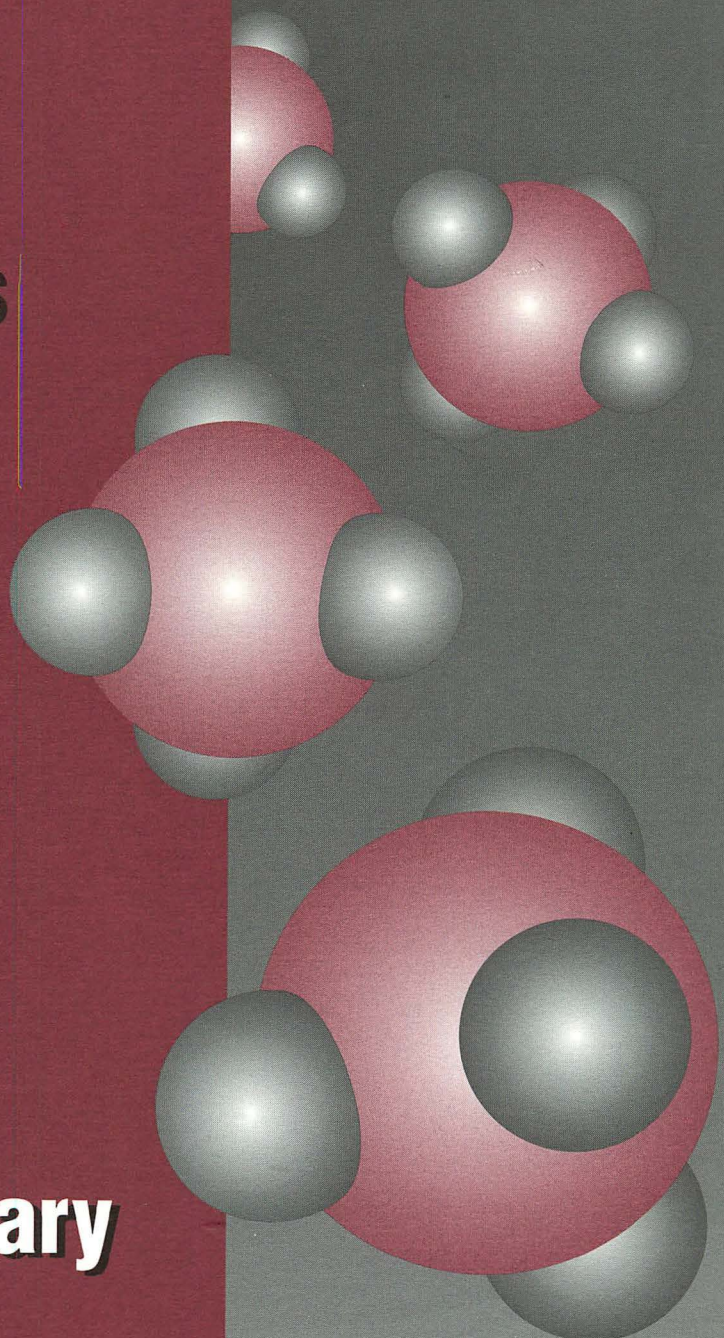
The Potential for Natural Gas in the United States



Executive Summary

December 1992
National Petroleum Council

On the Cover: Graphic Representation of Methane Molecules, CH_4, the Primary Chemical Compound in Natural Gas.

NATIONAL PETROLEUM COUNCIL

1625 K Street, N.W., Washington, D.C. 20006 (202) 393-6100

December 17, 1992

The Honorable
James D. Watkins
Secretary of Energy
Washington, D.C. 20585

Dear Mr. Secretary:

On behalf of the members of the National Petroleum Council, I am pleased to transmit to you herewith the Council's report entitled *The Potential for Natural Gas in the United States.* This report was prepared in response to your request and was unanimously approved by the membership at their meeting today.

Natural gas has the potential to make a significantly larger contribution both to this nation's energy supply and its environmental goals. Achieving that potential will take a commitment of innovation, leadership, and resources by the industry to overcome challenges that arise from its current operations, its history, and its regulation. The National Petroleum Council concludes that industry has already initiated actions in support of that commitment and believes the industry is prepared to continue those activities.

This study finds that natural gas is uniquely positioned to take on this expanded role for three reasons:

1. Natural gas can be produced and delivered in volumes sufficient to meet expanding market needs at competitive prices.
2. Natural gas is a clean-burning fuel, and can be used in a variety of applications to satisfy environmental requirements.
3. Natural gas is a secure, primarily domestic source of energy that can help improve the national balance of foreign trade.

In addition, much of the groundwork necessary to develop a more competitive and customer-oriented industry has already been laid.

Perceptions of natural gas that arise from its heavily regulated past represent the greatest challenge to be overcome by the industry. In particular, the industry must pay more attention to meeting customer needs through greater efficiency and more competitive services. Efforts like this study to define the problem and outline its solution, have become critical to realization of natural gas' potential.

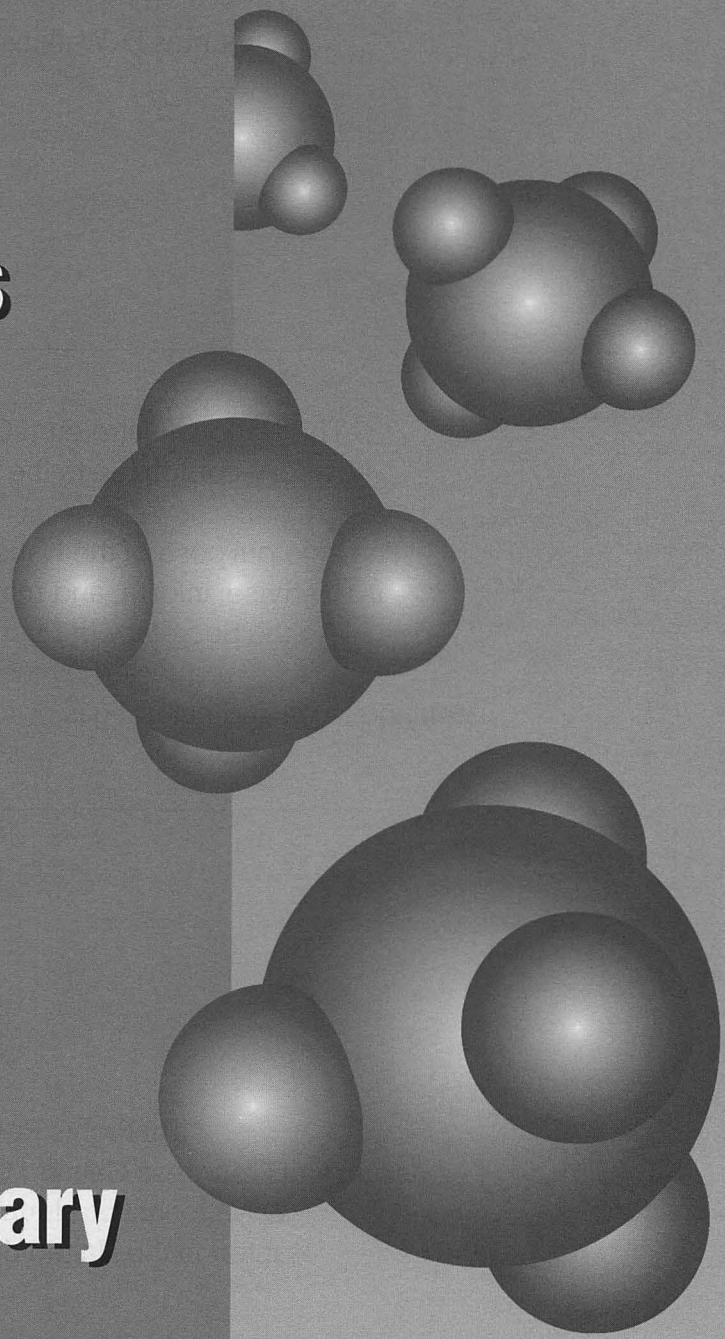
The National Petroleum Council sincerely hopes the enclosed report will be of value to the Department of Energy, and government at all levels, as natural gas and the natural gas industry realize their potential.

Respectfully submitted,

Ray L. Hunt
Chairman

Enclosure

The Potential for Natural Gas in the United States



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December 1992
National Petroleum Council

Committee on Natural Gas
Frank H. Richardson, Chairman

NATIONAL PETROLEUM COUNCIL

Ray L. Hunt, *Chairman*
Kenneth T. Derr, *Vice Chairman*
Marshall W. Nichols, *Executive Director*

U.S. DEPARTMENT OF ENERGY

James D. Watkins, *Secretary*

The National Petroleum Council is a federal advisory committee to the Secretary of Energy.

The sole purpose of the National Petroleum Council is to advise, inform, and make recommendations to the Secretary of Energy on any matter requested by the Secretary relating to oil and natural gas or to the oil and gas industries.

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PREFACE

The National Petroleum Council (NPC), an advisory body to the Secretary of Energy, has completed a study on natural gas, spanning issues from production through consumption. The Secretary, in his letter to the NPC requesting this study, specifically asked for:

> **a comprehensive analysis of the potential for natural gas to make a larger contribution . . . to our Nation's energy supply . . . [and] . . . to consider carefully the . . . potential barriers that could impede the deliverability of gas to the most economic, efficient and environmentally sound end-users.**

(See Appendix A for the complete text of the Secretary's letter.)

The NPC established a Committee on Natural Gas to develop a response to the Secretary's request. The Committee was chaired by Frank H. Richardson, President and Chief Executive Officer, Shell Oil Company, Houston, Texas. Mr. Richardson was assisted by Kenneth L. Lay, Chairman and Chief Executive Officer, Enron Corp., who served as Vice Chairman, Transmission, and Eugene A. Tracy, Immediate Past Chairman of the Executive Committee, Peoples Energy Corporation, who served as Vice Chairman, Distribution. The Government Cochairman for the study was James G. Randolph, Assistant Secretary for Fossil Energy, U.S. Department of Energy. The Committee was assisted by a Coordinating Subcommittee and four task groups. (See Appendix B for study group rosters.)

The response to the Secretary's request has taken nearly two years of study and analysis and has involved contributions from some 200 individuals in industry, government, trade associations, academia, and private enterprise. This study has brought together representatives from all segments of the natural gas industry (major and independent producers, transmission companies, local distribution companies, and marketers) as well as end users and federal and state regulators.

Additionally, the study utilized focus group interviews with participants representing consumer advocates, regulators, various customer classes, and the different industry segments. The focus group participants were encouraged to provide input on where the natural gas industry was not meeting their specific requirements, what concerns they had about the industry, and suggestions on how the industry could improve. These results were considered by the NPC study members in analyzing the potential barriers to increased use of natural gas and developing recommendations for moving the industry toward its goals.

Results from the study have been assembled into six volumes, the first of which is a summary of the overall findings and recommendations along with the methodology used in conducting the study. This summary is supported by reports of each of the four task groups created by the Natural Gas Committee. Volumes II through V cover Source and Supply, Demand and Distribution, Transmission and Storage, and Regulatory and Policy Issues, respectively. The final volume contains descriptions of the computer models used in the study and selected output from the analyses. Copies of these volumes may be obtained from the NPC or by using the order form in the back of this Executive Summary.

OVERVIEW

Over the course of the study, the NPC assessed (1) the growth opportunities for natural gas under two different scenarios, (2) the economic potential for satisfying growing demand with the domestic gas resource base and available imports, (3) the ability of the transportation and storage system to meet the increased demand, and (4) how the regulatory environment affects the operations of the industry. The NPC further identified actions by government and industry that are necessary for natural gas to compete effectively for a larger fraction of the nation's energy requirements.

