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U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves

1998 Annual Report

December 1999

Energy Information Administration
Office of Oil and Gas
U.S. Department of Energy
Washington, DC 20585

Preface

The *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1998 Annual Report* is the 22nd prepared by the Energy Information Administration (EIA) to fulfill its responsibility to gather and report annual proved reserves estimates. The EIA annual reserves report series is the only source of comprehensive domestic proved reserves estimates. This publication is used by the Congress, Federal and State agencies, industry, and other interested parties to obtain accurate estimates of the Nation's proved reserves of crude oil, natural gas, and natural gas liquids. These data are essential to the development, implementation, and evaluation of energy policy and legislation.

This report presents estimates of proved reserves of crude oil, natural gas, and natural gas liquids as of December 31, 1998, as well as production volumes for the United States and selected States and State subdivisions for the year 1998. Estimates are presented for the following four categories of natural gas: total gas (wet after lease separation), nonassociated gas and associated–dissolved gas (which are the two major types of wet natural gas), and total dry gas (wet gas adjusted for the removal of liquids at natural gas processing plants). In addition, reserve estimates for two types of natural gas liquids, lease condensate and natural gas plant liquids, are presented. The estimates are based upon data obtained from two annual EIA surveys: Form EIA–23, "Annual Survey of Domestic Oil and Gas Reserves" and Form EIA–64A, "Annual Report of the Origin of Natural Gas Liquids Production." Also included is information on indicated additional crude oil reserves and crude oil, natural gas, and lease condensate reserves in nonproducing reservoirs. A discussion of notable oil and gas exploration and development activities during 1998 is provided.

The appendices contain data by operator production size class for crude oil and natural gas reserves and production; the top 100 U.S. fields ranked within an oil or gas proved reserves group for 1998; report Table 1 converted to metric units; historical State data; a summary of survey operations; a discussion of statistical considerations; methods used to develop the estimates provided in this report; maps of selected State subdivisions; and examples of the survey forms. A glossary of the terms used in this report and in survey Forms EIA–23 and EIA–64A is provided to assist readers in more fully understanding the data.

This annual reserves report was prepared by the Reserves and Production Division (located in Dallas, Texas), Office of Oil and Gas, Energy Information Administration. General information regarding preparation of the report may be obtained from Kenneth A. Vagts, Director, Office of Oil and Gas and John H. Wood, Director, Reserves and Production Division (214·720·6160).

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EIA's CD-ROM, ***Energy InfoDisc***, contains most EIA publications and major energy database applications. The ***Energy InfoDisc***, produced quarterly, is available for a fee from STAT-USA, Department of Commerce, 1-800-STAT-USA.

Other EIA Oil and Gas Publications

Other reports published by the Energy Information Administration (EIA) offer additional information and analysis related to domestic oil and gas supply. They may be obtained from the Government Printing Office in the same manner as this oil and gas reserves report.

Natural Gas Annual 1998, DOE/EIA–0131(98), October 1999
Petroleum Supply Annual 19968, DOE/EIA–0340(98), June 1999

These annual reports provide comprehensive statistics on supply, disposition, and prices of natural gas and petroleum in the United States.

Natural Gas 1998: Issues and Trends, DOE/EIA–0560(98), August 1999

Focuses on the increasing choices and challenges in the natural gas industry, as regulatory requirements are increasingly removed from the sale and transport of natural gas.

Petroleum: An Energy Profile, DOE/EIA–0545(99), July 1999

Explains in layman's terms the major components and operations of the U.S. Petroleum Industry.

Contents

Page

Tables

Page

Figures

Executive Summary

It was a down year for U.S. proved reserves in 1998, particularly crude oil reserves. U.S. proved reserves of crude oil fell 7 percent in 1998, the largest percentage decline in 53 years. Inflation adjusted crude oil prices, which began a decline in 1997, plunged by December 1998 to levels last seen in 1935. Falling crude prices led to a drop of almost 60 percent in rigs drilling for oil during 1998, followed by a decline in the number of new and producing oil wells, which was followed by the drop in oil reserves. Only 24 percent of 1998 oil production was replaced by proved reserve additions.

As of December 31, 1998 proved reserves were:

Crude Oil (million barrels)	
1997	22,546
1998	21,034
Decrease	-6.7%
Dry Natural Gas (billion cubic feet)	
1997	167,223
1998	164,041
Decrease	-1.9%
Natural Gas Liquids (million barrels)	
1997	7,973
1998	7,524
Decrease	-5.6%

U.S. dry natural gas reserves declined 2 percent in 1998. This decline broke a 4-year string of annual increases, and offset two-thirds of the gain in the prior 4 years. Natural gas reserve additions in 1998 replaced only 83 percent of gas production.

Proved reserves are those quantities that geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. Petroleum engineering and geological judgment are required in estimating proved reserves; therefore, the results are not precise measurements. This report of 1998 U.S. proved reserves of crude oil, natural gas, and natural gas liquids is the 22nd in the annual series prepared by the Energy Information Administration.

Crude Oil

Price matters. Crude oil reserve additions were less than a fifth of those in 1997. Additions would have been even smaller in the absence of a few large, long-term development projects that were continued by their operators in the face of low oil prices. Large revisions associated with property acquisitions and development in some of California's old and heavy oil fields helped that State's reserves to increase.

Changes in proved reserves are impacted by price in several ways. Low prices imply poor economics for oil producers, and poor economics leads to low drilling levels. Only twice in over 100 years have fewer oil wells been drilled than in 1998.

The onshore lower 48 States is a mature exploration and development area where, in the absence of enough exploratory and development wells drilled, it is next to impossible to add sufficient new fields, new reservoirs, and positive revisions to replace production. In the few less mature frontier areas not subject to drilling moratoria, it is still possible to drill very prolific wells that can be profitable even at moderately low prices. But, in 1998, even offshore and Alaskan North Slope projects were canceled or delayed.

Use of the December 1998 oil prices to evaluate oil field economics forced many companies to write down proved reserves in some fields, even in the offshore. The December 1998 price ($8.05 per barrel) was much tougher on smaller and marginal oil well operators as thousands of wells were shut in because they could not meet their direct operating costs, much less turn a profit. As a result, oil production and proved reserves dropped sharply in most lower 48 States areas. Texas' proved oil reserves fell 13 percent in 1998, which for the first time in a decade placed Texas second to Alaska in oil reserves.

In a sharp reversal from several years of increases, oil reserve additions dropped to less than a fifth of those in 1997. Reserve additions are the sum of *total discoveries* and *revisions and adjustments.* For crude oil, *revisions and adjustments* are usually larger than *total discoveries*, but they were a negative 120 million barrels in 1998. This was the first time in 22 years that *revisions and adjustments* did not make a positive contribution to oil reserve additions.

Total discoveries of crude oil were 599 million barrels in 1998, well under the prior 10-year average and less than half those of 1997. The Gulf of Mexico Federal Offshore and Alaska accounted for over 50 percent of them. *Total discoveries*, which equaled only 30 percent of 1998 oil production, are those reserves attributable to field *extensions*, *new field discoveries*, and *new reservoir discoveries in old fields*. They result from drilling exploratory wells.

- In a major reversal from 1997, *new field discoveries* were only 152 million barrels, less than a quarter of the 1997 level and well under the prior 10-year average. Most of the new field discoveries were in Alaska and the Gulf of Mexico Federal Offshore. Over half of the proved reserves of oil in the Gulf of Mexico are now located in deep water (water depths greater than 200 meters.)
- *New reservoir discoveries* in old fields were 120 million barrels, about the same as in 1997 but less than the prior 10-year average.
- Field *extensions*, down in 1998, added 327 million barrels of proved oil reserves.

Other 1998 crude oil events of note:

- The annual average domestic first purchase price for crude oil declined 37 percent for 1998 to $10.88 per barrel.
- Exploratory oil completions were down about 30 percent at 303. Total oil well completions were down 32 percent at 7,064.
- Total discoveries per exploratory oil well were down 31 percent to an average of 1.98 million barrels per new exploratory well in 1998.

Looking ahead to 1999 on a more positive note for oil production and reserves:

- U.S. crude oil prices at the wellhead began increasing in March 1999, reached $20 per barrel in September, and continue to rise. But oil drilling has not rebounded. Nevertheless, higher oil prices in December 1999 will bring back some of the oil reserves that became uneconomic in 1998.

Indicated additional reserves of crude oil decreased 1 percent to 3,160 million barrels in 1998. These are crude oil volumes that may become economically recoverable from known reservoirs through the application of improved recovery techniques using current technology. The presence of large indicated additional reserves in north Alaska, California, Texas, and Louisiana implies that significant upward revisions to crude oil proved reserves can occur in the future.

Natural Gas

The four-year increasing trend for U.S. natural gas proved reserves came to an end in 1998. Lower 48 States dry natural gas reserves also declined about 2 percent from the 1997 level. Even the Gulf of Mexico Federal Offshore proved reserves were down in 1998—dry gas reserves in the Gulf of Mexico Federal Offshore declined 5 percent in 1998. The reserve additions of natural gas were lower in 1998 because *total discoveries* were lower. The other component, *revisions and adjustments* (4,105 billion cubic feet) was about the same as in 1997.

U.S. *total discoveries* of dry gas reserves were 11,433 billion cubic feet in 1998, down 27 percent from 1997.

- *New field discoveries* were 1,074 billion cubic feet, less than half of the new field volume discovered in 1997 and 30 percent less than the prior 10-year average.
- Field *extensions* were 8,197 billion cubic feet, down from 1997 but still 19 percent above the prior 10-year average.
- *New reservoir discoveries in old fields* were 2,162 billion cubic feet, down 9 percent from 1997 and 7 percent less than the prior 10-year average.

Coalbed methane reserves and production continued to grow in 1998, despite the decline in reserves and production of conventional natural gas. Coalbed methane reserves accounted for 7 percent of 1998's proved dry gas reserves. Coalbed methane production in 1998 was 6 percent of the U.S. total dry gas production.

Other 1998 natural gas events of note:

- Exploratory gas well completions and total gas well completions both increased 7 percent in 1998.
- Although the number of wells increased, the average of total discoveries per exploratory gas well was 32 percent less in 1998.
- Natural gas prices at the wellhead fell 16 percent in 1998 to an annual average of $1.94 per thousand cubic feet.
- U.S. gas production was also down in 1998, in keeping with lower natural gas demand.

Natural Gas Liquids

U.S. natural gas liquids proved reserves decreased 6 percent to 7,524 million barrels in 1998. A reassessment of natural gas liquids reserves in Alaska represents the bulk of the 1998 change.

Natural gas liquids reserves are the sum of natural gas plant liquids and lease condensate reserves.

Total proved reserves of liquid hydrocarbons (crude oil plus natural gas liquids) were 28,558 million barrels in 1998, a 6 percent decrease from the 1997 level. Natural gas liquids represented 26 percent of total liquid hydrocarbon proved reserves in 1998.

Data

These estimates are based upon analysis of data from Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," filed by 2,739 operators of oil and gas wells, and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production," filed by operators of 605 active natural gas processing plants. The U.S. proved reserves estimates for crude oil and natural gas are associated with sampling errors of less than 1 percent.

1. Introduction

Background

The principal focus of this report is to provide accurate annual estimates of U.S. proved reserves of crude oil, natural gas, and natural gas liquids. These estimates are essential to the development, implementation, and evaluation of national energy policy and legislation. In the past, the Government and the public relied upon industry estimates of proved reserves. However, the industry ceased publication of reserve estimates after its 1979 report.

In response to a recognized need for credible annual proved reserves estimates, Congress, in 1977, required the Department of Energy to prepare such estimates. To meet this requirement, the Energy Information Administration (EIA) developed a program that established a unified, verifiable, comprehensive, and continuing annual statistical series for proved reserves of crude oil and natural gas. It was expanded to include proved reserves of natural gas liquids for the 1979 and subsequent reports.

Survey Overview

EIA defines proved reserves, the major topic of this report, as those volumes of oil and gas that geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. There are other categories of reserves, but by definition they are more speculative and less precise than proved reserves. Readers who are unfamiliar with the distinctions between types of reserves or with how reserves fit in the description of overall oil and gas resources should see Appendix G.

While the primary topic of this report is proved reserves, information is also presented on indicated additional crude oil reserves. Indicated additional crude oil reserves are not included in proved reserves because of their uncertain economic recoverability. When economic recoverability is demonstrated, these volumes will be reclassified and transferred to the proved reserves category as positive revisions.

This report provides proved reserves estimates for calendar year 1998. It is based on data filed by large operators of oil and gas wells on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," and by operators of all natural gas processing plants on Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production." The U.S. crude oil and natural gas proved reserves estimates are associated with sampling errors of less than 1 percent at a 95-percent confidence level.

Form EIA-23

On Form EIA-23, an operator is defined as an organization or person responsible for the management and day-to-day operation of oil and/or gas wells. This definition eliminates responses from royalty owners, working interest owners (unless they are also operators), and others not directly responsible for oil and gas production operations.

Operator size categories are based upon their annual production as indicated in various Federal, State, and commercial records. Large operators are those that produced at least 1.5 million barrels of crude oil or 15 billion cubic feet of natural gas, or both, during the report year. Intermediate operators produced less than large operators, but more than 400,000 barrels of crude oil or 2 billion cubic feet of natural gas, or both. Small operators are those that produced less than intermediate operators. All data are reported on a total operated basis, encompassing all proved reserves and production associated with wells operated by an individual operator. This concept is also called the "gross operated" or "8/8ths" basis.

Large operators and most intermediate size operators report reserves balance data on Form EIA-23 to show how and why reserves components changed during the year on a field-by-field basis. Intermediate size operators who do not keep reserves data were not asked to provide estimates of reserves at the beginning of the year or annual changes to proved reserves by component of change; i.e., revisions, extensions, and new discoveries. These volumes were estimated by applying an algebraic allocation scheme that preserved the relative relationships between these items within each State or State subdivision, as reported by large and intermediate operators.

The published reserve estimates include an additional term, adjustments, calculated by the EIA, that preserves an exact annual reserves balance of the form:

Published Proved Reserves at End of Previous Report Year
+ Adjustments
+ Revision Increases
– Revision Decreases
+ Extensions
+ New Field Discoveries
+ New Reservoir Discoveries in Old Fields
– Report Year Production
= Published Proved Reserves at End of Report Year

Adjustments are the annual changes in the published reserve estimates that cannot be attributed to the estimates for other reserve change categories. They result from the survey and statistical estimation methods employed. For example, variations caused by changes in the operator frame, different random samples, changes in reserve estimates following ownership changes, incorrectly reported data, or imputations for missing or unreported reserve changes can contribute to adjustments.

Form EIA-64A

Form EIA-64A data were first collected for the 1979 survey year in order to develop estimates for total natural gas liquids reserves. Data on liquids recovered from natural gas, as reported by natural gas processing plant operators, are combined with lease condensate data collected on Form EIA-23 to provide the total natural gas liquids reserves estimates.

Data Collection Operations

An intensive effort is made each year to maintain an accurate and complete survey frame consisting of operators of oil and gas wells and of natural gas processing plants. The Form EIA-23 operator frame contained 23,620 probable active operators and the Form EIA-64A plant frame contained 621 probable active natural gas processing plants in the United States when the 1998 surveys were initiated. As usual, additional operators were added to the survey as it progressed, and many operators initially in the sample frame were found to be inactive in 1998.

For the report year 1998, EIA mailed 598 EIA-23 forms to all known large and intermediate size oil and gas well operators that were believed to be active during 1998. Of these, 26 were found to be nonoperators that did not have successor operators in 1998. Data were received from 588 operators, an overall response rate of 100 percent of the active operators in the Form EIA-23 survey. EIA mailed 621 EIA-64A forms to natural gas processing plant operators. More than one form is received for a plant that has more than one operator during the year. Forms were received from 100 percent of the operators of the 605 unique active natural gas processing plants in the Form EIA-64A survey.

National estimates of the production volumes for crude oil, lease condensate, natural gas liquids, and dry natural gas based on Form EIA-23 and Form EIA-64A were compared with corresponding official production volumes published by EIA, which are obtained from non-survey based State sources. For report year 1998, the Form EIA-23 National production estimates were 5 percent lower than the comparable *Petroleum Supply Annual (PSA) 1998* volumes for crude oil and lease condensate combined, and were 0.5 percent lower than the comparable *Natural Gas Annual 1998* volume for 1998 dry natural gas. For report year 1998, the Form EIA-64A National estimates were 8 percent lower than the *PSA 1998* volume for natural gas plant liquids production.

