

# **U.S. Oil & Gas Outlook**

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An Interim Report of the  
National Petroleum Council

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October 1986

James L. Ketelsen, Chairman  
Committee on U.S. Oil & Gas Outlook

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## OVERVIEW

With the precipitous drop in oil prices this year, petroleum exploration and development budgets have been slashed, drilling has fallen drastically, reserves and production are declining, and the productive capacity of the industry is being seriously threatened. These events are leading to greater dependence on oil imports and heightened vulnerability, and could lead to a repeat of the energy crises of the last decade. The energy-producing areas of the nation have been hit hard.

It is important to distinguish between the concepts of dependence and vulnerability. Dependence is measured by the share of oil imported. Vulnerability is measured by the potential damage a physical shortage and/or a rapid price change could cause and the likelihood of such events occurring.

As the Secretary of Energy noted in requesting this study in September 1985, U.S. dependence on foreign energy sources had diminished and the nation's vulnerability to energy supply disruptions had been reduced. Net U.S. imports of crude oil and petroleum products peaked at 8.6 million barrels per day in 1977, 46 percent of total U.S. petroleum consumption. Due to the declining oil demand and the stabilization of domestic oil production, imports dropped steadily to 4.3 million barrels per day in 1985, 27 percent of total consumption.

Also significant was the shift away from dependence on Middle East OPEC\* oil to more diverse sources. During the 1981-1985 period, Mexico replaced Saudi Arabia as the primary supplier of foreign oil to the United States. Imports of crude oil and petroleum products from Mexico, Canada, and Venezuela, as a percentage of total oil imports, rose from 23 percent in 1981 to 43 percent in 1985. During this same period, imports of oil from Middle East OPEC decreased from 20 percent of imports to only 6 percent. More significantly, the share of non-communist petroleum demand satisfied by OPEC oil declined from 61 percent in 1977 to 37 percent in 1985.

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\*Middle East OPEC includes: Iran, Iraq, Kuwait, United Arab Emirates, Saudi Arabia, Qatar, and the Neutral Zone.

*Note: The study's final report, which will present options to avoid or mitigate the vulnerability to future energy crises, is under preparation and will be published in early 1987.*

Now these positive trends toward reduced dependence on imported oil are being reversed. In the first seven months of 1986, U.S. oil imports increased by 900,000 barrels per day (18 percent) over the comparable 1985 period, and they are still climbing. During this same period, imports from Middle East OPEC more than doubled from 400,000 barrels per day to 900,000 barrels per day. In the future, additional imports must be linked with increased Middle East OPEC production.

The recent severe oil price decline has resulted in significant reductions in exploration and production budgets and drilling activity, which, in turn, have caused major layoffs in the petroleum industry. In a survey by Salomon Brothers, Inc., 20 major oil companies indicated that they plan to reduce their 1986 exploration and production budgets by 39 percent compared to 1985, and 115 independents plan to cut by 48 percent. Drilling rigs operating in the United States dropped from a peak of 4,500 in 1981 to below 700 by mid-1986. The domestic oil and gas extraction labor force fell from a 1982 high of 708,000 to 443,000 in June 1986.

The reductions in the level of exploration and production activity brought on by a sustained period of lower prices and reduced cash flow cannot be quickly reversed. The price declines have significantly reduced the willingness and ability of external sources (banks, insurance companies, and publicly raised funds) to support the industry. The time required to restore the industry's productive capacity will depend on both the depth and duration of reduced prices, which determine the availability of investment capital, manpower, and equipment. This time lag, not just the reduction in exploration and production activity, will act to further increase U.S. energy vulnerability.

The lower prices are reducing U.S. oil and gas production and encouraging growth in energy demand. These trends combine to increase U.S. dependence on imported oil. Middle East OPEC possesses 55 percent of world proven crude oil reserves. In addition, because of the dependence of the non-communist world on Middle East oil and the United States' trade relations and oil sharing agreements, it is essential that the United States recognize its vulnerability to a major world oil supply disruption. The degree of vulnerability will depend on the level of domestic oil and gas production, the size and accessibility of the Strategic Petroleum Reserve, the stability and diversity of U.S. energy sources, and the feasibility to utilize alternate fuels.

A survey conducted by the National Petroleum Council (NPC) shows on Figure 1 that net imports of crude oil and products could rise from 27 percent of consumption in 1985 to almost 50 percent by 1990. Also, the share of the oil supplied to the non-communist world from Middle East OPEC could increase by 50 percent by 1990 if real oil prices remain significantly below the 1985 level. Such a situation would increase U.S. vulnerability to a major world oil supply disruption and could provide the genesis for another energy crisis.

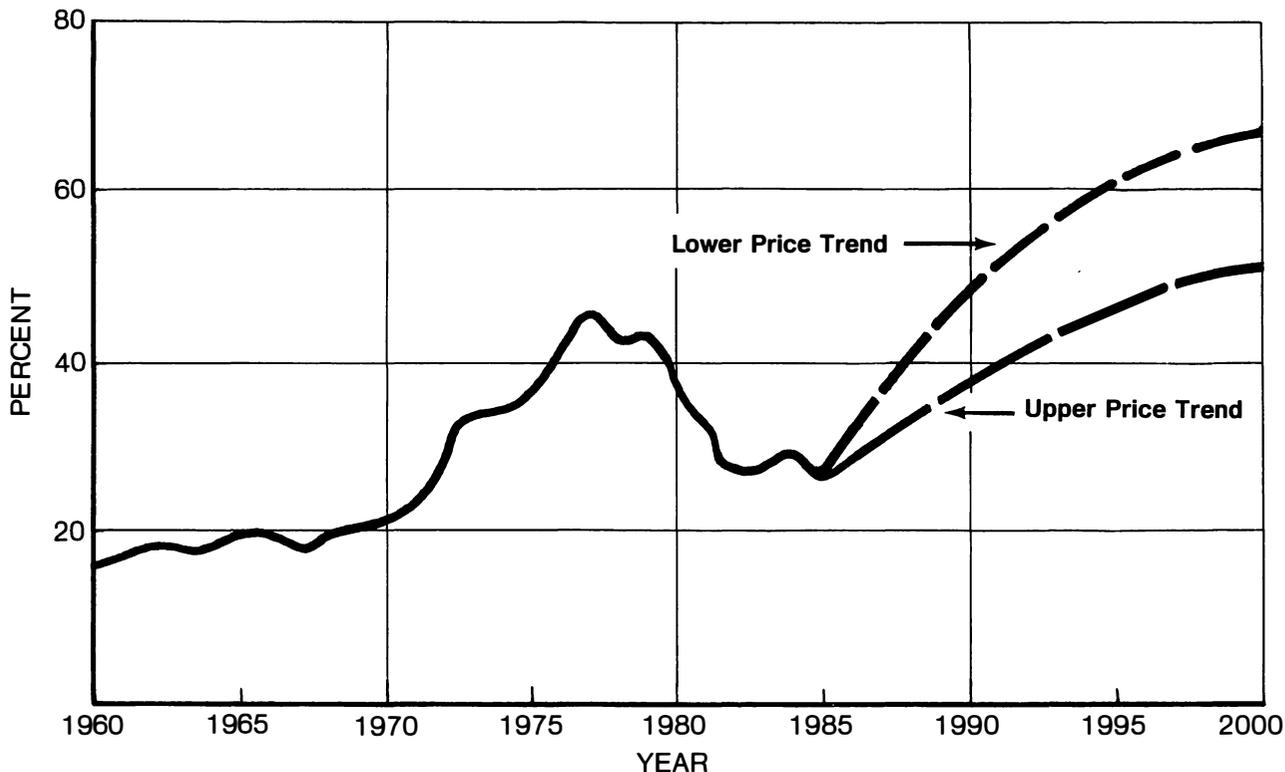


Figure 1. Net U.S. Oil Imports as a Percentage of Oil Consumption.

NOTE: Potential import levels are based on responses to an NPC survey of future supply/demand outlooks that utilized two oil price trends provided by the Department of Energy: an upper price trend starting at \$18/barrel in 1986 and growing at a real rate of 5%/year to \$36 in 2000, and a lower price trend starting at \$12/barrel in 1986 and growing at a real rate of 4%/year to \$21 in 2000.

There is no question that the depressed conditions that exist in the petroleum industry will affect the long-term welfare of the nation. Until oil prices increase appreciably, U.S. exploration will remain stagnant, our dependence on imports will continue to increase, and our vulnerability to oil price shocks and possible oil shortages or stoppages will rise to an excessively dangerous level. All of this will seriously affect our strategic and national security as well as our economic stability. The imminence and gravity of this national energy vulnerability mandates that the National Petroleum Council request the Secretary of Energy to convey the urgency of the situation to the Administration, the U.S. Congress, and the American people.

## INTRODUCTION

### STUDY REQUEST

On September 23, 1985, Secretary of Energy John S. Herrington requested that the NPC undertake a study to examine the factors affecting the nation's future supply of and demand for oil and natural gas. The Secretary's letter also requested that the study examine the factors that precipitated the 1970s energy crises, their financial impact on the nation's economy, the appropriateness of government's response, and the potential for the recurrence of such crises. In addition, the Council was asked to advise on how the vulnerability to future energy crises can be avoided or mitigated. The Council agreed to this request. The letter from the Secretary is provided in Appendix A.

### STUDY ORGANIZATION AND METHODOLOGY

To assist in responding to the Secretary's request, the Council established the Committee on U.S. Oil & Gas Outlook under the chairmanship of James L. Ketelsen, Chairman and Chief Executive Officer of Tenneco Inc. Donald L. Bauer, Acting Assistant Secretary for Fossil Energy, U.S. Department of Energy, serves as Government Cochairman of the Committee. The Committee established a Coordinating Subcommittee to aid it in directing the overall study effort, and three task groups -- the Economic and Environmental Impacts Task Group, the Historical Factors Task Group, and the Future Supply/Demand Factors Task Group. The broad membership of these groups includes representatives of both major and independent petroleum companies, natural gas producers and pipelines, the petroleum services industry, the electric power and automotive industries, energy trade and research associations, and the academic, consulting, financial, and environmental communities. Rosters of these study groups are provided in Appendix B.

At the time the Committee held its initial meeting on April 22, 1986, the price of oil had been on a severe decline for over four months. The spot price of West Texas Intermediate crude oil had dropped from about \$32 per barrel in November 1985 to under \$12 per barrel, a decline of over 60 percent. In the first four months of 1986, employment in oil and gas extraction had fallen 21 percent, a total of 127,000 jobs. Severe cutbacks in exploration and development budgets were being announced almost daily. In short, much of the exploration and development sector of the petroleum industry was being dismantled by the rapid decline in the price of oil.

The Committee felt it imperative that an interim report should be developed and published no later than October 1986, focusing on the recent severe drop in oil prices and its impact on the oil and gas business -- and in turn on the economic and strategic security of the United States.

The Council's approach to fulfilling the Secretary's request has been to first identify the various factors that affect the historical supply of and demand for oil and gas, then to analyze how each of these factors operates to increase or decrease supply and demand. These analyses are currently in progress and will be discussed in the final report. In addition, the final report will present options to avoid or mitigate the vulnerability to future energy crises.

As one tool for analyzing factors affecting oil and gas supply and demand, a survey was conducted of future supply/demand outlooks utilizing two simplified price trends provided by the Department of Energy. This survey was sent to 52 industry, utility, government, consulting, and financial community representatives; 33 responses were received. The survey results are intended to illustrate the sensitivity of supply and demand and future drilling activity levels to oil prices and the resultant changes in U.S. vulnerability to future oil supply disruptions. Results of the survey are discussed in Chapter Two and Appendix C.

Another survey to elicit views on the near-term outlook for drilling was sent to approximately 7,000 members of the Independent Petroleum Association of America (IPAA) and to the Society of Independent Professional Earth Scientists (SIPES); 1,023 responses were received. Summary results of the IPAA/SIPES Drilling Survey are discussed in Chapter Two and Appendix D.



## CHAPTER ONE

### ECONOMIC IMPACTS OF MAJOR OIL PRICE CHANGES

As events of the 1970s and early 1980s demonstrate, the price and availability of energy, and in particular oil and gas, play a significant role in determining the overall performance of the U.S. economy. Because energy costs are a pervasive component of total production and distribution costs, changes in energy prices affect the prices of most goods and services. Energy is also an important element of personal consumption expenditures. Consequently, changes in energy prices affect the amount households can spend on other goods and services.

The impact of energy price shocks on the U.S. economy is heightened by the importance of energy in U.S. international trade. In 1979, for example, crude oil and petroleum product imports were nearly \$56 billion and represented over 27 percent of U.S. imports. The United States is by far the largest oil importer; in 1979, imports into the United States accounted for 22 percent of all world oil trade.

The effects of severe energy price changes on most of the U.S. economy is somewhat offset by the impact on the energy industry, which has accounted for more than 10 percent of total industrial capital spending in recent years. The benefit of the current oil price decline to the economy has been mitigated by the deterioration of the domestic energy exploration and production industry.

Among energy sources, oil and natural gas have the greatest impact on economic activity, due to their predominant shares in U.S. energy consumption (roughly two-thirds); their widespread use in industry, transportation, heating, and electric power generation; the lack of alternatives in some uses (such as transportation fuels and petrochemical feedstocks); the importance of oil in international trade; and the fact that oil prices strongly influence the prices of other fuels.

### ECONOMIC IMPACT OF 1970s ENERGY CRISES

In 1973-74 and 1979-80, large increases in oil prices were triggered by events in the Middle East -- the Arab Oil Embargo and the Iranian Revolution. When these price shocks occurred, the U.S. economy was booming, unemployment was low, inflation was accelerating, and interest rates were high. In each case, the consensus economic forecast called for a mild recession the following year. Instead, the U.S. economy suffered its two worst post-war recessions during the 1974-75 and 1980-82 periods.

In order to determine how much rising oil prices contributed to the 1974-75 and 1980-82 recessions, a set of macroeconomic models\* was used to simulate the U.S. economy absent the oil price shocks of 1973 and 1979. Monetary and fiscal policies were held constant in order to isolate the impact of the price shocks alone. That part of the recessions not attributable directly to the oil price shocks was largely due to these policies, which may indeed have been influenced by the oil price shocks.

The model results indicate that the cumulative macroeconomic effects of the oil price shocks grew for about two years before leveling off. All three models produced similar estimates of the ultimate impacts of the 1973 and 1979 oil price shocks. The results obtained using the Wharton model are summarized in Figures 2 through 5.

