

# **1.0 EXECUTIVE SUMMARY**

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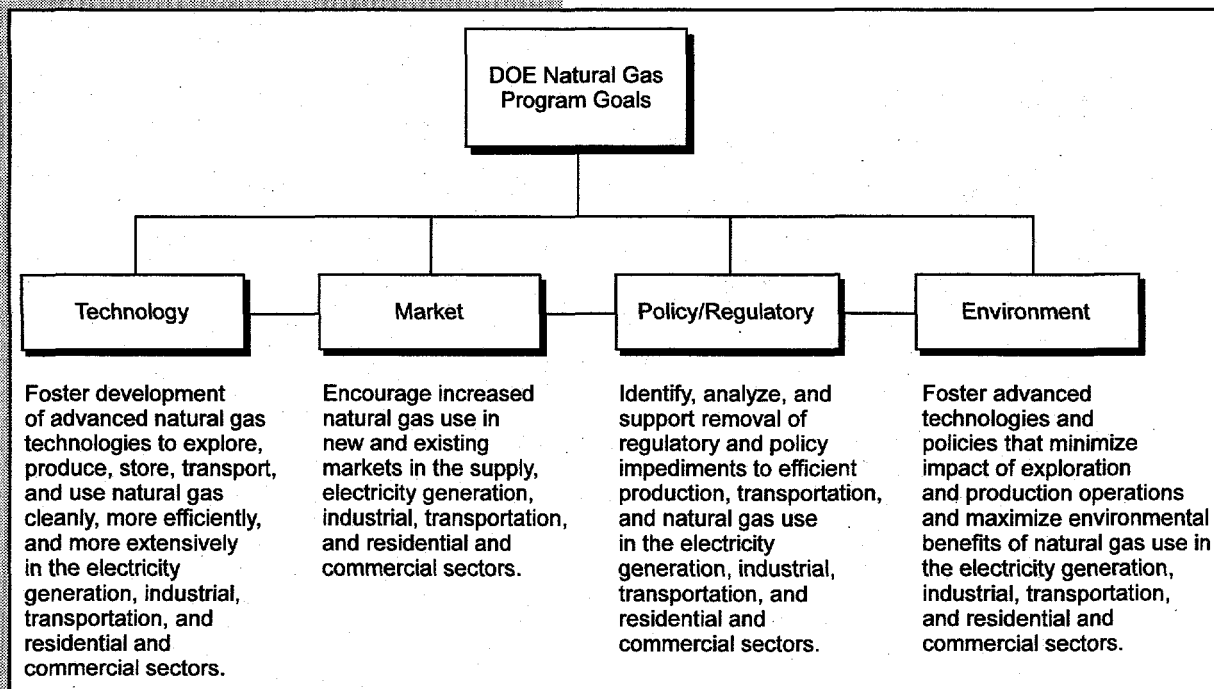
# EXECUTIVE SUMMARY

## 1.1 INTRODUCTION

This document comprises the Department of Energy (DOE or the Department) Natural Gas Multi-Year Program Plan, and is a follow-up to the "Natural Gas Strategic Plan and Program Crosscut Plans," dated July 1995.

DOE's natural gas programs are aimed at simultaneously meeting our national energy needs, reducing oil imports, protecting our environment, and improving our economy. The Natural Gas Multi-Year Program Plan represents a Department-wide effort on expanded development and use of natural gas and defines Federal government and U.S. industry roles in partnering to accomplish defined strategic goals. The four overarching goals of the Natural Gas Program are to: (1) foster development of advanced natural gas technologies; (2) encourage adoption of advanced natural gas technologies in new and existing markets; (3) support removal of policy impediments to natural gas use in new and existing markets; and (4) foster technologies and policies to maximize environmental benefits of natural gas use. The program structure and goals are presented in Exhibit 1.

**Exhibit 1 - DOE Natural Gas Program Goals.**



## 1.2 HISTORICAL TRENDS

### GENERAL OVERVIEW

Natural gas, a relatively clean-burning and domestically abundant fossil fuel, is an important component of the Nation's energy portfolio. Once viewed as a diminishing short-term resource, natural gas now is recognized as the fuel of choice in the long-term transition to a more sustainable energy future in the 21st century. Reports published by independent agencies, as well as the Department of Energy, have contributed to a better understanding of the U.S. domestic natural gas resource base, and allayed fears of shortages. For example, the National Petroleum Council (NPC) in their report, *The Potential for Natural Gas in the United States* (1992), estimated the recoverable gas resource base for the Lower-48 States, including offshore, at 1,295 trillion cubic feet (Tcf)—sufficient gas resources to meet U.S. demand, at current levels, for about 60 years. This estimate is conditional on advanced technologies to convert much of the gas resources-in-place into recoverable resources. In fact, the NPC estimate reflects an expected 25 percent expansion in remaining unproven recoverable resources in the Lower-48 States, which are expected to be available only through improved technology without regard to cost.

Technology and efficiency improvements have provided many benefits to gas consumers and industry. Natural gas consumption in 1996 reached 22 Tcf, the highest level since the 22.1 Tcf recorded in 1973 and 5.7 Tcf, or 35 percent, more than just 10 years earlier. Domestic production in 1996 continued the upward trend evident since 1986, reaching 18.8 Tcf, the highest level since 1981.