Accuracy in reserves reporting is EIA's first and foremost goal for this report. Estimates of production within this report may be lower than those made specifically to estimate oil or gas production like those in the *PSA*. There were over a thousand significant oil and gas field sales in 1998 reviewed by EIA as part of our quality assurance program. Often, new operators of a field acquired through purchase correctly reported their new proved reserves on Form EIA-23, but then reported only their 1998 production since assuming ownership – which may leave out several months of production from their reported annual total for a field. The net effect of this was a larger than usual difference between the total oil production reported on Form EIA-23 and the annual production reported in the *PSA 1998*.

2. Overview

National Summary

The United States had the following proved reserves as of December 31, 1998:

- **Crude Oil — 21,034 million barrels**
- **Dry Natural Gas — 164,041 billion cubic feet**
- **Natural Gas Liquids — 7,524 million barrels.**

This Overview summarizes the 1998 proved reserves balances of crude oil, dry natural gas, and natural gas liquids on a National level and provides historical comparisons between 1998 and years past.

Table 1 lists the estimated annual reserve balances since 1988. From 1997 to 1998, proved reserves of crude oil decreased by 7 percent—the largest percentage decline in 53 years. Proved reserves of dry natural gas decreased by 2 percent, ending a 4-year increasing trend in gas reserves. Natural gas liquids reserves declined 6 percent.

Crude Oil

Proved reserves of crude oil decreased by 1,512 million barrels in 1998. **Figure 1** shows the crude oil proved reserves levels by major region and **Figure 2** shows the components of reserves changes from 1988 through 1998.

As shown in **Figure 2**, total reserve additions (the positive side of the scale) were down substantially in 1998, as operators reacted to a significant drop in oil prices in the last months of 1998. Net revisions and adjustments were negative for the first time since EIA began recording these data in 1977. Production of crude oil (the negative side of the scale of **Figure 2**) declined slightly for the seventh year in a row.

Total discoveries are those reserves attributable to field *extensions*, *new field discoveries*, and *new reservoir discoveries in old fields*. There were 599 million barrels of *total discoveries* of crude oil proved reserves in 1998. This is less than half of what was discovered in 1997.

Extensions added 327 million barrels of proved reserves. This is 31 percent less than in 1997 (477 million barrels) and 25 percent less than the average *extensions* in the prior 10 years (435 million barrels).

New field discoveries were 152 million barrels, substantially less than the 1997 level and 14 percent less than the average volume discovered in the prior 10 years (176 million barrels). New field discoveries in Alaska and the Gulf of Mexico Federal Offshore (143 million barrels) made up 94 percent of the 1998 volume of new field discoveries.

New reservoir discoveries in old fields added 120 million barrels of proved reserves. This is more than the 1997 level (119 million barrels) but less than the prior 10-year average for the United States (135 million barrels).

Revisions and adjustments deducted 120 million barrels of proved reserves. This is the first negative total for net revisions and adjustments for crude oil since EIA began collecting this data in 1977. In the past 10 years, net revisions and adjustments have added an average of 1,181 million barrels of crude oil proved reserves each year, but this was not the case in 1998. Poor oil economics due to very low oil prices caused many operators to shut-in production and revise their crude oil proved reserves downward.

Production removed an estimated 1,991 million barrels of proved reserves from the National total. Production was down 7 percent from 1997's level (2,138 million barrels), and down 17 percent from the prior 10-year average (2,399 million barrels). Reserves additions in 1998 replaced only 24 percent of production.

Natural Gas

U.S. proved reserves of dry natural gas decreased, ending a four-year increasing trend. Reserves of dry natural gas declined 2 percent from 1997's level to a total of 164,041 billion cubic feet. Dry natural gas reserves declined by 2,547 billion cubic feet in the Lower 48 States, and in Alaska declined by 635 billion cubic feet. **Figure 3** shows the dry natural gas proved reserves levels by major region and **Figure 4** shows the components of reserves changes from 1988 through 1998. Dry natural gas production declined almost 3 percent from 1997 to 1998. Operators were only able to replace 83 percent of 1998's dry gas production with new reserves.

For 1998, U.S. *total discoveries* of dry gas reserves were 11,433 billion cubic feet, down 27 percent from 1997,

Table 1. Total U.S. Proved Reserves of Crude Oil, Dry Natural Gas, and Natural Gas Liquids, 1988-1998

Year	Adjustments (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[a] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[b] Discoveries (8)	Production (9)	Proved[c] Reserves 12/31 (10)	Change from Prior Year (11)
	Crude Oil (million barrels of 42 U.S. gallons)										
1988	364	2,684	1,221	1,827	355	71	127	553	2,811	26,825	-431
1989	213	2,698	1,365	1,546	514	112	90	716	2,586	26,501	-324
1990	86	2,483	1,000	1,569	456	98	135	689	2,505	26,254	-247
1991	163	2,097	1,874	386	365	97	92	554	2,512	24,682	-1,572
1992	290	1,804	1,069	1,025	391	8	85	484	2,446	23,745	-937
1993	271	2,011	1,516	766	356	319	110	785	2,339	22,957	-788
1994	189	2,364	1,357	1,196	397	64	111	572	2,268	22,457	-500
1995	122	1,823	795	1,150	500	114	343	957	2,213	22,351	-106
1996	175	1,723	986	912	543	243	141	927	2,173	22,017	-334
1997	520	1,998	1,084	1,434	477	637	119	1,233	2,138	22,546	+529
1998	-638	2,752	2,234	-120	327	152	120	599	1,991	21,034	-1,512
	Dry Natural Gas (billion cubic feet, 14.73 psia, 60° Fahrenheit)										
1988	2,193	23,367	[d]38,427	-12,867	6,803	1,638	1,909	10,350	16,670	[d]168,024	-19,187
1989	3,013	26,673	23,643	6,043	6,339	1,450	2,243	10,032	16,983	167,116	-908
1990	1,557	18,981	13,443	7,095	7,952	2,004	2,412	12,368	17,233	169,346	+2,230
1991	2,960	19,890	15,474	7,376	5,090	848	1,604	7,542	17,202	167,062	-2,284
1992	2,235	18,055	11,962	8,328	4,675	649	1,724	7,048	17,423	165,015	-2,047
1993	972	17,597	12,248	6,321	6,103	899	1,866	8,868	17,789	162,415	-2,600
1994	1,945	21,365	15,881	7,429	6,941	1,894	3,480	12,315	18,322	163,837	+1,422
1995	580	20,465	12,731	8,314	6,843	1,666	2,452	10,961	17,966	165,146	+1,309
1996	3,785	17,132	13,046	7,871	7,757	1,451	3,110	12,318	18,861	166,474	+1,328
1997	-590	21,658	16,756	4,312	10,585	2,681	2,382	15,648	19,211	167,223	+749
1998	-1,635	28,003	22,263	4,105	8,197	1,074	2,162	11,433	18,720	164,041	-3,182
	Natural Gas Liquids (million barrels of 42 U.S. gallons)										
1988	11	1,168	715	464	268	41	72	381	754	8,238	+91
1989	-277	1,143	1,020	-154	259	83	74	416	731	7,769	-469
1990	-83	827	606	138	299	39	73	411	732	7,586	-183
1991	233	825	695	363	189	25	55	269	754	7,464	-122
1992	225	806	545	486	190	20	64	274	773	7,451	-13
1993	102	764	640	226	245	24	64	333	788	7,222	-229
1994	43	873	676	240	314	54	131	499	791	7,170	-52
1995	192	968	691	469	432	52	67	551	791	7,399	+229
1996	474	844	669	649	451	65	109	625	850	7,823	+424
1997	-15	1,199	910	274	535	114	90	739	864	7,973	+150
1998	-361	1,302	1,094	-153	383	66	88	537	833	7,524	-449

[a]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.

[b]Total discoveries = Col. 5 + Col. 6 + Col. 7.

[c]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

[d]An unusually large revision decrease to North Slope dry natural gas reserves was made in 1988. It recognizes some 24.6 trillion cubic feet of downward revisions reported during prior years by operators because of economic and market conditions. The Energy Information Administration (EIA) in previous years carried these reserves in the proved category.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves" and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production." They may differ from the official EIA production data for crude oil, natural gas, and natural gas liquids for 1998 contained in the *Petroleum Supply Annual 1998*, DOE/EIA-0340(98) and the *Natural Gas Annual 1998*, DOE/EIA-0131(98).

Sources: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, 1988 through 1998 annual reports, DOE/EIA-0216.

Figure 1. U.S. Crude Oil Proved Reserves, 1988-1998

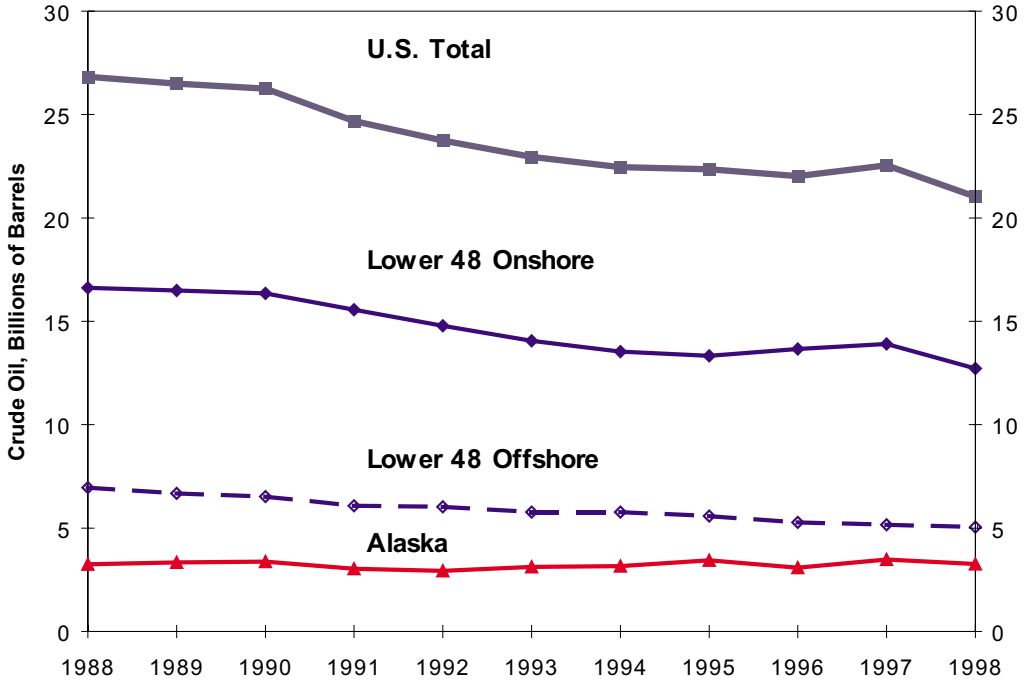
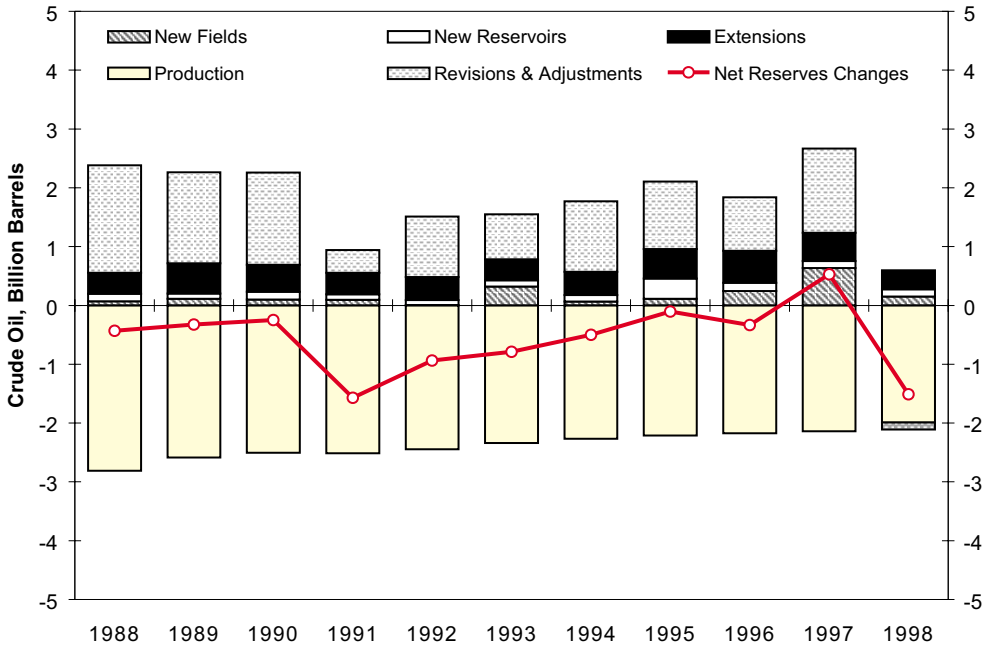


Figure 2. Components of Reserves Changes for Crude Oil, 1988-1998



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1988-1998 annual reports, DOE/EIA-0216.{11-21}

Figure 3. U.S. Dry Natural Gas Proved Reserves, 1988-1998

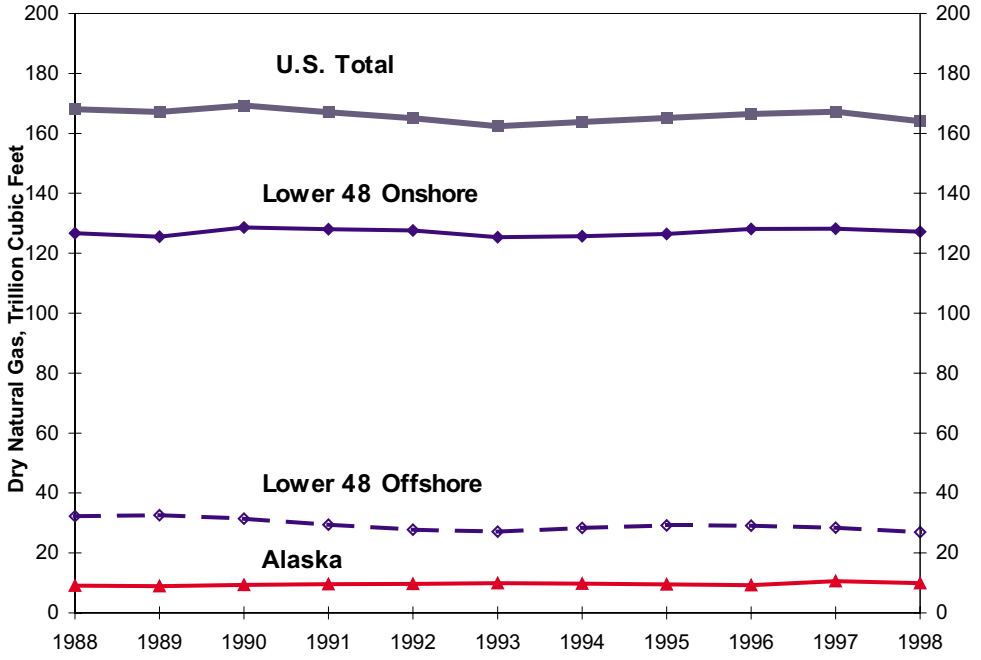
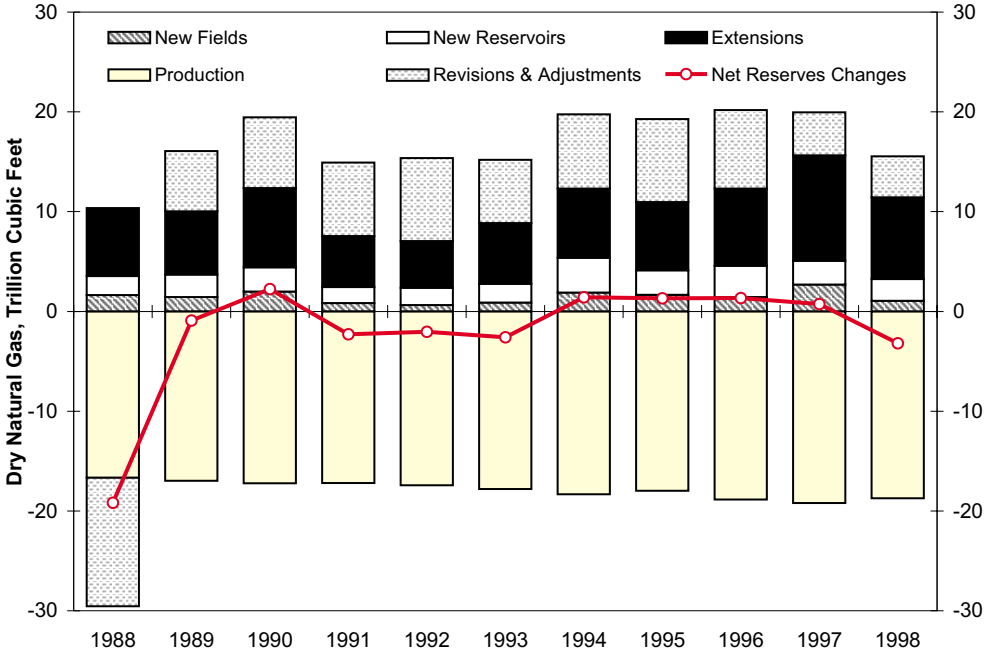


Figure 4. Components of Reserves Changes for Dry Natural Gas, 1988-1998



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1988-1998 annual reports, DOE/EIA-0216.{11-21}

but 6 percent greater than the average annual volume discovered in the past 10 years. *Total discoveries* were 74 percent of all reserve additions in 1998, while *revisions and adjustments* provided the remaining 26 percent.