Figure 2 indicates that the 1973 and 1979 energy price increases shrank the U.S. economy by approximately 2.5 percent and 3.5 percent, respectively. The 1979 case shows a greater impact because, relative to the 1973 case, the price increases were larger and the level of oil imports was higher. In today's

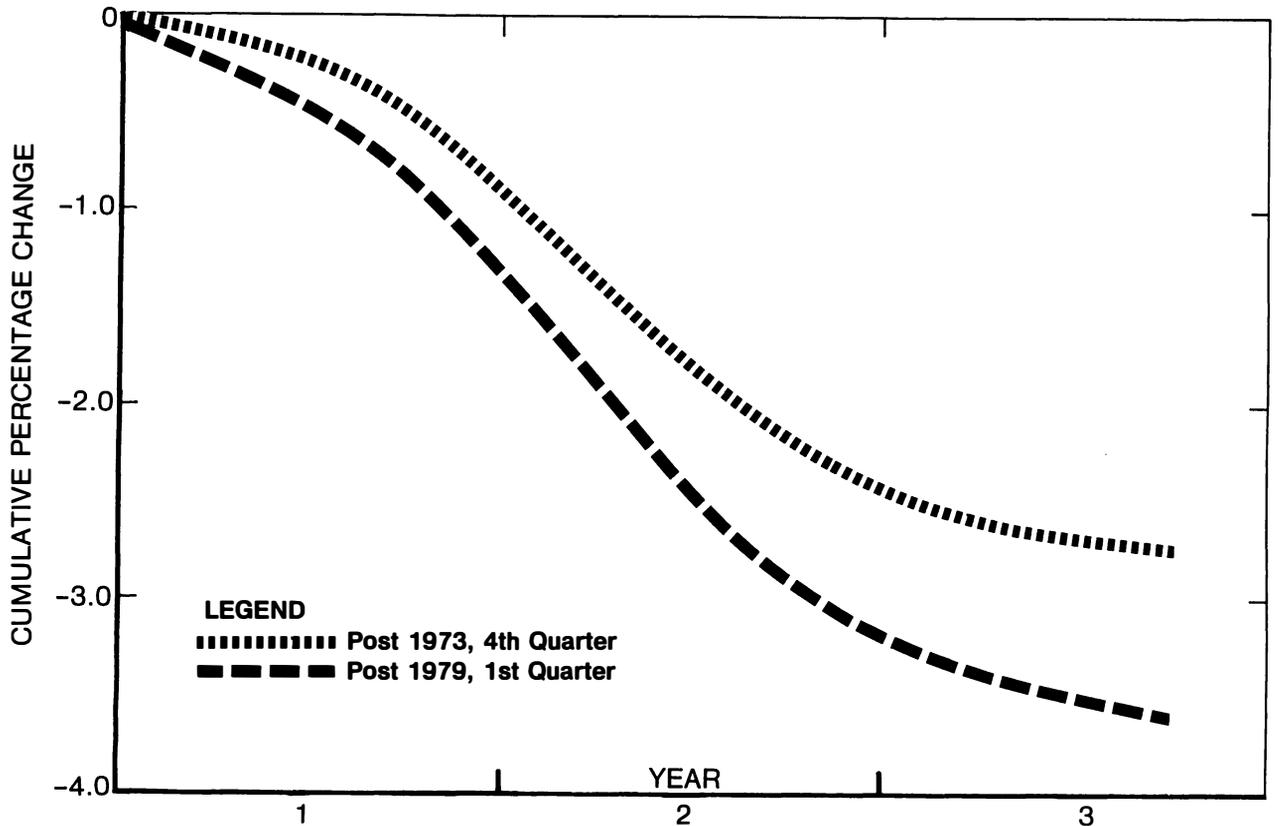


Figure 2. Impact of Oil Price Shocks on Real GNP, in 1982 Dollars.

\*The models used were economic models of Data Resources Inc., Wharton Econometric Forecasting Associates, and Laurence H. Meyer and Associates.

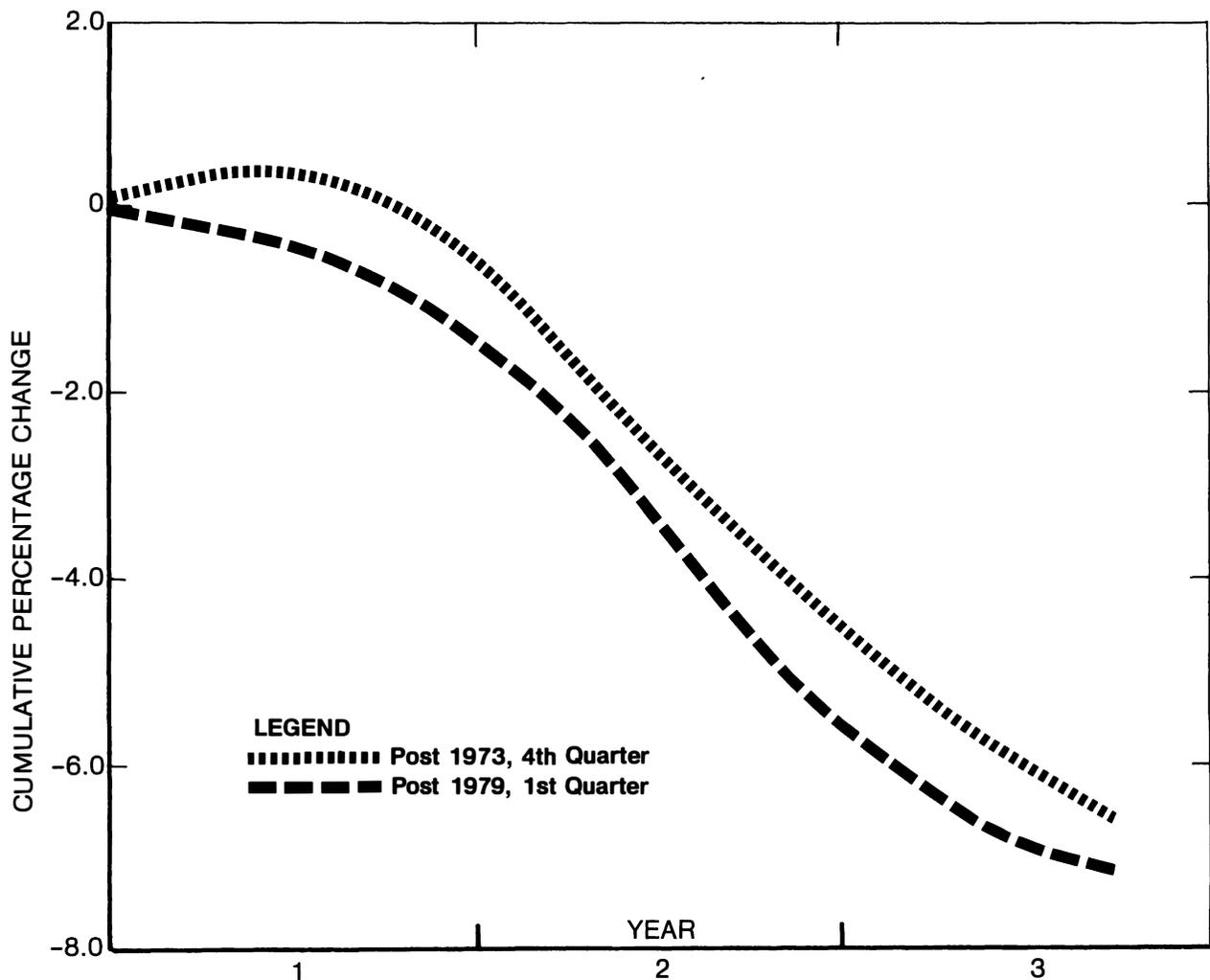


Figure 3. Impact of Oil Price Shocks on Real Business Fixed Investment, in 1982 Dollars.

economy, each percent reduction in GNP would mean about a \$42 billion reduction in the value of goods and services produced in the United States.

A dramatic increase in energy prices affects business spending more severely than the economy in general. As shown in Figure 3, the level of business fixed investment was reduced by about 7 percent by each of the 1970s price shocks. In today's economy, each percent reduction in investment would mean a \$5 billion decline in investment in plant and equipment each year.

Reduced economic activity and business investment have a critical effect on jobs. As Figure 4 indicates, the 1973 and 1979 oil price shocks increased the unemployment rate by approximately 1.5 and 2 percentage points, respectively. In today's economy, each percentage point increase in the unemployment rate would mean the loss of over one million jobs.

The rate of inflation accelerated sharply following the energy price shocks. Figure 5 portrays the Consumer Price Index,

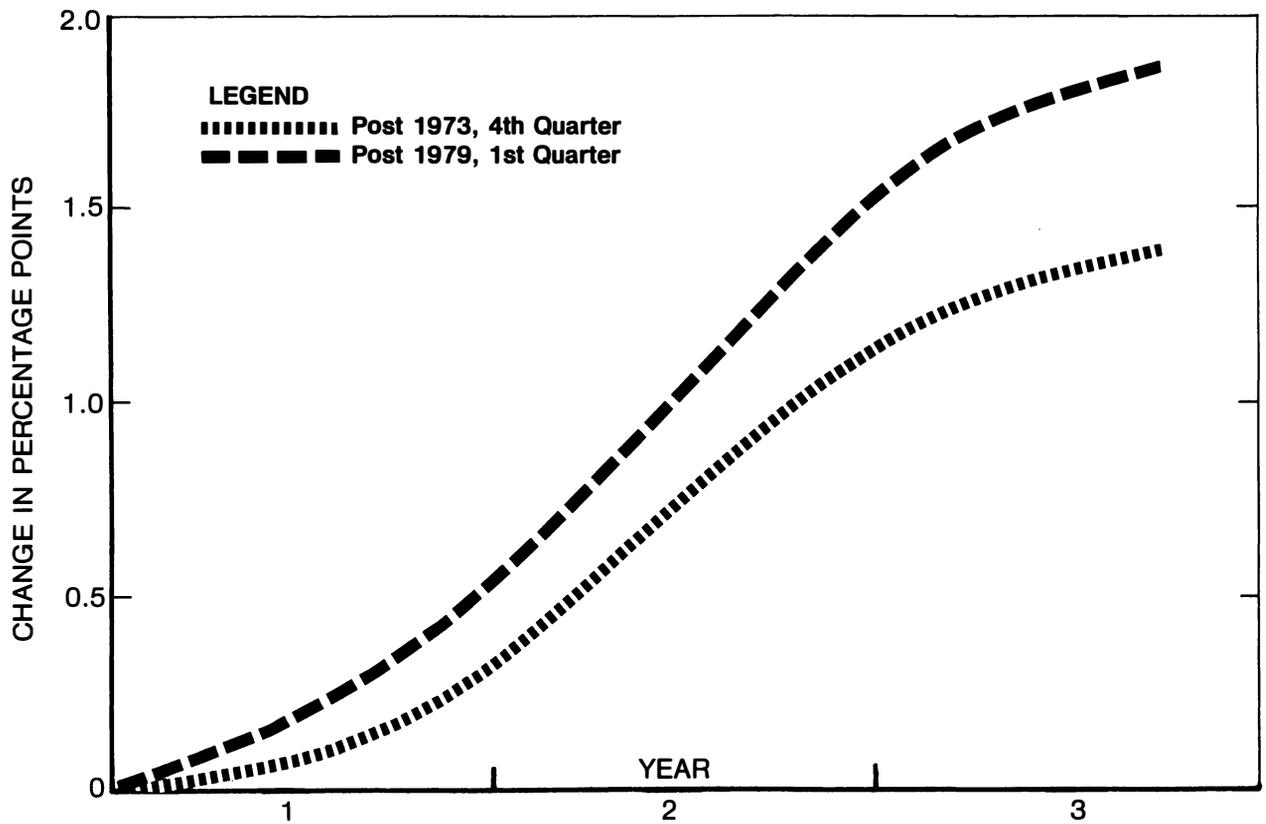


Figure 4. Impact of Oil Price Shocks on Unemployment Rate.

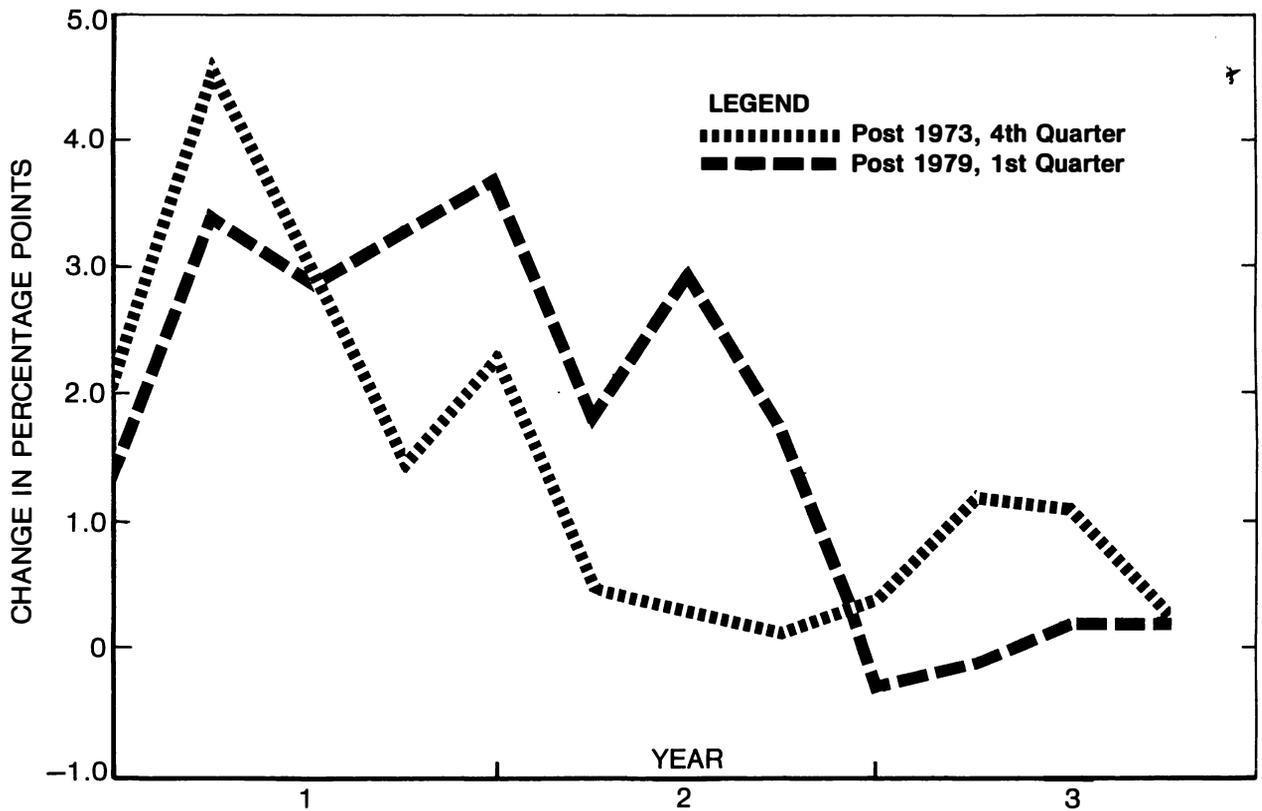


Figure 5. Impact of Oil Price Shocks on Inflation Rate, (Consumer Price Index—Annualized Rate of Change).

which jumped an additional three percentage points for two years following each shock. While the rate of increase then subsided, the level of prices remained higher than without the shocks. Differences in patterns between the 1973 and 1979 cases reflect, among other things, the status of price controls.