Domestic producers enjoyed a great deal of success in meeting the challenges of expanding output despite lower prices. Expanded supplies resulted in a period of generally lower prices. Between 1987 and

1996, gas wellhead prices have averaged \$2.01 per thousand cubic feet (Mcf), which is 48 percent below the 1983 peak of \$3.89 per Mcf.<sup>1</sup>

Strong industry performance in 1996 is expected to continue at least for the near term. Gas proved reserves<sup>2</sup> increased from 1993 to 1996, the first sustained increase in gas reserves since 1967. Proved reserves are significant as an indicator of future gas production potential. The growth in reserves shows a response to the greater number of gas exploratory wells, which have more than doubled since 1992.

A key aspect of recent industry experience has been the sometimes difficult transition, since the mid-1980s, from a heavily regulated industry to one in which natural gas is viewed as a competitive commodity. The story of the natural gas industry since the early 1980s has been one of extensive change and considerable success. The natural gas industry and markets have undergone a radical alteration to practices and performance during the past decade because of technological and institutional changes.

The next section provides an overview of regulatory and legislative changes affecting natural gas markets. This is followed by a discussion of major industry segments, and trends and measures that demonstrate the impact of technological changes within this altered institutional framework.

### CHANGING MARKET DYNAMICS

The recent transition in the natural gas industry to a reduced regulatory environment has significantly affected business operations. The current industry is much more efficient than that of the early 1980s, but is affected by greater complexity in operations and contracting. Today's market reflects substantial changes in the industry since the mid-1980s.

The core of the natural gas industry consists of markets where the commodity itself is

<sup>1</sup> All prices in the Historical Trends section are in 1996 dollars.

<sup>2</sup> Improved reserves are the estimated quantities of natural gas that analysis of geological and engineering data demonstrate, with reasonable certainty, to be recoverable in future years from known reservoirs under existing economic and operating conditions.

priced and traded. The natural gas industry before 1985 was highly regulated from the wellhead to the burnertip. This system operated under numerous rules, policies, and guidelines. One important consequence was that prices tended to be fairly stable on both a monthly and annual basis, but they were not an effective signal of market conditions. The goal of improving price signals from the consumer to the supplier has been accomplished through legislative and regulatory initiatives, which included deregulation of wellhead prices and open access to the pipeline transportation system.

Since the mid-1980s, the Federal Energy Regulatory Commission (FERC) has issued a series of orders designed to further competition. These efforts began with Order No. 436 (1985) and culminated in Order No. 636, called the Restructuring Rule. Order No. 636 was issued in April 1992 and implemented in November 1993. It required interstate pipeline companies to separate (or "unbundle") all of their services. Under the Order, interstate pipeline companies were required to separate their merchant and transportation functions by November 1, 1993. Unbundling supply activities is an essential procompetitive action. It restricts the extension of monopoly power from one phase of supply, such as transportation, into other markets, such as storage or sales to end-users. Regulation of interstate transportation continues, but pipeline companies are no longer allowed to bundle natural gas sales with transportation services.

Gas can now be obtained from many sources and transported along numerous pipelines. Marketing companies have developed to provide marketing and supply aggregation services previously supplied by pipeline companies. Oversight of gas sales and marketing activities has been significantly reduced, but sales by interstate pipeline companies and interstate transportation remain subject to FERC jurisdiction. Gas purchases are essentially free from regulation, while transportation and storage remain subject to FERC jurisdiction.

Purchasers and sellers now operate in a market that can react rapidly to changes in supply and demand conditions. Advantages to firms in the industry from increased market flexibility are partially offset by the complexity of contracting for purchases and sales, and uncertainty about future gas prices. The extensive nature of earlier regulations limited negotiating flexibility and the associated contractual complexity. Contracting arrangements now include short-term spot contracts, longer-term contracts, futures contracts, and the exchange of futures for physicals. Gas can be purchased under fixed-price contracts or indexed to spot prices, futures prices, or alternate fuel prices. While the competitive market structure ensures that supply and demand conditions are balanced, there is also potential for significant price volatility, with price risk for both sellers and purchasers resulting from sudden unexpected price changes. Achieving the goals of one firm generally requires concessions to the other party, such as adjustments to price, assumption of risk, or quality of service. The challenge of contract negotiations in today's markets stands in marked contrast to the relative simplicity of earlier times.

### **MARKET COMPETITION AND PRICES**

The movement to a more competitive environment greatly increased price responsiveness. The evolution of the market since 1980 is reflected in three distinct phases of wellhead price behavior, which correspond roughly to the periods up to 1984, 1984 through 1987, and from 1987 to the present (Exhibit 2). As reported by the Energy Information Administration (EIA), average annual wellhead prices grew by almost a dollar between 1980 and the three year plateau of 1982-1984, when prices ranged between \$3.86/Mcf and \$3.90/Mcf. Prices fell steadily between 1984 and 1987 as many companies shed their long-term supply contracts that were priced above the market. As more pipeline companies became solely providers of transportation service, they renegotiated many of their long-term, high-

priced contracts with producers. Additional competitive pressure was introduced into gas markets with the virtual collapse of petroleum product prices in early 1986. With gas prices no longer propped up by long-term contracts, wellhead prices began to fall. Prices fell to \$2.22/Mcf in 1987. Thereafter, prices have averaged \$2.01/Mcf, which is slightly more than half the 1983 peak of \$3.90/Mcf. This trend is expected to continue with relatively low gas wellhead prices projected through 2015. Prices are projected to be \$2.12/Mcf in 2002; \$2.21/Mcf in 2007; and \$2.38/Mcf in 2015.<sup>3</sup>

Price differentials from the wellhead to the end-use delivery point have declined gradually for all classes of customers since the mid-1980s, indicating efficiency improvements in transmission and distribution. However, the greater portion of the decline in delivered prices results from the decrease in wellhead prices.