Results from the study have been consolidated into four key findings and two categories of recommendations. The four key findings are:

- **The natural gas resource base is abundant and can be produced and delivered at prices that allow both expansion of the market and continued development of the resource.** The study results indicate that sufficient new natural gas supplies can be delivered at competitive prices, even though a substantial portion of this gas is in reservoirs that are more expensive to develop and require sustained real growth in wellhead gas prices and time to bring on the new production. The continued evolution of technology and efficiency improvements combine to reduce delivered prices below what they would have been without these advances, and tend to mitigate the increasing cost of developing the more expensive supplies. The study participants believe that, with the proper emphasis on research and development, technology impacts in the future will be even greater than evidenced in the past.
- **The natural gas market is increasingly diverse, with new challenges and opportunities.** Natural gas has potential growth opportunities in all existing market segments and several new technologies, but will face substantial challenges from the other traditional fuel sources as well as improved energy efficiencies and conservation. Regional and site-specific factors will be important in determining the growth potential for natural gas.
- **Increased reliance on competitive market forces has improved the gas industry's ability to serve customer needs in a diverse and expanding marketplace.** New regulatory policies are encouraging competition and the natural gas industry is responding by providing additional value-added services, flexible contracting options, and increased attention to customer needs. Sound management, operational mechanisms, contract diversity, and active use of financial markets can work together to manage risk and reduce the short-term volatility that is likely to occur as the industry moves through various transitional phases.
- **The gas industry faces significant challenges requiring proactive steps by industry and government,** as evidenced from the responses of both the study participants and the focus groups. Potential customers are concerned about the ability of the industry to deliver gas when and where it is needed, particularly during

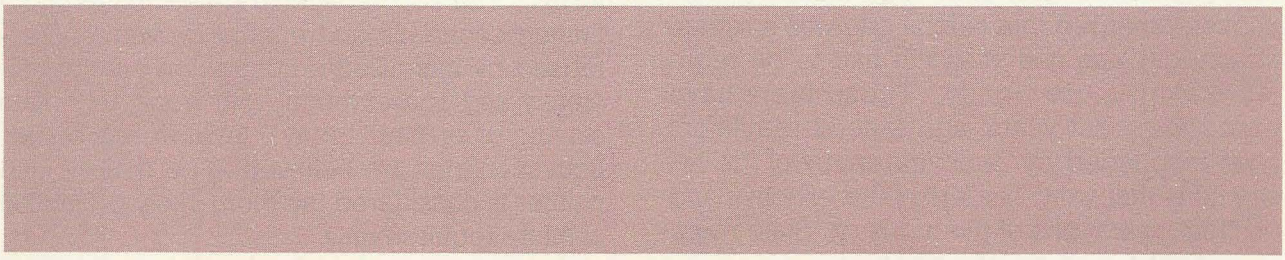
times of peak demand. Additionally, the industry does not have a good public image and has not been sufficiently effective in the past at marketing natural gas, in spite of its inherent beneficial qualities, and has been overdependent on regulation for setting direction and resolving conflicts.

The two general categories of recommendations that have emerged from the study are directed toward government officials and industry, respectively:

- **Federal, state, and local officials need to allow competitive market forces to continue to develop and work.** They need to promote and support policies and regulations that foster customer choice and reduce regulatory uncertainty, and eliminate programs, policies, and procedures, both regulatory and environmental, that unduly increase the delivered cost of natural gas. In addition, regulators and legislators will need to exercise restraint during periods of price and supply volatility as the industry adjusts to the changing marketplace.

- **Industry needs to make the market work.** These recommendations involve: continued and accelerated development of technology and procedures to reduce the delivered cost of natural gas; promotion and commercialization of new end-use technologies; development of new and innovative strategies for dealing with environmental issues; concentration of efforts to improve the reliability of supply and delivery systems; increased customer focus in marketing; and increased leadership efforts.

The adoption of the principles embodied by these recommendations is a necessary prerequisite to achieving the expectation set out in the request from the Secretary, **"that natural gas can make a greater contribution to the energy security and environmental enhancement of our Nation."**



FINDINGS AND RECOMMENDATIONS

The domestic natural gas industry of the 1990s finds itself in transition. The industry has changed dramatically since the middle part of this century when gas was considered a by-product of oil production and a surplus of gas stimulated large expansions in transmission and distribution systems. These systems were historically considered natural monopolies and regulated by different entities with little attention to a coordinated, forward-looking energy policy. The consumption of gas in the United States grew rapidly until the early 1970s and then declined due to regulated gas prices and the resultant curtailments. The incorrect perception emerged that natural gas was a scarce commodity, the use of which had to be regulated even more tightly. Those fears have eased in recent years, and federal regulators have responded by removing many of the restrictions that were hindering the effective and efficient operations of the industry. State regulators have begun to follow that lead.

At the same time, there have been emerging concerns about the overall growth of energy consumption in the nation and the world, and about the potential environmental impacts associated with that growth. Also, the use of short-term, least-cost purchase strategies has created uncertainties on both the supply and demand sides of the energy equation. Regulatory agencies have begun seeking ways to balance energy supply and demand through Integrated Resource Planning, which includes economic optimization of supply-side and demand-side measures.

These concerns and uncertainties add to the complexity of responding to the Secretary's request to study the potential for expanding the production, distribution, and use of natural gas. What will be the overall energy demand levels in the United States and the regulatory and economic framework within which natural gas will compete with other energy sources? The NPC concluded that it could not answer these questions with sufficient certainty and elected to specify two different scenarios for conducting a quantitative evaluation of natural gas growth opportunities over the long term.

The two scenarios are sufficiently different to provide independent alternative views of future energy requirements. The first scenario anticipates an environment characterized by moderate economic and energy growth, with world oil prices increasing gradually in real terms. The second scenario anticipates more limited economic and energy growth, characterized by increased emphasis on energy efficiency and conservation, with world oil prices staying at or near today's level in real terms. Both scenarios are believed to be realistic and neither is considered the more likely projection of future requirements.

The principal time frame covered by the study extends to the year 2010. This time horizon was considered the minimum needed for investment decisions, which span 10 to 20 years and depend on projections of long-term supply. In addition, the supply of natural gas was examined for its ability to satisfy potential domestic gas demands to the year 2030 at various assumed price levels.

The NPC used a set of supply, transportation, and demand models to estimate the future natural gas supply/demand balance and resultant equilibrium gas prices under each scenario. These results should not be interpreted as forecasts of prices or volumes, but rather as reasonable projections of what could occur under the assumed scenarios. Under the scenario with moderate energy demand growth (Reference Case 1), natural gas reaches approximately 25 quadrillion British thermal units

(QBTU) by 2010, a 25 percent increase from the 1991 level. This growth represents supply, transportation, and demand in economic equilibrium at natural gas wellhead prices that rise gradually by 2010 to about $3.50 per million BTU (MMBTU [1990$]). Under the scenario with low energy growth (Reference Case 2), natural gas maintains its relative market share with 7 percent growth by 2010. The wellhead gas price required to balance supply and demand in this case is projected to rise to about $2.75 per MMBTU (1990$) by 2010.

As a consequence of selecting this long-range focus for the study, short-term fluctuations around these trends are not addressed. Some price and volume volatility is natural, especially as industry moves through various transition periods. New risk allocation approaches using freely negotiated contracts rather than regulation will allow both the industry and its customers to handle volatility more effectively than in the past. As the changes foreseen and recommended in this study take hold, a more effective, competitive, and stable industry will emerge.

There are significant opportunities for natural gas to increase its share of the nation's energy consumption. However, all industry participants will have to work hard to continue providing quality service to existing customers and to address and overcome several obstacles with potential new customers. Increasingly, industry participants understand and are accepting the responsibility of addressing customer concerns and believe all obstacles can be overcome.

The results from the study are contained in the findings and recommendations that follow.

FIRST KEY FINDING

NATURAL GAS IS AN ABUNDANT DOMESTIC RESOURCE AND CAN BE PRODUCED AND DELIVERED AT PRICES THAT ALLOW BOTH EXPANSION OF THE MARKET AND CONTINUED DEVELOPMENT OF THE RESOURCE

Availability of Natural Gas Supplies

The United States has a vast and diverse natural gas resource base and estimates of the recoverable portion continue to grow with production experience and technological advances. The NPC concludes that this trend is likely to continue through at least the 2010 time horizon of this study, and estimates the technically recoverable resource at 1,295 trillion cubic feet (TCF) for the lower-48 states alone. Some 600 TCF of this gas is expected to be recoverable at wellhead prices of $2.50 per MMBTU (1990$) or less. However, production of this gas occurs over an extended period of time and, to satisfy a growing demand, other portions of the resource will need to be developed concurrent with the production of the less expensive gas.

Characterization of the Natural Gas Resource Base

The natural gas resources represent a diverse mix of opportunities (Table 1). Substantial

TABLE 1

NATURAL GAS RESOURCE BASE FOR THE LOWER-48 STATES (Trillion Cubic Feet)

Proved Reserves	**160**
Conventional Resources	
Reserve Appreciation	203
New Fields	413
Subtotal	**616**
Nonconventional Resources	
Coalbed Methane	98
Shales	57
Tight Sands	349
Other	15
Subtotal	**519**
Total Resources	**1,295***

*Technically recoverable resource base as of January 1, 1991, assuming that current access moratoria expire as scheduled and incorporating technology advancement through 2010. Assuming various price levels, with current and advanced technology, yields the following total resource estimates:

	Recoverable Resource Base (TCF)	
Price (1990$)	1990 Technology	2010 Technology
Unspecified	1,065	1,295
$3.50/MMBTU	600	825
$2.50/MMBTU	400	600

reserve growth and exploration prospects remain in conventional, historical producing areas, and there is important potential in new areas such as the increasingly significant Norphlet trend in the Gulf Coast Basin. Nonconventional resource opportunities include coalbed methane, shale gas, and gas in tight sand formations in major basins throughout the United States.

Figure 1 illustrates the dynamic, growing nature of the recoverable resource base. The 160 TCF of currently proved reserves represent, and should be perceived as, an inventory ready to contribute to near-term production. The proved reserves are backed up by another 1,135 TCF of resources that can supplement and replace the proved reserves as they are produced, given sufficient price and technology growth. The inventory of proved reserves is expected to remain at an approximate 10 year supply, a level that has been the industry norm for the past 15 years.

A significant portion of the resource base is currently inaccessible due to leasing moratoria on the Outer Continental Shelf (OCS); is restricted in wilderness areas, marine sanctuaries, National Parks, and Fish and Wildlife Service lands; and is subject to other *de facto* administrative moratoria. The full potential of these areas will not be known until access is granted. The reference scenarios assume there will be no access to these OCS areas until the current moratoria expire, with no production until after the year 2005, despite high prospectivity and the potential for significant low cost supply.

The costs associated with converting the natural gas resource to producible supplies are dependent on, among other things, the type of resource being developed, technology advancement rates, overall industry activity levels, and access to prospective acreage both onshore and offshore. Figure 2 shows future gas supplies under various wellhead price assumptions. These estimates are calculated from the model runs and include both domestic resources and available imports. While these calculations are subject to certain assumptions, including the rate of potential demand growth, producer response to market signals, and uncertainties in the description of the resource base itself, the results are believed to be indicative for the range of prices shown. At an average wellhead price of $1.50 per MMBTU (1990$), a 19 TCF (20 QBTU) supply level cannot be maintained. Prices that increase gradually to $3.50 per MMBTU (1990$) allow supply to grow with demand to 24 TCF (25 QBTU) annually.