#### ECONOMIC IMPACT OF RECENT OIL PRICE DECLINES

The rapid decline in oil prices that began in late 1985 has prompted expectations of increased economic growth. A decline in oil prices increases real disposable income and stimulates spending on all goods and services. At the same time, lower prices for energy and energy-intensive products reduce the inflation rate. Also, lower oil prices immediately improve the nominal oil trade balance.

There are several reasons why these positive economic effects of declining prices will be considerably smaller in magnitude, and slower to occur, than the negative impacts of the 1970s price increases. Because of conservation efforts, improvements in energy-use technology, and the growth of the service sector relative to the manufacturing sector, the U.S. economy is less energy-intensive than it was in the 1970s. Thus, energy price movements, either positive or negative, have smaller economic impacts today than they did in the 1970s.

In addition, the petroleum exploration and production sector of the U.S. economy was significantly larger at the onset of the recent price decline. In the 1970s, the benefits of higher oil prices to the petroleum industry and related industries only slightly offset the negative impact on the rest of the economy. In contrast, the negative impact of the recent price collapse on these industries offsets the benefits to the rest of the economy to a much greater extent.

Furthermore, adjustments to changing economic conditions are never instantaneous and without cost. Regardless of whether prices rise or fall, costs are incurred in adjusting to the new price level.

Because of the time lag and these adjustment costs, the full economic benefits from lower oil prices will not be felt until considerable time has passed. Furthermore, a rapid return to higher prices, or even the fear of such a rapid return, might slow the speed of adjustment and limit the ultimate economic benefits. Consumers and producers of goods and services are not likely to change spending habits or make substantial investments if the price collapse is perceived to be temporary. Eventually, however, a sustained period of lower oil prices should result in increased economic activity except in the petroleum and its related industries, which will experience further depressed activity, leading to greater dependence and vulnerability to increased oil imports.

## REGIONAL AND SECTORAL EFFECTS

Despite the generally positive impacts of lower oil prices on the economy as a whole, certain regions of the country are experiencing substantial economic deterioration.

As shown in Table 1, the major oil producing states of Texas, Louisiana, Alaska, and Oklahoma, which account for roughly 10 percent of U.S. employment, are suffering unemployment rates well in excess of the national average. Employment cuts in the petroleum and petroleum-service industries have led to unemployment in other industries dependent upon consumer spending.

TABLE 1  
UNEMPLOYMENT RATES IN  
MAJOR OIL PRODUCING STATES  
(Percent)

<u>Unemployment</u>	<u>1985</u>	<u>1986</u>
United States	7.1	7.0
Alaska	9.7	10.8
Louisiana	11.5	13.6
Oklahoma	7.1	9.0
Texas	7.0	11.1

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Source: U.S. Bureau of Labor Statistics, Employment and Earnings, July 1986, May 1986. 1985 data are averages, 1986 U.S. is for June. 1986 state data are from state agencies.

Operating bases for supply and service companies are generally located in small cities and towns near oil and gas fields. These communities expanded services such as schools, streets, utilities, and housing in response to the oil booms of the late 1970s and early 1980s. With the recent sharp downturn in oil and gas activities, these communities must pay from an eroded tax base for the projects initiated during the growth period.

Another important impact of lower oil prices on oil producing regions is the reduction in state revenues from income, severance, and ad valorem taxes. These reductions have already led to state government spending cuts and employee layoffs.

Certain regions and industries have benefitted from the lower oil prices. The primary regional beneficiaries are the non-petroleum producing areas. Petrochemical, refining, transportation, paper, and metals industries are experiencing significantly lower fuel and feedstock costs.

## CHAPTER TWO

### SUPPLY/DEMAND RESPONSES TO MAJOR OIL PRICE CHANGES

Since its inception in the mid-1800s, the U.S. oil industry has been through many periods of price volatility. As shown in Figure 6, the annual percentage changes in oil prices between 1900 and the early 1930s rival those the world has been through since the early 1970s.

Currently, oil prices are unstable. Since November 1985, crude oil prices have ranged from about \$32 per barrel to under \$10 per barrel. Several causes of oil price instability exist, such as daily oil futures market fluctuations, seasonal demand movements, OPEC-induced supply changes, and long-term oil supply and demand imbalances.

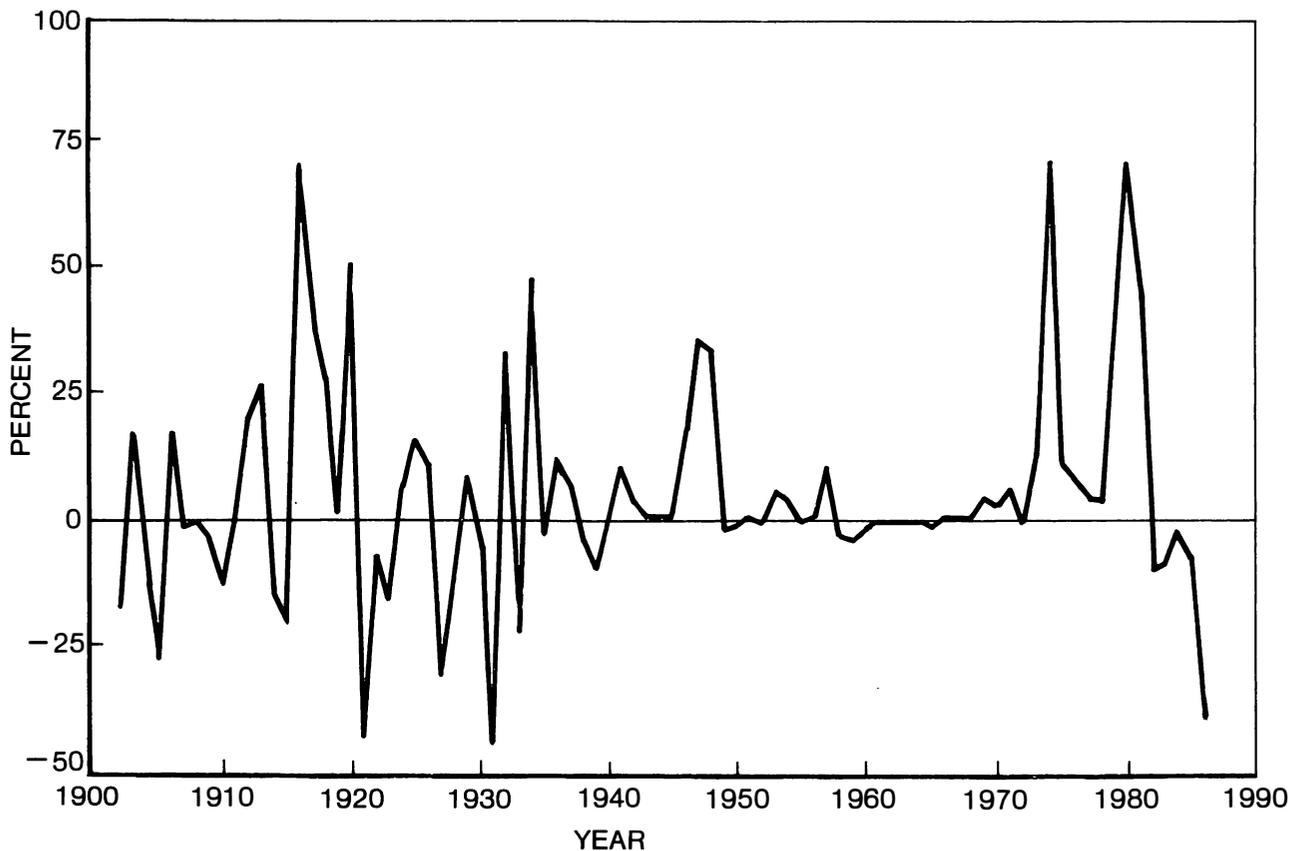


Figure 6. Percentage Change in Annual Average Wellhead Prices (Nominal Dollars per Barrel).

SOURCE: Salomon Brothers

A major factor affecting price instability since the mid-1970s has been the shift of swing oil production capacity to Middle East OPEC. During the 1970s, as OPEC's capacity utilization level moved above 80 percent, some members were able to adjust their production to hold prices at high levels. Subsequent to the second oil price shock, due to increases in non-OPEC energy supplies and the decline in world oil demand, OPEC's capacity utilization fell to such a low point that in late 1985 some members opted to regain their market share rather than hold the price at former levels.

Price instability is difficult to cope with in the capital intensive oil and natural gas industry, with the long lead times required for investment. This price instability and the resulting uncertainty represent an added risk that raises the expected return needed to justify an investment.

The world has experienced short-term oil price instability within longer-term oil pricing cycles. A trend toward lower real prices, as occurred in the 1950s and 1960s, and shown in Figure 7, carries with it the seeds of its own destruction and can result in a sudden price spike. This is because, in a low price

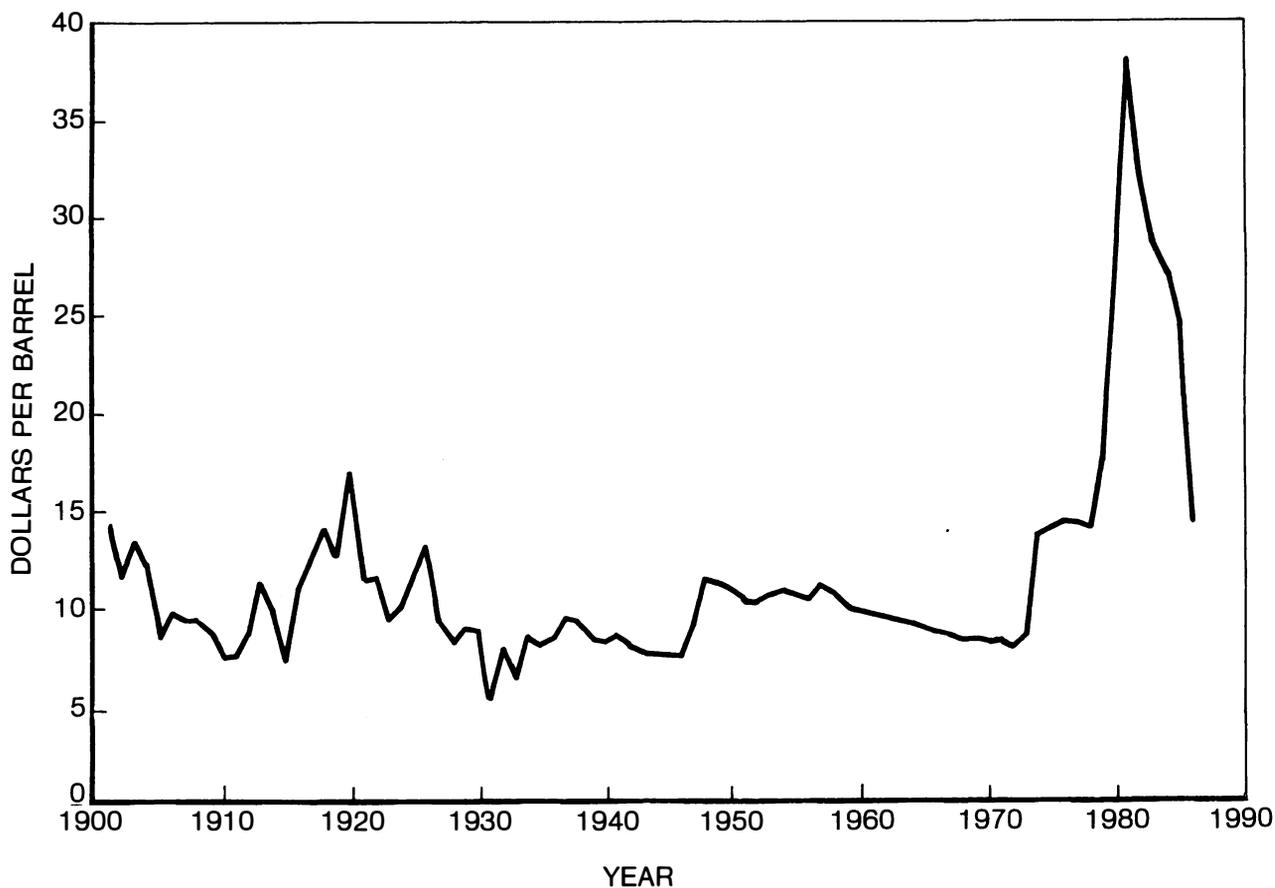


Figure 7. Annual Average U.S. Wellhead Prices (Constant 1986 Dollars per Barrel).



environment, investment in exploration and development usually falls short of the level required to meet demand growth.

### EFFECT OF ACTUAL AND EXPECTED PRICES AND COSTS ON FINDING, DEVELOPING, AND PRODUCING OIL AND GAS

Current and expected oil and gas prices affect exploration and development activity. Figure 8 compares a standard measure of exploration and development activity, the Hughes count of active drilling rigs, to the annual average U.S. wellhead crude oil price in 1986 dollars. In general, drilling activity rises and falls with oil prices.