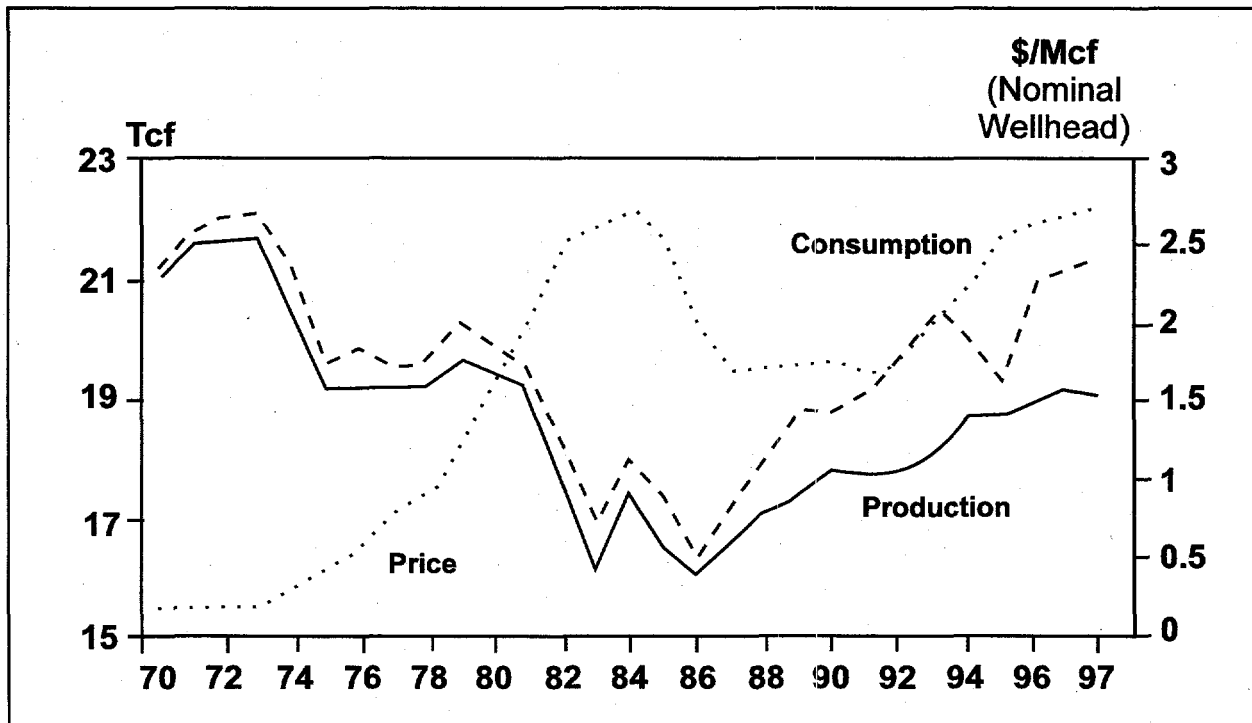
Additionally, price differentials tend to fluctuate less than the wellhead price, thus the pattern in delivered prices tends to track

that of wellhead prices, as shown in the average delivered prices for residential consumers and electric utilities. The outlook for natural gas prices shows a slight increase in wellhead prices, with further declines in delivered price differentials. The net result is a decline in gas prices through 2015 for residential customers, although electric utilities face a slight rise by 2015.

### GAS SUPPLY

The expected success from continued technological improvements has been reflected in recent natural gas resource assessments. This perspective is encouraged by recent industry performance. Production in 1996, at 18.8 Tcf, was more than 2.7 Tcf higher than the 16.1 Tcf produced ten years earlier (Exhibit 2). The 1996 production volume was the highest level since 1981. This recent trend in gas supply continues into the future according to EIA projections. U.S. natural gas production is expected to expand by another 7 Tcf to a total of 26.1 Tcf by 2015. This level of domestic production is

Exhibit 2 - Natural Gas Trends (1970-1997).



<sup>3</sup> All projected volumes and prices are from the *Annual Energy Outlook 1998*, Energy Information Administration, (December 1997).

conditional on continued improvements in technology at a rate comparable to that observed today. While continuation of this long-term trend may be a reasonable assumption for analysis, the source of supporting research and development activity is not identified.

The importance of technology improvement is seen particularly in a number of supply sources that were not economically or technically feasible even ten years ago, such as offshore deepwater production. Production from the entire Gulf of Mexico in 1996 increased 8.2 percent over 1995 volumes. Production from the deepwater region in the Gulf of Mexico expanded as new fields, such as the Mars project, initiated production. Some fields, such as Shell's Auger project and others that started during 1995, were able to produce for an entire year, adding to the growing offshore production total.