Annual oil and gas expenditures for the producing industry have averaged $35 to $40 billion (1990$) over the past few years. This is comparable to the level of expenditure in the mid-1970s and about half of the peak expendi-

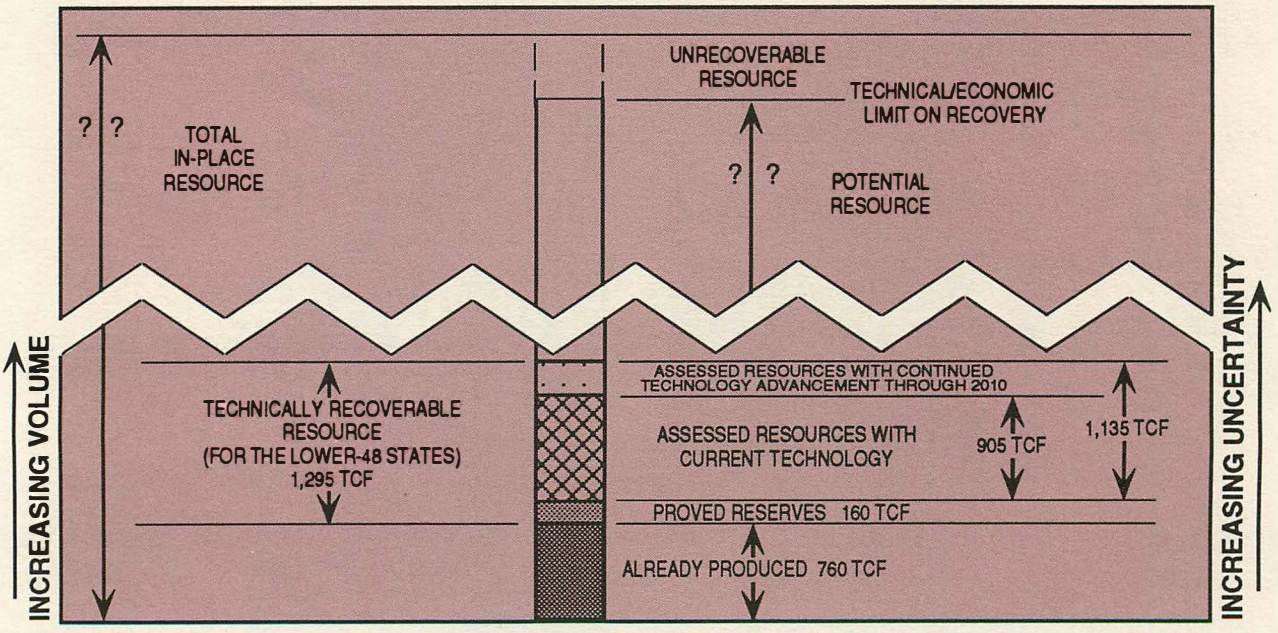
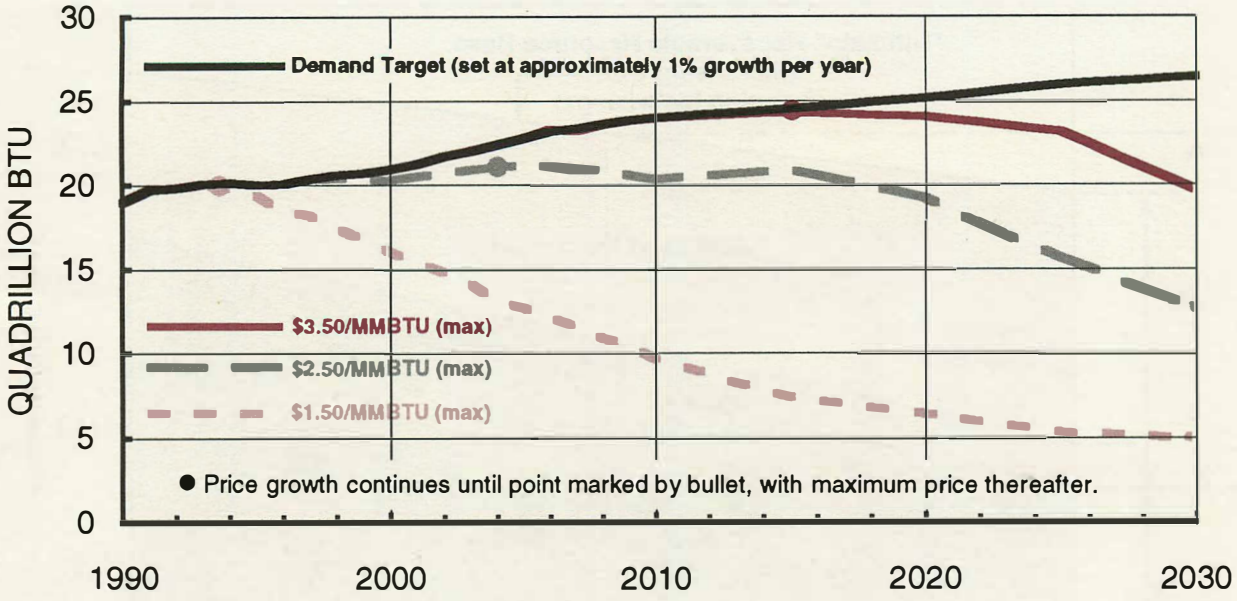


Figure 1. Schematic of Natural Gas Resource Base.



NOTES: 1. Assumes technology advancing throughout the period.
2. Prices are in 1990$ per million BTU for Texas Gulf Spot.
3. Demand target fully satisfied through 2030 at prices which do not exceed $4.50/MMBTU.

Figure 2. Long-Term Gas Supply Potential at Various Maximum Wellhead Price Levels.

ture years in the early 1980s. For Reference Case 1, where domestic production increases to over 20 TCF by the year 2010, investment levels are projected to increase gradually over the next 10 years and average about $60 billion (1990$) annually during the 2000-2010 time period. Lesser increases are expected for Reference Case 2, which projects annual investments remaining below $50 billion (1990$) throughout the study period.

As shown in Figure 3, the "ultimate" recoverable resource base grows with time and partially offsets the cumulative production, with a substantial resource base still available in 2030. It is also possible, of course, that time and technology will open the door to higher levels of recovery and new natural gas resources that are known to exist but have not been included in the current assessment—just as the coalbed methane, shale, and tight sand resources were not included in assessments made 20 to 30 years ago.

Impact of Supply Technology

Technology advancement has a significant impact on supply availability through dissemination of knowledge, mitigation of cost increases, and improved exploration and recovery processes that allow the industry to find and produce more gas economically. The results of an analysis of drilling costs revealed that during the past two decades, technology advancement has acted to reduce drilling costs by almost 3 percent per year below what they would have been in the absence of the advancing technology.

The rate of technology advance appears to be accelerating, with more effect in the 1980s than in the 1970s. As reflected in the 1,295 TCF recoverable resource estimate, the contribution of technology is expected to increase the lower-48 recoverable natural gas resource base by more than 200 TCF between 1990 and 2010. This rate of growth is consistent with that experienced during the past 20 years.

A sensitivity analysis indicated that if the rate of advancement of supply-related technologies could be increased by 25 percent over what was included in the moderate energy growth scenario, average wellhead prices could be as much as $0.50 per MMBTU (1990$) less than in the scenario projection. As a result, gas consumption would be encouraged, particularly in the industrial and electric utility sectors. The net value of this wellhead price reduction

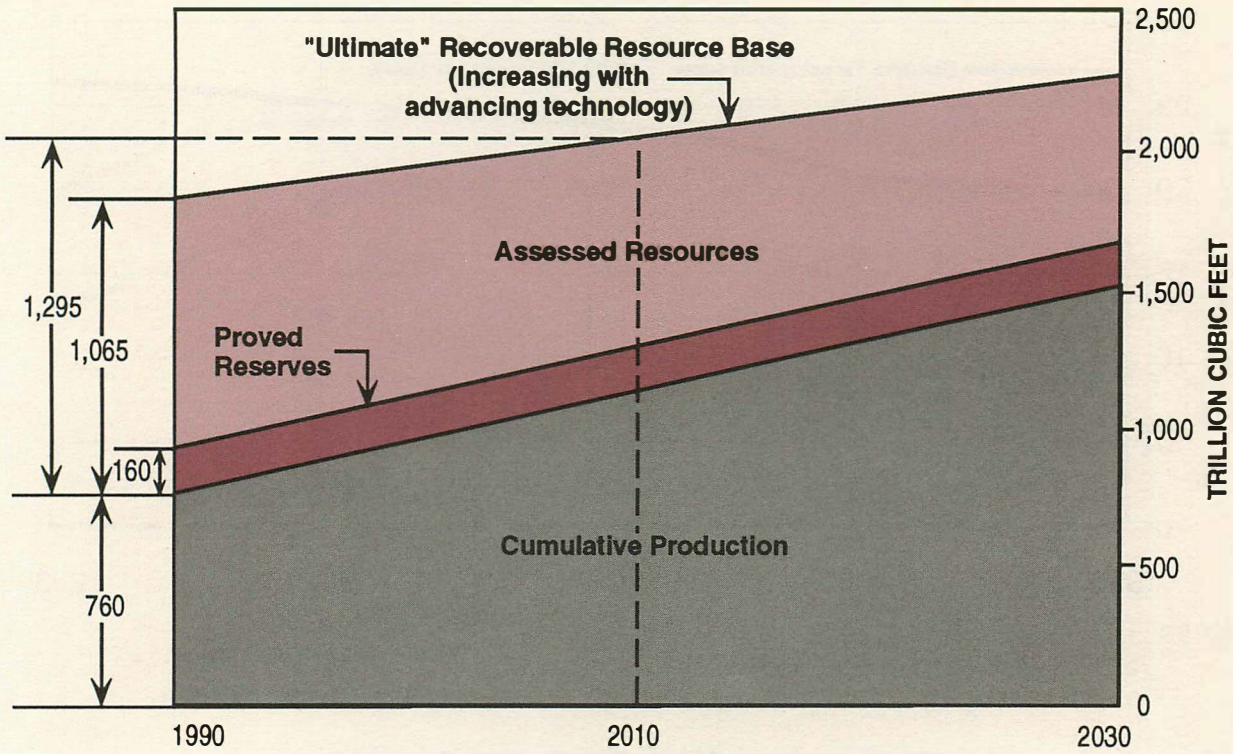


Figure 3. Gas Resource Base.

through 2010 would likely exceed $50 billion in total reduced costs to gas customers. Net imports of gas and residual fuel oil would also be reduced for additional savings to the nation. Conversely, if technology advances less rapidly than assumed in the calculations, an opposite impact would likely occur.

Impact of Environmental Compliance Costs on Supply Availability

In the NPC Reference Cases, the level of exploration and production (E&P) environmental compliance costs is based on a projection of requirements under the 1990 Clean Air Act Amendments, the Safe Drinking Water Act, and pending Resource Conservation and Recovery Act and Clean Water Act reauthorizations. This projection assumes the reasonable application of additional new rules under these regulations and results in compliance costs that continue to rise at a pace somewhat below the historical rate. By 2010, these additional costs reach $750 million (1990$) per year, or an increase in overall gas-producing costs of about 10 percent.

A sensitivity analysis was made of the impact of higher compliance costs if more cost-effective solutions are not found for future environmental regulations. In this sensitivity analysis, compliance costs grow to $3.5 billion per year in 2010. Over the period, the potential increase in costs exceeds $30 billion, additional to the $10 to $12 billion calculated for the Reference Cases, and results in 2010 production of 2 to 2.3 TCF less than the Reference Cases (10-12 percent of current annual supply) with a cumulative reduced production of up to 20 TCF over the period. The magnitude of these potential impacts highlights the need for government and industry to work together to develop more cost-effective solutions to environmental problems.