Extensions added 8,197 billion cubic feet of proved reserves. This is 23 percent less than 1997's *extensions* but 19 percent more than the average of *extensions* in the prior 10 years (6,909 billion cubic feet).

New field discoveries added 1,074 billion cubic feet of proved reserves. This is 40 percent of what was discovered in 1997 and 29 percent lower than the average volume discovered in the prior 10 years (1,518 billion cubic feet).

New reservoir discoveries in old fields added 2,162 billion cubic feet of proved reserves. This is 9 percent less than the volume discovered in 1997, and 7 percent lower than the prior 10-year average (2,318 billion cubic feet).

Revisions and Adjustments added 4,105 billion cubic feet of proved reserves. This is 5 percent less than 1997's revisions and adjustments and 18 percent less than the prior 10-year average (5,022 billion cubic feet).

Production removed an estimated 18,720 billion cubic feet of proved reserves from the National total. Gas production decreased almost 3 percent compared to 1997.

Coalbed methane gas production and reserves are included in the 1998 totals. However, EIA separately tracks these reserves in order to record the development and performance of this gas source. Coalbed methane reserves increased in 1998 to a volume of 12,179 billion cubic feet. Coalbed methane accounted for 7 percent of 1998 U.S. dry natural gas reserves and 6 percent of 1998 U.S. dry gas production. No Federal tax incentives for new coalbed methane wells have been available for 5 years.

Natural Gas Liquids

Proved reserves of natural gas liquids decreased 449 million barrels to 7,524 million barrels during 1998— a 6 percent decrease from 1997 levels. A reassessment of the natural gas liquids reserves of Alaska represents the bulk of the 1998 change. **Figure 5** shows the natural gas liquids proved reserves levels by major region and **Figure 6** shows the components of reserves changes from 1988 through 1998.

Operators replaced 46 percent of their 1998 natural gas liquids production with reserve additions. *Total discoveries* added 537 million barrels, but net *revisions and adjustments* took away 153 million barrels.

Total proved reserves of liquid hydrocarbons (crude oil plus natural gas liquids) were 28,558 million barrels in 1998—a 6 percent decrease from the 1997 level. Natural gas liquids represented 26 percent of total liquid hydrocarbon proved reserves in 1998.

Reserves Changes Since 1977

EIA has collected oil and gas reserves estimates annually since 1977. **Table 2** lists the cumulative totals of the components of reserves changes for crude oil and dry natural gas from 1978 through 1998. **Table 2** contains two sections, one for the lower 48 States and another for the U.S. total (which includes Alaska's contribution). Annual averages for each component of reserves changes are also listed, along with the percentage of that particular component's impact on total U.S. proved reserves. In this section, we compare these averages to the 1998 proved reserves estimates as a means of gauging the past year against history.

Crude Oil: Since 1977 U.S. operators have:

- discovered an average of 803 million barrels per year of new reserves
- revised and adjusted their proved reserves upward by an average of 1,295 million barrels per year from *revisions and adjustments*
- ended each year with an average net reduction in U.S. proved reserves of 567 million barrels (the difference between post-1976 average annual production and post-1976 average annual reserve additions) because production has outpaced reserve additions.

Since 1977, crude oil reserves have been primarily sustained by the extension and development of existing fields (called field growth, reserves growth, or the EIA preferred term: proved ultimate recovery appreciation. See the Proved Ultimate Recovery section later in this chapter.) rather than the discovery of new oil fields. Only 8 percent of reserves additions since 1976 were booked as *new field discoveries*. Proved ultimate recovery appreciation is the sum of net revisions and adjustments, extensions, and new reservoirs in old fields. Since 1977, the largest component of proved ultimate recovery appreciation for crude oil is upward *revisions and adjustments*, which accounted for 62 percent of all crude oil reserves additions. The 17,668 million barrels of *total discoveries*

Figure 5. U.S. Natural Gas Liquids Proved Reserves, 1988-1998

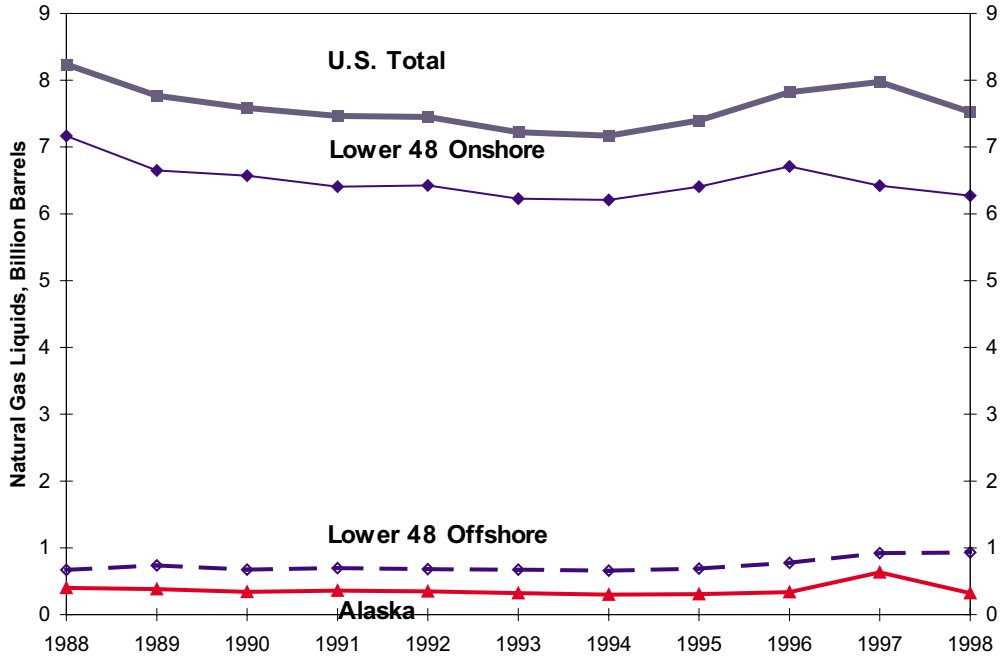
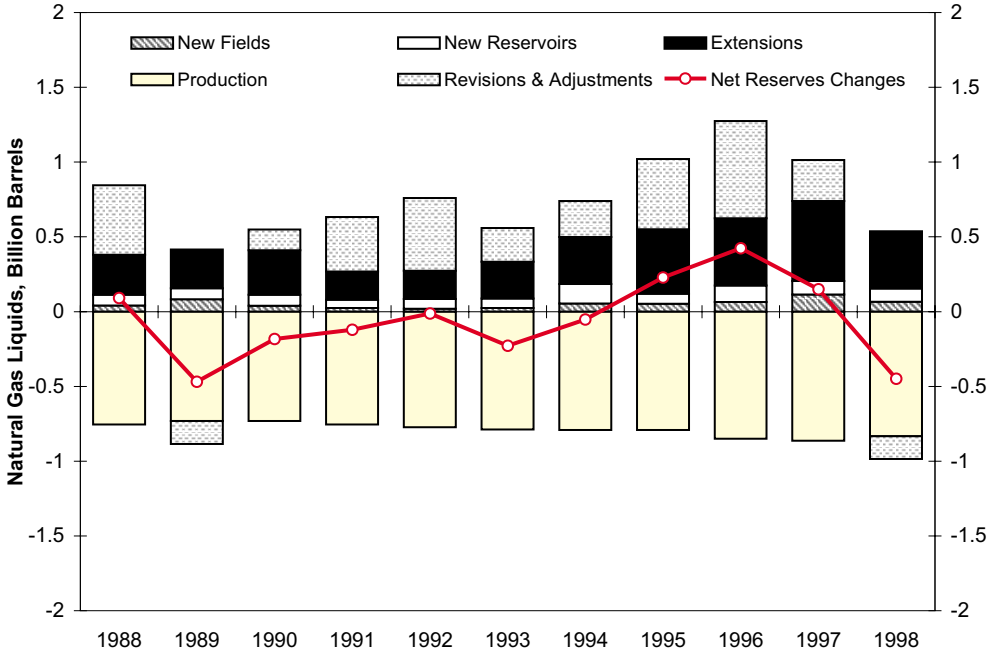


Figure 6. Components of Reserves Changes for Natural Gas Liquids, 1988-1998



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1988-1998 annual reports, DOE/EIA-0216.{11-21}

Table 2. Reserves Changes, 1977-1998

Components of Change	Lower 48 States			U.S. Total		
	Volume	Average per Year	Percent of Reserve Additions	Volume	Average per Year	Percent of Reserve Additions
	Crude Oil (million barrels of 42 U.S. gallons)					
Proved Reserves as of 12/31/76	**24,928**	––	––	**33,502**	––	––
New Field Discoveries	3,043	138	8.2	3,634	165	7.9
New Reservoir Discoveries in Old Fields	2,999	136	8.1	3,029	138	6.6
Extensions	9,856	448	26.7	11,005	500	23.8
Total Discoveries	**15,898**	**723**	**43.1**	**17,668**	**803**	**38.3**
Revisions and Adjustments	21,024	956	56.9	28,500	1,295	61.7
Total Reserve Additions	**36,922**	**1,678**	**100.0**	**46,168**	**2,099**	**100.0**
Production	**45,868**	**2,085**	**124.2**	**58,636**	**2,665**	**127.0**
Net Reserve Change	**-8,946**	**-407**	**-24.2**	**-12,468**	**-567**	**-27.0**
	Dry Natural Gas (billion cubic feet at 14.73 psia and 60° Fahrenheit)					
Proved Reserves as of 12/31/76	**180,838**	––	––	**213,278**	––	––
New Field Discoveries	42,637	1,938	12.0	42,729	1,942	12.6
New Reservoir Discoveries in Old Fields	56,300	2,559	15.9	56,665	2,576	16.7
Extensions	164,255	7,466	46.3	165,172	7,508	48.6
Total Discoveries	**263,192**	**11,963**	**74.2**	**264,566**	**12,026**	**77.9**
Revisions and Adjustments	91,507	4,159	25.8	75,114	3,414	22.1
Total Reserve Additions	**354,699**	**16,123**	**100.0**	**339,680**	**15,440**	**100.0**
Production	**381,423**	**17,337**	**107.5**	**388,917**	**17,678**	**114.5**
Net Reserve Change	**-26,724**	**-1,215**	**-7.5**	**-49,237**	**-2,238**	**-14.5**

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves* 1977-1998 annual reports, DOE/EIA-0216.{1-21}

accounted for the remaining 38 percent of reserves additions.

Compared to the average reserves changes since 1977, 1998 was a down year for crude oil discoveries. 1998's *total discoveries* of crude oil (599 million barrels) were 25 percent less the post-1976 U.S. average, and net *revisions and adjustments* were negative for the first time since EIA began publishing this data in 1977. The cause of this large decline in net revisions was poor oil economics, as explained in the Economics and Drilling section of this chapter.

No components of *total discoveries* in 1998 exceeded the post-1976 averages for crude oil.

Dry Natural Gas: Since 1977, U.S. operators:

- discovered an average of 12,026 billion cubic feet per year of new reserves
- revised and adjusted their proved reserves upward by an average 3,414 billion cubic feet per year
- had an average net reduction in U.S. reserves of 2,238 billion cubic feet per year.

Like crude oil reserves, natural gas reserves have been sustained primarily by proved ultimate recovery appreciation since 1977. However, *extensions* rather than net *revisions and adjustments* is the largest component. *Extensions* account for 49 percent while *revisions and adjustments* account for only 22 percent of all reserve additions since 1977. In recent years, the percentage of net *revisions and adjustments* has been as high as 39 percent. In 1998, *extensions* were 53 percent of all reserves additions while net *revisions and adjustments* were 26 percent.

Compared to the average reserves changes since 1977, 1998 was a below average year for natural gas reserve additions from *total discoveries*. U.S. total dry natural gas reserves decreased 2 percent, ending a 4-year increasing trend. Operators reported 11,433 billion cubic feet of *total discoveries* of dry natural gas proved reserves—5 percent less than the post-1976 average (12,026 billion cubic feet). However, compared to the

post-1976 U.S. average, *net revisions and adjustments* were 20 percent higher in 1998 (4,105 billion cubic feet).

Economics and Drilling

Economics: Poor oil economics, caused by low crude oil prices, had a strong negative impact on domestic U.S. proved reserves in 1998. A direct consequence of the low oil prices was reduced 1998 drilling levels. This section describes the drastic price behavior in 1998 and the following section addresses drilling.

Table 3 lists the average annual domestic wellhead prices of crude oil and natural gas, as well as the average number of active rotary drilling rigs, from 1970 to 1998.

The U.S. crude oil first purchase price (less the Alaskan North Slope) started at an average of $13.48 per barrel in January 1998, but declined to $10.00 per barrel by June. Prices increased slightly to $11.32 by October 1998, but then fell below the $10 mark to $8.05 per barrel in December. The average U.S. crude oil first purchase price (less the Alaskan North Slope) declined from an average $17.23 in 1997 to $10.88 per barrel in 1998.

Table 3. U.S. Average Annual Domestic Wellhead Prices for Crude Oil and Natural Gas, and the Average Number of Active Rotary Drilling Rigs, 1970-1998

Year	Crude Oil		Natural Gas		Number of Rigs
	Current	1998 Constant	Current	1998 Constant	
	(dollars per barrel)		(dollars per thousand cubic feet)		
1970	3.18	11.71	0.17	0.63	1,028
1971	3.39	11.87	0.18	0.63	976
1972	3.39	11.40	0.19	0.64	1,107
1973	3.89	12.38	0.22	0.70	1,194
1974	6.87	20.11	0.30	0.88	1,472
1975	7.67	20.48	0.44	1.18	1,660
1976	8.19	20.70	0.58	1.47	1,658
1977	8.57	20.38	0.79	1.88	2,001
1978	9.00	19.89	0.91	2.01	2,259
1979	12.64	25.76	1.18	2.40	2,177
1980	21.59	40.28	1.59	2.97	2,909
1981	31.77	54.33	1.98	3.39	3,970
1982	28.52	45.85	2.46	3.95	3,105
1983	26.19	40.38	2.59	3.99	2,232
1984	25.88	38.43	2.66	3.95	2,428
1985	24.09	34.54	2.51	3.60	1,980
1986	12.51	17.49	1.94	2.71	964
1987	15.40	20.89	1.67	2.26	936
1988	12.58	16.47	1.69	2.21	936
1989	15.86	19.93	1.69	2.12	869
1990	20.03	24.12	1.71	2.06	1,010
1991	16.54	19.16	1.64	1.90	860
1992	15.99	18.02	1.74	1.96	721
1993	14.25	15.65	2.04	2.24	754
1994	13.19	14.14	1.85	1.98	775
1995	14.62	15.33	1.55	1.62	723
1996	R18.46	19.00	2.17	2.23	779
1997	R17.23	17.40	R2.32	2.34	943
1998	10.88	10.88	1.96	1.96	827

R=Revised data.

Sources: Current dollars and number of rigs: *Monthly Energy Review November 1999*, DOE/EIA-0035(99/11). 1998 constant dollars: U.S. Department of Commerce, Bureau of Economic Analysis, Gross Domestic Product Implicit Price Deflators, June 1999.