The trend for increasing gas production from the offshore Gulf of Mexico is expected to continue during the next few years. The Mensa project, in a record 5,400 feet of water, is expected to begin production in 1997. The depth of this project eclipses the deepwater record set in 1989 at 1,760 feet with the Joliet field. These technical accomplishments are impressive in themselves, and each milestone results in the expansion of future production opportunities as another technical barrier is overcome. The extension of recovery opportunities into deep water has established the deep offshore as an area of considerable national significance and one that clearly requires continued development and deployment of new technologies.

A second source of increased supply is gas from coalbed formations, which began producing significant marketed gas volumes only in the late-1980s. Natural gas production from coalbed methane fields continued to grow in 1996 as projects initiated mainly in the early- to mid-1990s matured through the dewatering phase into higher rates of gas production. Coalbed formations contributed almost 1 Tcf, roughly 5 percent, to U.S. production in 1996.

Continued production growth from coalbeds, however, is not likely in light of the precipitous drop in new wells completed in coalbed formations since termination of the production tax credit at the end of 1992. New well completions in coalbed formations averaged 244 in 1995 and 1996, compared with 1,325 from 1990 through 1992.

Natural gas market dynamics have changed dramatically as the industry adjusts to a more flexible and efficient market with deregulated wellhead prices and open access to the transportation network. Better price signals from end-users to suppliers and the ability to negotiate contracts and services more freely have resulted in competition that requires firms to focus on cost containment and greater productivity.

### 1.3 NATURAL GAS POLICY

The Administration's policy is to increase our use of natural gas so as to maximize its economic, environmental, and national security benefits.

Increased natural gas usage will reduce our economic dependence on foreign energy suppliers. The vast majority of natural gas consumed in the U.S. is domestically produced, and almost all imports come from Canada, one of our partners in the North American Free Trade Agreement (NAFTA). U.S. gas reserves will be sufficient to meet domestic demand at current levels for about 60 years, and our NAFTA partners also have large reserves.

Natural gas is the cleanest burning of all fossil fuels, emitting lower levels of pollutants that contribute to smog, acid rain, and the greenhouse effect. Gas combustion does not create solid waste. It is delivered safely, reliably, and invisibly through a network of pipelines, the construction of which has little, if any, lasting effect on the environment.

*DOE's Sustainable Energy Strategy: Clean and Secure Energy for a Competitive Economy* (July 1995) discusses the Administration's approach toward

implementation of its natural gas policy. The major implementation strategies are to:

- Develop advanced natural gas technologies
- Provide incentives for increased exploration and production
- Stimulate end-use markets
- Continue regulatory reforms that reduce costs and increase efficiency

The Administration supports providing appropriate revenue-neutral incentives to increase natural gas exploration and production. DOE's ongoing *Domestic Natural Gas and Oil Initiative* encompasses a variety of actions to substitute domestically produced natural gas for foreign oil. A proposal to reduce the royalty rate for onshore marginal natural gas wells is also being assessed. The proposal has potential to conserve resources, improve ultimate recovery of finite resources, increase the domestic natural gas resource base, and promote natural gas production. The measure would be similar to the "Stripper Program" rule currently in effect for oil.

By purchasing natural gas vehicles for Federal fleets, providing tax incentives, and encouraging use of natural gas for electric power generation, the Administration is working to stimulate markets for natural gas use. The Energy Policy Act of 1992 established targets for purchase of alternative fuel vehicles by the Federal government. A 1993 Executive Order increased these targets. By the end of Fiscal Year (FY) 1994, the Federal government had purchased 6,700 natural gas vehicles.

The Administration supports continued regulatory reform throughout the Federal government to reduce the cost of natural gas exploration and production and to increase efficiency in natural gas markets. The current Federal and State regulatory framework lacks sufficient incentives for cost-effective pollution control and adoption of promising technologies. These regulations are often complex, redundant, and inflexible.

Industry faces increased regulatory uncertainty and high compliance costs, while Federal, State, and local governments also spend more than necessary on implementing and enforcing regulations.

The Administration supports regulatory reforms to ensure a more robust secondary market for interstate natural gas pipeline capacity, to promote efficient and fair pricing of natural gas transportation service, and to expedite construction of new facilities to ensure reliable natural gas delivery. DOE continues to support States that are examining their regulations to bring the benefits of competition to retail natural gas markets.

#### **1.4 DOE RD&D PROGRAM FOR NATURAL GAS**

In the past, DOE natural gas programs were focused mainly on technology development, with only minor consideration of market and policy issues. Now, the focus of DOE natural gas programs has shifted to an integrated "systems approach," which addresses "reservoir to end use" technology needs, regulatory constraints, and market opportunities for increasing gas use. Expanding natural gas use in the U.S. presents many challenges and opportunities that include expanding the domestic resource base, developing new ways to use natural gas to maximize economic efficiency, and establishing policies and regulations to allow gas to compete with other fuels in new and existing markets. DOE's natural gas program focus is primarily on the near- and mid-term impacts on industry and consumers; reducing costs system-wide; enhancing efficient use of natural gas; reducing environmentally detrimental emissions; and increasing reliability of gas supply and deliverability.