Potential Imports of Natural Gas

An assessment was also made of natural gas available from sources outside the lower-48 states. The Canadian resource base was analyzed, including estimates for the potential of nonconventional gas supplies similar to those in the United States. Model studies indicate that imports of gas from Canada are likely to continue to increase in the future and could possibly reach a level of 3 TCF or more per year, dependent, of course, on domestic demand for gas in Canada and the absence of trade restrictions. Mexico is expected to continue to be a net export market for U.S. producers over the next 10 years, but could become a

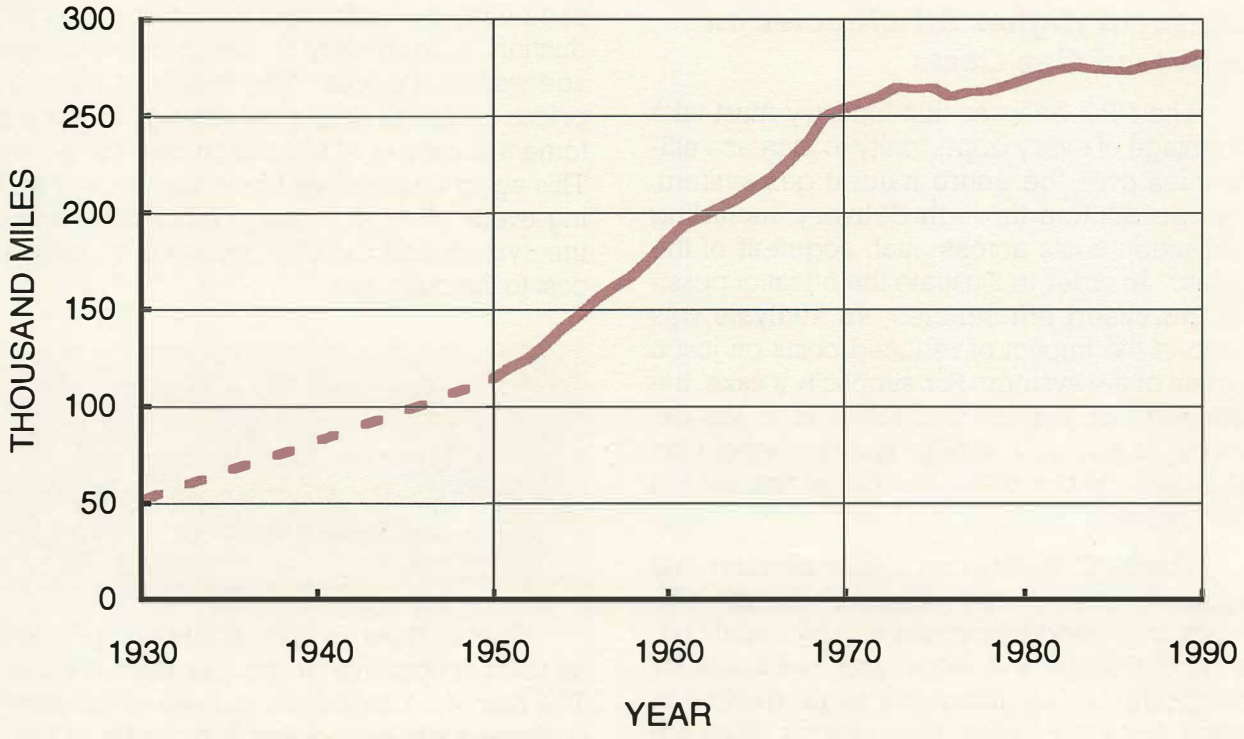
supply source if economic conditions supported development of Mexico's substantial resource base. Imports of liquefied natural gas (LNG) are likely to remain low under the assumptions of the two scenarios used in the study. Similarly, calculated price and demand levels appear to be inadequate for developing the Alaskan North Slope gas resources or the northern frontier gas in Canada for domestic consumption prior to 2010. Potential Canadian, Mexican, and Alaskan supply, as well as LNG, are also backed by large resources, although the domestic demand in these areas will be a competing market for the available supply.

Natural Gas Transmission and Storage

For natural gas to serve effectively the potential demand markets, the industry requires an efficient and reliable transportation and storage system. A critical analysis of the current system led to the conclusion that it can support a growing U.S. natural gas market served by a variety of supply sources. Although the consumption of natural gas in the United States peaked in 1972 at 22.1 TCF, the transmission and storage system has continued to expand due to geographic shifts in supply and demand (Figures 4 and 5). Today there are more than 280,000 miles of gas transmission pipeline and approximately 8 TCF of storage capacity.

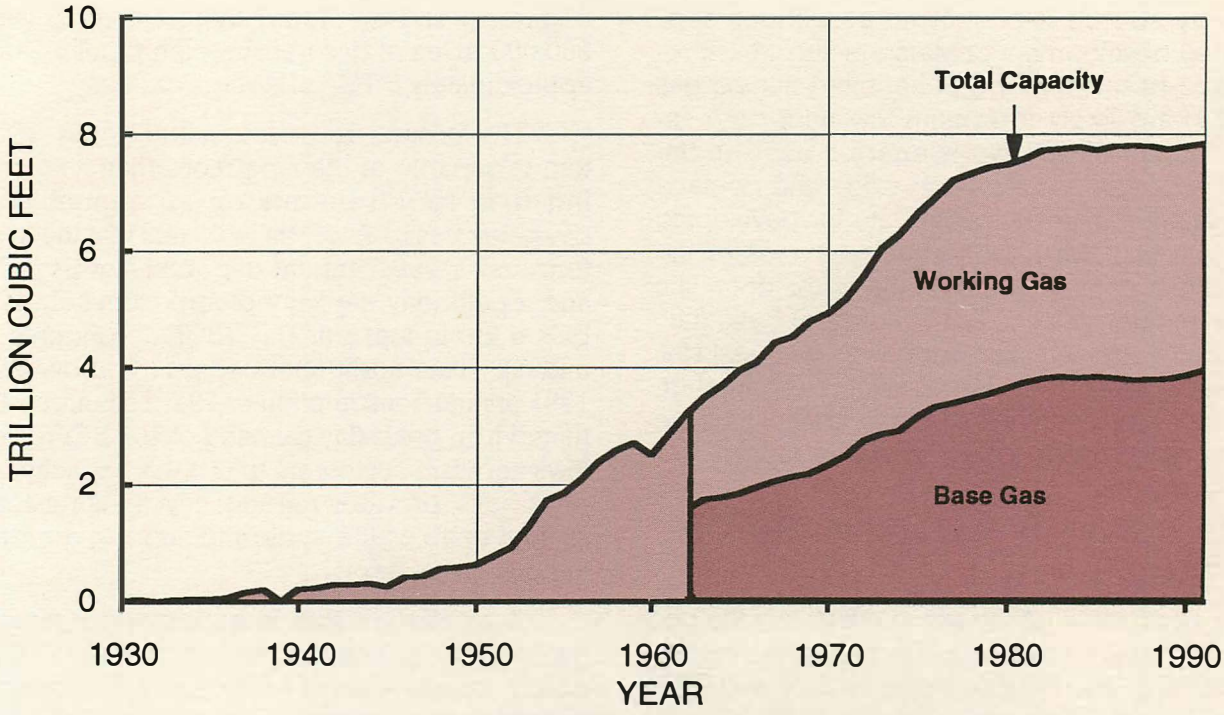
The existing transmission and storage system is capable of meeting more than its existing firm requirements on an annual and peak-day basis. Analysis indicates that the system had a 1991 annual capability of 24 TCF and a peak-day capacity of approximately 120 billion cubic feet per day (BCF/D) (Figures 6 and 7). This additional capability above the 1991 annual consumption of 19.2 TCF, and estimated firm peak-day demand of 102 BCF/D, allows non-firm customers to use this capacity on peak days, provides redundancy, adds reliability, and enables the system to support a growing U.S. gas market.

A significant shift is expected in natural gas supply and consumption patterns by 2010, which creates a need for construction of new transportation and storage facilities. With the anticipated decline in production from the Southwest Central region, additional transmission and storage capability will be required to move gas from the North Central region and from Canada to neighboring regions, and to move gas into the Northeast and California regions. The expenditures anticipated for this



NOTE: Data prior to 1950 less reliable.

Figure 4. Miles of Natural Gas Transmission Line.



NOTE: Prior to 1962, storage data not distinguished between Base Gas and Working Gas.

Figure 5. Underground Natural Gas Storage Capacity–1930-1991.

investment are comparable to average total industry expenditures over the past 20 years and should not be a major constraint to future industry growth.

Impact of Higher Efficiencies on Delivered Gas Costs

The NPC believes that industry must take advantage of every opportunity to increase efficiencies over the entire natural gas system, from production through delivery, including transaction costs across each segment of the system. In order to illustrate the effect of possible increased efficiencies, an analysis was made of the impact of reduced costs on just a portion of the system. For simplicity's sake, the transportation system was selected as the example; however, a similar analysis would be applicable to the other sectors of the natural gas system.

The NPC Reference Cases assume that higher volumetric throughputs and some efficiency improvements would approximately offset real increases in labor and fuel costs for transportation, resulting in a slight decline in overall costs in constant dollar terms. If an additional net cost reduction of 2 percent per year could be achieved, the calculated delivered gas cost in 2010 could be reduced by some $0.17 per MMBTU. These lower costs could stimulate nearly 2 TCF of additional gas demand (cumulative) over the projection period. Most of that demand was projected to be supplied from domestic reserve additions and production, at essentially no net increase in average wellhead prices. The lower delivered gas prices could result in a net savings to gas customers in excess of $30 billion over the period. This again emphasizes the importance of making every effort to increase efficiencies across the system and thereby reduce the delivered cost to the customer.

SECOND KEY FINDING

The Natural Gas Market is Increasingly Diverse, with New Challenges and Opportunities

The markets for natural gas are as diverse as the participants in the gas industry itself. The markets range from individual residential customers whose consumption can be as low as 30 thousand cubic feet per year, to large industrial facilities and power generation installations

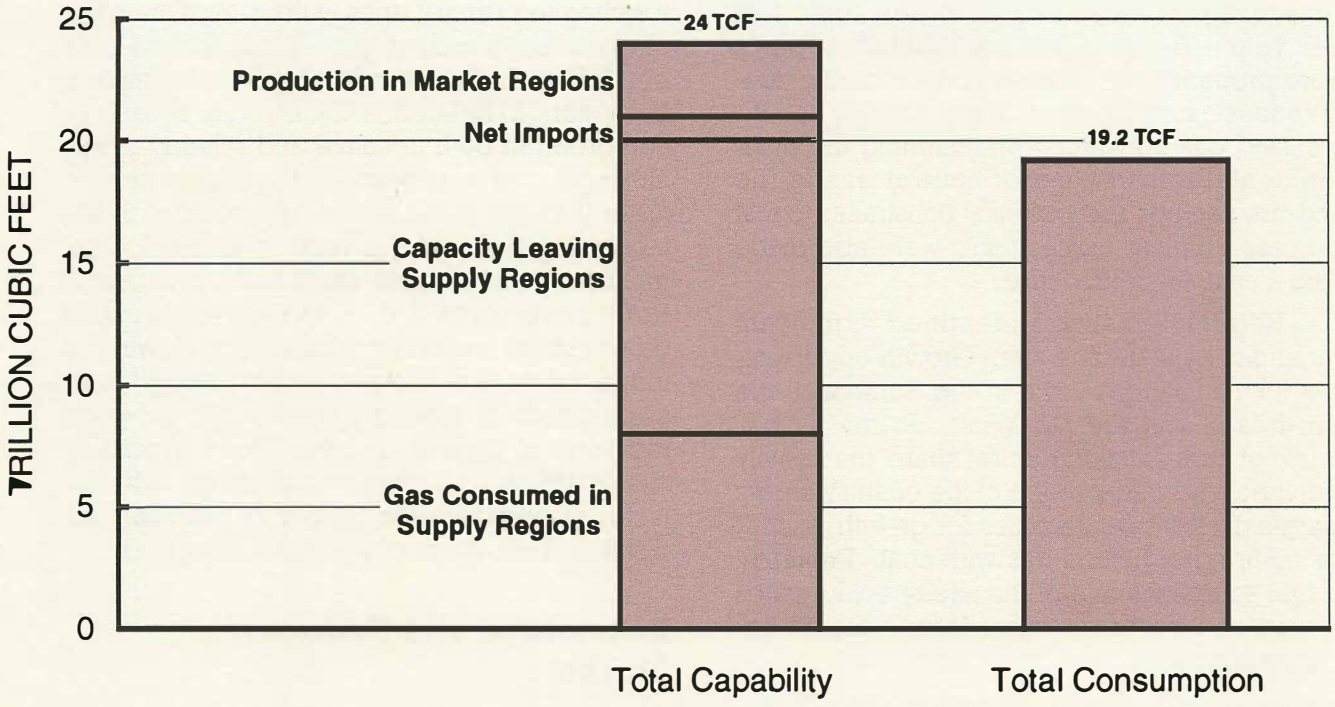


Figure 6. 1991 U.S. Transmission and Storage System—Annual Capability.