Oil prices vary by region. In Texas the average 1998 crude oil first purchase price was $12.28 per barrel, while in California it was $9.61 per barrel, and only $8.49 per barrel on the Alaskan North Slope. The lowest average crude oil first purchase price in 1998 was for Federal Offshore California oil—$6.98 per barrel.{22}

The average annual wellhead natural gas price decreased from $2.32 in 1997 to $1.96 per thousand cubic feet in 1998. Gas prices started at $1.99 per thousand cubic feet in January 1998 and rose to $2.22 per thousand cubic feet by April 1998 (the highest average price of the year). In June, prices dipped to $1.97 but crept up to $2.08 in July. After July, prices hovered around $1.85 per thousand cubic feet, and then declined in December to $1.73 per thousand cubic feet—the lowest average price for the year.{23}

Drilling: From 1997 to 1998, the annual average active rig count decreased from 943 to 827 (**Table 3**). The rig count remains well below the peak activity level of 1981 (average 3,970 rigs) but, it must be realized that a comparison of only the bulk number of wells drilled is not representative of drilling's impact on reserves levels over time. Operators are now using significantly improved drilling and seismic exploration technology to dramatically increase their drilling success rate.

Looking first at exploratory wells, there were 2,691 exploratory wells drilled in 1998 (**Table 4**). Of these, 11 percent were oil wells, 21 percent were gas wells, and 67 percent were dry holes. The total (which includes dry holes) was 12 percent less than in 1997.

The number of active rigs decreased in 1998, resulting in 12 percent fewer successful exploratory wells than in 1997. There were 7 percent more exploratory gas wells (**Figure 7**) and 29 percent fewer exploratory oil wells (**Figure 8**) than in 1997. The number of successful development wells decreased 32 percent for oil and increased 7 percent for gas from 1997.

Figures 9 and 10 show the average volume of discoveries per exploratory well for dry natural gas and oil, respectively, since 1977. Both the average volume of gas discoveries per exploratory well and the average volume of oil discoveries per exploratory well in 1998 decreased to levels closer to those of 1996. Altogether there were an estimated 24,083 exploratory and development wells drilled in 1998, 12 percent less than in 1997 and 8 percent less than the average number of wells drilled annually in the prior 10 years (26,143).

For the sixth year in a row, the number of gas well completions exceeded the number of oil well completions in both the exploratory and development categories.

Mergers and Acquisitions

Not all the notable activity in 1998 occurred in frontier drilling areas, some occurred around the boardroom tables of major oil and gas corporations. Over 1,400 major field ownership transactions, mergers, and acquisitions were announced in 1998. The following large mergers were announced in 1998, and are expected to have a major impact on the energy industry in the future:

On August 11, 1998, British Petroleum announced that it would acquire Amoco for $48.2 billion in stock, the largest oil industry merger and the largest foreign take-over of a U.S. company to date. The company will be known as BP Amoco, and it will be the world's third-largest multinational oil company in terms of net income behind Exxon and Royal Dutch/Shell Group.{24}

On December 2, 1998, Exxon Corporation agreed to buy Mobil Corporation for approximately $75.4 billion, making the company the largest corporation in the U.S. The company will be known as Exxon Mobil, and said they expect to cut about 9,000 jobs from their combined worldwide workforce of 122,700 and to close offices, saving $730 million. The merger comes in the context of low oil prices, which have hurt profits at many oil companies.{25}

On December 30, 1998, U.S. federal regulators approved the proposed purchase of Amoco by British Petroleum P.L.C. after extracting a handful of antitrust concessions from the new company. With a market capitalization of about $140 billion, BP Amoco would rank third in the global oil industry behind the proposed Exxon-Mobil merger and Royal Dutch/Shell.{26}

Reserve-to-Production Ratio and Ultimate Recovery

R/P Ratios

The relationship between proved reserves and production levels, expressed as the ratio of reserves to production (R/P ratio) is often used in analyses. For a

Table 4. U.S. Exploratory and Development Well Completions,[a] 1970-1998

	Exploratory[b]				Total Exploratory and Development[b]			
Year	Oil	Gas	Dry	Total	Oil	Gas	Dry	Total
1970	763	478	6,193	7,434	13,043	4,031	11,099	28,173
1971	664	472	5,995	7,131	11,903	3,983	10,382	26,268
1972	690	659	6,202	7,551	11,437	5,484	11,013	27,934
1973	642	1,067	5,952	7,661	10,167	6,933	10,320	27,420
1974	859	1,190	6,833	8,882	13,647	7,138	12,116	32,901
1975	982	1,248	7,129	9,359	16,948	8,127	13,646	38,721
1976	1,086	1,346	6,772	9,204	17,688	9,409	13,758	40,855
1977	1,164	1,548	7,283	9,995	18,745	12,122	14,985	45,852
1978	1,171	1,771	7,965	10,907	19,181	14,413	16,551	50,145
1979	1,321	1,907	7,437	10,665	20,851	15,254	16,099	52,204
1980	1,764	2,081	9,039	12,884	32,639	17,333	20,638	70,610
1981	2,636	2,514	12,349	17,499	43,598	20,166	27,789	91,553
1982	2,431	2,125	11,247	15,803	39,199	18,979	26,219	84,397
1983	2,023	1,593	10,148	13,764	37,120	14,564	24,153	75,837
1984	2,198	1,521	11,278	14,997	42,605	17,127	25,681	85,413
1985	1,679	1,190	8,924	11,793	35,118	14,168	21,056	70,342
1986	1,084	793	5,549	7,426	19,097	8,516	12,678	40,291
1987	925	754	5,049	6,728	16,164	8,055	11,112	35,331
1988	855	732	4,693	6,280	13,636	8,555	10,041	32,232
1989	607	705	3,924	5,236	10,204	9,539	8,188	27,931
1990	654	689	3,715	5,058	12,198	11,044	8,313	31,555
1991	592	534	3,314	4,440	11,770	9,526	7,596	28,892
1992	493	423	2,513	3,429	8,757	8,209	6,118	23,084
1993	502	548	2,469	3,519	8,407	10,017	6,328	24,752
1994	570	726	2,405	3,701	6,721	9,538	5,307	21,566
1995	542	570	2,198	3,310	7,627	8,354	5,075	21,056
1996	483	570	2,136	3,189	8,314	9,302	5,282	22,898
1997	428	536	2,110	3,074	10,436	11,327	5,702	27,465
1998	303	572	1,816	2,691	7,064	12,106	4,913	24,083

[a]Excludes service wells and stratigraphic and core testing.
[b]All drilling counts for the years 1973-1997 have been revised.
Notes: Estimates are based on well completions taken from American Petroleum Institute data tapes through October 1999. Due to the method of estimation, data shown are frequently revised. Data are no longer rounded to nearest 10 wells.
Sources: Years 1970-1972: Energy Information Administration, Office of Oil and Gas.Years 1973-1998: *Monthly Energy Review November 1999*, DOE/EIA-0035(99/11).

mature producing area, the R/P ratio tends to be reasonably stable, so that the proved reserves at the end of a year serve as a rough guide to the production level that can be maintained during the following year. Operators report data which yield R/P ratios that vary widely by area depending upon:

- category of operator
- geology and economics
- number and size of new discoveries
- amount of drilling that has occurred.

R/P ratios are an indication of the state of development in an area and, over time, the ratios change. For example, when the Alaskan North Slope oil reserves were booked, the U.S. R/P ratio for crude oil increased because significant production from these reserves did not begin until 7 years after booking due to the need to first build the Trans Alaska pipeline. The U.S. R/P ratio for crude oil decreased from 11.1-to-1 to 9.4-to-1 between 1977 and 1982, as Alaskan North Slope oil production reached high levels.

Figure 7. U.S. Exploratory Gas Well Completions, 1977-1998

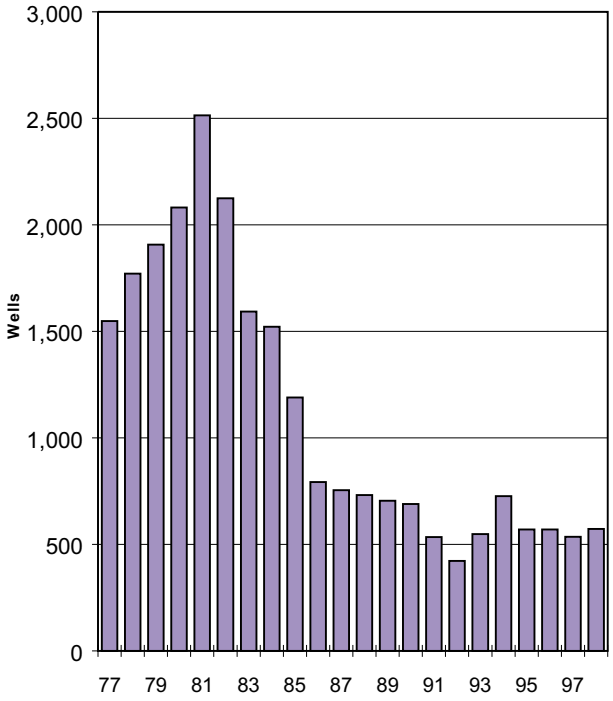


Figure 8. U.S. Exploratory Oil Well Completions, 1977-1998

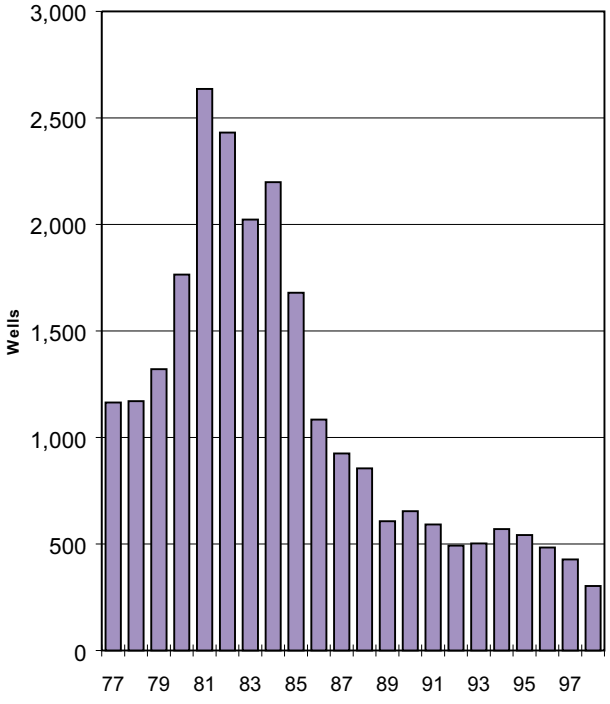


Figure 9. U.S. Total Discoveries of Dry Natural Gas per Exploratory Gas Well Completion, 1977-1998

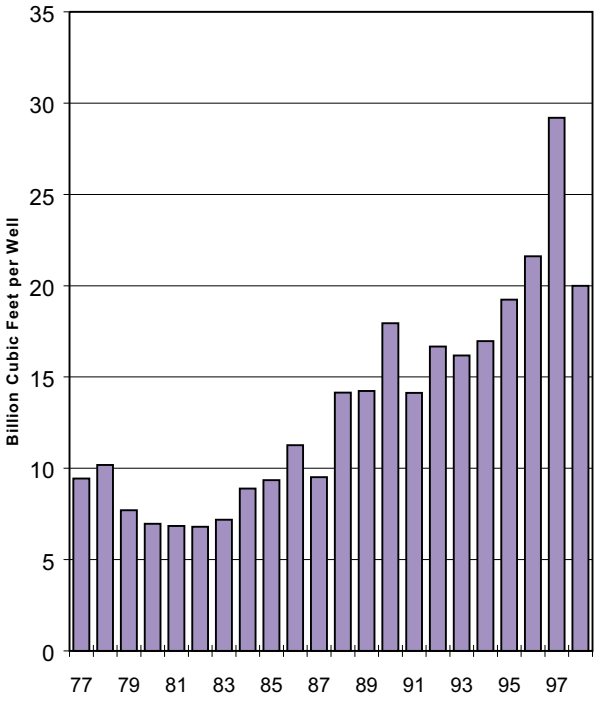
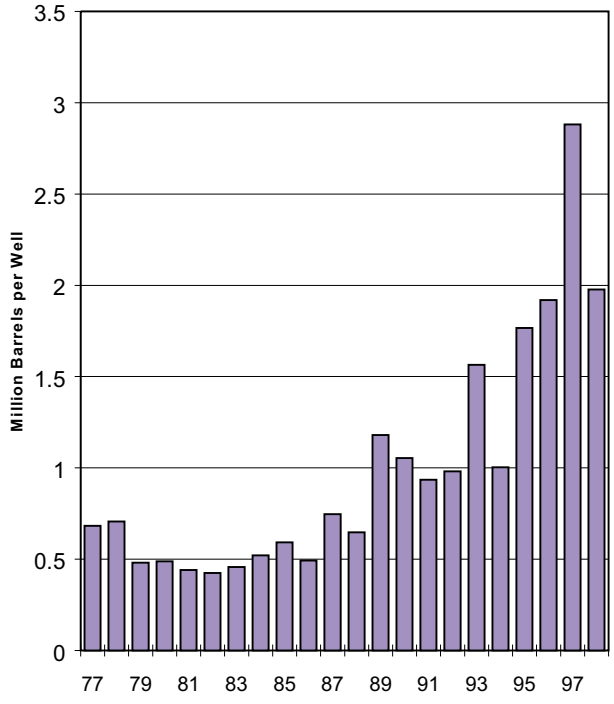


Figure 10. U.S. Total Discoveries of Crude Oil per Exploratory Oil Well Completion, 1977-1998



Source: Energy Information Administration, Office of Oil and Gas.

In 1998, both U.S. crude oil proved reserves and oil production decreased—resulting in no significant change in the National average R/P ratio (10.6).

Figure 11 shows the U.S. R/P ratio trend for crude oil since 1945. After World War II, increased drilling and discoveries led to a greater R/P ratio. Later, when drilling found fewer reserves than were produced, the ratio became smaller. R/P ratios also vary geographically. Less developed areas of the country, such as the Pacific offshore, have higher R/P ratios for crude oil than the 1998 National average of 10.6-to-1. Other areas with relatively high R/P ratios are the Permian Basin of Texas and New Mexico, and California, where enhanced oil recovery techniques such as carbon dioxide (CO_2) injection or steamflooding have improved recoverability of oil in old, mature fields. Areas that have the lowest R/P ratios, like the Mid-Continent region, usually have many older fields. There, new technologies such as horizontal drilling have helped add reserves equivalent to the annual production, keeping the regional reserves and R/P ratio for oil relatively stable.

Figure 12 shows the historical R/P ratio for wet natural gas since 1945. Prior to 1945, R/P ratios were very high since the interstate pipeline infrastructure was not well developed. The market for and production of natural gas grew rapidly after World War II, lowering the R/P ratio. The U.S. average R/P ratio for natural gas increased in 1998, as reserves decreased, but not more than the decline in production.

Different marketing, transportation, and production characteristics for gas are seen when looking at regional average R/P ratios, compared to the 1998 U.S. average R/P ratio of about 8.8-to-1. The areas with the higher range of R/P ratios are the less developed or less productive areas of the country, such as the Pacific offshore and the Rockies, and also include areas such as Alabama and Colorado where considerable booking of coalbed methane reserves has recently occurred. Several major gas producing areas have R/P ratios below the National average, particularly Texas, the Gulf of Mexico Federal Offshore, and Oklahoma. The R/P ratio of these three areas combined increased from 6.8-to-1 in 1997 to 6.9-to-1 in 1998, and is below the National 1998 average.

Proved Ultimate Recovery

EIA has in past reports defined Ultimate Recovery as the sum of proved reserves and cumulative production. However, despite EIA's clear definition, the volume presented by EIA has often been misused or misinterpreted as the maximum recoverable volume of resources for an area. This neglects the addition of proved reserves over time through ultimate recovery appreciation (a.k.a. reserves growth or field growth) and has led some to make overly-pessimistic resource assessments for the United States. EIA is therefore introducing a new term, *Proved Ultimate Recovery*:

> **Proved Ultimate Recovery** is the sum of proved reserves and cumulative production. It is expected to change over time for any field, group of fields, State, or Country. Proved Ultimate Recovery does not represent the maximum recoverable volume of resources for an area. It is instead a gauge of how much has already been produced plus proved reserves. Proved reserves of crude oil or natural gas are the estimated quantities of petroleum which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. When deterministic proved reserves estimation methods are used, the term reasonable certainty is intended to express a high degree of confidence that the estimated quantities will be recovered. When probabilistic methods are used there should be at least a 90 percent probability that the actual quantities recovered will exceed the estimate.

Figures 13 and 14 show successive estimates of proved ultimate recovery and its components, proved reserves and cumulative production, for crude oil plus lease condensate, and wet natural gas, from 1977 through 1998. They illustrate the continued appreciation (growth) of proved ultimate recovery over time.