The Department also is participating in the coordination and reform of Federal, State, and local government statutes and regulations to increase competition in energy markets. DOE policy and regulatory initiatives focus on four key areas: (1) market



efficiency, (2) market opportunities, (3) reducing regulatory impediments to gas use, and (4) encouraging consistency in Federal, State, and local regulatory oversight of the industry. Restructuring of the natural gas industry and potential restructuring of the electricity industry will affect future technology development choices and impact program budgets. The Department will need to perform further analysis of the impact Federal, State, and local regulations and electric power industry restructuring will have on the Department's ability to realize its vision for natural gas.

The Administration supports development of advanced natural gas technologies which increase the economically efficient use of natural gas. The Federal budget has supported advanced gas technology research, development, and demonstration (RD&D), thereby helping the Nation attain environmental and economic goals. Natural gas funding continues to be concentrated on technology RD&D. To support this new approach, DOE is forging stronger relationships with stakeholders. Jointly funded natural gas RD&D projects are ongoing in partnership with the Gas Research Institute (GRI), the Electric Power Research Institute (EPRI), industry, academic institutions, the National Laboratories, and other Federal agencies. These partnerships are intended to foster U.S. technical leadership and accelerate technology development and deployment, achieve national environmental goals, and define DOE's role in technology commercialization.

DOE is working with the natural gas industry to develop new production and end-use technologies. Remaining natural gas reservoirs are more difficult to develop because of their depth and size, hardness of the rock, impermeability, or the quality of the natural gas they contain. DOE and industry are developing new advanced drilling system technologies to induce fractures and to locate and drill through natural fractures. As for end-uses, DOE and its industrial partners are working to develop and deploy natural gas

equipment for residential and commercial air conditioning, natural gas vehicles, high efficiency industrial gas turbines, and fuel cells that chemically convert natural gas to electricity at efficiencies of 50 to 60 percent.

New gas turbines and combined cycle technology are among the most attractive technologies for new electric generation capacity. Under the auspices of *The Climate Change Action Plan*, DOE has been funding projects to accelerate commercialization of high-efficiency gas technologies, such as fuel cells. DOE has entered into joint ventures with utilities, research organizations, and technology developers, and has funded demonstrations and market entry initiatives. DOE and EIA have also been working to address concerns about the long-term reliability of natural gas supplies by providing timely data on the availability and deliverability of natural gas supplies.

Environmental policies have become and will remain one of the most important considerations undertaken by DOE when assessing the future of natural gas markets. DOE recognizes the environmental benefits of natural gas, a cleaner-burning fuel, relative to the other fossil fuels.

## 1.5 PROGRAM MISSION AND GOALS

The Program mission, as defined in the DOE Natural Gas Strategic Plan, is to undertake and promote activities, in partnership with DOE's stakeholders, and establish policies to maximize the Nation's ability to supply, transport, and use natural gas to encourage growth, enhance national security, and improve the environment.

The program goals are presented in Exhibit 3.

## 1.6 DOE MULTI-YEAR PROGRAM CROSSCUT PLAN

DOE's natural gas RD&D program activities crosscut the Offices of Fossil Energy, Energy Efficiency and Renewable Energy, Energy Research, and Policy, and the Energy Information Administration. Specific

activities are carried out and funded either independently by each Office or jointly, depending on the Office mission, program focus, crosscutting programmatic relationships, and budgetary considerations. The overall program strategy has been developed by a Department-wide planning Committee charged with ensuring that all natural gas programs are conducted with a single strategic focus to provide a united and integrated program to the natural gas industry and stakeholders.

In developing the Natural Gas Strategic Plan, the Committee established seven technology panels in the following focus areas: Natural Gas Supply, Delivery and Storage, Power Generation, Industrial, Residential and Commercial sectors, Natural Gas Vehicles, and the Environment. Each panel, comprising members from program offices and representative industry observers, developed a program strategic plan that reflects the strategic direction and goals provided in the Department-wide Natural Gas Strategic Plan.