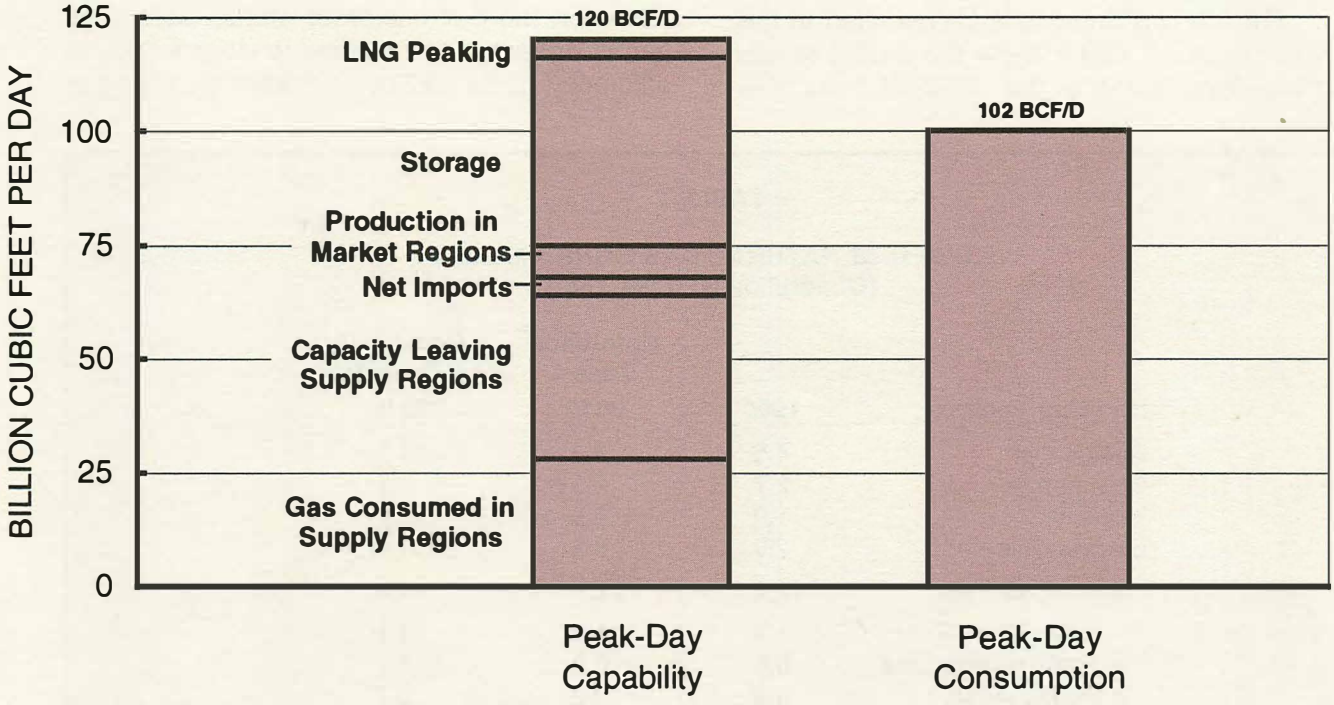


Figure 7. 1991 U.S. Transmission and Storage System—Peak-Day Capability.

consuming or exceeding 50 billion cubic feet per year. Ten regional assessment reports were prepared on: market and economic conditions; descriptions of opportunities for increasing gas consumption, including the environmental advantages of natural gas in the end-use sectors; and potential constraints to that increase. Similar assessments were also made from a national perspective.

Regional analyses identified significant variations by state and site. Growth opportunities for natural gas exist in the Southeast, the Northeast, and the Far West. Primarily because of high existing market share, the heavily industrialized mid-portion of the country shows marginally low opportunities for growth, except for co-firing of natural gas with coal. Proximity to fuel sources is one of the site-specific issues considered by prospective large volume energy customers.

Improved energy efficiency and conservation (stimulated in part by state integrated resource plans, environmental considerations, building efficiency requirements, and appliance efficiency standards) are impacting gas and electricity demand. Within this changing market, natural gas competes with coal, oil, electricity, and renewables.

For the two Reference Cases used in this study, Figures 8 and 9 show the model results for the distribution of the different fuels contributing to primary energy consumption in the markets using natural gas. Table 2 contains a breakdown of the calculated gas consumption by sector. In Reference Case 1, gas consumption grows in both absolute and relative terms, although coal is projected to grow somewhat faster than gas in the second decade due to the increasing price of gas relative to coal. Gas' market share remains essentially constant in Reference Case 2 due to slower demand growth in the industrial sector. This slowing of industrial sector demand growth results from assumptions of more aggressive conservation measures in Case 2. In both Cases, increased use of natural gas, even with price growth, is a factor in reversing the growth of residual and distillate fuels, much of which are imported.

Residential and Commercial Markets

The residential and commercial markets form the backbone of the natural gas industry. Natural gas is used in some 55 percent of all single-family dwellings, varying by region. Extensive efforts to extend service areas through aggressive marketing of gas services and technologies are expected to increase the total number of residential customers by 2010. However, the per customer annual consumption is projected to continue to decline due to efficiency gains and conservation, resulting in

TABLE 2

LOWER-48 NATURAL GAS CONSUMPTION
(Quadrillion BTU per Year)

End-Use Sectors	1990	Reference Case 1 2010	Reference Case 2 2010
Residential	4.5	4.9	4.7
Commercial	2.7	3.5	3.1
Industrial	7.0	8.9	6.1
Electric Utility	2.9	5.4	4.9
Total End Use	**17.1**	**22.7**	**18.8**
+ Lease/Plant Fuel	1.1	1.3	1.1
+ Transmission Fuel	0.6	0.9	0.7
+ Exports/Misc.	0.2	0.2	0.7
Total Consumption	**19.0**	**25.0**	**21.3**

Note: Totals may not agree due to rounding.

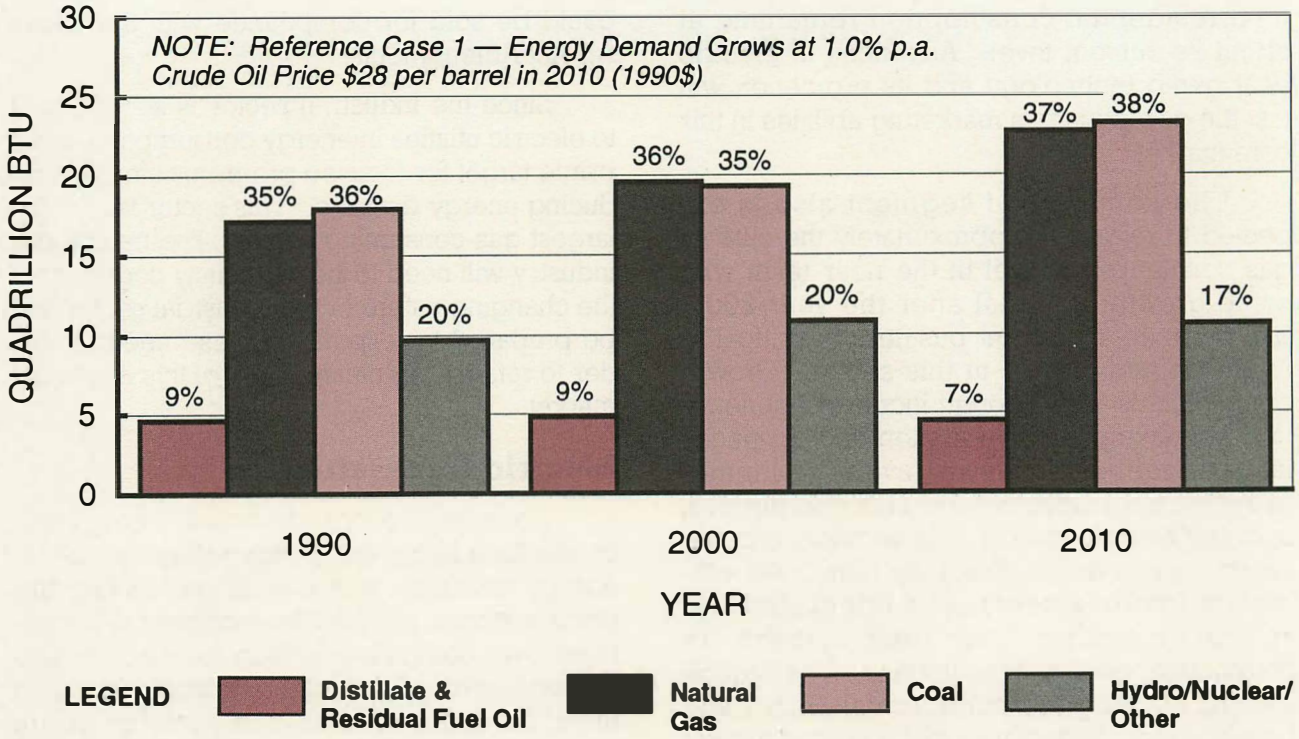


Figure 8. Primary Energy Consumption and Market Share—Reference Case 1
(Excludes Coking Coal, Oil Feedstocks, and Liquid Transportation Fuels; Gas Data Exclude Lease/Plant Fuel, Transmission Fuel, and Exports.)