In 1977, U.S. crude oil and lease condensate proved reserves were 33,615 million barrels. Cumulative production of crude oil and lease condensate for 1977 through 1998 was 59,205 million barrels. This substantially exceeds the 1977 proved reserves, but at the end of 1998 there were still 22,370 million barrels of crude oil and lease condensate proved reserves. Therefore, the Nation's estimated proved ultimate recovery of crude oil was fundamentally increased during this period owing to the *proved ultimate recovery appreciation* process (continued development of old fields). In fact, only 8 percent of proved reserves additions of crude oil were booked as *new field discoveries* from 1976 through 1998. The rest was from proved reserves categories included in the proved ultimate recovery appreciation process (*new reservoir discoveries in old fields*, *extensions*, and *revisions and*

Figure 11. Reserves-to-Production Ratios for Crude Oil, 1945-1998

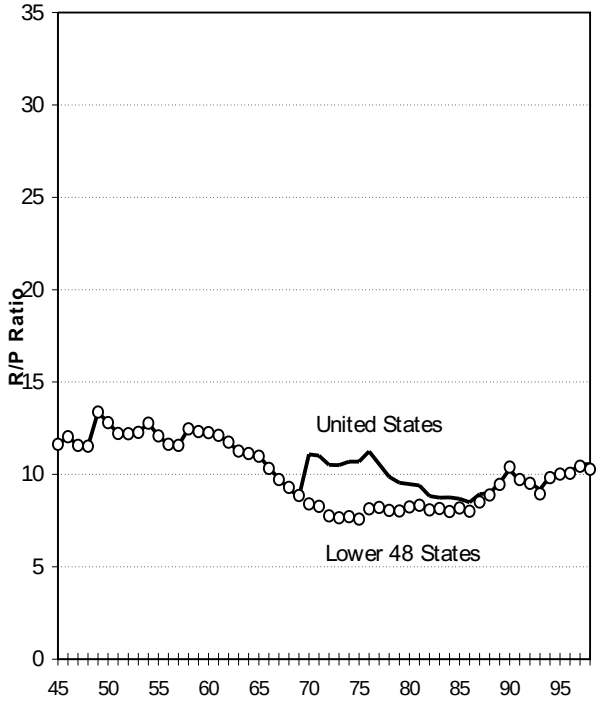


Figure 12. Reserves-to-Production Ratios for Wet Natural Gas, 1945-1998

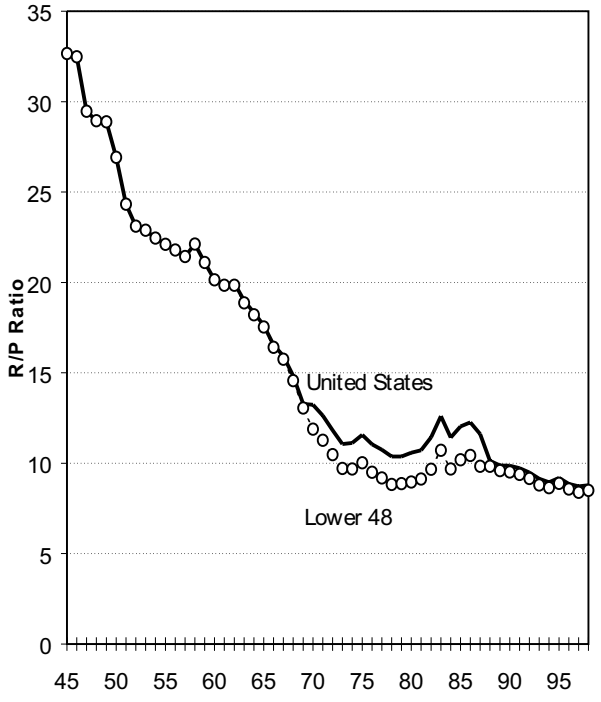


Figure 13. Components of Proved Ultimate Recovery for Crude Oil and Lease Condensate, 1977-1998

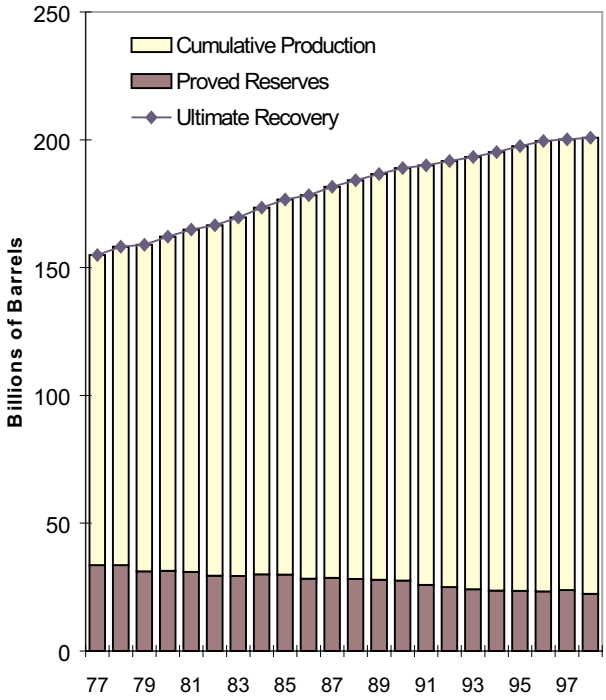
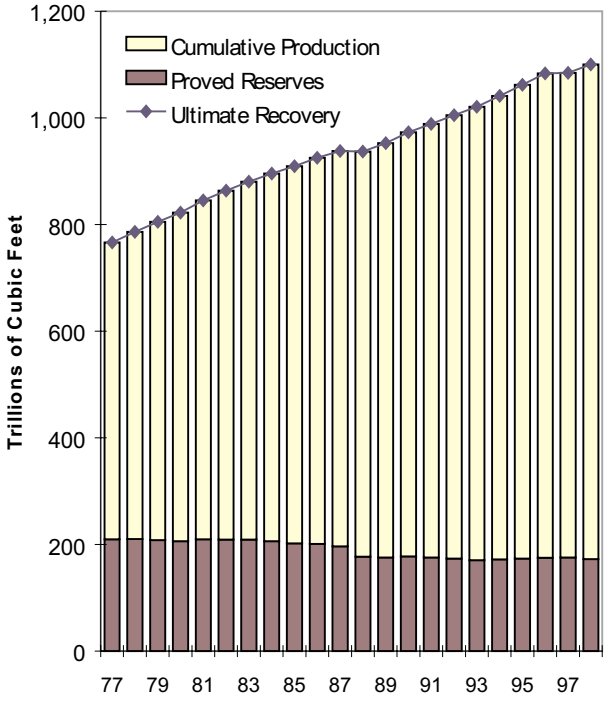


Figure 14. Components of Proved Ultimate Recovery for Wet Natural Gas, 1977-1998



Sources: Annual reserves and production - American Petroleum Institute and American Gas Association (1945–1976){27} and Energy Information Administration, Office of Oil and Gas (1977–1998){1-21}. Cumulative production: *U.S. Oil and Gas Reserves by Year of Field Discovery* (1977-1988).{28}

Table 5. International Oil and Natural Gas Reserves as of December 31, 1998

Oil (million barrels)				Natural Gas (billion cubic feet)			
Rank[a]	Country	Oil & Gas Journal	World Oil	Rank[b]	Country	Oil & Gas Journal	World Oil
1	Saudi Arabia[c]	[d]261,500	[d]261,425	1	Former U.S.S.R.	1,977,000	1,904,350
2	Iraq[c]	112,500	98,975	2	Iran[c]	812,300	812,238
3	Kuwait[c]	[d]96,500	[d]94,680	3	Qatar[c]	300,000	395,000
4	Iran[c]	89,700	92,870	4	United Arab Emirates[c]	212,500	202,550
5	United Arab Emirates[c]	97,800	63,505	5	Saudi Arabia[c]	[d]204,500	[d]208,000
6	Former U.S.S.R.	57,000	66,641	**6**	**United States**	**[e]167,223**	**167,772**
7	Venezuela[c]	72,600	45,500	7	Venezuela[c]	142,500	146,571
8	Mexico	47,822	28,399	8	Algeria[c]	130,300	137,500
9	China	24,000	33,520	9	Nigeria[c]	124,000	124,000
10	Libya[c]	29,500	26,900	10	Iraq[c]	109,800	112,600
Top 10 Total		**888,724**	**810,090**	**Top 10 Total**		**4,179,823**	**4,210,581**
11	Nigeria[c]	22,500	22,500	11	Malaysia	81,700	85,831
12	**United States**	**[e]22,546**	**22,013**	12	Indonesia[c]	72,268	77,066
13	Norway	10,913	11,901	13	Canada	63,874	63,555
14	Algeria[c]	9,200	13,000	14	Netherlands	63,107	62,516
15	Brazil	7,106	7,500	15	Kuwait[c]	[d]52,200	[d]56,350
16	Indonesia[c]	4,980	8,637	16	Mexico	63,456	30,300
17	Oman	5,283	5,564	17	Libya[c]	46,400	46,300
18	Canada	4,931	5,582	18	China	48,300	42,360
19	United Kingdom	5,191	5,153	19	Norway	41,424	43,627
20	Angola	5,412	4,030	20	Australia	44,638	28,410
21	Qatar[c]	3,700	5,338	21	Egypt	31,500	37,205
22	Malaysia	3,900	4,645	22	Oman	28,416	29,100
23	Egypt	3,500	3,710	23	United Kingdom	27,016	26,652
24	India	3,972	3,027	24	Argentina	24,148	24,247
25	Yemen	4,000	1,850	25	Pakistan	21,600	21,600
Top 25 Total		**1,006,056**	**931,988**	**Top 25 Total**		**4,889,670**	**4,881,700**
OPEC Total		**800,480**	**733,330**	**OPEC Total**		**2,206,768**	**2,318,175**
World Total		**1,034,667**	**968,513**	**World Total**		**5,144,736**	**5,148,978**

[a]Rank is based on an average of oil reserves reported by *Oil & Gas Journal* and *World Oil*.

[b]Rank is based on an average of natural gas reserves reported by *Oil & Gas Journal* and *World Oil*.

[c]Member of the Organization of Petroleum Exporting Countries (OPEC).

[d]Includes one-half of the reserves in the Neutral Zone.

[e]Energy Information Administration proved reserves as of December 31, 1997 were published by the *Oil & Gas Journal* as its estimates as of December 31, 1998.

Note: The Energy Information Administration does not certify these international reserves data, but reproduces the information as a matter of convenience for the reader.

Sources: PennWell Publishing Company, *Oil and Gas Journal*, December 28, 1998, pp. 38-39. Gulf Publishing Company, *World Oil*, August, 1999, pp. 28-29.

adjustments.) A significant part of the total proved ultimate recovery appreciation came from the proved ultimate recovery appreciation of those new fields discovered between 1976 and 1998.

Similarly, the 1977 dry natural gas proved reserves were 213,278 billion cubic feet, and cumulative dry gas production from 1977 through 1998 was 388,917 billion cubic feet. Cumulative dry gas production exceeded the 1977 reserves, but at the end of 1998 there were still 164,041 billion cubic feet of dry natural gas proved reserves, for the same reasons. Only 13 percent of proved reserve additions of natural gas were booked as *new field discoveries* from 1976 through 1998.

International Perspective

International Reserves

The EIA estimates domestic oil and gas reserves but does not systematically estimate worldwide reserves. As shown in **Table 5**, international reserves estimates are presented in two widely circulated trade publications. The world's total reserves are estimated to be roughly 1 trillion barrels of oil and 5 quadrillion cubic feet of gas.

The United States ranked 12th in the world for proved reserves of crude oil and 6th for natural gas in 1998. A comparison of EIA's U.S. proved reserves estimates with worldwide estimates obtained from other sources shows that the United States had about 2 percent of the world's total crude oil proved reserves and over 3 percent of the world's total natural gas proved reserves at the end of 1998. There are sometimes substantial differences between the estimates from these sources. The *Oil & Gas Journal* reported oil reserves for the United Arab Emirates at about 98 billion barrels. This is about 50 percent higher than the *World Oil* estimate of 64 billion. One reason (among many) for these differences is that condensate is often included in foreign oil reserve estimates.

The *Oil & Gas Journal*{29} estimate for world oil reserves increased 1 percent in 1998, while the *World Oil*{30} estimate decreased less than 1 percent. For world gas reserves, the *Oil & Gas Journal* reported a 6 percent increase, while *World Oil* reported a 1 percent increase. The *Oil & Gas Journal*'s estimates were boosted mostly by increases in their estimate of gas reserves for Australia, Nigeria, and Saudi Arabia, but also because EIA proved reserves as of December 31, 1997 were published by the *Oil & Gas Journal* as its estimates as of December 31, 1998.

Several foreign countries have oil reserves considerably larger than those of the United States. Saudi Arabian oil reserves are the largest in the world, dwarfing U.S. oil reserves. Iraqi oil reserves are almost 5 times U.S. reserves. Closer to home, Venezuela has almost triple and Mexico has around 81 percent more than the United States' oil reserves. (Based on averages of the World Oil and Oil & Gas Journal estimates).

Petroleum Consumption

The United States is the world's largest energy consumer. The EIA estimates energy consumption and publishes it in its *Annual Energy Review*.{31} In 1998:

- The U.S. consumed 94,231,275,000,000,000 Btu of energy (94.23 quadrillion Btu).
- 62 percent of U.S. energy consumption was provided by petroleum and natural gas—crude oil and natural gas liquids combined (39 percent), and natural gas (23 percent).
- U.S. petroleum consumption was about 18.7 million barrels of oil and natural gas liquids and 58.3 billion cubic feet of dry gas per day.

Dependence on Imports

The United States remains heavily dependent on imported oil and gas to satisfy its ever-increasing appetite for energy. In 1998, the U.S. was dependent on net petroleum imports for 51 percent of energy consumption.

Net gas imports increased slightly in 1998 to 3 trillion cubic feet, which is approximately 14 percent of consumption. Almost all of this gas was pipelined from Canada, some came from Mexico, though Mexico remains a net importer of natural gas from the U.S., and liquefied natural gas was imported from Algeria and Australia.

Venezuela, Canada, Saudi Arabia, Mexico, and Nigeria were the primary foreign suppliers of petroleum to the United States.{32}

List Of Appendices

Appendix A: Reserves by Operator Production Size Class - How much of the National total of proved reserves are owned and operated by the large oil and gas corporations? Appendix A separates the large

operators from the small and presents reserves data according to operator production size classes.

Appendix B: Top 100 Oil and Gas Fields - What fields have the most reserves and production in the United States? The top 100 fields for oil and natural gas out of the inventory of more than 45,000 oil and gas fields are listed in Appendix B. These fields hold two-thirds of U.S. crude oil proved reserves.

Appendix C: Conversion to the Metric System - To simplify international comparisons, a summary of U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves expressed in metric units is included as Appendix C.

Appendix D: Historical Reserves Statistics - Appendix D contains selected historical reserves data presented at the State and National level. Readers interested in a historical look at one specific State or region can review these tables. We have again included Table D9, Deepwater Production and Proved Reserves of the Gulf of Mexico Federal Offshore 1992-1998, due to expressed interest from the industry regarding this area. Table D9 contains the production and proved reserves for 1992-1998 for the Gulf of Mexico Federal Offshore region by water depths greater than 200 meters, and less than 200 meters.

Appendix E: Summary of Data Collection Operations - This report is based on two EIA surveys. Proved reserves data is collected annually from U.S. oil and gas field operators on Form EIA-23. Natural gas liquids production data is collected annually from U.S. natural gas plant operators on Form EIA-64A. Appendix E describes survey designs, response statistics, reporting requirements, and sampling frame maintainance.

Appendix F: Statistical Considerations - The EIA strives to maintain or improve the accuracy of its reports. Since complete coverage of all oil and gas operators is impractical, the EIA has adopted sound statistical methods to impute data for those operators not sampled and for those data elements that smaller operators are not required to file. These methods are described in Appendix F.

Appendix G: Estimation of Reserves and Resources - Reserves are not measured directly. Reserves are estimated on the basis of the best geological, engineering, and economic data available to the estimator. Appendix G describes reserve estimation techniques commonly used by oil and gas field operators and EIA personnel when in the field performing quality assurance checks. A discussion of the relationship of reserves to overall U.S. oil and gas resources is also included.

Appendix H: Maps of Selected State Subdivisions - Certain large producing States have been subdivided into smaller regions to allow more specific reporting of reserves data. Maps of these States identifying the smaller regions are provided in Appendix H.

