have improved the efficiency and reliability of photovoltaics and reduced the costs of photovoltaic electricity by a factor of 5; and
- The Federal sector has installed 1,745 solar energy systems as of April, 2000. They are well on their way to install 2,000 systems by the end of calendar year 2000.

Benefits:

- In 2010, with one million solar energy roofs in place, the Initiative could reduce carbon emissions in an amount equivalent to the annual emissions from 850,000 cars;

- By 2010, approximately 70,000 new jobs could be created as a result of the increased demand for photovoltaic, solar hot water and related solar energy systems;
- By increasing the domestic market for solar energy, increasing domestic production and reducing the unit cost for solar energy systems, the Initiative could enable U.S. companies to retain their competitive edge in the worldwide market; and
- By 2005, the photovoltaic market alone is expected to exceed $1.5 billion worldwide.

For More Information, Contact: Peter Dreyfuss, Energy Efficiency and Renewable Energy, (202-586-8779) or go to: www.eren.doe.gov/millionroofs/index.html

Environmentally-Friendly Hydropower Turbines

DOE Challenge: Mitigating Environmental Impacts

Program Activity: The Department's hydropower research and development program is focused on enhancing the environmental performance of hydroelectric generating systems. The Advanced Hydropower Turbine Systems Program was initiated in 1994 as a partnership with industry and other government agencies. Targeted improvements in environmental performance include greater survival of fish passing through turbines and improved water quality. Accomplishing these aims will support the Department's Comprehensive National Energy Strategy goal of maintaining the viability of existing hydropower sources.

Current activities involve turbine field testing and laboratory, field, and computational studies in a coordinated effort to improve fish survival in turbines. New "fish-friendly" turbine design concepts have been developed, along with a better understanding of biological criteria for turbine design, and improved sensor technology for measuring the physical conditions inside operating turbines.

Accomplishments:

- Conceptual designs for environmental upgrades of existing turbine designs were completed. Testing of one of these concepts, the minimum-gap runner, at Bonneville Dam resulted in 40 percent less fish injury than in the original design;
- An innovative conceptual turbine design was completed, and pilot-scale biological and engineering proof-of-concept testing activities have been initiated;
- Advanced "sensor fish" technology was developed and is now being used to measure the effects on fish passing through turbines; and
- Biological experiments to characterize and quantify shear and pressure stresses on fish in the turbine environment were completed.

Benefits:

- Turbine technology capable of reducing fish mortality to 2 percent or less will be commercially available by 2010, compared to current mortality levels ranging up to 30 percent or greater.

For More Information, Contact: Don Richardson, Office of Biopower and Hydropower Technologies, (202-586-4541) or go to: hydropower.id.doe.gov/

Crosscutting

Promoting International Cooperation for Clean Energy

DOE Challenge: Mitigating the Environmental Impacts of Energy Production and Use

Program Activity: The Department of Energy is pursuing international cooperation to address the challenge of affordable, efficient and clean energy on a global scale. Specifically, U.S. policies seek to develop competitive international energy markets, facilitate the adoption of clean, safe, and energy efficiency systems, and promote international science and technology cooperation in clean energy systems.

Accomplishments: The Department has obtained the agreement of several dozen countries in supporting clean energy technology, energy efficiency, and the Clean Development Mechanism. We have energy efficiency programs with numerous countries, including Brazil, China, India, Mexico, Russia, South Africa, Ukraine and Venezuela.

Through the U.S./China Forum on Environment and Development, led by Vice President Al Gore and Premier Zhu Rongji of China, DOE established, in cooperation with the U.S. Export-Import Bank and the State Bank of China, a $100 million Clean Energy Program, signed and implemented new protocols to promote clean fossil energy, renewables and energy efficiency, and launched a U.S.-China Oil and Gas Industry Forum to promote oil, natural gas and coal-bed methane development in China.

In October 1999, DOE signed a Joint Statement on Cooperation in Energy and Related Environmental Aspects with the Government of India. The Joint Statement has led to bilateral policy dialogue and a South Asia Regional Initiative on clean energy development and climate change. It set the stage for President Clinton's visit to India in March, 2000, at which time the Administration signed a Clean Energy and Environmental agreement. Also in March 2000, a Joint Statement on Clean Energy and Climate Change was signed with the Government of the Philippines, facilitating international negotiations on climate change.