### **1.7 CROSSCUTTING FUNDAMENTAL RESEARCH RELATED TO NATURAL GAS**

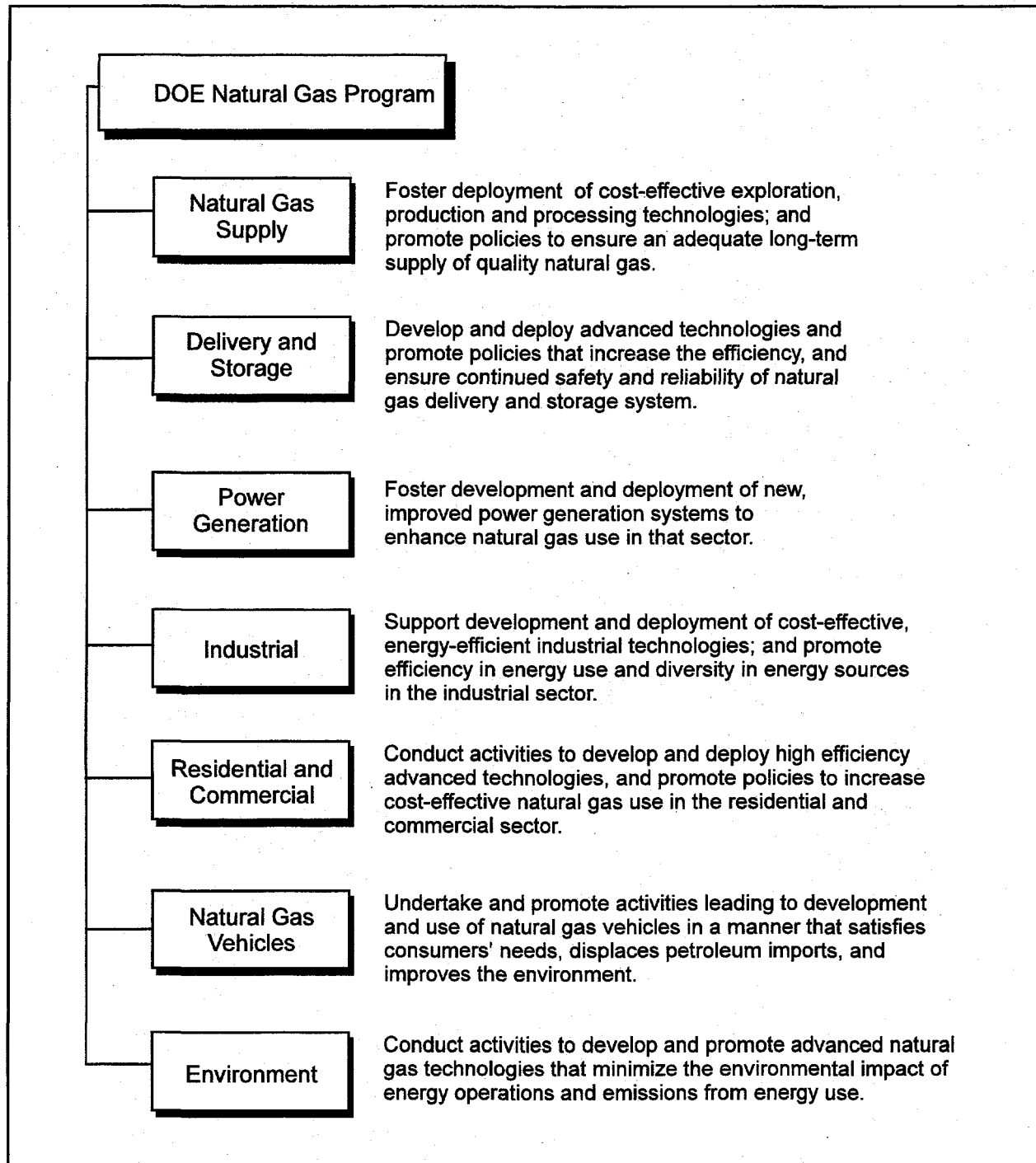
Basic research is currently being de-emphasized in the natural gas industry, raising questions about the adequacy of technological developments to maintain stable reserves, prices and markets. As a result, the Federal Government will need to maintain or increase its role in fundamental research in all areas of the natural gas industry. The Department of Energy historically has a number of broad-based research programs which have significance for the natural gas system, although they are not funded as parts of the directed natural gas program. They are distributed among various offices including the Office of Energy Research, the Office of Fossil Energy, the Office of Energy Efficiency and Renewable Energy, the Office of Environmental Management, and the Office of Defense Programs.

Because basic research is not directed at specific end users, it is best discussed in the context of its technical area rather than its funding source. Basic research in atmospheric, water and solid waste chemistry will underlie improved environmental technologies and regulatory decisionmaking. Geosciences research, funded across a wide spectrum of topics, contributes to improved potential for natural gas resource development. Material sciences and chemical sciences research improves the efficiency, durability and safety of the natural gas system. Other research activities, directly funded as parts of the natural gas program, are described in other parts of this report.

DOE, through its National Laboratory system and broad grant programs to university-based researchers, provides support to all energy industries. User facilities at the laboratories are regularly used by industry participants for diverse efforts, which few companies can afford individually. In the future, these user facilities will have higher profiles than they do now.

Cooperative research and development agreements between the National Laboratories and industrial partners are a major success story and have increasingly provided mutual benefits to both parties. Future partnerships, including those involving university-based researchers, on issues of interest to industry will be a major component of companies' basic research portfolios, and will feed into the more focused applied research activities that companies will maintain on their own. DOE and other Federal agencies, through their Small Business Innovative Research programs, are incubating basic research developments in the business sector that will have direct applicability to fossil fuel applications, but which are not part of the directed natural gas program.

DOE-funded researchers are leaders in global research issues that cannot be the focus of individual companies, but which form the context of the regulatory environment in

**Exhibit 3 - Natural Gas Program Elements and Goals.**

which they operate. Such research includes climate change, urban ozone, and environmental waste mitigation standards.

### **ATMOSPHERIC CHEMISTRY**

The Office of Energy Research maintains a basic research program in atmospheric chemistry through its Office of Biological and Environmental Research. This research seeks to understand the atmospheric chemistry processes related to energy emissions (and their by-products) into the environment (e.g., sulphur, nitrogen oxides, ozone, carbon dioxide). The components of the research are: (a) mid-latitude tropospheric ozone studies, (b) aerosol influences on clouds and climate forcing, (c) pollution-influences on stratospheric ozone and associated effects on surface uv-b radiation, and (d) assessment of the influence of methane and NO<sub>x</sub> (primary emissions when methane is burned as fuel) and other greenhouse gas emissions on the global environment. The basic research portfolio has as its mission to understand fundamental atmospheric processes. To do this, it is necessary to understand atmospheric science, both where energy emissions are significant and where they are not.