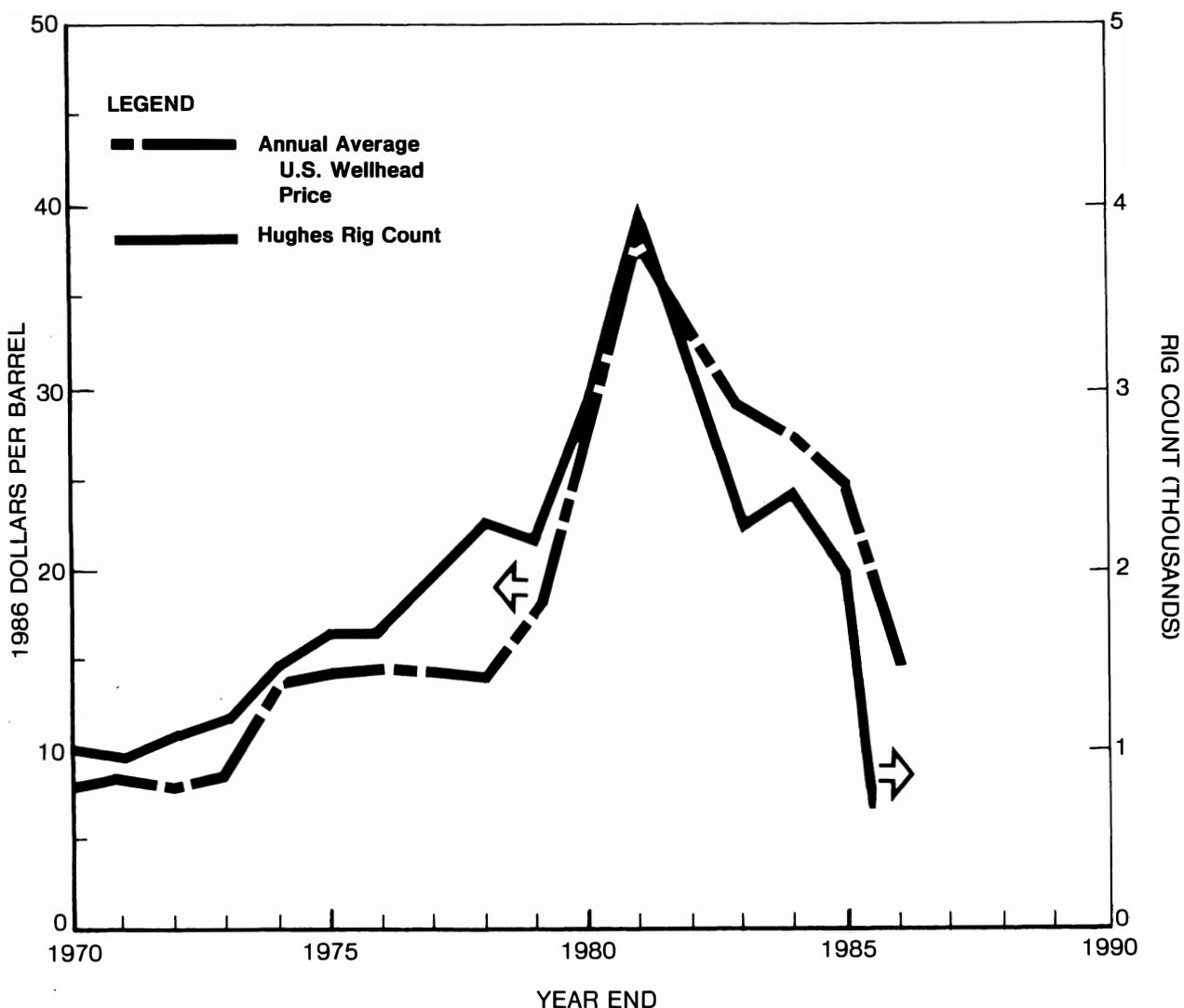


Figure 8. U.S. Wellhead Crude Oil Price and Drilling Rig Activity Levels (Constant 1986 Dollars).

Figure 9 shows total industry expenditures to find, develop, and produce oil and gas. It does not include federal and state

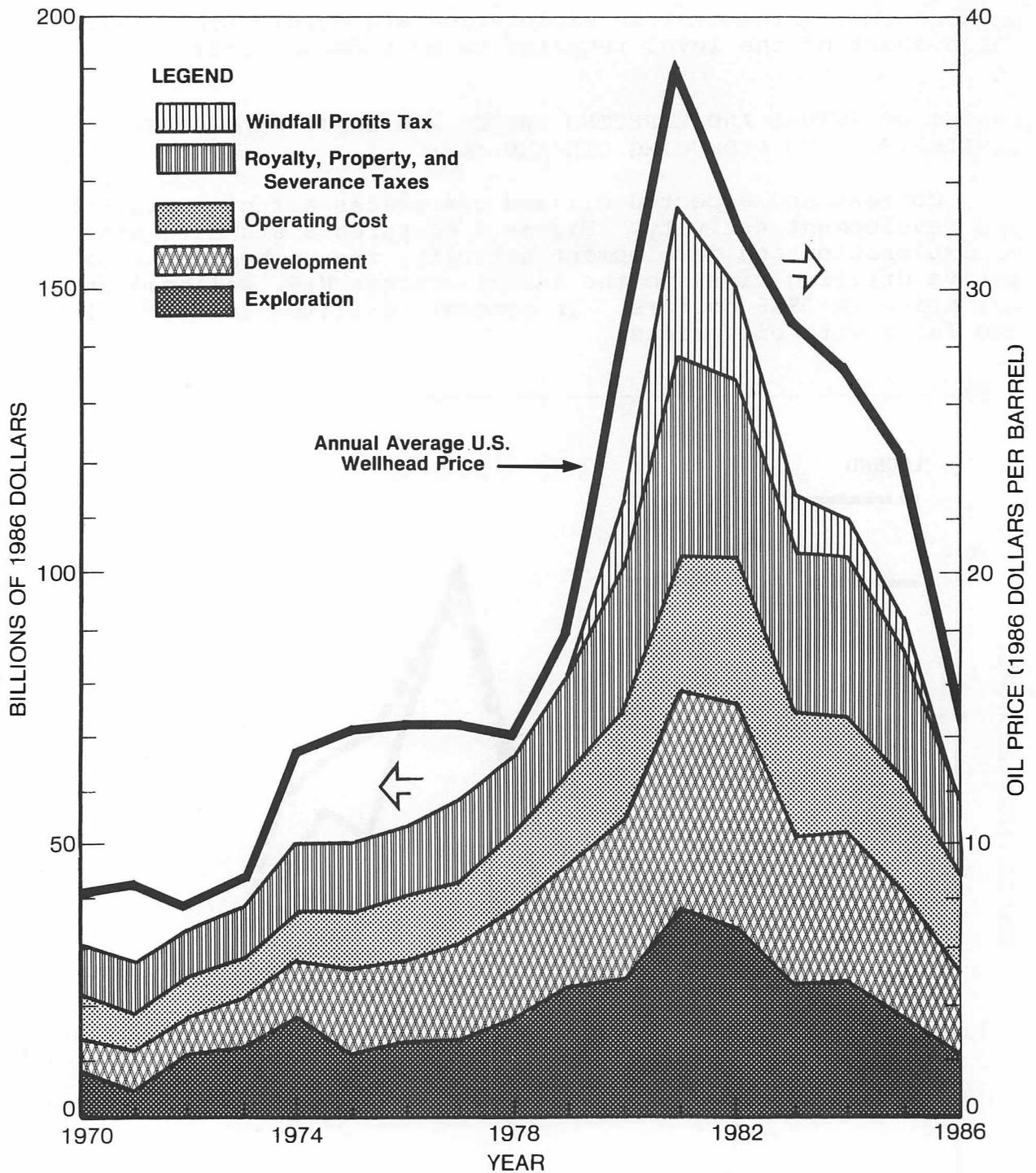


Figure 9. U.S. Exploration, Development, and Production Expenditures (Constant 1986 Dollars).

income taxes, dividends, and interest payments. Average wellhead crude oil prices are also shown for comparison. Through 1981, the industry's expenditures increased, reflecting the rapid buildup in exploration and development activity based on the assumption that oil and gas prices would continue to grow

rapidly. After 1981, however, expenditures fell as exploration and development activity declined, due to the industry's perception of lower future oil and gas prices.

As activity declined, costs also declined due to an extensive oversupply of drilling rigs on the market. Since 1981, daily contract rates for jack-up rigs in 200 feet of water declined from \$38,000 per day in 1982 to \$9,000 per day in early 1986. For land rigs drilling 10,000-foot wells, the daily contract rates fell from a peak of about \$7,300 per day in 1981 to about \$3,600 per day in 1986. Another measure of the oversupply of rigs was the decline in well completion costs. For offshore Louisiana wells at 10,000 to 12,500 feet, completion costs fell from a peak of about \$4.5 million per well in 1982 to just under \$3 million in 1986.

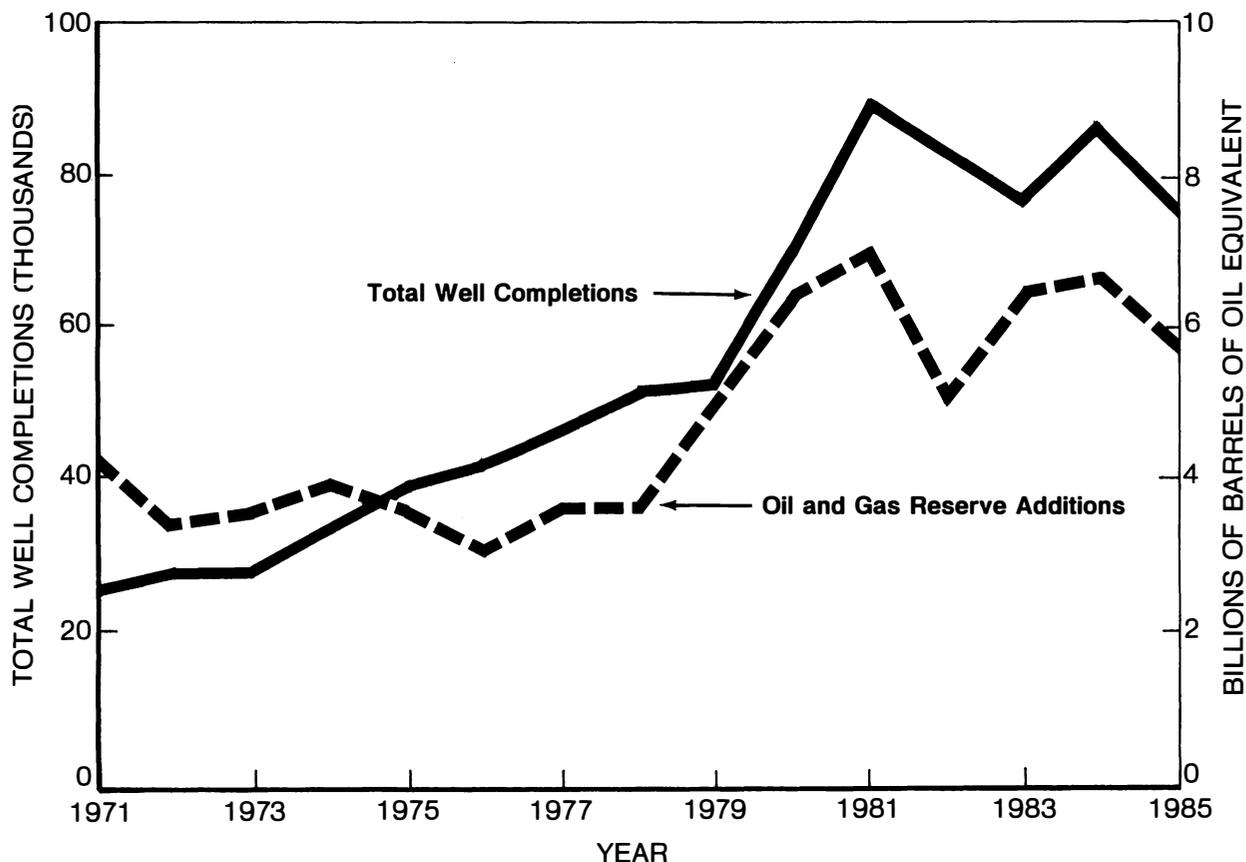


Figure 10. Oil and Gas Reserve Additions versus Well Completions.

The large drop in crude oil prices in 1986 has lowered the industry's price expectations once again. The Hughes rig count has fallen from just under 2,000 rigs at the end of 1985 to fewer than 700 rigs by mid-1986. As shown in Figure 10, oil and gas reserve additions correlate positively with well completions. As drilling remains depressed, the rate of new reserve additions will decline and production will fall as a result. Even if the

price goes back up, production in the lower 48 states will remain below the 1985 level because of the drilling decline. It has taken five years of drilling about 80,000 wells annually to get production to remain steady. The fall-off in drilling will undermine much of what has been gained since 1979.

For wells that are producing, it is an oversimplification to assume that they will continue producing if and only if revenues from the sale of the oil exceed the operating costs of the well. The factors involved in whether to produce also include: the physical characteristics of the reservoir; the shutdown and startup costs associated with the well; the anticipated level and path of future prices; the regulatory and/or contractual requirements associated with the well; and the operator's need for short-term cash flow.

## DRILLING SURVEYS

The IPAA/SIPES Drilling Survey was sent to the independent producers and petroleum technical specialists responsible for the investment and drilling decisions for the majority of the oil and gas wells drilled in the United States. Respondents were requested to estimate their level of drilling activity for each of the next five years assuming average oil and gas prices of \$13 per barrel and \$1.30 per thousand cubic feet, respectively; \$20 per barrel and \$2.40 per thousand cubic feet; and \$27 per barrel and \$3.50 per thousand cubic feet. The first two oil price assumptions approximate the 1986-1990 prices of the lower and upper price trends, respectively, of the NPC Oil & Gas Outlook Survey described below. The \$27 price assumption was selected as being representative of the price levels expected by the industry prior to the recent severe price decline.

At an oil price of \$13 per barrel, the 1,023 respondents expect their drilling to decline to 22 percent of the 1985 level in 1986 and to further decline to 15 percent in 1990. At a price of \$20 per barrel, drilling would fall to half the 1985 level by 1986 and remain at that level through 1990. Finally, at \$27 per barrel, drilling would initially decline about 5 percent, then increase steadily to about 124 percent of the 1985 level in 1990.

In March 1986, the American Petroleum Institute (API) surveyed 21 large integrated petroleum companies on the effect of lower prices. Like the IPAA/SIPES Drilling Survey, the results of the API Crude Oil Price Effects Survey indicate that there would be a sustained decline in drilling activity under low price scenarios. The API survey indicates that well completions would be 31,100 in 1991 under a constant \$15 per barrel scenario (1985 dollars), a decline of 60 percent; and 12,500 under the \$10 per barrel scenario, an 80 percent decline. The API survey respondents projected relatively unchanged drilling activity (73,400 completions in 1991) had prices stayed at the 1985 level of \$28.

## LAGGED RESPONSE IN EXPLORATION AND PRODUCTION TO CHANGES IN PRICE

Oil and gas exploration and production is a long lead-time business. An offshore project can easily take up to ten years to advance from preliminary geological and geophysical work to initial production. An enhanced oil recovery (EOR) project can take a similar length of time to move from preliminary engineering, through a test program, drilling injection wells and injecting fluid, to the beginning of tertiary production. Frontier areas, such as Alaska and deep-water Gulf of Mexico, which are believed to contain much of the nation's future oil and gas reserves, may require 10 or more years before production can be obtained.

Today's oil and gas production still benefits from the high oil and gas prices of the late 1970s and the first half of the 1980s. These prices encouraged borrowing and generated revenue that was plowed back into exploration and development. The drilling boom of the late 1970s and early 1980s was fed by the expectations of ever-rising oil and gas prices.

Conversely, decisions not to invest because of today's low prices have a negative impact that will not be visible for years to come. Furthermore, when prices begin to rise, investors may react slowly, waiting until they can evaluate the upward price trend as sustainable. Financial institutions, which have historically supported the various components of the oil and gas industry, have also been stung by the rapid decline in oil and gas prices. These institutions are experiencing increasing levels of non-performing and under-performing loans, resulting in a retrenchment of their loan portfolios and an unwillingness or inability to make available additional funding.