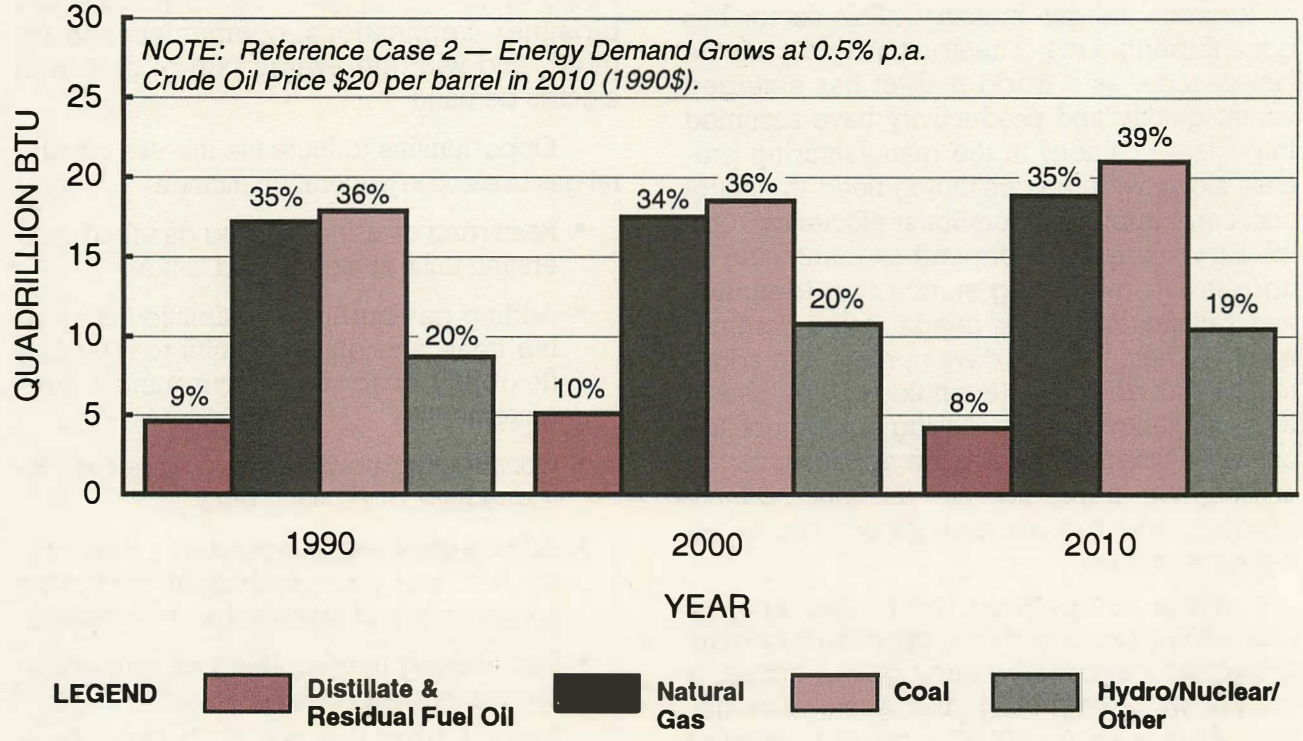


Figure 9. Primary Energy Consumption and Market Share—Reference Case 2
(Excludes Coking Coal, Oil Feedstocks, and Liquid Transportation Fuels; Gas Data Exclude Lease/Plant Fuel, Transmission Fuel, and Exports.)

total residential consumption remaining at about its current level. Advances in electric heat pump technology and its promotion will test the gas industry's marketing abilities in this core market.

The commercial segment also is expected to remain at approximately the current gas consumption level in the near term with some growth potential after the year 2000. Maintenance of current business is critical to future demand levels in this sector. Growth opportunities exist through increased penetration of packaged cogeneration and advances in gas cooling. However, even the limited growth opportunities face stiff competition from the electric industry. In addition, emphasis on conservation, federally mandated efficiency improvements, and Integrated Resource Planning will limit growth in commercial energy consumption. The organizations serving the commercial sector will have to work diligently to maintain this market at its current level.

Industrial Market

The industrial market represents one of the largest potential market areas for growth, or loss, for the gas industry. This sector has gone through a major restructuring during the last decade, as a world market has emerged where quality and productivity have assumed important positions in the manufacturing process along with the continuing need to control costs and improve operational efficiency. Gas industry success will depend on combining an aggressive marketing stance that identifies and satisfies customer needs with a commitment to champion the development and adoption of gas end-user technology. The use of high-efficiency, gas-processing equipment and energy-efficient cogeneration applications are an essential approach that the gas industry needs to adopt to maintain its position in the industrial market.

While competition from other energy sources will be formidable, opportunities exist to expand the use of natural gas in emission control, waste recycling, and waste remediation. Also, a strong potential exists to convert existing industrial coal boiler operations to natural gas or co-firing. These actions could allow for the creation of valuable allowances that could be sold for compliance with the Clean Air Act Amendments.

Since the industrial sector is second only to electric utilities in energy consumption, it is a prime target for focused programs aimed at reducing energy demand. This sector is also the largest gas-consuming sector. The natural gas industry will need to be especially cognizant of the changing nature of the industrial sector and be prepared to respond to these needs in order to retain a dominant share of this important market.

Electric Generation

Consumption of electrical energy accounts for a large and growing share of the U.S. energy demand, with natural gas having important economic and environmental advantages over competing fuels in the electric generation market. Advanced gas-fired generating units, particularly combined-cycle units, are more efficient and less capital intensive than other alternatives, have lower non-fuel operating costs, and can be constructed with shorter lead times with smaller, economically sized units. The potential for natural gas to have an increased role in the electric generation sector varies widely among sites (e.g., distance from a pipeline), applications, companies, and regions, and with the overall rate of growth of electric demand.

Opportunities to increase the use of natural gas in electric generation include:

- Restarting or using existing gas-fired generating units at higher load factors
- Adding gas-burning capabilities in existing coal- and oil-fired units to gain fuel flexibility or to meet environmental requirements
- Constructing new gas-fired baseload, intermediate, or peaking units
- Adding gas-fired independent power production and self-generation, including commercial and industrial cogeneration
- Repowering uncompleted or retired nuclear generating units.

Results from the two NPC Reference Cases suggest impressive growth potentials for natural gas in electric generation. Major obstacles will need to be overcome, though, before

these opportunities can be converted to increased gas consumption. Among the more significant of these are:

- Competition from other energy sources, with the competitiveness of gas being dependent on the wide variation among sites, regions, applications, companies, and distances from pipelines
- Understanding factors affecting electric generators' fuel choices and responding to electric generators' concerns, needs, perceptions, and expectations
- Satisfying potential customers that the delivered price of natural gas, including the cost of gas transportation, will continue to be competitive with other energy sources and with potential demand-side measures
- Convincing potential customers that natural gas supplies will be available when needed and can meet their operational requirements.

A key assumption for any projection of gas demand in the electric generation market is the annual electricity demand growth rate. Annual gas consumption for electric generation could be lower due to demand-side activities and slower economic growth rates. Conversely, more vigorous economic growth assumptions can increase electricity usage, and thus, gas demand.

Natural Gas Vehicles

There are an estimated 30 million fleet vehicles in the United States and over one-third of these are located in ozone non-attainment areas as defined by the 1990 Clean Air Act Amendments. The Natural Gas Vehicle Coalition estimates that all U.S. fleet vehicles combined consume an equivalent of 2 TCF per year of liquid fuels. In the NPC Reference Cases, the penetration of natural gas by vehicle type and location was estimated to result in a consumption level of 140 BCF per year by 2010. A more optimistic natural gas vehicle market penetration and gas supply sensitivity case, with consumption levels increased to 640 BCF per year by 2010, indicated that the natural gas industry could supply additional volumes of gas to the natural gas vehicle market without adversely affecting other markets.

THIRD KEY FINDING

Increased Reliance on Competitive Market Forces Has Improved the Gas Industry's Ability to Serve Customer Needs in a Diverse and Expanding Marketplace

Information collected during the course of this study shows that the newly evolving natural gas market works. Market forces have been the primary drivers of change ever since the decontrol of wellhead gas prices and the Federal Energy Regulatory Commission (FERC) began open-access transportation with the introduction of FERC Order 436 in 1985. The subsequent increase in competition has resulted in lower delivered gas prices, increased availability of supply, and new service options for consumers.

FERC Orders 636 and 636A mandate nearly complete unbundling of pipeline gas sales from transportation services and is intended to foster competition for natural gas transportation and storage. Creation of a secondary market for pipeline capacity is an integral part of Order 636. This should further improve efficiencies by allowing capacity to be assigned to those who value it most, whether on a short-term or long-term basis. Such activity would serve another important function that has traditionally been lacking in the industry: clear market signals regarding the need for new capacity.

The expansion of value-added services being offered by the industry is additional confirmation of this new competitiveness. Today's market is rapidly evolving with resources and production being efficiently matched with customers on an ongoing, operational basis. Through the mid-1980s, the regulatory framework generally mandated that interstate pipelines aggregate gas supplies for sale to all customer groups. Under today's more open and competitive regulatory environment, gas supplies are being combined into economically and operationally viable packages by many different industry participants. The packaging of gas volumes at a market-clearing price is still evolving, and other services are

making natural gas much easier to acquire when and where needed.

Integral to the evolving service environment is access to data, from production through consumption. Electronic gas measurement, electronic bulletin boards, operational balancing agreements, pooling points, and other devices, both physical and contractual, have an important role in making it easier to provide gas in a responsive manner. Separate from the traditional industry segments offering various service options, a new role within the industry has emerged over the past ten years for "natural gas services providers." This category is broadly defined to include an array of companies within the industry that are moving beyond their traditional roles and providing a new variety of customized services aimed at meeting customers' specific needs. The ability of natural gas service providers to enter into a variety of contracts without threat of after-the-fact regulatory intervention, but being prepared to live with the consequences of their actions, is a key element in making these providers a vital part of the industry's future.

With this new gas marketplace, the customer's ability to buy its own supply and choose only the transportation and storage services it needs, along with the ability to reassign such services when not needed, provides substantial flexibility to select appropriate levels of risk. Supply contracts, together with transportation and storage service arrangements, provide a fundamental structure under which individual buyers can balance risk versus delivered gas costs, and under which sellers can secure gas outlets at optimum prices. In conjunction with a diversity of contract structures tailored to individual needs, the natural gas futures market can be used to help manage near-term risk. For example, producers can reduce their exposure by using futures to lock in prices for their gas several months in advance. Local distribution companies (LDCs) and other customers can purchase futures contracts to provide a ceiling for the price they pay for gas in later months.

Some industry participants have yet to take advantage of the opportunities made available to them in these markets. For example, LDCs face a unique problem in that state regulators must be convinced that long-term contracts, futures, options, and other diverse contract arrangements can be effective risk management tools, rather than highly speculative "gambles," as they are often perceived. In an effective market-based environment, LDCs, along with all industry participants, should be provided the opportunity to use these tools.

Gas industry participants often mention that federal and state regulatory uncertainty is a major impediment to industry growth. With parties willing to match their risk tolerance with costs and obligations, federal and state regulatory policy initiatives must continue to support the move toward contract-defined relationships. Similarly, gas providers and consumers must be allowed to be accountable for their contractual decisions in the marketplace, not in regulatory proceedings. Contract diversity, a regulatory climate that honors contract sanctity, and active financial markets that can be used to manage risk can work together to assure that each market participant attains the desired degree of reliability and security.

FOURTH KEY FINDING

THE GAS INDUSTRY FACES SIGNIFICANT CHALLENGES REQUIRING PROACTIVE STEPS BY INDUSTRY AND GOVERNMENT

The natural gas industry faces numerous challenges as it moves to increase the role that natural gas plays in meeting the energy and environmental needs of the nation. The challenges are diverse and include both real and perceived concerns that result both from past experiences of customers and from uncertainties about the changing industry.

Ignoring these challenges would be harmful to the prospects of the natural gas industry itself, as well as the national economy and the environment. The challenges for industry have been grouped into the following areas for discussion and recommended action:

- Reliability
- Customer orientation and marketing
- Behavioral issues.

Government policy and regulation can constrain the ability of industry to react to cus-

tomer needs. The NPC concludes that government and regulatory policy makers should minimize intrusion into markets where competition can exist, and weigh the additional costs of regulation in all markets. Accepting that there is a continuing, albeit more limited, role for governmental action in the natural gas market, the challenges to government fall into the following categories:

- Fostering choices that serve the public interest
- Promoting system efficiencies
- Reducing regulatory uncertainty.

In addition, both industry and government face significant challenges in the areas of: access restrictions, technology development and commercialization, and environmental regulation.

Challenges for Industry

Reliability Concerns

A long history of intense and changing regulation, accentuated by public and private underestimates of supply potential, has worked to suppress demand and perpetuate the prevailing oversupply situation. The recent downsizing in the domestic E&P sector and declines in drilling activity in North America are largely the result of this situation—rather than a lack of drilling opportunities—and the trend should be reversible in part if market signals are favorable. However, there is likely to be some lag and some continued price volatility due to the lead time inherent in many investment decisions in all phases of the business. Increasingly widespread and lengthening access restrictions and OCS moratoria compound the concerns as do ever more stringent application of environmental law to producer activity.