The Department has initiated a program of clean energy cooperation with Mexico, Costa Rica and Bolivia. In Mexico, the focus is on clean fossil technology development and deployment, while maintaining the affordability of fossil fuels and fossil-based power generation.

DOE has signed bilateral Clean Energy Statements with the Governments of Russia, Estonia, Latvia, Lithuania and the Kyrgyz Republic. These statements emphasize the role of the energy sector in joint efforts to protect and enhance the environment, and advance the international negotiating process on climate change. The Administration has actively promoted energy efficiency and renewable energy in Russia through regional energy efficiency laws, renovation of district heating systems, improved efficiency in enterprise housing, energy-savings codes and standards, advances in energy-efficient window technologies, construction of wind-diesel hybrid power stations at remote sites in the Northern Territories, and a planned new geothermal power plant in Kamchatka. In Ukraine the Department has launched an $850,000 initiative for financing energy efficiency projects, sponsored energy audits for 5 industrial firms, and helped facilitate a $30 million World Bank loan to retrofit municipal buildings in Kiev. The Department has established a regional oil spill response system with the countries bordering the Black Sea. The effort includes a website for information exchange and technical workshops to build institutional capacity in the region.

Benefits:

- Accelerated deployment of clean energy technology in international markets;
- Reduced air and water pollution and a reduced rate of growth of greenhouse gas emissions worldwide; and
- More efficient use of fossil fuels.

For More Information, Contact: Matt Willis, (202-586-5800) or go to: www.osti.gov/international

Promoting International Competition and Private Sector Investment

DOE Challenge: Enhancing America's Energy Security

Program Activity: The Department promotes the opening of global markets to U.S. trade and investment through encouraging competition, energy sector reform and regional market integration. In cooperation with U.S. business, the Department recently hosted three major international conferences involving Energy Ministers from the Western Hemisphere, Africa, and the Asia-Pacific Economic Cooperation (APEC) community. The Department is leading major energy initiatives in Africa, Asia, Latin America, and Europe.

Accomplishments: In the Asia-Pacific region, APEC energy ministers and leaders have endorsed the APEC natural gas initiative. This initiative seeks to accelerate investment in natural gas supplies, infrastructure and trading networks throughout the region, and has been developed in close collaboration with the business sector. The initiative aims to reduce investor risk through implementation of appropriate policies by the member governments of the APEC region. These policies include permitting private ownership of natural gas facilities, ensuring sanctity of contracts, establishing autonomous regulators, promoting non-discriminatory treatment of foreign and domestic companies, fostering competition among all sources of energy, and supporting the free flow of exports and imports of natural gas and natural gas-related products and services across borders.

With regard to China, the Department leads the Energy Policy Working Group of the US-China Forum on Environment and Development chaired by Vice-President Gore and Premier Zhu Rongji. The Department has set up an Oil and Gas Industry Forum, which encouraged China's decision to develop its natural gas resources, import liquefied natural gas, and permit foreign ownership of natural gas production and transportation infrastructure. DOE cooperative programs with Russia have resulted in passage of Production Sharing Laws to encourage investment in the oil and gas sector. In the Caspian region, bilateral policy dialogue with Turkmenistan, Turkey, Azerbaijan and Georgia has fostered an investment climate for private sector investment in oil and gas pipelines to transport oil and gas to markets outside of the region. In the Baltics and Eastern Europe, DOE has supported the efforts of U.S. companies to invest in the energy sector, and has encouraged host governments to adopt fair and transparent procurement practices, and to allow private investment. Through the International Energy Agency (IEA), the Organization for Economic Development and Cooperation (OECD), and the European Union (EU), the Department has accelerated the opening of the European gas and electricity sectors to competition and U.S. private investment.

Benefits:

- Enhanced energy security of nations through interdependence and competitive markets;
- Increased opening of international markets to U.S. trade and investment; and
- Accelerated deployment of clean energy technology in international markets.

For More Information, Contact: Matt Willis, International Affairs (202-586-5800) or go to: www.osti.gov/international

Use of Energy Efficiency and Renewable Energy Technologies in Clean Air Act State Implementation Plans

DOE Challenge: Mitigating Environmental Impacts, Enhancing Energy Security

Program Activity: Each year the nation spends over $100 billion to clean up pollution that is an unintended consequence of energy use. Much of this pollution could be avoided through wider application and use of clean energy technologies through comprehensive multi-pollutant prevention strategies. In recent years, the Administration has been aggressively pursuing these broader strategies to prevent pollution.