### **ENVIRONMENTAL REMEDIATION**

Although its primary focus is on remediation of DOE-generated waste, the Office of Environmental Management, through its Office of Technology Development, has been a pioneer in funding basic research on characterization, remediation and monitoring many kinds of wastes, including non-aqueous phase liquids. Information on research in this area can be obtained from the Office of Technology Development.

### **GEOSCIENCES**

The Engineering and Geosciences Division of the Office of Basic Energy Sciences, Office of Energy Research, funds fundamental research in geomechanics, geochemistry, geophysics and hydrology. The program emphasizes research on processes that control responses of natural systems. These include

multiphase fluid flow in porous and fractured rock systems, technology and processing improvements for geophysical imaging, and basic thermodynamic studies of geochemical systems, including those with organic components. Further information on the program can be obtained from the Geosciences Research Program in its annual "Summaries of FY 1997 Geosciences Research", or on its web site at URL address <http://www.er.doe.gov/production/bes/geo/geohome.html>.

### **ENERGY MATERIALS**

The Division of Material Sciences in the Office of Basic Energy Sciences, Office of Energy Research, annually coordinates publishing the summary volume of the Energy Materials Coordinating Committee. This Committee is tasked to present an overview of DOE material sciences activities drawn from all DOE research programs. It includes subcommittees on six materials areas of particular importance to the Department: (1) electrochemical technologies, (2) metals and intermetallics, (3) radioactive waste containers, (4) semiconductors, (5) structural ceramics and (6) superconductivity. The annual reports are available from the Material Sciences Division, Office of Basic Energy Sciences, Office of Energy Research.

The metals and intermetallics areas have broad applications for the natural gas system as exploration expands in difficult environments, pipeline transport networks become more extensive, and downstream activities increase. The performance parameters, economics, environmental acceptability and safety of energy production, transmission and conservation technologies are limited by behavior and performance of materials used in these energy technologies. As a basic research program, which is applicable to many energy areas, it seeks to understand the synergistic relationships between synthesis, processing, structure, properties, behavior, and operational performance. Research in this area is funded by a number of offices within DOE, including

the Office of Energy Research, the Office of Fossil Energy, The Office of Energy Efficiency and Renewable Energy and the Office of Defense Programs. Further detailed information is available from the relevant program offices, such as Summaries of FY 1997 Research in Material Sciences, available from the Division of Material Sciences, Office of Energy Research.

### **CHEMICAL SCIENCES**

Through its Division of Chemical Sciences in the Office of Basic Energy Sciences, the Office of Energy Research provides broad support for fundamental, molecular level understanding of the chemistry underpinning natural gas technologies. These programs include: (1) combustion research to use natural gas resources more efficiently, (2) catalysis research to provide environmentally benign approaches to improve conversion efficiency in production of products and chemical feedstocks from natural gas, (3) research on thermophysical and transport properties of complex mixtures, (4) separations research to improve efficiency of these energy-intensive processes, and (5) research in analytical chemistry to provide the foundations for improved process sensing and control.

The Division also manages a number of national user facilities, including the Combustion Research Facility at Sandia National Laboratory, Livermore, California. Some of the activities relevant to natural gas technologies are cooperatively supported with the Office of Energy Efficiency and Renewable Energy and the Gas Research Institute. Further information on the Chemical Sciences Division can be found in DOE publication "Summaries of FY 1997 Research in the Chemical Sciences," available on the World Wide Web at the following address: <http://www.er.doe.gov/production/bes/chm/chm.html>.

### **ADVANCED RESEARCH IN FOSSIL ENERGY**

The Office of Advanced Research and Technical Development in the Office of Fossil Energy funds research at National Laboratories and universities focused on fundamental understanding of materials and processes in energy generation. This includes fossil fuel processing and distribution environments, among others. Current research areas include ceramics (composite structural ceramics, catalyst supports, solid state electrolytes, and membranes), new alloys (aluminides, advanced austenitic steels, and coatings and claddings) and corrosion research.

### **1.8 EIA NATURAL GAS-RELATED ACTIVITIES**

The increasing complexity and competitiveness of the natural gas industry requires extensive and comprehensive decisionmaking information for the industry itself, as well as for Federal and State programs. A significant issue confronting realization of the natural gas program goals outlined in the DOE Strategic Plan is the need for widely available, accurate and timely natural gas information to support informed decisionmaking.

The Energy Information Administration promotes understanding of energy markets, industries and major policy issues through the compilation, validation, development and dissemination of information. This information includes reported data from survey operations, other data collection, the results of aggregation and analysis of these data, and short- and mid-term projections of energy markets. EIA information programs represent work products with applications for natural gas research within DOE. However, many of these information products are neither directed at nor funded for natural gas research alone.

EIA maintains comprehensive natural gas data series that cover reserves, production, storage, consumption, flows, and prices. These data are published in various hardcopy

reports such as the *Natural Gas Annual*, the *Natural Gas Monthly*, the *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves* report, and the *Monthly Energy Review*.