Capital for new project financing will be made available again only when the loaning institutions have rebuilt their confidence in the liquidity of the industry and perceive a sustainable upwardly moving price. Investments by private and public drilling and production funds, a major source of capital for independent producers, have declined 80 percent from a high of \$4.0 billion in 1981 to \$0.8 billion in 1985. In the absence of outside capital, the petroleum industry will be restricted to its own internal cash flow for investment in new exploration and development projects.

## THE NPC OIL & GAS OUTLOOK SURVEY

There is currently considerable uncertainty over the likely future evolution of crude oil prices. As one tool for analyzing factors affecting oil and gas supply and demand, a survey of future supply/demand outlooks was made utilizing two oil price trends provided by the Department of Energy: an upper price trend starting at \$18 per barrel and growing at 5 percent real per year, and a lower price trend starting at \$12 per barrel and growing at 4 percent real per year. The resultant prices, through the year 2000, are shown in Table 2.

TABLE 2  
REFINERY ACQUISITION COST OF CRUDE OIL  
 (1986 Dollars per Barrel)

	<u>1986</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
Upper Price Trend	18	22	28	36
Lower Price Trend	12	14	17	21

The survey respondents were requested to assume there would be no change in present laws (e.g., no early deregulation of natural gas, no early phaseout of Windfall Profit Tax, continuation of current tax law), no changes in environmental regulations or leasing policies, no drastic changes in the world (such as major wars, revolutions, or the end of OPEC), no dramatic changes in exchange rates among the world's currencies, no worldwide banking or financial crises, no new major technological breakthroughs in either the production or consumption of energy, and that refining capacity would be adequate.

The NPC Oil & Gas Outlook Survey was intended only to elicit future supply and demand levels that are believed by the respondents to be likely if the price trends specified were to occur and all the assumptions specified prevail. It is recognized that future oil prices will probably not follow either of these trends. The survey responses, and the data developed from the study group analysis of the responses, are not intended to be predictions, projections, or forecasts of what either the respondents or the NPC expect as to future oil and gas supply or demand and should not be interpreted as such. The results are included as Appendix C and summarized in Figures 11 through 14.

#### Supply Response to Major Oil Price Reductions

Because the oil price trends used in the survey start well below 1985 levels, U.S. crude oil production is estimated to fall substantially from the 1985 level of 8.9 million barrels per day. While analysis of the survey responses is not completed as yet, results do give some insights and trend indications. In the upper price trend, the survey indicates that U.S. crude oil production could fall to about 8 million barrels per day by 1990 and 6.4 million barrels per day by 2000. Likewise for the lower price trend, production could fall to 7.1 million barrels per day by 1990 and 4.5 million barrels per day by 2000.

As a result, U.S. net oil imports for the lower price trend could rise dramatically from about 27 percent of domestic consumption in 1985 to almost 50 percent in 1990, about 60 percent in 1995, and almost 70 percent in 2000. This represents greater oil import dependence than occurred in the United States in the late 1970s. For the upper price trend, import levels rise to over 35 percent in 1990, over 45 percent in 1995, and over 50 percent in 2000.

The survey also indicates that, under the upper price trend, 30 percent of non-communist world demand will have to be supplied by Middle East OPEC in 1995 and 35 percent in 2000, up from 21 percent in 1985. Under the lower price trend, this dependence rises to approximately 40 percent in 1995 and over 45 percent in 2000. Because OPEC possesses 67 percent of world proven crude oil reserves, 82 percent of which are in Middle East OPEC, there will be no problem in meeting these export levels if OPEC chooses to do so. However, as OPEC production increases and its surplus capacity declines, its members will have greater power to restrict output and increase prices.

At the survey price trends, falling domestic gas production plus available gas imports will be insufficient by the 1990s to maintain gas consumption at historical levels (with wellhead gas prices determined through a netback from the burnertip in competition with low sulfur residual fuel oil prices).

The "gas bubble" should end by the late 1980s in the lower price trend and during the early 1990s in the higher price trend. Once the "gas bubble" ends, in order to balance U.S. natural gas supply and demand, burnertip gas prices will need to rise slightly above the low sulfur residual fuel oil price to reduce potential demand, mostly through fuel switching back to residual fuel oil.

#### Demand Response to Major Oil Price Reductions

It is expected that lower oil prices will increase oil demand and stimulate the economy, thus increasing overall energy demand. This is reflected in responses to the NPC Oil & Gas Outlook Survey. In the upper price trend, total energy and oil consumption increase at average rates of 1.1 percent and 0.7 percent per year, respectively, between 1985 and 2000. For the lower price trend, the rates of increase are 1.3 and 1.7 percent per year, respectively. The bulk of the oil consumption increase occurs in the transportation, industrial, and electric utility sectors.

Energy consumption patterns in the industrial sector have been dominated since 1973 by improved conservation and structural changes, notably the trend away from energy-intensive products. Survey responses generally continue these patterns for both oil price trends, although at a somewhat diminished pace compared to recent years.

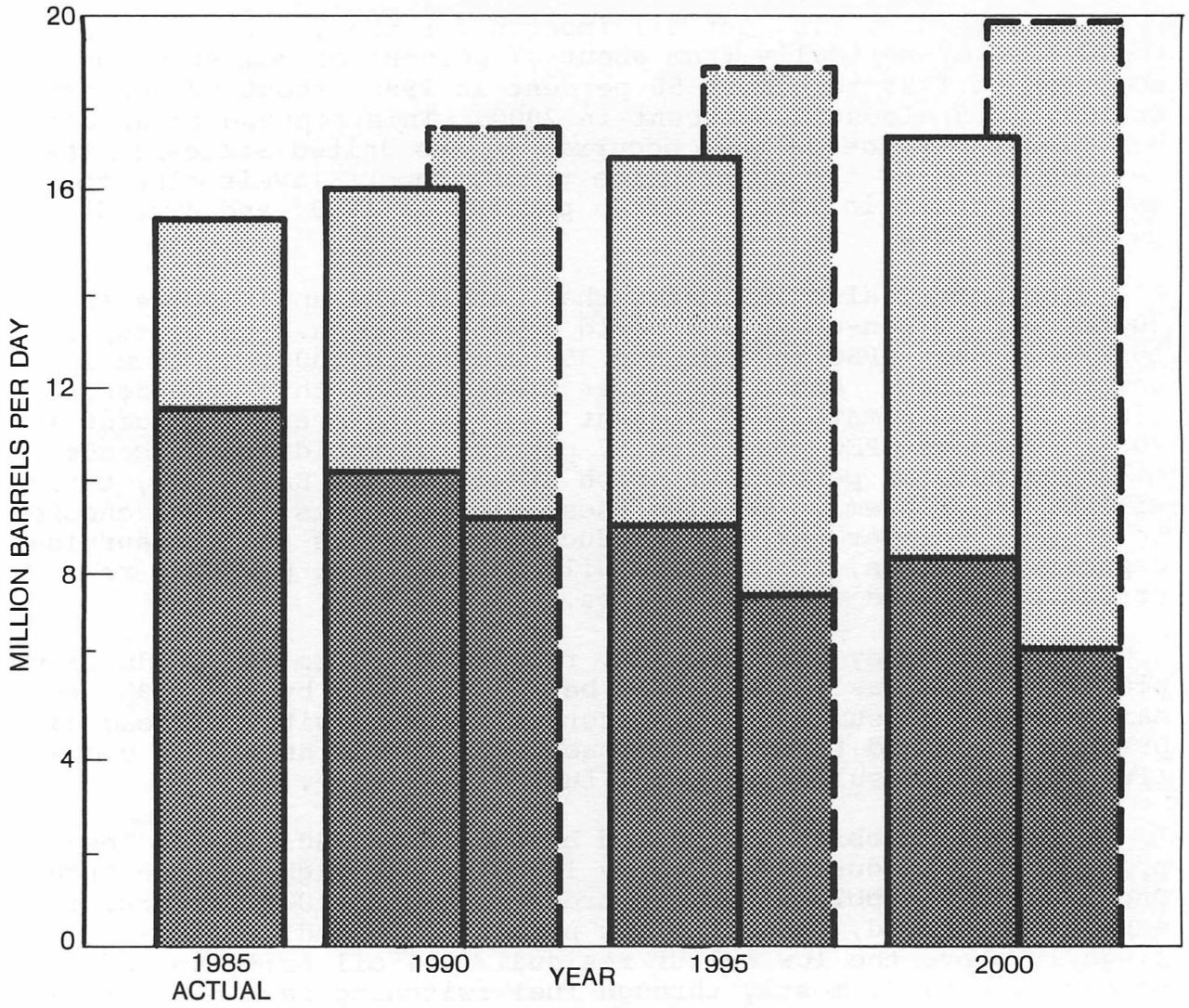


Figure 11. U.S. Oil Supply/Demand Balance.

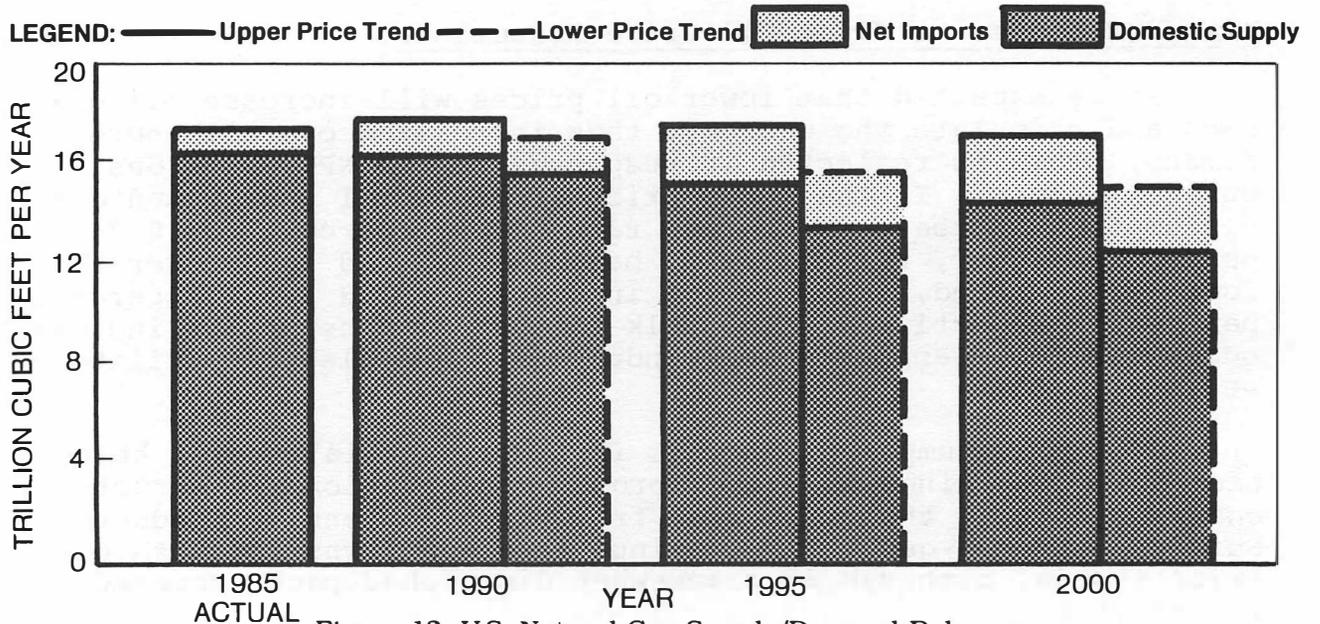


Figure 12. U.S. Natural Gas Supply/Demand Balance.



SURVEY RESPONSE

U.S. OIL SUPPLY/DEMAND BALANCE  
(Millions Barrels Per Day)

	Actual			
	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
<u>Upper Price Trend</u>				
Domestic Consumption	15.7	16.3	17.0	17.4
Domestic Crude Oil Production	8.9	8.0	7.0	6.4
NGL and Other Supply	2.5	2.1	2.1	1.9
Total Domestic Supply	<u>11.4</u>	<u>10.1</u>	<u>9.1</u>	<u>8.3</u>
Net Imports Needed to Meet Demand	4.3	6.2	7.9	9.1
Imports as a Percent of Consumption	27%	38%	47%	52%
<u>Lower Price Trend</u>				
Domestic Consumption	15.7	17.6	19.0	19.9
Domestic Crude Oil Production	8.9	7.1	5.7	4.5
NGL and Other Supply	2.5	2.1	1.9	1.8
Total Domestic Supply	<u>11.4</u>	<u>9.2</u>	<u>7.6</u>	<u>6.3</u>
Net Imports Needed to Meet Demand	4.3	8.4	11.4	13.6
Imports as a Percent of Consumption	27%	48%	60%	68%

SURVEY RESPONSE

U.S. NATURAL GAS SUPPLY/DEMAND BALANCE  
(Trillion Cubic Feet Per Year)

	Actual			
	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
<u>Upper Price Trend</u>				
Domestic Consumption	17.2	17.6	17.3	17.0
Domestic Production (Dry Gas)	16.4	16.4	15.2	14.5
Net Imports	0.8	1.3	2.2	2.6
Other Supply & Inventory Change	0.0	(0.1)	(0.1)	(0.1)
Total Supply	<u>17.2</u>	<u>17.6</u>	<u>17.3</u>	<u>17.0</u>
Memo: Unsatisfied Gas Demand				
Filled By Oil -- TCF	-	-	-	0.2
Million barrels per day, oil equivalent	-	-	-	0.1
<u>Lower Price Trend</u>				
Domestic Consumption	17.2	17.0	15.5	15.0
Domestic Production (Dry Gas)	16.4	15.5	13.3	12.4
Net Imports	0.8	1.5	2.2	2.6
Other Supply & Inventory Change	0.0	0.0	0.0	0.0
Total Supply	<u>17.2</u>	<u>17.0</u>	<u>15.5</u>	<u>15.0</u>
Memo: Unsatisfied Gas Demand				
Filled By Oil -- TCF	-	0.3	0.7	1.0
Million barrels per day, oil equivalent	-	0.1	0.3	0.5