Additional reliability concerns arise from both real experience and perceptions. The history of the U.S. natural gas industry includes several cases where natural gas did not prove to be reliable **in the view of the customer,** e.g., the curtailments of the 1970s and the extraordinarily cold period in late 1989. The concerns of the natural gas consumers about reliability depend heavily on the type of customer served. Residential and small commercial customers have expressed little concern about reliability of supply, although they are concerned about potential price volatility. On the other hand, with curtailments and confusion during periods of regulatory change, industrial and power generation customers have had a less impressive experience with natural gas reliability; these sectors also represent the most promise for growth.

As the commercial interactions within the industry shift from a regulated to a contractual basis, some of these concerns should fade. While action has been undertaken recently to address reliability issues, such as the FERC/DOE Deliverability Task Force and the consideration by the Natural Gas Council of a Natural Gas Reliability Council, nevertheless the development of a set of reliable services designed to meet customer needs, and the marketing of those services, remain as serious challenges to the industry.

Customer Orientation and Marketing

The natural gas industry generally has not been sufficiently customer oriented. In the past, natural gas marketing consisted of passing a commodity down the chain in the general direction of the end user, where all the commercial relationships had extensive regulatory limitations and natural gas was "marketed" by taking orders. Now, many natural gas companies are playing integrated energy service roles all along the line from producer to end user. Companies that can add value to the process need to develop additional marketing capabilities that are critical to a successful natural gas industry future. Full development of possible services requires that all segments of the industry explore new and more effective ways of using talents, facilities, and experience.

Behavioral Issues

The behavioral concerns are more difficult to address as they tend to influence actions in all industry segments. Many customers believe that the regulated sectors of the natural gas industry have little or no incentive to become more efficient. This perception arises from the belief that with regulation, economic incentives are masked and that regulatory "game-playing" is rewarded. Competition in the context of an open and competitive market creates good results for customers. Unnecessary fighting by industry participants

in the context of regulatory hearings and judicial proceedings, and without regard to customer reactions, sends adverse signals to customers. Such behavior conveys the impression that different segments of the natural gas industry cannot work together, and the customer will be convinced that reliable energy services cannot be developed.

In the natural gas industry of the past, regulatory policy shaped the destiny of the industry. In the emerging, more competitive market, individual businesses must develop their own vision of the future. It should not be inferred from the above that all of industry's challenges come from its regulated history; ultimately it is industry's own behavior that has the greatest effect.

Challenges for Government

Fostering Choice

The findings from this study support the premise that a competitive gas industry is developing, that it can function effectively and provide a range of services and products, and that this can work to the benefit of informed customers who may choose the terms and prices that best meet their needs. Correspondingly, regulatory policy should be directed toward increasing the number and quality of choices available to buyers and sellers without unnecessarily interfering in the consequences of those choices.

A robustly competitive natural gas industry will increase consumer satisfaction. Also, a competitive market will allow consumers and service providers, through mutual agreement, to make individual decisions about managing and allocating risks and associated costs. Because the exercise of individual choice is integral to achieving the public interest, regulators and policy makers should not substitute their opinion of risk tolerance for that of the customer.

Promoting System Efficiencies

Efficiency improvements, innovations, and new value-added services are more likely to develop in a competitive market than in one that is regulated. Incentives may be required in the regulated environment in order to obtain these same benefits.

Reducing Regulatory Uncertainty

During a period of industry transition, particularly transition aided and encouraged by regulatory policy, the most important challenge to regulators is to be clear about the goals of regulatory change. Uncertainty that arises from regulatory change, exacerbated by a lack of clarity, can limit the efficient and effective development of markets.

Finally, as the industry develops the ability to operate more effectively and with greater customer orientation, regulators and policy makers will be challenged to exercise restraint during periods of price and supply volatility. The emerging industry will not look like the historical industry, and lessons learned from the past may not have direct application in the future.

Challenges for Both Industry and Government

Development and Commercialization of Technology

Technology's role in increasing natural gas supply and mitigating cost increases is a cornerstone of the findings of this study. For natural gas to fulfill its role in the United States' energy picture, the technologies related to its production, distribution, and consumption must continue to evolve.

The NPC supports the fundamental premise that funding for technology development and commercialization should come first from private industry using risk capital and responding to market signals with the benefits accruing to the investor in recognition of the risk taken. Of the $750 million of estimated 1992 investment in natural gas technology development, near two-thirds was provided by private industry. The Gas Research Institute and other associations accounted for about one-quarter of the total investment in natural gas technologies, while the federal government contributed about one of every eight dollars invested. The majority of private investment was directed toward increasing supply and reducing costs, where the market mechanism has generally proven to be capable of providing good direction and allowing this sector to recognize the benefits of its investment in the successful deployment of new technology.

In contrast, however, regulated companies traditionally use a rate-of-return methodology that provides little reward to shareholders for the rapid development, commercialization, or adoption of new technologies. The resultant funding for end-use technology development and its ultimate commercialization has thus been constrained. This is also due, at least in part, to the fact that end-use equipment manufacturers are generally fuel neutral, since they manufacture different models of the same appliances and equipment to use either gas, oil, or electricity. This includes U.S. auto makers, who are finding little profit motive to develop natural gas vehicles.

The gas industry's challenge for technology development and commercialization involves continued funding by the producing segment of the industry, increased incentives for investing in technology by the regulated segments, and justification for investments in commercialization of end-use technologies. Also, the low level of federal government spending on gas-related technologies, relative to other energy sources, suggests a need to reexamine the potential benefits of investments in this segment, particularly in light of the evidence that natural gas is an abundant natural resource with superior environmental qualities.

Environmental Regulation and Access Restrictions

This study examined the impacts of potential future environmental regulations and access limitations on the exploration, production, transportation, and storage of natural gas. The results of this analysis demonstrate a clear potential to limit the ability of industry to increase the production of natural gas as an important resource in the national energy mix. At the end-use sectors, however, there remain unfulfilled opportunities to increase the use of natural gas driven by environmental regulations aimed at solving the nation's air quality problems.

Within this apparent dichotomy, the challenge is for industry and government to work together to solve the pressing environmental issues facing the E&P and transportation sectors in a balanced and cost-effective manner. The opportunity is for industry to develop new markets and for improved air quality for the nation.

FIRST RECOMMENDATION

FEDERAL, STATE, AND LOCAL OFFICIALS NEED TO ALLOW COMPETITIVE MARKET FORCES TO CONTINUE TO DEVELOP AND WORK

To allow the competitive gas market to continue to develop and function effectively, actions are recommended that:

- Foster choices that serve the public interest
- Promote system efficiencies
- Reduce regulatory uncertainty
- Support development and commercialization of technologies that reduce cost and increase the choices available to the consumer
- Promote cost-effective environmental regulation and reduce access restrictions.

Fostering Choice

Policy makers and regulators need to more explicitly define public interest and establish objectives that include a clear identification of whose public interest is being furthered by individual regulatory or policy actions. This new definition of the public interest should emphasize the principles of competitive markets and consumer choice, while recognizing a continuing, although greatly reduced, role for regulation. Industry and regulators should continue the evolutionary process toward deregulation in competitive markets and should explore the potential for incentive regulation in those markets where competition has not been shown to exist.

- Where market forces are sufficiently robust to provide reasonable service choices, regulatory decision making should defer to market forces. For example, the FERC should eliminate the traditional tests for new interstate pipeline construction and parties should be permitted to allocate risk through contractual mechanisms.
- Regulation should refrain from unnecessarily restricting the number and quality of choices made available to the buyers and

sellers of energy services; neither should it interfere with the consequences of those choices.

- The FERC should continue to promote the development of robust secondary markets for regulated transport services with customers allowed to trade capacity rights in minimally regulated secondary markets.
- Regulators should consider new forms of incentive rate making, phased activities, and pilot projects to examine the feasibility of new, less intrusive, regulatory structures. Where continued regulatory oversight is required, rate ceilings should be emphasized over profit ceilings.
- State commissioners should evaluate and direct as appropriate the unbundling of LDC and intrastate pipeline services to further competition and consumer objectives.
- Gas procurement should be deregulated where competitive markets exist and buyers have equal access to competing gas supplies.
- State regulators should explore alternatives to traditional service obligations so that competitive service offerings may be developed. The benefits of and need for franchise protection for LDC services to certain market segments should be reviewed and reevaluated. State regulators should distinguish between captive and non-captive customers.
- Oversight of gathering systems at the state level may be indicated in isolated cases where abuse of market power may prevent access, but regulation is not appropriate where sufficient competition exists.
- The regulation of safety and minimum service standards at state and federal levels should remain intact.

Improving System Efficiencies

Commissions should consider different forms of incentive regulation that lead to increased efficiency, improved productivity, and reduced costs, and encourage new and innovative services that are responsive to customer needs.

- Cost-of-service and rate design principles should be used that avoid cross subsidies among types of services and classes of customers.
- Current programs and policies should be examined at both the state and federal level to eliminate unnecessary costs across the entire system, including environmental costs or restrictions that are not commensurate with the ultimate benefit to the consumer.
- State regulators should adopt a fully integrated approach to energy resource planning, which recognizes the environmental benefits of natural gas.

Reducing Regulatory Uncertainty

Uncertainty about rates and access to transportation capacity makes it difficult for customers to make decisions regarding future energy needs. A regulatory system needs to be developed that allows the affected parties to have a knowledge of and confidence in natural gas prices and transportation rates at the time a transaction occurs, without the danger of those prices or rates being disturbed by lags in regulatory decision making.

- Regulators should determine the rate treatment for new facilities in advance of construction.
- Regulators must no longer permit rate changes that have a retroactive impact.
- Regulatory proceedings that remain necessary must be timely and efficient with procedures that guarantee completion within a reasonable time frame.
- Individual rules and regulations, as well as authorizing statutes, must be reviewed to remove impediments to real-time informed choices and educated risk assumptions by natural gas sellers, transporters, and customers.
- Regulators should account for the effects of their regulatory decisions on all sectors of the industry, in order to prevent undesirable side effects, and for consistency with overall national policy objectives.

Technology Development and Commercialization

Consideration needs to be given at the federal and state levels for support of the de-

velopment and commercialization of new technologies where the results can be reasonably expected to foster additional choices for the consumer or reduce the consumers' ultimate cost of service.

- The federal government should re-examine its natural gas research, development, and demonstration (RD&D) effort in light of the evidence that natural gas is an abundant natural resource whose increased use could provide environmental and balance-of-trade benefits.
- Serious consideration should be given to increasing the annual federal funding level for gas-related RD&D, including development of cost-effective environmental compliance technology, to about $250 million, consistent with other recent recommendations.
- A review should be initiated by the Department of Energy, in concert with industry and regulators, of limitations on end-use commercialization efforts caused by a cost-based regulation system.
- The federal RD&D program should examine new ways to sponsor cooperative, joint research projects with industry participants, particularly independent producers.
- Coordination efforts should continue to be increased between the DOE and industry organizations and associations.

Environmental Regulation and Access

Government agencies at all levels should create a balance between costs and benefits in the legislative and regulatory process for environmental and access issues that affect the natural gas industry. A balanced approach will ensure protection of the environment while moderating the financial impact on industry and providing the necessary access to the available resources.