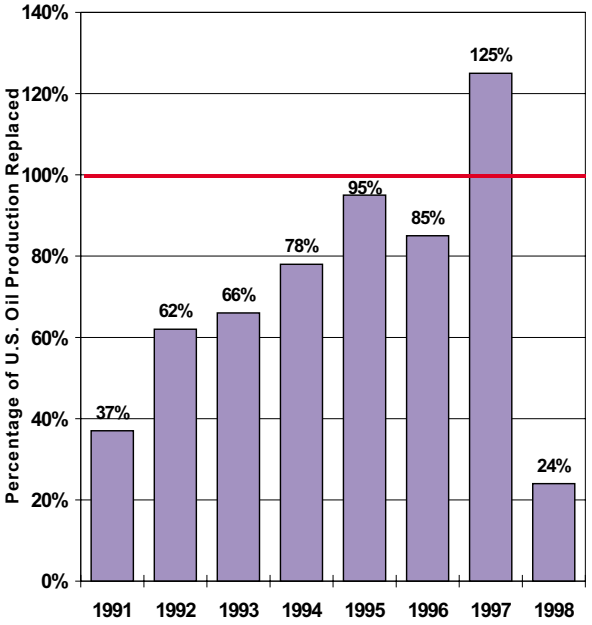
Appendix I: Annual Survey Forms of Domestic Oil and Gas Reserves - Samples of Form EIA-23 and Form EIA-64A are presented in Appendix I.

Glossary - Contains definitions of many of the technical terms used in this report.

3. Crude Oil Statistics

The United States had 21,034 million barrels of crude oil proved reserves as of December 31, 1998. This is 7 percent (-1,512 million barrels) less than in 1997, and is the largest percentage decline in oil reserves in 53 years. *Reserves additions* of crude oil were less than a fifth of those in 1997—operators only replaced 24 percent of 1998 oil production (**Figure 15**). Crude oil prices, which began a decline in 1997, fell dramatically during 1998 to levels last seen in 1935 by December. Low prices curtailed new drilling and imposed negative revisions on producing oil fields, which resulted in the large drop in crude oil proved reserves in 1998.

Figure 15. Reserve Additions Replace Only 24 Percent of U.S. Oil Production in 1998



Source: Energy Information Administration, Office of Oil and Gas.

Over the past decade, U.S. crude oil proved reserves had been declining (**Figure 1**) an average of 2 percent per year. However, less new reserve additions and more negative revisions made the decline much more severe in 1998. As of December 1999, prices have rebounded—yet oil well drilling has yet to resume at the pace observed in the last decade. If drilling resumes, it is expected that the 2 percent declining trend will reestablish itself in the future. In the absence of that needed drilling, declines will be higher as the reserves base depletes through production.

Proved Reserves

Table 6 presents the U.S. proved reserves of crude oil as of December 31, 1998, by selected States and State subdivisions.

Figure 16 maps 1998 crude oil proved reserves by area. The following four areas account for 79 percent of U.S. crude oil proved reserves:

Area	Percent of U.S. Oil Reserves
Alaska	24
Texas	23
California	18
Gulf of Mexico Federal Offshore	13
Area Total	**79**

Of these four areas, California increased its reserves in 1998, while Alaska, the Gulf of Mexico, and Texas all had decreases in crude oil proved reserves.

Discussion of Reserves Changes

Figure 17 maps the change in crude oil proved reserves from 1997 to 1998 by area. Here's how the top four areas fared compared to the total United States:

Area	Change in U.S. Oil Reserves (million barrels)
Texas	-760
Alaska	-109
California	+93
Gulf of Mexico Federal Offshore	-156
Area Total	**-932**
U.S. Total	**-1,512**

Figure 2 in Chapter 2 shows the components of the changes in crude oil proved reserves for 1998 and the preceding 10 years.

Table 6. Crude Oil Proved Reserves, Reserves Changes, and Production, 1998

(Million Barrels of 42 U.S. Gallons)

State and Subdivision	Published Proved Reserves 12/31/97	Changes in Reserves During 1998							Proved Reserves 12/31/98
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (--)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	5,161	1	267	64	28	96	0	437	5,052
Lower 48 States	**17,385**	**-639**	**2,485**	**2,170**	**299**	**56**	**120**	**1,554**	**15,982**
Alabama	47	2	6	9	0	0	0	7	39
Arkansas	45	-1	24	14	0	0	0	7	47
California	3,750	-131	789	336	23	0	18	270	3,843
Coastal Region Onshore	430	-33	62	86	0	0	0	19	354
Los Angeles Basin Onshore	268	-39	19	42	0	0	18	17	207
San Joaquin Basin Onshore	2,871	-58	708	204	23	0	0	213	3,127
State Offshore	181	-1	0	4	0	0	0	21	155
Colorado	198	17	37	21	1	0	0	20	212
Florida	91	-1	0	13	0	0	0	6	71
Illinois	92	-25	56	32	0	0	0	10	81
Indiana	10	-4	12	4	0	0	0	[b]1	[b]13
Kansas	238	28	85	77	5	1	0	34	[b]246
Kentucky	20	9	0	4	0	0	0	2	23
Louisiana	714	-81	180	208	17	3	9	83	551
North	136	11	31	62	3	0	0	18	101
South Onshore	427	-58	139	129	14	2	6	48	353
State Offshore	151	-34	10	17	0	1	3	17	97
Michigan	68	-5	8	19	0	0	0	8	44
Mississippi	183	20	13	65	9	0	0	19	141
Montana	159	-11	30	13	15	1	0	14	167
Nebraska	21	2	4	6	0	0	0	3	18
New Mexico	735	-36	79	126	23	0	4	59	620
East	719	-33	78	123	23	0	4	58	610
West	16	-3	1	3	0	0	0	1	10
North Dakota	279	-29	33	21	16	0	0	33	245
Ohio	43	0	9	6	0	0	0	6	40
Oklahoma	605	-62	207	106	16	1	0	62	599
Pennsylvania	17	-2	1	2	2	0	0	1	15
Texas	5,687	-295	514	621	48	2	9	417	4,927
RRC District 1	83	-18	35	32	1	0	0	8	[b]61
RRC District 2 Onshore	66	-22	16	8	0	0	0	7	45
RRC District 3 Onshore	259	-11	45	56	9	0	0	35	211
RRC District 4 Onshore	70	-23	6	7	0	0	0	6	40
RRC District 5	54	-23	19	8	1	0	5	8	40
RRC District 6	348	-13	19	15	1	0	0	32	308
RRC District 7B	155	-21	16	21	1	0	0	15	115
RRC District 7C	227	-37	19	22	3	1	0	18	173
RRC District 8	2,100	-58	129	192	20	1	3	138	1,865
RRC District 8A	2,098	-40	173	219	10	0	0	127	1,895
RRC District 9	144	-25	21	15	1	0	1	16	111
RRC District 10	79	-1	15	25	1	0	0	[b]7	[b]62
State Offshore	4	-3	1	1	0	0	0	0	1
Utah	234	-9	10	21	1	0	0	14	201
West Virginia	26	0	1	9	0	0	0	1	17
Wyoming	627	-2	46	98	31	1	0	58	547
Federal Offshore	3,477	-22	340	336	92	47	80	417	3,261
Pacific (California)	528	-16	33	42	5	0	5	45	468
Gulf of Mexico (Louisiana)	2,587	15	275	263	84	47	74	336	2,483
Gulf of Mexico (Texas)	362	-21	32	31	3	0	1	36	310
Miscellaneous[a]	19	-1	1	3	0	0	0	2	14
U.S. Total	**22,546**	**-638**	**2,752**	**2,234**	**327**	**152**	**120**	**1,991**	**21,034**

[a]Includes Arizona, Missouri, Nevada, New York, South Dakota, Tennessee, and Virginia.

[b]Indicates the estimate is associated with a sampling error (95 percent confidence interval) that exceeds 20 percent of the estimated value.

Note: The production estimates in this table are based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves." They may differ from the official Energy Information Administration production data for crude oil for 1998 contained in the *Petroleum Supply Annual 1998*, DOE/EIA-0340(98).

Source: Energy Information Administration, Office of Oil and Gas.

Figure 16. 1998 Crude Oil Proved Reserves by Area

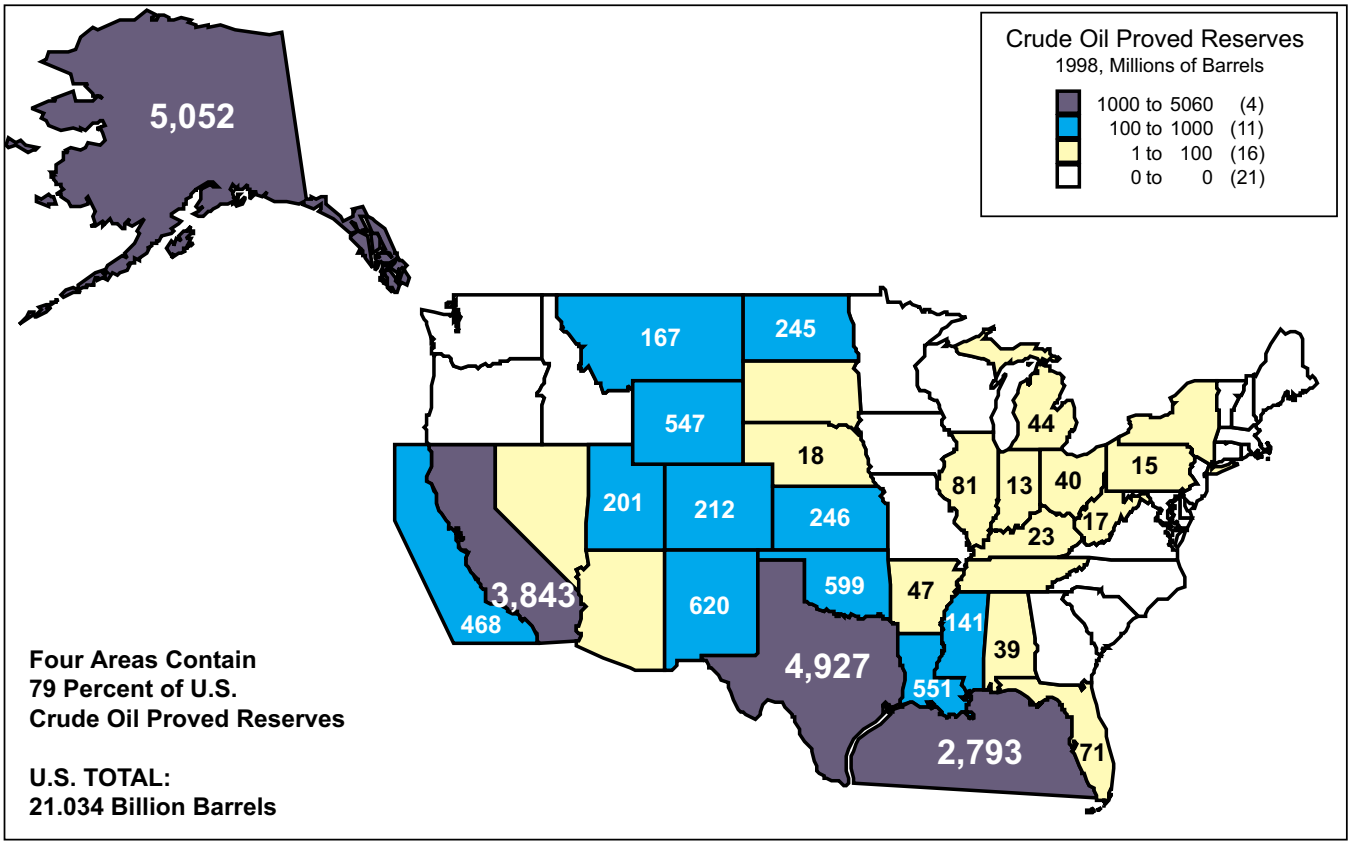
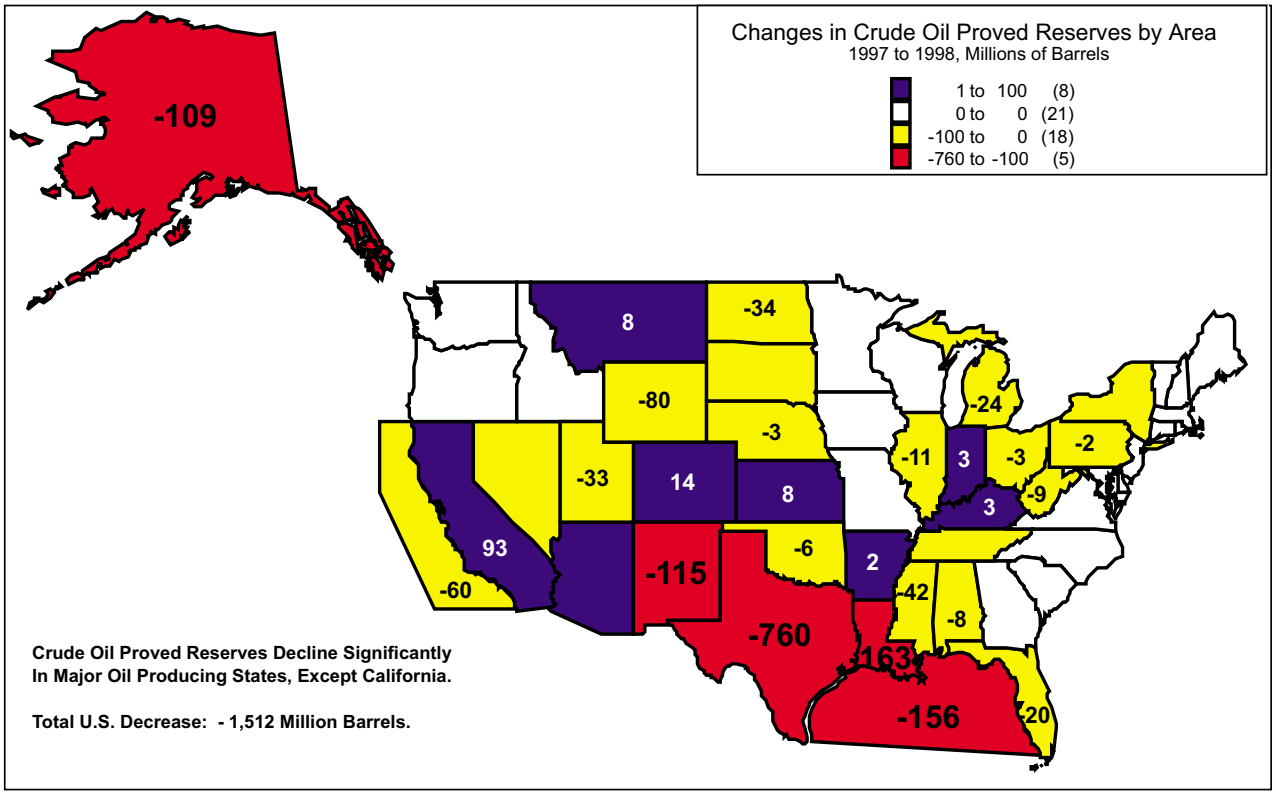


Figure 17. Changes in Crude Oil Proved Reserves by Area, 1997 to 1998



Source: Energy Information Administration, Office of Oil and Gas.

Total Discoveries

Total discoveries are those new reserves attributable to *extensions* of existing fields, *new field discoveries*, and *new reservoir discoveries in old fields*. They result from the drilling of exploratory wells.

Total discoveries of crude oil were 599 million barrels in 1998, less than half those of 1997. Only five areas had *total discoveries* exceeding 30 million barrels:

- The Gulf of Mexico Federal Offshore had 209 million barrels of *total discoveries*, 35 percent of the National total.
- Alaska had 124 million barrels of *total discoveries*, 21 percent of the National total.
- Texas had 59 million barrels of *total discoveries*, 10 percent of the National total.
- California had 41 million barrels of *total discoveries*, 7 percent of the National total.
- Wyoming had 32 million barrels of *total discoveries*, 5 percent of the National total.

The United States discovered an average of 747 million barrels of new crude oil proved reserves per year in the prior 10 years (1988 through 1997). *Total discoveries* in 1998 were 20 percent less than that average.

Extensions

Operators reported 327 million barrels of *extensions* in 1998. The highest volume of *extensions* was reported in the Gulf of Mexico Federal Offshore (87 million barrels of *extensions*.) Operators in Texas reported 48 million barrels of *extensions*. Wyoming was third with 31 million barrels, followed by Alaska with 28 million barrels.