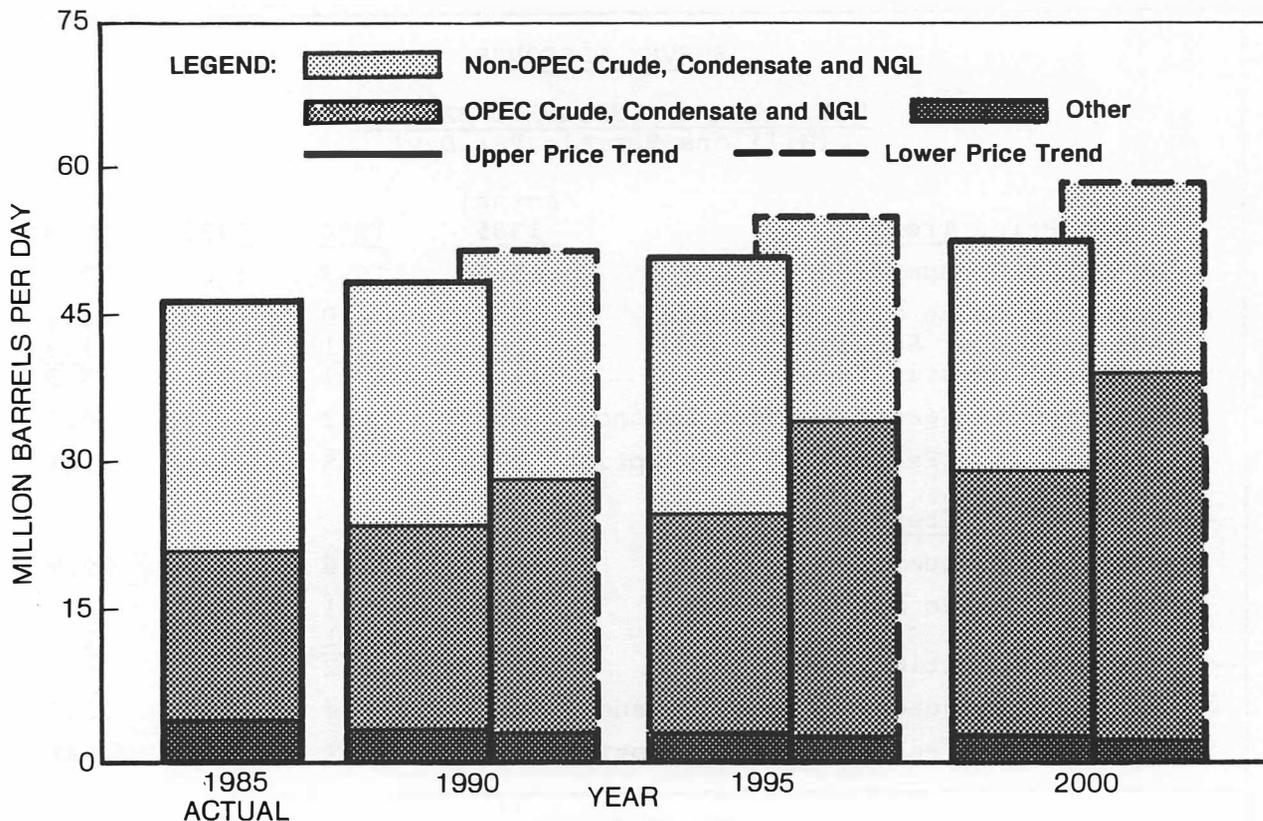


Figure 13. Non-Communist World Oil Supply/Demand Balance.

<u>NON-COMMUNIST WORLD OIL SUPPLY/DEMAND BALANCE</u> (Million Barrels Per Day)				
	Actual			
<u>Upper Price Trend</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
Total Consumption	45.8	48.2	50.5	52.5
Non-OPEC Crude Oil and NGL	25.1	24.7	23.9	22.5
Other Supply	3.3	2.9	2.6	2.5
OPEC Crude Oil & NGL Production	17.1	20.6	24.0	27.5
Total Supply	45.5	48.2	50.5	52.5
Memo: Middle East OPEC Crude Oil as a Percent of Total Supply	21%	25%	30%	35%
<u>Lower Price Trend</u>				
Total Consumption	45.8	51.0	54.7	58.0
Non-OPEC Crude Oil and NGL	25.1	22.4	20.4	18.6
Other Supply	3.3	2.8	2.5	2.4
OPEC Crude Oil & NGL Production	17.1	25.8	31.8	37.0
Total Supply	45.5	51.0	54.7	58.0
Memo: Middle East OPEC Crude Oil as a Percent of Total Supply	21%	32%	40%	46%

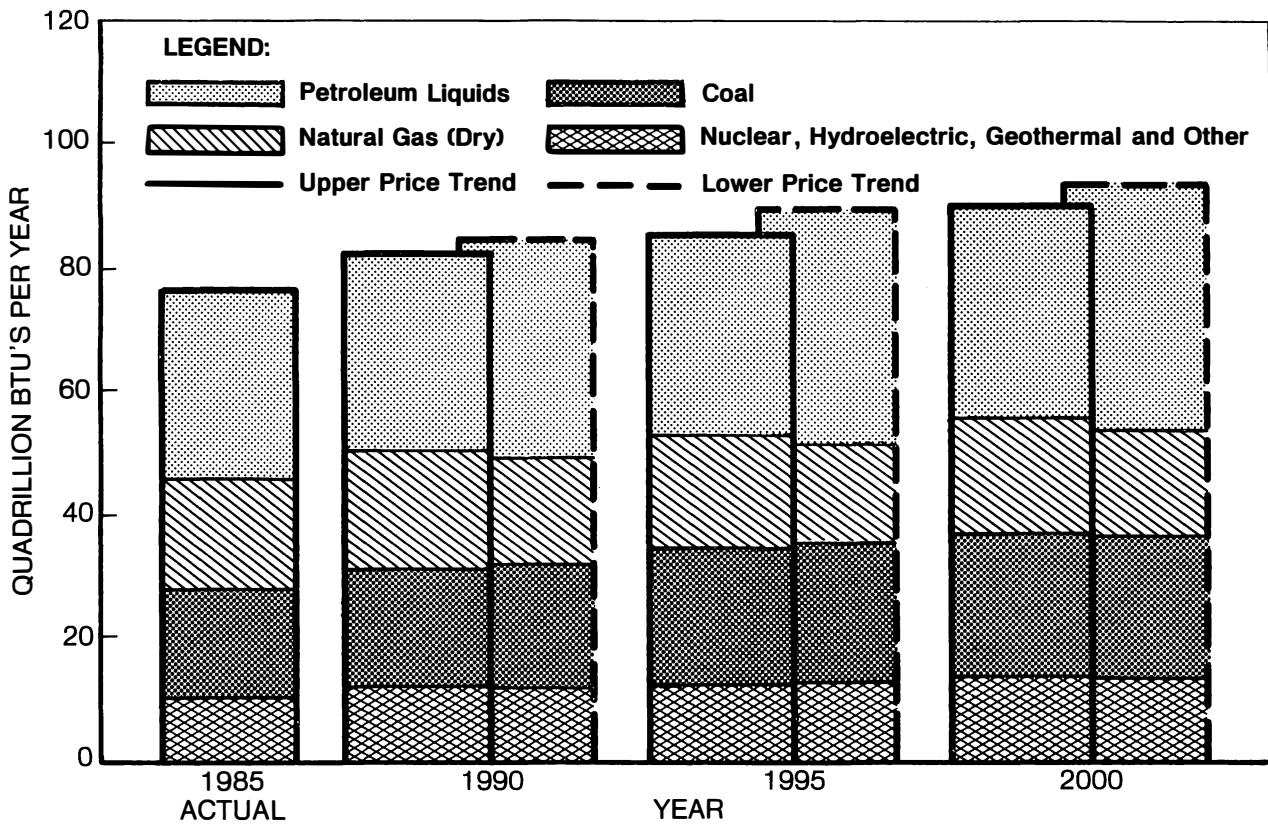


Figure 14. Total U.S. Energy Consumption by Fuels.

U.S. ENERGY CONSUMPTION BY FUELS  
(Quadrillion BTU/Year)

	Actual			
<u>Upper Price Trend</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
Petroleum Liquids	30.9	32.2	33.5	34.3
Natural Gas (Dry)	17.8	18.1	17.8	17.5
Coal	17.5	19.2	22.0	25.3
Nuclear, Hydro, Other	10.3	12.7	13.3	13.5
Total Primary Energy	76.5	82.2	86.6	90.6
<u>Lower Price Trend</u>				
Petroleum Liquids	30.9	34.8	37.5	39.4
Natural Gas (Dry)	17.8	17.5	16.0	15.4
Coal	17.5	19.3	22.4	25.3
Nuclear, Hydro, Other	10.3	12.6	13.2	13.4
Total Primary Energy	76.5	84.2	89.1	93.5

## CHAPTER THREE

### IMPACTS OF RECENT PRICE DECLINES ON PETROLEUM SERVICE AND SUPPLY SECTORS

The oil and gas exploration and production industry is made up of thousands of producers, manufacturers, suppliers, and service contractors. Oil and gas companies rely extensively on specialized subcontractors for their exploration, development, and well completion work. While the recent price decline has affected all segments of the petroleum industry, it has been particularly onerous for the companies that comprise the oil field service and supply sector.

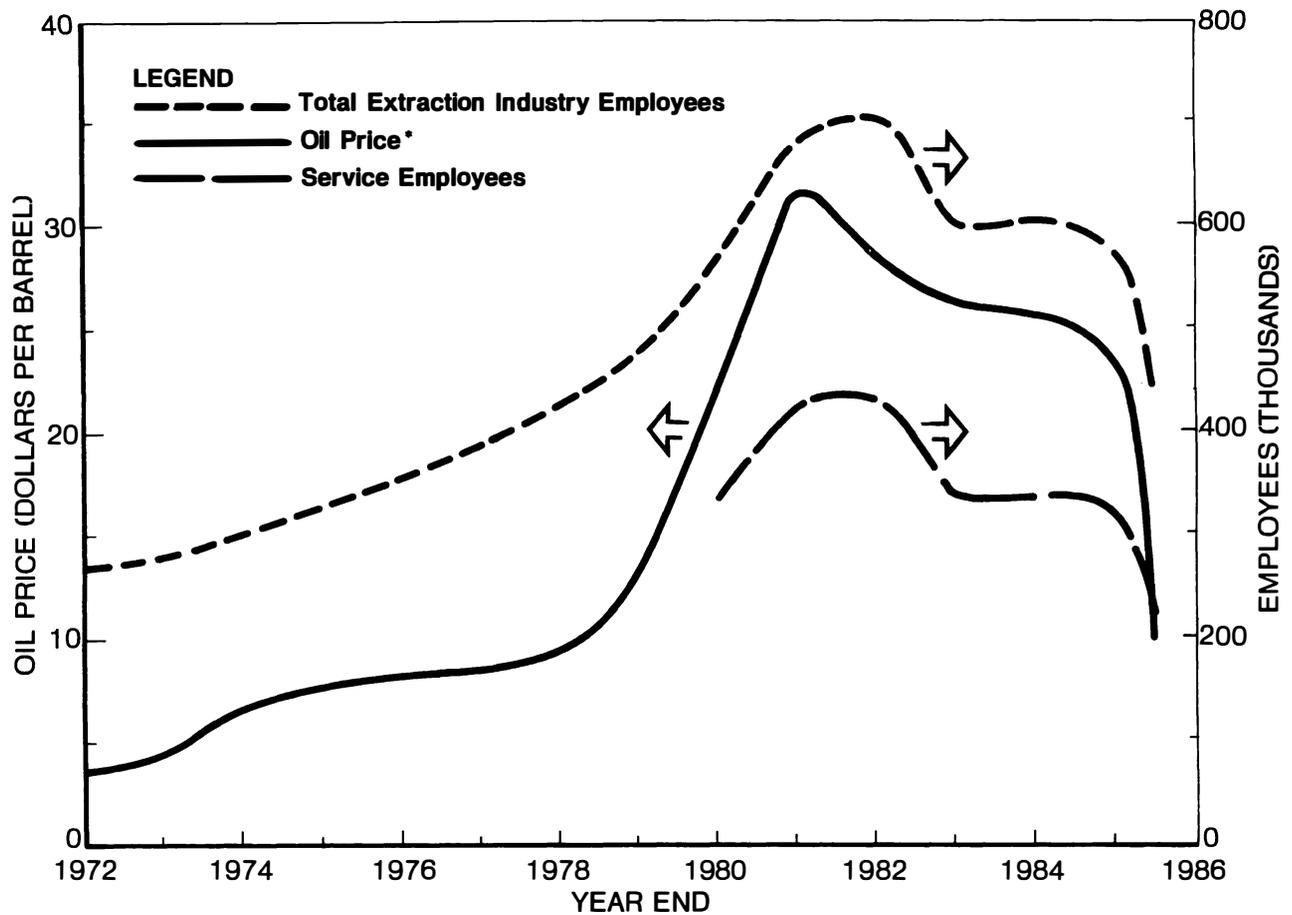
A vast network of supply and service companies operates in nearly two-thirds of the states. Nearly all field work is done by the supply and service segment of the industry. Many are small independent contractors, who supply services at the well sites or at the producers' field operations.

Services that are supplied directly in the field by contractors include geophysical surveys, geological supervision and surveillance, drilling services, offshore services, offshore platform design and construction, stimulation, surfactant injection, and well servicing.

The major types of equipment used by the oil field service industry can be generally grouped under drilling, production, well servicing, and transportation. The industry is a major consumer of tubular steel goods, in the form of drill pipe, casing, tubing, and line pipe. In addition to using highly specialized technical equipment, the oil field service industry uses much general equipment and machinery that is manufactured and supplied by companies not in the petroleum industry.

#### EMPLOYMENT

The total number of employees in U.S. oil and gas extraction has fluctuated historically with the price of oil, as shown in Figure 15. Since the peak year 1982, total oil and gas extraction employment dropped from 708,000 to 443,000 in June 1986, a loss of 265,000 jobs (37 percent). Service industry employment decreased from 435,000 to 212,000, a loss of 223,000 jobs (51 percent). This indicates that 84 percent of the total loss of jobs was in this segment of the industry. According to a Dresser Industries report, service industry field employment can be expected to fall from an average of 241,000 persons in 1985 to 174,000 persons in 1986, a decline of 28 percent. In addition,



\*Average Annual Wellhead Price in Current Dollars.

Figure 15. U.S. Oil Price, Oil and Gas Extraction Employees.

SOURCE: Employee Data: U.S. Department of Labor, Bureau of Labor Statistics LABSTAT Series Report; Total Extraction Industry Employees (SIC 13); Service Employees, (SIC 138—N/A before 1980).

by the end of 1986 the Dresser report indicates that service employment could be below 120,000. The recent API study, "Two Energy Futures," indicates that for every \$1 billion reduction in oil and gas investment, the petroleum industry will lose more than 10,000 jobs, and other industries nationwide could lose more than 8,000 additional jobs.

Executives in the oil service industries estimate that a period of about three years is required to train personnel for skilled oil service jobs. For highly skilled field service jobs, seven to ten years may be required. The longer the period of depressed drilling persists, the more skilled personnel will leave the industry and the more difficult it will be to respond to a rapid upturn.

For the exploration and production segment of petroleum operations, university trained geologists, geophysicists, and petroleum engineers are critical. Surveys of major universities show that enrollments in petroleum engineering and geology peaked in the early 1980s, then fell rapidly through 1985. In spite of this, the Society of Petroleum Engineers reports that there

has been a large oversupply of petroleum engineering graduates since the 1980-81 academic year. This oversupply is projected to last at least through the end of the decade.