- The federal regulatory moratoria should be extended for the review and modification of the current regulatory and permitting process to ensure a technically based and balanced approach to designing and implementing new regulatory requirements. These revisions should specifically include the net environmental benefits of natural gas.
- Minimize and/or alleviate access restrictions on industry by:
  - Developing an approach to leasing and permitting that will assure access to prospective acreage for prudent, environmentally sound exploration and development programs. This includes a re-evaluation of acreage currently under moratoria as their terms expire.
  - Modifying federal leasing programs so that successful bids that are based on accepted environmental guidelines would be issued with drilling permits.
  - Expediting the review and approval process for new pipeline projects at the federal, state, and local levels without diluting substantive environmental protection.
- Government agencies at all levels should move forward cautiously with the use of environmental externalities until they have carefully researched methodologies and have developed a well thought out approach for implementation.

SECOND RECOMMENDATION

Industry Needs to Make the Market Work

If natural gas is to play a more significant role in the U.S. energy mix, it is imperative that industry base its practices on the findings that the resource base is not limiting, that gas supplies can be delivered at competitive prices on a timely and reliable basis, and that opportunities exist to increase gas consumption in a variety of markets. Regulators and other policy makers are poised to help the competitive natural gas market work, but it is the responsibility of industry to make it work and perform to the benefit of the consumer, the environment, and the nation.

Reliability

Natural gas reliability is of concern to all sectors of the industry and in particular to the

electric utility and industrial customers, who have unique operational requirements. Concerns encompass price volatility as well as supply and pipeline deliverability. Reliability has different meanings to different people and perceptions are often as important as facts and analyses. It is, therefore, imperative that industry openly address the reliability issue to ensure that natural gas is best able to compete effectively in the nation's energy markets.

The NPC believes that industry should give serious consideration to the formation of a Natural Gas Reliability Council and recommends support for the scoping study that is being performed by the Natural Gas Council to establish the requirements for such an organization. The purpose of the Reliability Council would be to improve reliability of natural gas service and increase customer confidence in natural gas. Its mission would be to provide facts, analysis, and recommendations relevant to improving the reliability of gas service.

Other actions should be undertaken independent of the formation of a Natural Gas Reliability Council to reduce the customers' concerns over reliability:

- The findings from this study should be used by industry to enhance confidence in the nation's current supply and delivery systems.
- Transmission companies and LDCs should undertake efforts to coordinate maintenance and downtime across industry segments to minimize potential interruptions in gas deliverability.
- Producers should insist on the maximum possible discretion in managing production in relation to swings in market demand and prices, while recognizing that states have an obligation to protect correlative rights and prevent waste.

The consuming sectors must be able to make decisions based on economics, service, and environmental requirements with full confidence in the reliability of natural gas being available when, where, and under the terms specified by the contracting parties.

Customer Orientation and Marketing

A commitment to the customer is essential to achieving growth in market share. This will require a dedication to being customer oriented and providing the products and services appropriate to the needs of the customer.

- The industry should adopt and communicate to its customers a philosophy of "working with customers to install facilities required for economical, efficient, and reliable services responsive to customer needs."
- It is imperative that LDCs continue aggressive programs to increase demand and maintain market share in existing residential, commercial, and base load industrial sectors.
- Other industry segments should support and leverage LDC efforts by providing a full range of services designed to meet customers' gas acquisition needs. Recognition and support should be given to the new role of natural gas service providers.
- Industry needs to focus effort on demand growth in the major market opportunity areas (e.g., electric power generation, natural gas vehicles, and gas cooling) as well as identifying and maximizing opportunities in niche markets (e.g., gas engine drive, environmental emissions control, gas heat pumps, and gas process cooling).
- The natural gas and power generating industries must cooperate, coordinate, and compromise to make the transporter/customer relationship work.
- Mechanisms must be devised to make it easy for customers to buy natural gas. Innovative contracting practices should continue to be offered, supported by a regulatory environment that honors contract sanctity. The development of emerging markets (financial, transportation, and others) should be encouraged.
- Industry should support the creation of additional market centers as mechanisms to promote better access and improved reliability of natural gas services.
- Better methods need to be developed to communicate to customers the availability of transmission and storage capacity.
- Efficiencies must be improved across the entire natural gas system, including re-

ducing regulatory compliance costs, so natural gas can continue to be delivered to the customer at the lowest possible cost.

Technology Development and Commercialization

The continued development and commercialization of technology is fundamental to maintaining and expanding market opportunities, increasing the supply of natural gas to those markets, and reducing gas cost to make it even more competitive with alternative energy sources.

- Each segment of the gas industry must ensure that gas technology is a priority for its own facilities and operations to provide the demonstration sites necessary for commercialization efforts and to demonstrate its belief in these technologies.
- Industry must continue to invest in its own development programs and should be willing to participate with government in appropriate jointly funded programs.
- Industry segments must recognize the inherent limitations of a regulated structure and cooperate with policy makers in devising mechanisms that allow the benefits of investments to flow to the providers of the risk capital.

Environmental Regulation

Industry must play an active role in developing environmental data on natural gas, increasing the public's understanding of the positive benefits of natural gas, and developing new and innovative strategies for dealing with environmental issues.

- Initiate an industry/government project to develop a methodology for doing cost-benefit environmental evaluations and document the results in a "How To" manual for industry, government, and public use.
- Gather the technical information and knowledge necessary for the natural gas industry to develop a strategy regarding environmental externalities.
- Initiate an industry/government project to develop methodologies and tools for education and communication efforts that explain the role of natural gas in a balanced but comprehensive energy conservation, pollution prevention, and energy development program.
- Improve the integration of environmental issues into strategic business planning and decision-making processes.
- Develop direct business opportunities for the natural gas industry by developing or adapting products, processes, and services to meet the current and future needs of the American consumer.

Leadership

Finally, leaders in all segments of the natural gas industry must commit to a concerted, ongoing, and consistent effort that focuses on the unique attributes of natural gas and its ability to deliver superior value to customers.

First and foremost, a consistent and coherent vision must be developed for the future direction of the industry.

Second, the industry needs to educate both itself and its customers on the facts about natural gas. Information should be made available on (a) the ability of supply to economically and reliably meet the needs of the consumer, (b) the environmental and life-cycle cost advantages of natural gas, and (c) the opportunities for improved customer and service orientation.

Third, industry must improve communication and coordination with its customers in order to best satisfy their objectives. The joint task groups that were formed recently between the natural gas and electric generation industries should be continued and expanded to include other customer classes. Industry also needs to encourage federal and state policies and guidelines that explicitly recognize the potential of natural gas to enhance national economic growth and achieve environmental goals.

Fourth, the industry needs to encourage and support the development of economic natural gas use within the industry, especially in vehicles and cooling. This demonstration of commitment will encourage potential customers to make the decision to use natural gas in their own facilities.

CLOSING

As the natural gas industry advances through the last decade of the 20th century, it is at a fork in the road — if it fails to deal with the issues described in this report it will likely become "dysfunctional." On the other hand, if the natural gas industry participants work cooperatively together to turn their challenges into opportunities, natural gas will realize its potential in which:

- Efficient Natural Gas Usage Contributes to the Nation's Environmental and Energy Independence Goals
- The Natural Gas Industry Meets Customer's Energy and Environmental Needs for Economic, Efficient, and Reliable Products and Services
- Federal, State, and Local Policies Support a Competitive Market for Natural Gas.

APPENDICES

The Secretary of Energy
Washington, DC 20585

June 25, 1990

Mr. Lodwrick M. Cook
Chairman
National Petroleum Council
1625 K Street, N.W.
Washington, D.C. 20006

Dear Mr. Cook:

Through this transmittal, I am formally requesting that the National Petroleum Council (NPC) perform two studies that are currently of critical interest to the Department of Energy. These studies are described below.

Constraints to Expanding Natural Gas Production, Distribution and Use

I request that the NPC conduct a comprehensive analysis of the potential for natural gas to make a larger contribution, not only to our Nation's energy supply, but also to the President's environmental goals. The study should consider technical, economic and regulatory constraints to expanding production, distribution and the use of natural gas. In the conduct of this study, I would like you to consider carefully the location, magnitude and economics of natural gas reserves, and the projected undiscovered and unconventional resource; the size, kind and location of future markets; the outlook for natural gas imports and exports; and potential barriers that could impede the deliverability of gas to the most economic, efficient and environmentally sound end-uses.

This study comes at a critical time, given the increased interest in natural gas, for developing public and private sector confidence that natural gas can make a greater contribution to the energy security and environmental enhancement of our Nation. I anticipate that the results of your work will be able to contribute significantly to the development of the Department's policies and programs.

The U.S. Refinery Sector in the 1990's

U.S. refineries face significant changes to processing facilities in the next decade, particularly in response to new environmental legislation that will affect emissions and waste disposal from refineries and the composition of motor fuels. Substantial investments are likely to be required to comply with proposed Clean Air Act Amendments, including provisions dealing with air toxics and alternative fuels. There is concern about the U.S. engineering and construction industry's capability to design, manufacture, and install quickly the large number of new, sophisticated processing facilities that would be necessary to supply these fuels.

Product imports, which are projected to increase, may also have to be treated differently than in the past. For example, if U.S. refiners have different gasoline specifications (e.g., Reid Vapor Pressure, aromatics, olefins, oxygen content) than foreign refineries, imported products may require additional U.S. refining.

I request that the NPC assess the effects of these changing conditions on the U.S. refining industry, the ability of that industry to respond to these changes in a timely manner, regulatory and other factors that impede the construction of new capacity, and the potential economic impacts of this response on American consumers.

I look forward to receiving your results from these two studies and would like to be notified of your progress periodically.

Sincerely,

James D. Watkins
Admiral, U.S. Navy (Retired)

DESCRIPTION OF THE NATIONAL PETROLEUM COUNCIL

In May 1946, the President stated in a letter to the Secretary of the Interior that he had been impressed by the contribution made through government/industry cooperation to the success of the World War II petroleum program. He felt that it would be beneficial if this close relationship were to be continued and suggested that the Secretary of the Interior establish an industry organization to advise the Secretary on oil and natural gas matters.

Pursuant to this request, Interior Secretary J. A. Krug established the National Petroleum Council on June 18, 1946. In October 1977, the Department of Energy was established and the Council was transferred to the new department.

The purpose of the NPC is solely to advise, inform, and make recommendations to the Secretary of Energy on any matter, requested by him, relating to oil and natural gas or the oil and gas industries. Matters that the Secretary of Energy would like to have considered by the Council are submitted in the form of a letter outlining the nature and scope of the study. This request is then referred to the NPC Agenda Committee, which makes a recommendation to the Council. The Council reserves the right to decide whether it will consider any matter referred to it.

Examples of recent major studies undertaken by the NPC at the request of the Secretary of Energy include:

- *Unconventional Gas Sources* (1980)
- *Emergency Preparedness for Interruption of Petroleum Imports into the United States* (1981)
- *U.S. Arctic Oil & Gas* (1981)
- *Environmental Conservation—The Oil & Gas Industries* (1982)
- *Third World Petroleum Development: A Statement of Principles* (1982)
- *Enhanced Oil Recovery* (1984)
- *The Strategic Petroleum Reserve* (1984)
- *U.S. Petroleum Refining* (1986)
- *Factors Affecting U.S. Oil & Gas Outlook* (1987)
- *Integrating R&D Efforts* (1988)
- *Petroleum Storage & Transportation* (1989)
- *Industry Assistance to Government* (1991)
- *Short-Term Petroleum Outlook* (1991).
- *Petroleum Refining in the 1990s–Meeting the Challenges of the Clean Air Act* (1991).

The NPC does not concern itself with trade practices, nor does it engage in any of the usual trade association activities. The Council is subject to the provisions of the Federal Advisory Committee Act of 1972.

Members of the National Petroleum Council are appointed by the Secretary of Energy and represent all segments of the oil and gas industries and related interests. The NPC is headed by a Chairman and a Vice Chairman, who are elected by the Council. The Council is supported entirely by voluntary contributions from its members.

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The Potential for Natural Gas in the United States

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