In the prior 10 years, U.S. operators reported an average of 435 million barrels of *extensions* per year. The 1998 *extensions* were 25 percent less than that average.

New Field Discoveries

There were 152 million barrels of *new field discoveries* reported in 1998. Only eight areas in the United States reported any *new field discoveries*, and only two contributed more than 2 percent to the total:

- Alaska (63 percent; 96 million barrels)
- Gulf of Mexico Federal Offshore (31 percent; 47 million barrels).

In the prior 10 years, U.S. operators reported an average of 176 million barrels of reserves from *new field discoveries* per year. Reserves from *new field discoveries* in 1998 were 14 percent less than that average volume.

New Reservoir Discoveries in Old Fields

Operators in the United States reported 120 million barrels of crude oil reserves from *new reservoir discoveries in old fields* in 1998. As with *new field discoveries*, the most significant portion of the *new reservoir discoveries in old fields* came from the Gulf of Mexico Federal Offshore—75 million barrels or 63 percent of the total. California had 18 million barrels (15 percent), and Louisiana and Texas each had 9 million barrels (8 percent each). In the prior 10 years, U.S. operators reported an average of 135 million barrels of reserves from *new reservoir discoveries in old fields* per year. Reserves from *new reservoir discoveries in old fields* in 1998 were 89 percent of that average.

Revisions and Adjustments

Thousands of positive and negative *revisions* to proved reserves occur each year as infill wells are drilled, well performance is analyzed, new technology is applied, or economic conditions change. *Adjustments* are the annual changes in the published reserve estimates that cannot be directly attributed to the estimates for other reserve change categories because of the survey and statistical estimation methods employed.

There were -120 million barrels of net *revisions and adjustments* for crude oil in 1998. This was the first time in 22 years that revisions and adjustments did not make a positive contribution to oil reserve additions. Average *revisions and adjustments* for the prior 10 years were 1,181 million barrels.

Production

U.S. *production* of crude oil in 1998 was 1,991 million barrels. This was 7 percent lower than 1997's total of 2,138 million barrels. U.S. crude oil *production* has declined in 12 of the last 13 years. Alaska and Texas are still the largest producers of crude oil in the United States with 22 percent and 21 percent of the total, respectively. The Gulf of Mexico Federal Offshore is third with 19 percent, and California has 14 percent.

In 1998, the Form EIA-23 National production estimates were 5 percent lower than the comparable *Petroleum Supply Annual (PSA) 1998* volumes for crude

oil and lease condensate combined. There were over a thousand significant oil and gas field sales in 1998 reviewed by EIA as part of our quality assurance program. Often, new operators of a field acquired through purchase correctly reported their new proved reserves on Form EIA-23, but then reported only their 1998 production since assuming ownership – which may leave out several months of production from their reported annual total for a field. The net effect of this was a larger than usual difference between the total oil production reported on Form EIA-23 and the annual production reported in the *PSA 1998*.

Areas of Note: Large Discoveries and Reserves Additions

The following State and area discussions summarize notable activities during 1998 concerning expected new field reserves, development plans, and possible production rates as reported in various trade publications. The citations do not necessarily reflect EIA's concurrence, but are considered important enough to be brought to the reader's attention.

The following areas are the major success stories for crude oil reserves and production for 1998.

California

California's proved oil reserves increased by 93 million barrels in 1998. The largest increase was from revisions and adjustments in the San Joaquin Basin Onshore, home of California's "heavy oil" fields. This area's reserves increased by 256 million barrels. California's production declined by about 5 percent from 1997's level of 285 million barrels. Reserves additions would have been even smaller in the U.S., had not certain operators (particularly those in California) continued to develop large, long-term projects despite low oil prices.

On February 5, 1998, following a ruling by a federal judge denying a request from environmentalists and Native Americans seeking to block the sale of the Elk Hills Naval Petroleum Reserve, the U.S. Department of Energy formally transferred ownership of the reserve to Occidental Petroleum Corporation. Occidental purchased a 78 percent interest in the field for $3.65 billion. Chevron Corporation currently holds the remaining 22 percent.{33}

Colorado

Colorado had the second highest net increase in crude oil proved reserves in 1998, an increase of 14 million barrels. Operators in Colorado, through acquisitions or field development, revised their crude oil proved reserves upward, and when combined with adjustments the total volume exceeded production in 1998. Colorado had an estimated 20 million barrels of oil production in 1998, which is 5 percent lower than 1997's production (21 million barrels).

Alaska

Alaska reported 124 million barrels of *total discoveries* of crude oil proved reserves in 1998—the second highest total discoveries in the United States (following the Gulf of Mexico Federal Offshore). Alaska led the nation in *new field discoveries* with a volume of 96 million barrels. The new field discoveries were made on the North Slope in "satellite fields", meaning that they are located next to large, existing Alaskan North Slope fields and can be developed economically by extending facilities from the existing production sites to reach them.

For example, in 1998, BP Exporation (now BP Amoco) began commercial production from Badami, a "satellite field" discovery on the North Slope. Badami is located on the shore of Mikkelsen Bay about 35 miles east of Prudhoe Bay. BP Exploration and its partner, PetroFina S.A. (Fina) developed this field. Badami leases lie both onshore and offshore in a sandstone reservoir at a depth of about 10,000 feet. The oil pay zone thickness is estimated to be 65-115 feet. Badami was developed as a single, onshore drill site with 40 wells and stand-alone processing facilities for handling 35,000 barrels per day. Crude oil is sent to the Endicott sales oil pipeline, which delivers it to the trans-Alaska pipeline. No road was built to Badami— access is by barge, aircraft and helicopter, and in winter by ice road. Production was briefly halted at Badami in early 1999 due to challenging reservoir conditions. Production was resumed on May 1, 1999. {34}

Gulf of Mexico Federal Offshore

Despite the net loss of reserves in 1998, the Gulf of Mexico still holds much promise for future development and reserves additions, especially in deep water. In 1998, this area had the most reserves additions of *extensions* and *new reservoir discoveries in old fields*.

- **Tanzanite:** On July 29, 1998 Anadarko Petroleum announced that it had discovered oil and natural gas at the Eugene Island South Addition Block 346 in the Gulf of Mexico, located approximately 75 miles offshore Louisiana. Anadarko estimates that the Tanzanite prospect contains reserves of at least 140 million barrels of oil equivalent. On September 14, 1998, Anadarko reported its Tanzanite No. 1 well tested 21,917 barrels oer day of oil and 29.7 million cubic feet per day of natural gas.{35}

- **Angus, Europa, Macaroni:** On March 19, 1998, Shell Exploration and Production Company announced it would spend $1 billion developing the Angus, Europa, and Macaroni oil and gas discoveries located in the Gulf of Mexico. Shell expects the Angus development can yield 40,000 barrels of oil per day and 60 million cubic feet of gas per day by the end of 1999. The Europa development is expected to produce 60,000 barrels of oil per day and 45 million cubic feet of gas per day by early 2001. The Macaroni development is anticipated to yield 35,000 barrels of oil per day and 65 million cubic feet of gas per day by late 1999. Shell expects these three discoveries could add 300 million barrels of oil equivalent to the Gulf of Mexico's deep water inventory.{36}

- **Hoover and Diana:** On April 8, 1998, Exxon Corporation and British Petroleum (now BP Amoco) announced that they will spend $1.2 billion developing the Hoover and Diana oil and gas fields, located south of Galveston, Texas, in the Gulf of Mexico. Exxon estimates the fields could contain recoverable reserves of more than 300 million oil-equivalent barrels, and production is estimated to begin by 2000. Exxon holds a 66.7 percent operating interest in the project, with British Petroleum holding the remaining 33.3 percent interest.{37}

Other Gain Areas

Montana: Montana's proved oil reserves increased by 5 percent (8 million barrels).

Kansas: Kansas' proved oil reserves increased by 3 percent (8 million barrels).

Areas of Note: Large Reserves Declines

The following areas had large declines in crude oil proved reserves due to downward revisions or unreplaced production.

Texas

Texas' proved oil reserves declined by 760 million barrels in 1998, the largest decline for any State. Crude oil proved reserves in this State were revised and adjusted downward by 402 million barrels in 1998. Texas' production also declined about 12 percent from 1997 levels.

Of Texas' many districts, the largest reserves decline (235 million barrels) was in RRC District 8. Ironically, RRC District 8 is also where the most *total discoveries* of crude oil proved reserves were made in Texas in 1998 (24 million barrels)—but this volume was meager compared to the negative double-whammy of a net downward revision of 121 million barrels and production of another 138 million barrels. Other areas where oil reserves significantly decreased were RRC District 8A (203 million barrels) and RRC District 7C (54 million barrels). Not one RRC District in Texas reported an increase in crude oil proved reserves in 1998.

Louisiana

Louisiana's proved oil reserves decreased by 163 million barrels. The South Onshore region of Lousiana reported almost half of the loss. Louisiana's production also decreased 17 percent from 1997's level.

Gulf of Mexico Federal Offshore

There was a net loss of 156 million barrels of crude oil proved reserves from the Gulf of Mexico Federal Offshore in 1998. Gulf oil reserves had been increasing for 6 years in a row—1998's decline interrupts this trend. It is expected that development and exploration in the Gulf of Mexico Federal Offshore will continue to add future reserves, making 1998's decline merely an economic "pothole" in the road of developing the Gulf's great resource base.

The Gulf of Mexico produced about 372 million barrels of crude oil in 1998, an increase of 9 percent (30 million barrels) over 1997's production. However, there were only 216 million barrels of total reserves additions

(which includes adjustments, net revisions, and total discoveries) in this area, which replaced just 58 percent of production from this area.

New Mexico

New Mexico's proved oil reserves decreased by 115 million barrels. The East region of New Mexico reported the bulk of the loss. New Mexico's production also decreased 7 percent from 1997's level.

Alaska

Alaska's crude oil proved reserves declined 109 million barrels in 1998, slightly less than the loss reported in 1997 (113 million barrels). Alaska had the most volume of *new field discoveries* (96 million barrels) of any State in 1998. It also had the second highest volume of net revisions and adjustments (204 million barrels). But these did not offset Alaska's oil production—an estimated 437 million barrels in 1998. Alaska's production declined 8 percent from its 1997 level.

Other Decline Areas

In the following areas of the United States, development of existing or new oil fields was outpaced by crude oil production.

Wyoming: Proved oil reserves decreased by 13 percent (80 million barrels).

Pacific Federal Offshore: Proved oil reserves decreased by 11 percent (60 million barrels). On June 12, 1998, President Clinton extended by 10 years the ban on offshore drilling for much of the United States. The extended ban prevents drilling for oil and natural gas in most parts of the Atlantic and Pacific coasts until 2012.{38}

Mississippi: Proved oil reserves decreased by 23 percent (42 million barrels).

Reserves in Nonproducing Reservoirs

Not all proved reserves of crude oil were contained in reservoirs that were producing. Operators reported 4,147 million barrels of proved reserves in nonproducing reservoirs, 10 percent more than reported in 1997 (3,755 million barrels).

Nonproducing reserves are those waiting for well workovers, drilling additional development or replacement wells, installing production or pipeline facilities, and awaiting depletion of other zones or reservoirs before recompletion in reservoirs not currently open to production.

Indicated Additional Reserves

In addition to proved reserves of crude oil, Category I and Category II operators estimate the quantities of crude oil, other than proved reserves, that may become economically recoverable from known reservoirs through the application of improved recovery techniques using currently available technology. The 1998 volume, 3,160 million barrels, is about 1 percent less than what was reported in 1997 (3,207 million barrels).

Table 7 lists the indicated additional reserves by selected States and State subdivisions. The presence of large indicated additional reserves in Alaska, California, south Louisiana and west Texas implies that significant upward revisions to proved crude oil reserves could occur in the future.

Table 7. Reported Indicated Additional Crude Oil Reserves,[a] 1998

(Million Barrels of 42 U.S. Gallons)

State and Subdivision	Indicated Additional Reserves
Alaska	832
Lower 48 States	2,328
Alabama	0
Arkansas	0
California	1,297
Coastal Region Onshore	40
Los Angeles Basin Onshore	0
San Joaquin Basin Onshore	1,257
State Offshore	0
Colorado	21
Florida	0
Illinois	0
Indiana	0
Kansas	0
Kentucky	0
Louisiana	309
North	0
South Onshore	307
State Offshore	2
Michigan	0
Mississippi	0
Montana	0
Nebraska	0
New Mexico	168
East	168
West	0
North Dakota	1
Ohio	0
Oklahoma	59
Pennsylvania	0
Texas	400
RRC District 1	0
RRC District 2 Onshore	0
RRC District 3 Onshore	28
RRC District 4 Onshore	0
RRC District 5	0
RRC District 6	<1
RRC District 7B	0
RRC District 7C	1
RRC District 8	272
RRC District 8A	99
RRC District 9	0
RRC District 10	0
State Offshore	0
Utah	56
West Virginia	0
Wyoming	10
Federal Offshore	7
Pacific (California)	0
Gulf of Mexico (Louisiana)	7
Gulf of Mexico (Texas)	0
Miscellaneous[b]	0
U.S. Total	**3,160**

[a]Includes only those operators who produced 400,000 barrels of crude oil or 2 billion cubic feet of natural gas, or both, during the report year (Category I or Category II operators).

[b]Includes Arizona, Missouri, Nevada, New York, South Dakota, Tennessee, and Virginia.

Source: Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," 1998.

4. Natural Gas Statistics

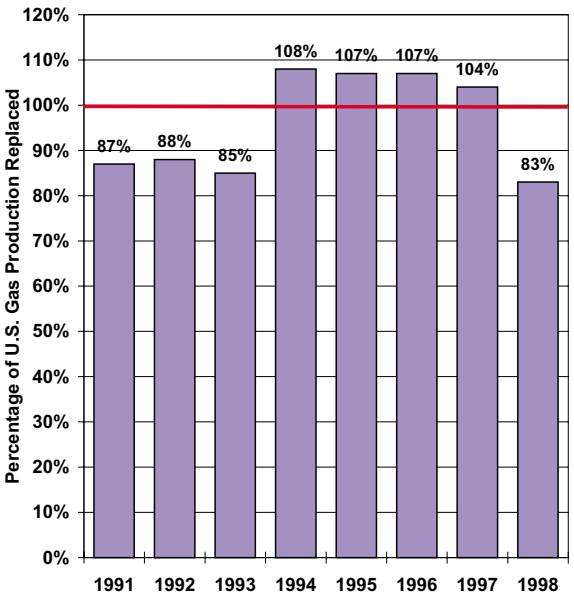
Dry Natural Gas

Proved Reserves

The Nation's 1998 proved reserves of dry natural gas were 164,041 billion cubic feet, 2 percent (3,182 billion cubic feet) less than in 1997 (**Table 8**). The four-year increasing trend for U.S. dry natural gas proved reserves came to an end in 1998.

Additions to dry gas reserves in 1998 were down 22 percent compared to 1997 (19,960 billion cubic feet) and replaced only 83 percent of gas production (**Figure 18**). Upward revisions of gas reserves in Colorado and Utah were outweighed by declines in reserves in other gas-producing States. U.S. *total discoveries* of dry natural gas reserves were 11,433 billion cubic feet in 1998, down 27 percent from 1997 (15,648 billion cubic feet). All components of *total discoveries* for gas (extensions, new field discoveries, and new reservoir discoveries in old fields) were down in 1998 compared to 1997.

Figure 18. Reserve Additions Replace only 83% of 1998 U.S. Dry Natural Gas Production.



Source: Energy Information Administration, Office of Oil and Gas.

Proved reserves by State are shown on the map in **Figure 19**. Seven areas account for 76 percent of the Nation's dry natural gas proved reserves:

Area	Percent of U.S. Gas Reserves
Texas	23
Gulf of Mexico Federal Offshore	16
New Mexico	9
Wyoming	8
Oklahoma	8
Alaska	6
Louisiana	6
Area Total	**76**

Of these seven areas, Wyoming and Oklahoma had increased reserves in 1998, while the other 5 had decreases in dry natural gas proved reserves.

Discussion of Reserves Changes

Figure 20 maps the change in dry gas proved reserves from 1997 to 1998 by area. Here's how the top seven areas fared, compared to the total United States:

Area	Change in U.S. Gas Reserves (billion cubic feet)
Texas	-177
Gulf of Mexico Federal Offshore	-1,500
New Mexico	-527
Wyoming	+88
Oklahoma	+206
Alaska	-635
Louisiana	-526
Area Total	**-3,071**
U.S. Total	**-3,182**

Figure 4 in Chapter 2 shows the components of the changes in dry natural gas proved reserves for 1998 and the preceding 10 years.