EIA publishes numerous analytical reports on a wide range of issues, including assessments of energy supply and price trends and other market-related events; impacts of technology changes on future energy markets; the energy-economic impact of environmental quality goals; and changes in the electric power industry under restructuring. Numerous studies are focused on issues specific to natural gas. Assessments of monthly natural gas wellhead productive capacity in the lower-48 States are published in the series, *Natural Gas Productive Capacity for the Lower-48 States*. *Natural Gas 1996: Issues and Trends* provides a summary of recent developments in the industry over the previous year, and also highlights issues relating to contracting for transportation capacity, the emergence of market centers, changes to natural gas producers, and the effects on consumers of changes to their access to natural gas services. Technology impacts of Gulf deep water projects, electricity restructuring efforts and potential impacts on the natural gas industry, deliverability of the natural gas distribution system, and short-term pricing issues are also being analyzed.

For broader energy market issues, the *Short-Term Energy Outlook* provides projections of energy supplies, demands and prices for the upcoming two years, while the *Annual Energy Outlook (AEO)* presents long-term forecasts through 2020. The 1998 *AEO* is the latest, and it includes projections under alternative economic and oil price scenarios, as well as technology cases targeted at isolating impacts of alternative technology outcomes on energy markets.

Many decisionmakers and analysts need quick access to timely and accurate information. The EIA has improved many of their products by making them available for access and downloading on the Internet at

<http://www.eia.doe.gov>. Release of these data and reports immediately on the EIA Internet site means that a wider set of customers have ready access to this information, often prior to the availability of the printed reports. Established in July 1995, the site currently averages more than 30,000 unique users per month. New products on the EIA Internet site include the *EIA Geographical Information System-Natural Gas*, a system providing data and analytical information on natural gas pipeline and storage capacity and deliverability. In 1997, EIA instituted the *Natural Gas Weekly Market Update*, a quick summary of timely events relating to spot and futures prices, and storage and weather developments.

EIA strategic goals are directed at providing timely and accurate information for a broad range of customers. Improvement to analytical efforts is being addressed through various outreach efforts intended to form stronger partnerships with DOE program offices, other Federal and State agencies, and industry participants including producers, transmission and distribution companies, and consumer groups. A key element in this outreach effort is the recent institution of roundtable meetings with selected participants providing opportunities for discussion of analytical needs of the users of EIA products.

# **2.0 FY 1996-1998 BUDGET OVERVIEW**

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FY 1996-1998 Natural Gas RD&D Program Crosscut Budget





# FY 1996-1998

## BUDGET OVERVIEW

Natural Gas Program Sectors	Department-Wide			GRI 1997 Actual	Fossil Energy			Energy Efficiency			Energy Research		
	FY 96	FY 97	FY 98		FY 96	FY 97	FY 98	FY 96	FY 97	FY 98	FY 96	FY 97	FY 98
Exploration and Production	19.7	22.0	21.9	38.0	14.2	14.0	13.9	-	-	-	5.5	8.0	8.0
Delivery and Storage	1.1	1.0	1.0	23.8	1.1	1.0	1.0	-	-	-	-	-	-
Utilization	168.5	174.0	182.6	59.6	94.1	102.5	92.9	69.6	67.2	85.4	4.8	4.3	4.3
Combustion Systems	6.0	5.1	5.7	14.0	-	-	-	1.4	1.0	1.6	4.6	4.1	4.1
Buildings-Heating and Cooling	7.2	8.3	8.7	2.4	-	-	-	7.2	8.3	8.7	-	-	-
Gas Turbines	62.8	75.0	83.9	1.1	36.8	46.6	45.0	26.0	28.4	38.9	-	-	-
Natural Gas Vehicles	15.1	13.4	16.7	7.6	-	-	-	15.1	13.4	16.7	-	-	-
Fuel Cells	56.8	55.3	46.6	1.0	52.5	50.1	40.2	4.3	5.2	6.4	-	-	-
Gas-to-Liquids	3.2	4.2	6.3	-	3.2	4.2	6.3	-	-	-	-	-	-
Low-Quality Gas Upgrade	1.3	1.3	1.1	-	1.3	1.3	1.1	-	-	-	-	-	-
International Gas Technology Center	0.3	0.3	0.3	-	0.3	0.3	0.3	-	-	-	-	-	-
Materials Technologies	10.4	7.9	6.9	-	-	-	-	10.4	7.9	6.9	-	-	-
Other	5.4	3.2	6.4	33.5	-	-	-	5.2	3.0	6.2	0.2	0.2	0.2
Environmental/Regulatory Impact	5.3	3.6	4.3	8.8	2.9	2.6	3.3	-	-	-	2.4	1.0	1.0
Other - GRI only (processing/resource base crosscut)	-	-	-	16.2	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>193.8</b>	<b>200.6</b>	<b>209.6</b>	<b>146.4</b>	<b>112.3</b>	<b>120.1</b>	<b>111.1</b>	<b>69.6</b>	<b>67.2</b>	<b>85.4</b>	<b>12.7</b>	<b>13.3</b>	<b>13.3</b>

Note: Totals above do not match individual projects due to periodic allocations of funds and procurement sensitive information.