It is probable that sufficient technical manpower would be available in the event of an upturn in drilling for several years. In the longer term, fewer graduates, and the firmer entrenchment in alternate careers of graduates not hired and trained by petroleum companies, will probably impede the ability of the industry to respond to an upturn.

## EQUIPMENT

Industry surveys indicate that total U.S. drilling rig utilization, onshore and offshore, has fallen by 60 percent from the end of 1985 through mid-1986. According to Offshore Data Services, Inc., utilization of mobile offshore rigs in the Gulf of Mexico was at 29 percent in mid-August 1986 (71 mobile rigs under contract out of 244 available). This is a decline from late December 1984 when the peak number of rigs under contract in the Gulf was 232 out of 249 available, a 93 percent utilization rate.

Most companies in the oil field service industry are being forced to dispose of idle equipment to cut costs and/or meet debt payments. This is reflected in the almost daily auctions in which modern drilling machinery and oil field equipment are being sold for as little as 2 to 5 cents on the dollar. Some of the used equipment is being sold to foreign operators for use outside the United States. With time, the remaining idle fleet will decline through corrosion, lack of maintenance, and cannibalization for spare parts.

The distressed market for used equipment limits the benefit of selling the equipment, and many companies have been and are continuing to be forced into bankruptcy. The International Association of Drilling Contractors (IADC) estimates that 40 percent of the firms engaged in contract drilling four years ago have left the field, and many more are struggling to survive.

The ability of the oil and gas industry to re-equip itself in the future will be limited by several factors. The fragmentation of equipment, the loss of equipment to overseas buyers, and the lack of economic incentive or ability to maintain idle equipment will reduce its availability when demand increases. There is a substantial cost associated with reactivating a stacked rig even if it were properly mothballed. Many of the manufacturers of oil field service equipment are no longer in existence, or have disposed of much of their manufacturing equipment.

During a time that the service industry is being rebuilt in response to a sharp upward shift in prices, shortages of rigs, equipment, service capability, and crews may occur. So long as the current oversupply of equipment exists, significant equipment

cost inflation would not be a problem. However, a prolonged depression of the service industry would reduce the equipment and personnel oversupplies. Thereafter, significant equipment and well operating inflation could occur during a rapid buildup in the early 1990s such as that which occurred in the 1970s. From 1972 through 1981, drilling costs and drilling equipment costs in the United States increased at average annual compound growth rates of 17.6 and 15 percent, respectively. Over the same period, the U.S. GNP deflator increased at 7.6 percent per year. The substantial real increases in costs of drilling, equipment, and operating reflect the inefficiencies of rapid increases in industry activity.

#### SERVICE INDUSTRY FINANCIAL PLIGHT

As noted above, much of the service industry is composed of small companies providing local services to the exploration and production sector of the petroleum industry. Current data on the impact of declining oil prices on these small companies is difficult to monitor, but Wall Street does follow the performance of the larger companies. For the 20 oil service, equipment, and drilling companies covered by Salomon Brothers, Inc., net losses for the June 1986 quarter totaled \$285 million (excluding asset write-offs) versus \$260 million in profits in the year-ago period. Salomon Brothers expects 18 of these 20 larger companies to lose money in the remainder of this year. If these massive losses continue, the future ability of the service industry to respond to increased demand will be questionable.

#### RESEARCH AND DEVELOPMENT

Another area severely affected by the current downturn is exploration and production research. According to press reports, oil companies have cut back sharply on R&D budgets and personnel, with reductions on the order of one-third to one-half from 1985 to 1986. Grants to universities and other research institutions also have been cut back. Lessened research in such areas as deep water drilling, improved seismic methods, and enhanced oil recovery will reduce the amount of oil and gas that is produced in the future. As prices rise, funds will be restored, but program development will involve lead times, possibly even longer than those that prevail now.

#### EXPORT OF TECHNOLOGY

Historically, the U.S. domestic drilling and oil field service industries have provided the world with the technology to explore, drill, develop, and produce the world's oil and gas resources. They still lead and sustain the modern worldwide drilling industry. This technology has been readily shared with the world, but the current collapse of this industry may permanently affect the industry's role as an exporter for the United States.

Companies in other nations, many of which are state-owned, are taking advantage of distressed equipment prices, with the support of government or national programs that encourage the development of their own oil field service industries.

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*Note: The study's final report, which will present options to avoid or mitigate the vulnerability to future energy crises, is under preparation and will be published in early 1987.*



# Appendices

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THE SECRETARY OF ENERGY  
WASHINGTON, D.C. 20585

APPENDIX A

September 23, 1985

Dear Mr. Bailey:

Since the 1970's energy crises, there have been numerous technical developments in the production and consumption of energy as well as new analytical tools and models developed for looking to the future. Our energy efficiency has increased; domestic energy resources are being developed more effectively; real prices have declined; U.S. dependence on foreign energy sources has diminished; and the Nation's vulnerability to energy supply disruptions has been reduced. However, we must not become complacent because the factors that determine future energy supply and demand are constantly changing.

Accordingly, I am requesting the National Petroleum Council to undertake a new study examining the factors affecting the Nation's future supply and demand of oil and gas. The study should also examine the set of factors that precipitated the 1970's energy crises, their financial impact on the Nation's economy, the appropriateness of government's response, and the potential for a recurrence. This retrospective analysis should provide advice on how the vulnerability to future crises can be avoided or mitigated.

For the purpose of this study, I designate Donald L. Bauer, Acting Assisting Secretary for Fossil Energy, to represent me and to provide the necessary coordination between the Department of Energy and the National Petroleum Council.

Yours truly,

A handwritten signature in black ink that reads "John S. Herrington".

John S. Herrington

Mr. Ralph E. Bailey  
Chairman  
National Petroleum Council  
1625 K Street, NW  
Washington, DC 20006

## DESCRIPTION OF THE NATIONAL PETROLEUM COUNCIL

In May 1946, the President stated 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 this close relationship should be continued and suggested that the Secretary of the Interior establish an industry organization to provide advice on oil and 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's functions were transferred to the new department.

The sole purpose of the NPC is to advise, inform, and make recommendations to the Secretary of Energy on any matter, requested by him, relating to petroleum or the petroleum industry. Matters that the Secretary would like to have considered by the Council are submitted as a request in the form of a letter outlining the nature and scope of the study. 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 include:

- Materials and Manpower Requirements (1979)
- Petroleum Storage & Transportation Capacities (1979)
- Refinery Flexibility (1979, 1980)
- 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 and Gas Industries (1982)
- Third World Petroleum Development: A Statement of Principles (1982)
- Petroleum Inventories and Storage Capacity (1983, 1984)
- Enhanced Oil Recovery (1976, 1984)
- The Strategic Petroleum Reserve (1984)
- U.S. Petroleum Refining (1986).

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 petroleum 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.

NATIONAL PETROLEUM COUNCIL

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## APPENDIX C

### PROVISOS REGARDING THE NPC SURVEY OF OIL & GAS OUTLOOK

The NPC Oil & Gas Supply Outlook Survey requested detailed energy outlooks for the U.S. and non-communist world under two price trends provided by the DOE in the attached letter of May 14, 1986. The upper price trend starts at an average refinery crude oil acquisition price of \$18 per barrel in 1986 and has real price growth of 5 percent per year, reaching \$36 per barrel in the year 2000. The lower price trend starts at \$12 per barrel in 1986 and has 4 percent per year real growth, reaching \$21 per barrel in 2000.

The analysis of the survey responses was complicated by the varying degree of detail provided among the responses. Although 52 questionnaires were distributed, only 28 of the 33 responses were in a usable form.

Even sophisticated statistical analysis of past events is inadequate for predicting the future if the historical data do not contain an event similar to the current or expected future events. This limitation is reflected in this survey. Energy forecasters have no recent historical events to measure the impact of sharply falling prices of petroleum, nor has there been a period in history when the price of petroleum grew in real terms at a 4 to 5 percent rate for fifteen years.

Fewer forecasts were received for the lower price trend. A number of respondents indicated that their proprietary models yielded results that were unacceptable or that their models could not reach a feasible solution in the later years in the lower price case.

Despite the difficulties experienced by some forecasters in developing "reasonable" responses to the two price outlooks provided, the general story told by the responses of experts is consistent as to direction if not as to the absolute level of specific variables. Both the domestic supply and demand of oil and gas are responsive to economic forces. Low prices stimulate demand and retard supply, and the reverse is true for higher prices. Hence the survey responses are not unreasonable in projecting higher oil imports in the lower price trend than in the upper price trend, although individual respondents and others may disagree with the projected level of oil imports in the later years.



## Department of Energy

Washington, DC 20585

May 14, 1986

Mr. James L. Ketelsen  
Chairman and Chief Executive Officer  
Tenneco Incorporated  
Tenneco Building  
Post Office Box 2511  
Houston, TX 77001

Dear Mr. Ketelsen:

Immediately following the April 22, 1986, meeting of the National Petroleum Council (NPC) Committee on U.S. Oil and Gas Outlook, the Coordinating Subcommittee met. A prime agenda item was to discuss critical path items for the study examining the primary factors affecting the Nation's future supply and demand of oil and gas.

It was agreed that the Department of Energy would provide two oil price cases intended to suggest a range of plausible prices as assumptions for the purpose of this study. In response, we would propose the following simplified cases:

1. Case A -- Starting at \$12 per barrel in 1986 and increasing by four percent per year to about \$21 per barrel in the year 2000.
2. Case B -- Starting at \$18 per barrel in 1986 and increasing by five percent per year to about \$36 per barrel in the year 2000.

These oil prices are expressed in 1986 dollars and should be interpreted as the U.S. Composite Refiner Acquisition Cost.

We appreciate the efforts of you and the other NPC members on this most important study.

Sincerely,

A handwritten signature in black ink that reads "Donald L. Bauer".

Donald L. Bauer  
Acting Assistant Secretary  
for Fossil Energy

cc:  
Marshall Nichols

C-2

TABLE C-1  
NON-COMMUNIST WORLD OIL SUPPLY/DEMAND BALANCE  
(Thousand Barrels Per Day)

<u>PRICE TREND BASIS: UPPER</u>	Actual			
	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
<b>CONSUMPTION</b>				
United States	15,697	16,331	17,004	17,403
Western Europe	11,643	11,891	12,116	12,362
Japan	4,351	4,531	4,658	4,667
Other OECD	2,539	2,562	2,635	2,712
Rest of World (1)	<u>11,600</u>	<u>12,883</u>	<u>14,061</u>	<u>15,306</u>
TOTAL CONSUMPTION	45,830	48,198	50,474	52,450
<b>SUPPLY</b>				
Non-OPEC Crude & Condensate Production (2)				
United States	8,920	7,959	6,990	6,353
Canada (ex. tar sands)	1,296	1,265	1,252	1,182
Mexico	2,734	3,015	3,351	3,664
Western Europe	3,762	3,515	3,100	2,636
Other Non-OPEC	<u>5,731</u>	<u>6,380</u>	<u>6,624</u>	<u>6,296</u>
Subtotal Non-OPEC Crude & Condensate	22,443	22,134	21,317	20,131
Non-OPEC NGL Production	2,678	2,592	2,586	2,388
OPEC Crude & Condensate Production (2)				
Ecuador	278	274	260	234
Venezuela	1,671	1,855	1,992	1,967
Algeria	639	690	724	706
Gabon	153	147	134	117
Libya	1,059	1,218	1,399	1,483
Nigeria	1,471	1,724	1,798	1,795
Iran	2,201	2,344	2,887	3,117
Iraq	1,433	2,175	2,663	3,161
Kuwait	846	1,065	1,395	1,821
Qatar	301	327	396	409
United Arab Emirates	1,193	1,307	1,618	2,030
Saudi Arabia	3,218	4,471	5,554	7,374
Neutral Zone	341	347	422	455
Indonesia	<u>1,258</u>	<u>1,374</u>	<u>1,314</u>	<u>1,250</u>
Subtotal OPEC Crude & Condensate	16,062	19,318	22,556	25,919
OPEC NGL Production	1,060	1,301	1,400	1,600
 Total Crude, Cond., & NGL Production	 42,243	 45,345	 47,859	 50,038
 Tar Sands, Shale & Other Syn. Fuels	 436	 488	 592	 713
Refinery Gains & Inven. Change (3)	1,130	874	924	930
Net Imports from Comm. Countries	1,700	1,491	1,099	769
 TOTAL OIL SUPPLY	 45,509	 48,198	 50,474	 52,450
 Errors & Omissions	 321	 0	 0	 0

(1) Includes OPEC, middle income countries, and the LDCs.

(2) Does not include tar sands, shale, and other synthetics, which are reported below.

(3) Includes strategic reserves.

PRICE TREND BASIS: UPPER

TABLE C-2

TOTAL U.S. ENERGY CONSUMPTION BY FUELS  
(Trillion BTU/Year) (1)

	<u>Petroleum Liquids</u>	<u>Natural Gas (Dry)</u>	<u>Coal</u>	<u>Nuclear</u>	<u>Hydro- electric</u>	<u>Geo- thermal</u>	<u>Other (2)</u>	<u>Total Primary Energy</u>
1985 (3)	30,851	17,761	17,487	4,144	2,915	97	3,259	76,514
1990	32,189	18,128	19,178	5,915	3,465	154	3,152	82,181
1995	33,520	17,826	22,038	6,169	3,480	199	3,336	86,568
2000	34,328	17,485	25,318	6,210	3,540	238	3,444	90,563

(1) Standard Conversion Factors:

Petroleum Liquids (total) -- approximately 5.39 million BTU/barrel

Natural Gas -- 1,030 BTU/cubic foot

Coal -- 21.4 million BTU/short ton

Nuclear, Hydro, Geothermal -- 10,400 BTU/KWH (equiv. fuel input in steam plant)

(2) Solar/Wood/Imports of Electricity/Other

(3) Actual Data

PRICE TREND BASIS: UPPER

TABLE C-3

U.S. LIQUID FUELS AND NATURAL GAS SUPPLIES

	Actual			
	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
OIL: (Thousand Barrels Per Day)				
Domestic Production - Total	10,542	9,359	8,259	7,495
Crude Oil & Lease Condensate	8,920	7,959	6,990	6,353
NGL	1,622	1,400	1,269	1,142
Net Imports (1)	4,147	6,214	7,937	9,068
Gross Imports - Total	4,928	6,905	8,617	9,667
Crude Oil (1)	3,098	4,605	5,917	6,667
Products (2)	1,830	2,300	2,700	3,000
Gross Exports - Total	(781)	(691)	(680)	(599)
Processing Gain, etc. (3)	730	709	738	750
Synthetic Liquids (4)	55	49	70	90
From(To) Inventory (1)	223	0	0	0
TOTAL OIL SUPPLY	15,697	16,331	17,004	17,403
GAS: (Billion Cubic Feet Per Year)				
Net Dry Gas Production	16,379	16,356	15,187	14,455
Marketed Production of Wet Gas (5)	17,167	17,127	15,902	15,136
Extraction Loss, Transfers Out	(788)	(771)	(715)	(681)
Gross Imports - Total	926	1,344	2,220	2,616
Canada	903	1,344	2,095	2,196
Mexico	0	0	125	220
LNG	23	0	0	200
Gross Exports	(55)	(55)	(55)	(55)
From(To) Inventory (Transmission				
Loss & Unaccounted)	(155)	(245)	(245)	(240)
Total Dry Natural Gas	17,095	17,400	17,107	16,776
Syngas & Other Supplemental				
Gaseous Fluids	134	200	200	200
TOTAL GAS SUPPLY	17,229	17,600	17,307	16,976

(1) Deduct crude oil supplied to the SPR (118 MB/D in 1985).