EPA's Clean Air Act programs are implemented by State governments through state environmental agencies. Particularly for the ambient air programs, each State develops a State Implementation Plan (SIP) which characterizes the nature of pollution challenges within the state and provides a plan of action by which the state can attain and maintain National Ambient Air Quality Standards. In order for a state to receive federal funds, EPA must find each SIP responsive to the requirements of statute, compliance with regulation and the needs of the environment. EPA produces guidance documents that provide states with an idea of what EPA will accept as applicable pollution reduction strategies.

DOE and EPA are currently working together to help provide for the widespread adoption of clean energy technologies by the States as a preferred means of reducing and preventing pollution.

Accomplishments:

- Development of Energy Efficiency & Renewable Energy Set-Aside in NOx Budget Trading Program;
- Assisted EPA with Monitoring & Verification strategies and requirements needed to implement this set-aside. In April, 2000, the EPA Office of Air and Radiation issued a Draft Guidance document entitled "Creating an Energy Efficiency and Renewable Energy Set-Aside in the NOx Budget Trading Program." This document is the second of three guidance documents that EPA is issuing to help states take advantage of the air quality benefits of voluntary energy efficiency and renewable energy actions; and
- Developed a strategy (with EPA and the Western Governors Association) for using renewable energy sources to help meet the regional haze rule.

Benefits:

- Simultaneous improvements to energy use, environmental quality and significant cost reductions.

For More Information, Contact: John Atcheson, Energy Efficiency and Renewable Energy, (202-586-2369) and/or David Bassett, Office of Planning, Budget and Outreach, (202-586-7943) and/or Greg Kats, Energy Efficiency and Renewable Energy, (202-586-1392)

Voluntary Partnerships with Industry

DOE Challenges: Enhancing Energy Security, Mitigating Environmental Impacts, and Increasing Competitiveness and Reliability

Program Activity: DOE actively seeks diverse partnerships to better develop, deploy and leverage the public investments in government and energy products and technologies. Our partnerships help develop the experience base, skill and knowledge pool, infrastructure, and user-familiarity that reduce the risk barriers associated with new technologies. They provide feedback to every stage of the continuous process of research, development, demonstration, production, deployment and market acceptance that is necessary for the accelerated evolution to a more balanced, efficient and productive energy economy.

Accomplishments:

- The DOE/industry's USABC developed the longer range battery used by PNGV partners, GM and DaimlerChrysler in their EV car, S-10 pickup and EPIC minivan. Customer response to these vehicles show satisfaction with their longer range and more consistent performance;
- Industry partnerships: OIT developed and commercialized over 100 technologies, saving more than 115 trillion btu. These advances reaped productivity improvements, reduced resource consumption, decreased emissions, and enhanced product quality;
- Wind Partnerships: DOE partnered with Enron Wind Corp., Zond Energy Systems, manufacturers and utilities to produce one of the world's largest wind generation facilities;
- Building America partnerships, with DOE and building industry members, cost-shares development and demonstration of new homes that are more than 50 percent more efficient, with no cost or performance penalty;
- Rebuild America partners established nearly 250 community partnerships to date that will reduce the energy costs of over 500 million square feet of building space;
- Energy Star commercial laundry partners, through a comprehensive program with EPA, retailers, the laboratories, and the appliance industry are, for example, cutting water consumption by 50 percent and water energy use by 44 percent, with membrane water filtration technology;
- Climate Challenge utility partnerships developed nine initiatives with over $50 million committed to accelerate commercialization of renewable energy technologies and energy-efficient electrotechnologies;
- Superconducting partnerships, utilizing superconducting cables in Georgia and Detroit, have set the world's benchmarks in transmission cables, transformers, motors, generators, and other electric power technologies. These are world firsts;
- Photovoltaic manufacturing partnerships have netted a 22 percent compound growth in the industry for the last 8 years, with 65 megawatts of U.S. manufactured PV sold in 1999 (200 megawatts total in 1999), and $2 billion in total sales in 1999 (2/3 foreign sales); and
- Federal partnerships with energy service companies have generated total private sector investment in Federal alternative financial projects of nearly $850 million.

Benefits:

- Pools large risks;
- Shares technology and resources;
- Accelerates research, development and deployment;
- Smooths market transformation; and
- The nations, its industries and consumers, receive energy, environmental, and cost savings years earlier and avoid significant opportunity costs.

For More Information, Contact: Mary Beth Zimmerman, Office of Planning, Budget and Outreach, (202-586-7249)