(2) Includes NGL, alcohol, and other unfinished.

(3) Includes other hydrocarbon and hydrogen refinery inputs, "unaccounted for" crude oil inputs and losses.

(4) Includes tar sands, shale, alcohols, and other synthetic fuels.

(5) Excludes quantities for repressuring, vented and flared.

TABLE C-4  
NON-COMMUNIST WORLD OIL SUPPLY/DEMAND BALANCE  
(Thousand Barrels Per Day)

<u>PRICE TREND BASIS: LOWER</u>	Actual			
	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
<b>CONSUMPTION</b>				
United States	15,697	17,625	18,977	19,938
Western Europe	11,643	12,681	13,269	13,861
Japan	4,351	4,845	5,044	5,284
Other OECD	2,539	2,657	2,833	3,031
Rest of World (1)	<u>11,600</u>	<u>13,193</u>	<u>14,527</u>	<u>15,870</u>
TOTAL CONSUMPTION	45,830	51,000	54,650	57,984
<b>SUPPLY</b>				
Non-OPEC Crude & Condensate Production (2)				
United States	8,920	7,136	5,654	4,542
Canada (ex. tar sands)	1,296	1,073	1,033	978
Mexico	2,734	2,980	3,203	3,446
Western Europe	3,762	3,343	2,584	2,041
Other Non-OPEC	<u>5,731</u>	<u>5,443</u>	<u>5,578</u>	<u>5,433</u>
Subtotal Non-OPEC Crude & Condensate	22,443	19,975	18,052	16,440
Non-OPEC NGL Production	2,678	2,464	2,367	2,158
OPEC Crude & Condensate Production (2)				
Ecuador	278	289	256	245
Venezuela	1,671	1,929	2,129	2,122
Algeria	639	770	781	776
Gabon	153	163	160	160
Libya	1,059	1,345	1,520	1,606
Nigeria	1,471	1,841	1,879	1,900
Iran	2,201	2,725	3,350	3,901
Iraq	1,433	2,734	3,406	4,184
Kuwait	846	1,398	1,823	2,264
Qatar	301	390	417	406
United Arab Emirates	1,193	1,567	1,962	2,264
Saudi Arabia	3,218	7,221	10,438	13,228
Neutral Zone	341	424	481	483
Indonesia	<u>1,258</u>	<u>1,535</u>	<u>1,526</u>	<u>1,520</u>
Subtotal OPEC Crude & Condensate	16,062	24,331	30,128	35,059
OPEC NGL Production	1,060	1,446	1,694	1,961
Total Crude, Cond., & NGL Production	42,243	48,216	52,241	55,618
Tar Sands, Shale & Other Syn. Fuels	436	424	499	605
Refinery Gains & Inven. Change (3)	1,130	958	949	975
Net Imports from Comm. Countries	1,700	1,403	961	786
TOTAL OIL SUPPLY	45,509	51,001	54,650	57,984
Errors & Omissions	321	0	0	0

(1) Includes OPEC, middle income countries, and the LDCs.

(2) Does not include tar sands, shale, and other synthetics, which are reported below.

(3) Includes strategic reserves.



PRICE TREND BASIS: LOWER

TABLE C-5

TOTAL U.S. ENERGY CONSUMPTION BY FUELS  
(Trillion BTU/Year) (1)

	<u>Petroleum Liquids</u>	<u>Natural Gas (Dry)</u>	<u>Coal</u>	<u>Nuclear</u>	<u>Hydro- electric</u>	<u>Geo- thermal</u>	<u>Other (2)</u>	<u>Total Primary Energy</u>
1985 (3)	30,851	17,761	17,487	4,144	2,915	97	3,259	76,514
1990	34,779	17,460	19,268	5,915	3,465	124	3,152	84,163
1995	37,502	15,960	22,437	6,169	3,480	176	3,336	89,060
2000	39,449	15,426	25,262	6,210	3,540	216	3,444	93,547

(1) Standard Conversion Factors:

Petroleum Liquids (total) -- approximately 5.39 million BTU/barrel

Natural Gas -- 1,030 BTU/cubic foot

Coal -- 21.4 million BTU/short ton

Nuclear, Hydro, Geothermal -- 10,400 BTU/KWH (equiv. fuel input in steam plant)

(2) Solar/Wood/Imports of Electricity/Other

(3) Actual Data

PRICE TREND BASIS: LOWER

TABLE C-6

U.S. LIQUID FUELS AND NATURAL GAS SUPPLIES

	Actual			
	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
<b>OIL: (Thousand Barrels Per Day)</b>				
Domestic Production - Total	10,542	8,420	6,742	5,484
Crude Oil & Lease Condensate	8,920	7,136	5,654	4,542
NGL	1,622	1,284	1,088	942
Net Imports (1)	4,147	8,439	11,397	13,608
Gross Imports - Total	4,928	9,139	12,082	14,256
Crude Oil (1)	3,098	6,439	8,382	9,556
Products (2)	1,830	2,700	3,700	4,700
Gross Exports - Total	(781)	(700)	(685)	(648)
Processing Gain, etc. (3)	730	725	793	800
Synthetic Liquids (4)	55	41	45	46
From(To) Inventory (1)	223	0	0	0
<b>TOTAL OIL SUPPLY</b>	<b>15,697</b>	<b>17,625</b>	<b>18,977</b>	<b>19,938</b>
<b>GAS: (Billion Cubic Feet Per Year)</b>				
Net Dry Gas Production	16,379	15,459	13,345	12,426
Marketed Production of Wet Gas (5)	17,167	16,187	13,974	13,011
Extraction Loss, Transfers Out	(788)	(728)	(629)	(585)
Gross Imports - Total	926	1,582	2,220	2,616
Canada	903	1,582	2,095	2,281
Mexico	0	0	125	300
LNG	23	0	0	35
Gross Exports	(55)	(55)	(55)	(55)
From(To) Inventory (Transmission Loss & Unaccounted)	(155)	(235)	(215)	(210)
<b>Total Dry Natural Gas</b>	<b>17,095</b>	<b>16,751</b>	<b>15,295</b>	<b>14,777</b>
Syngas & Other Supplemental				
Gaseous Fluids	134	200	200	200
<b>TOTAL GAS SUPPLY</b>	<b>17,229</b>	<b>16,951</b>	<b>15,495</b>	<b>14,977</b>

- (1) Deduct crude oil supplied to the SPR (118 MB/D in 1985).
- (2) Includes NGL, alcohol, and other unfinished.
- (3) Includes other hydrocarbon and hydrogen refinery inputs, "unaccounted for" crude oil inputs and losses.
- (4) Includes tar sands, shale, alcohols, and other synthetic fuels.
- (5) Excludes quantities for repressuring, vented and flared.

APPENDIX D

IPAA/SIPES DRILLING SURVEY

The Independent Petroleum Association of America (IPAA) and the Society of Independent Professional Earth Scientists (SIPES) surveyed their memberships, with the intent of determining how the recent oil price decline has impacted the near-term outlook for drilling. The respondents were asked to estimate their participation in wells from 1986 to 1990 based on three alternate price levels for oil and gas: \$13 per barrel and \$1.30 per thousand cubic feet respectively; \$20 per barrel and \$2.40 per thousand cubic feet; and \$27 per barrel and \$3.50 per thousand cubic feet. The low and middle price assumptions here approximate the lower and upper price trends of the NPC Oil & Gas Outlook Survey. There were 1,023 usable responses, out of an estimated 7,000 potential respondents. The responses covered participation in 18,102 wells in 1985, for an average of 17.7 well participations and \$2.4 million investment per respondent.

The data is best summarized by using 1985 as a base year and expressing the number of wells in which respondents would participate as a percentage of that base.

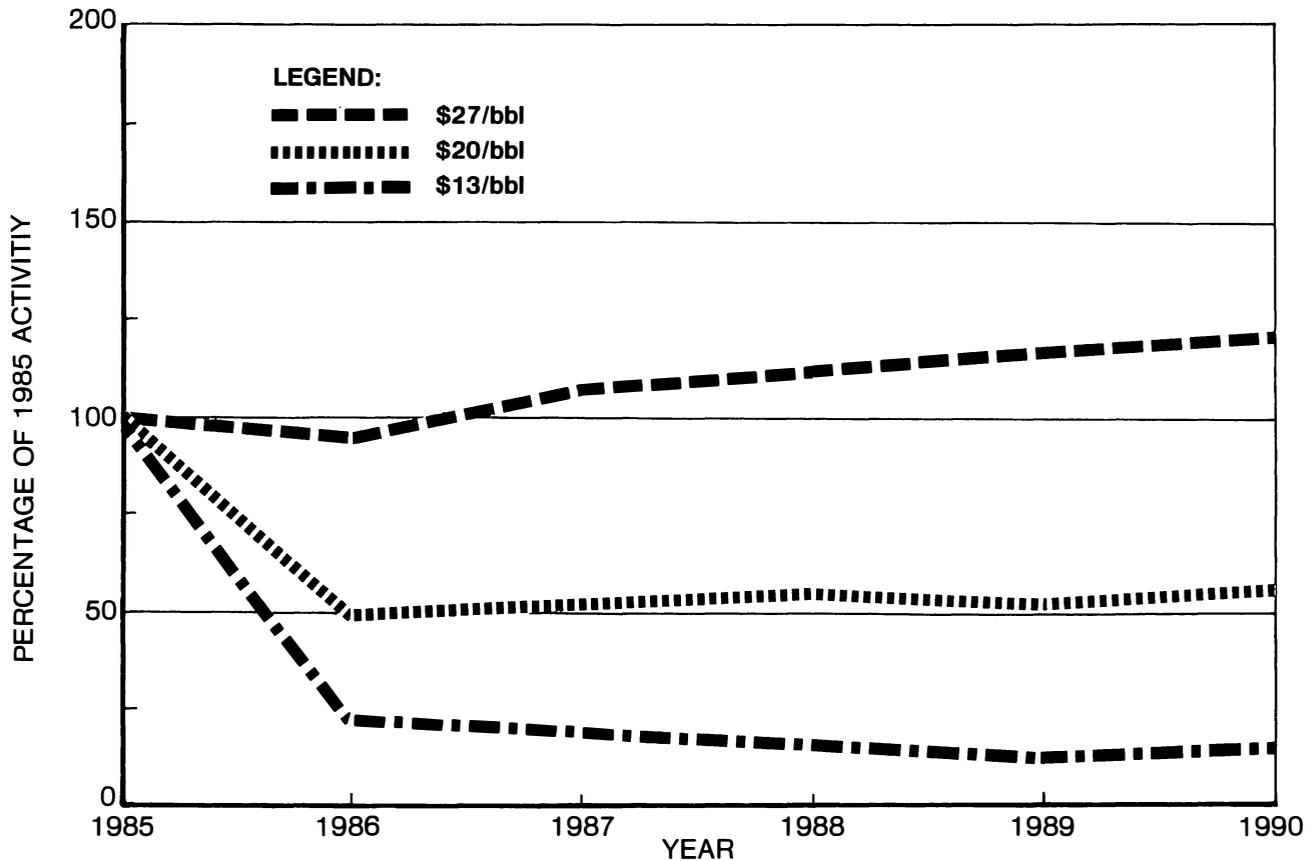


Figure D-1. Activity Change for All Respondents.

PERCENTAGE CHANGE IN RESPONDENT ACTIVITY

at	Percentage of 1985 Base					
	1985	1986	1987	1988	1989	1990
\$13/\$1.30	100%	21.6%	18.3%	15.6%	14.0%	14.7%
\$20/\$2.40	100	50.0	51.2	51.3	50.6	52.5
\$27/\$3.50	100	95.3	106.8	112.8	116.8	124.0

Clearly, a substantial reduction in drilling activity is projected by the respondents for the low and middle price assumptions. These drilling trends largely confirm the level of domestic activity implied by the NPC Oil & Gas Outlook Survey. The high price assumption in this IPAA/SIPES Survey represents approximately the oil price before the recent decline, and respondents indicate a decline in 1986, followed by moderate growth in drilling thereafter.

A breakdown of survey results was made by operating size of respondent, by comparing the estimates of respondents above and below the average of 17 wells per respondent in 1985. Those who participated in less than 17 wells in 1985 represented over 70 percent of the respondents. Of significance was that these smaller operators showed a more extreme response in estimated well participation in both high and low price assumptions.

PERCENTAGE CHANGE IN RESPONDENT ACTIVITY  
FEWER THAN 17 WELLS

at	Percentage of 1985 Base					
	1985	1986	1987	1988	1989	1990
\$13/\$1.30	100.0%	19.2%	14.0%	12.3%	11.5%	11.8%
\$20/\$2.40	100.0	61.6	64.8	67.0	68.4	69.3
\$27/\$3.50	100.0	124.0	143.8	154.0	162.9	171.1

PERCENTAGE CHANGE IN RESPONDENT ACTIVITY  
MORE THAN 17 WELLS

at	Percentage of 1985 Base					
	1985	1986	1987	1988	1989	1990
\$13/\$1.30	100.0%	22.4%	19.7%	16.7%	14.8%	15.7%
\$20/\$2.40	100.0	46.0	46.5	45.9	44.5	46.8
\$27/\$3.50	100.0	85.5	94.1	98.7	101.0	107.8

The above tends to confirm the empirical observation that the smaller operators respond faster and to a greater degree than the larger entities.

NATIONAL PETROLEUM COUNCIL DRILLING SURVEY

Total wells participated in during 1985 \_\_\_\_\_

Total investment in these wells (approximate) \_\_\_\_\_

Assuming present law tax treatment, availability of good quality prospects and 1985 drilling costs, plus/minus inflation (if any), we would anticipate participating in the following number of wells if the average prices were:

	<u>\$13/BBL</u> <u>\$1.30/MCF</u>	<u>\$20/BBL</u> <u>\$2.40/MCF</u>	<u>\$27/BBL</u> <u>\$3.50/MCF</u>
1986	_____	_____	_____
1987	_____	_____	_____
1988	_____	_____	_____
1989	_____	_____	_____
1990	_____	_____	_____

Please return by June 16, 1986 to:

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