Revisions and Adjustments

Revisions and adjustments declined to 4,105 billion cubic feet in 1998, down 5 percent compared to 1997's level (4,312 billion cubic feet). Colorado had the largest increase in *revisions and adjustments* (1,368 billion cubic

Table 8. Dry Natural Gas Proved Reserves, Reserves Changes, and Production, 1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Published Proved Reserves 12/31/97	Changes in Reserves During 1998							Proved Reserves 12/31/98
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	10,562	-172	169	125	2	4	0	513	9,927
Lower 48 States	**156,661**	**-1,463**	**27,834**	**22,138**	**8,195**	**1,070**	**2,162**	**18,207**	**154,114**
Alabama	4,968	5	309	313	19	10	0	394	4,604
Arkansas	1,475	-1	596	653	45	0	36	170	1,328
California	2,273	-88	574	328	47	0	12	246	2,244
Coastal Region Onshore	164	-42	44	48	0	0	0	12	106
Los Angeles Basin Onshore	141	-10	39	24	1	0	11	9	149
San Joaquin Basin Onshore	1,912	-44	491	244	46	0	1	217	1,945
State Offshore	56	8	0	12	0	0	0	8	44
Colorado	6,828	-93	1,898	437	361	0	0	676	7,881
Florida	96	-3	0	0	0	0	0	5	88
Kansas	6,989	-265	501	300	23	1	1	548	6,402
Kentucky	1,364	-93	14	41	20	0	21	63	1,222
Louisiana	9,673	-261	2,173	2,034	631	57	311	1,403	9,147
North	3,093	-31	833	725	128	0	0	400	2,898
South Onshore	5,855	-145	1,243	1,199	498	45	276	875	5,698
State Offshore	725	-85	97	110	5	12	35	128	551
Michigan	2,195	105	538	288	12	6	0	240	2,328
Mississippi	582	-19	177	112	109	0	0	79	658
Montana	762	-12	119	43	6	1	0	51	782
New Mexico	15,514	-48	2,040	1,882	805	1	6	1,449	14,987
East	2,642	12	623	439	275	1	6	427	2,693
West	12,872	-60	1,417	1,443	530	0	0	1,022	12,294
New York	224	-26	18	7	0	0	25	16	218
North Dakota	479	-31	47	27	25	0	0	46	447
Ohio	985	-179	276	118	1	0	19	94	890
Oklahoma	13,439	106	2,995	1,997	600	4	42	1,544	13,645
Pennsylvania	1,852	-9	218	114	19	1	4	131	1,840
Texas	37,761	-712	7,584	6,334	3,365	249	526	4,855	37,584
RRC District 1	953	138	174	168	108	7	5	113	1,104
RRC District 2 Onshore	1,634	-97	231	257	184	3	135	219	1,614
RRC District 3 Onshore	4,172	-250	1,079	773	378	43	93	781	3,961
RRC District 4 Onshore	8,099	-353	1,601	1,562	1,705	43	219	1,323	8,429
RRC District 5	1,710	29	689	557	276	17	13	224	1,953
RRC District 6	5,887	-78	1,439	1,019	313	1	0	594	5,949
RRC District 7B	478	-47	28	81	0	124	0	60	442
RRC District 7C	3,407	-108	401	304	70	3	0	356	3,113
RRC District 8	5,397	-133	767	790	121	5	31	541	4,857
RRC District 8A	847	29	100	106	3	0	0	66	807
RRC District 9	794	-5	100	80	26	0	0	101	734
RRC District 10	4,094	141	834	560	179	3	0	418	4,273
State Offshore	289	22	141	77	2	0	30	59	348
Utah	1,839	97	645	110	133	0	0	216	2,388
Virginia	2,446	-495	111	79	45	0	6	61	1,973
West Virginia	2,846	-11	297	180	15	0	71	170	2,868
Wyoming	13,562	-76	1,918	1,774	839	7	12	838	13,650
Federal Offshore[a]	28,466	663	4,770	4,966	1,075	733	1,070	4,909	26,902
Pacific (California)	544	-10	19	43	1	0	6	37	480
Gulf of Mexico (Louisiana)[a]	21,934	598	3,193	3,543	847	583	890	3,728	20,774
Gulf of Mexico (Texas)	5,988	75	1,558	1,380	227	150	174	1,144	5,648
Miscellaneous[b]	43	-17	16	1	0	0	0	3	38
U.S. Total	**167,223**	**-1,635**	**28,003**	**22,263**	**8,197**	**1,074**	**2,162**	**18,720**	**164,041**

[a]Includes Federal offshore Alabama.

[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.

[c]Indicates the estimate is associated with a sampling error (95 percent confidence interval) that exceeds 20 percent of the estimated value.

Note: The production estimates in this table are based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production." They may differ from the official Energy Information Administration production data for natural gas for 1998 contained in the *Natural Gas Annual 1998*, DOE/EIA-0131(98).

Source: Energy Information Administration, Office of Oil and Gas.

Figure 19. 1998 Dry Natural Gas Proved Reserves by Area

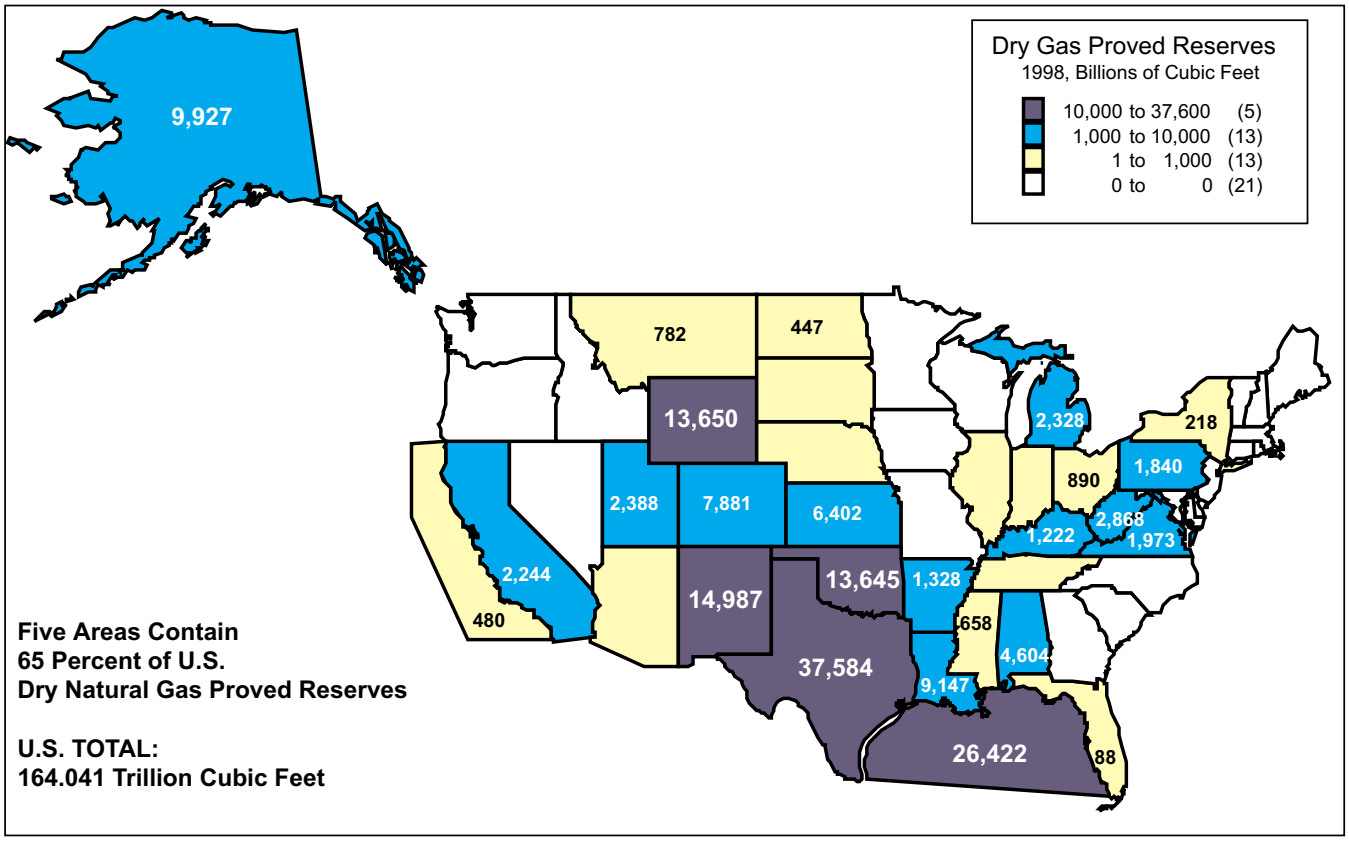
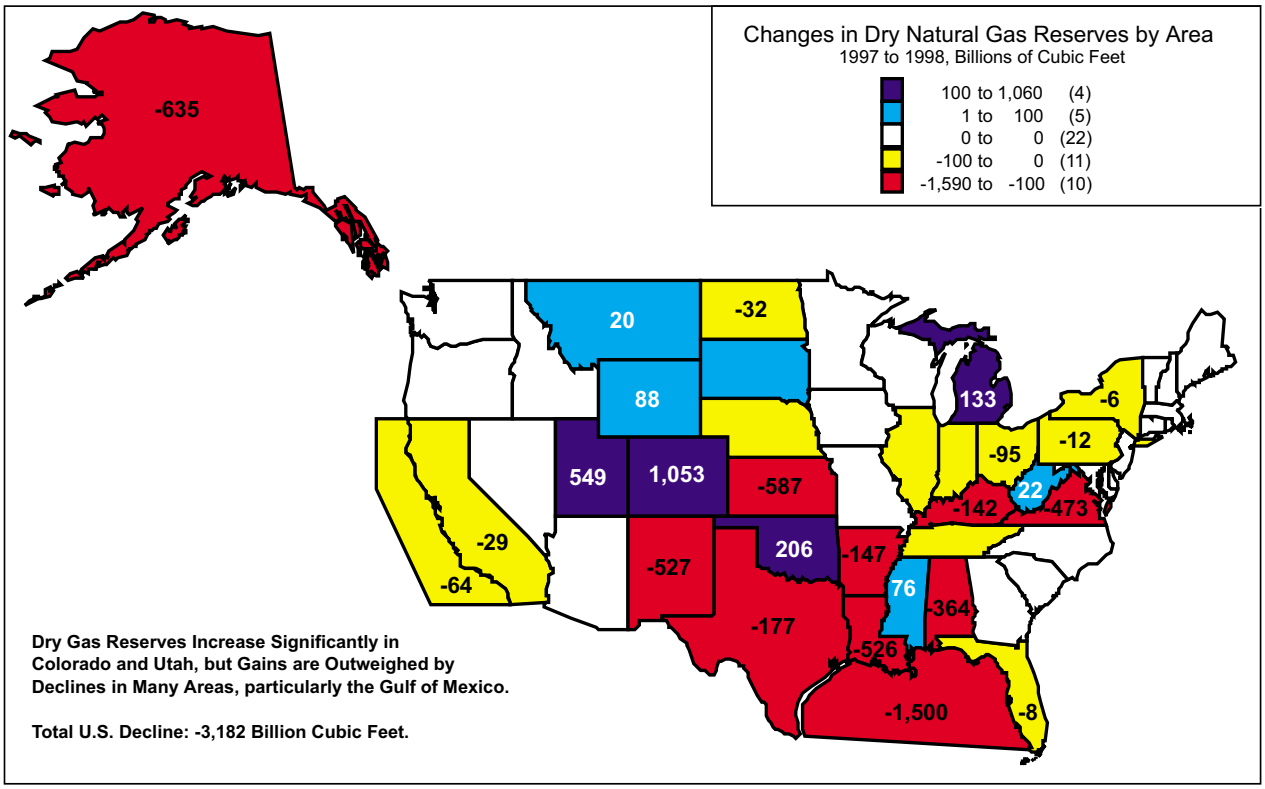


Figure 20. Changes in Dry Natural Gas Proved Reserves by Area, 1997 to 1998



Source: Energy Information Administration, Office of Oil and Gas.

feet). Oklahoma had the second largest with 1,104 billion cubic feet of net revisions and adjustments.

Discoveries

Total discoveries are those reserves attributable to field *extensions*, *new field discoveries*, and *new reservoir discoveries in old fields*; they result from drilling exploratory wells. *Total discoveries* of dry natural gas reserves were 11,433 billion cubic feet in 1998, a 27 percent decrease from the level reported in 1997 and equivalent to 61 percent of 1998 gas production. About 61 percent of the *total discoveries* were in the Gulf of Mexico Federal Offshore and Texas.

Extensions were 8,197 billion cubic feet, 23 percent lower than in 1997. Areas with the largest *extensions* and their percentage of total *extensions* were:

- Texas (41 percent)
- Gulf of Mexico Federal Offshore (13 percent)
- New Mexico (10 percent)
- Wyoming (10 percent)
- Louisiana (8 percent)
- Oklahoma (7 percent).

In the prior 10 years, U.S. operators reported an average of 6,909 billion cubic feet of reserves from *extensions* per year. Reserves from *extensions* in 1998 were 19 percent higher than that average volume.

New field discoveries were only 1,074 billion cubic feet in 1998—60 percent lower than in 1997. Those areas with the largest *new field discoveries* were the Gulf of Mexico Federal Offshore (with 68 percent of the total) and Texas (23 percent). In the prior 10 years, U.S. operators reported an average of 1,518 billion cubic feet of reserves from *new field discoveries* per year. Reserves from *new field discoveries* in 1998 were 29 percent lower than that average.

New reservoir discoveries in old fields were 2,162 billion cubic feet, 9 percent lower than 1997. Among the areas with the largest *new reservoir discoveries in old fields* and their percentage of the total were:

- Gulf of Mexico Federal Offshore (49 percent)
- Texas (24 percent)
- Louisiana (14 percent).

In the prior 10 years, U.S. operators reported an average of 2,318 billion cubic feet of reserves from *new reservoirs discovered in old fields* per year. Reserves from *new reservoirs discovered in old fields* in 1998 were 7 percent lower than that average volume.

Production

Dry natural gas production decreased 3 percent in 1998 (**Table 8**). As in 1997, the Gulf of Mexico Federal Offshore and the State of Texas were the leading producers of dry natural gas in 1998, each with over one-fourth of the U.S. total. The next three States combined, Oklahoma (8 percent), New Mexico (8 percent), and Louisiana (7 percent), added almost another one-fourth of the production.

Wet Natural Gas

U. S. proved reserves of wet natural gas, as of December 31, 1998, were 172,443 billion cubic feet, a 2 percent decrease from the volume reported in 1997 (**Table 9**). At year-end 1998 proved wet natural gas reserves for the lower 48 States had decreased by 2 percent (2,648 billion cubic feet) compared to 1997, while those of Alaska had decreased by 6 percent (630 billion cubic feet).

The volumetric differences between the estimates reported in **Table 8** (dry) and **Table 9** (wet) result from the removal of natural gas liquids at natural gas processing plants. A discussion of the methodology used to generate wet and dry natural gas reserves tables in this report is found in Appendix F. All natural gas proved reserves data shown in this report exclude natural gas held in underground storage.

Nonassociated Natural Gas

Proved Reserves

Proved reserves of nonassociated (NA) natural gas, wet after lease separation, in the United States decreased by 1 percent (1,556 billion cubic feet) in 1998 to 141,783 billion cubic feet (**Table 10**). The lower 48 States' NA wet natural gas proved reserves decreased by 1 percent to a level of 139,015 billion cubic feet, while Alaska declined 6 percent to a level of 2,768 billion cubic feet of NA wet natural gas proved reserves in 1998. Those areas with the largest increases in NA wet natural gas reserves were Colorado, Utah, Texas RRC District 4 Onshore, Texas RRC District 5, and Michigan. There were large decreases in NA wet natural gas reserves in

Table 9. Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 1998 (Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Published Proved Reserves 12/31/97	Changes in Reserves During 1998							Proved Reserves 12/31/98		
		Adjustments (+,–)	Revision Increases (+)	Revision Decreases (–)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Production (–)	Total Gas	Non-associated Gas	Associated Dissolved Gas
Alaska	10,673	-163	170	125	2	4	0	518	10,043	2,768	7,275
Lower 48 States	**165,048**	**-1,461**	**29,231**	**23,294**	**8,628**	**1,112**	**2,240**	**19,104**	**162,400**	**139,015**	**23,385**
Alabama	5,013	4	312	316	19	10	0	399	4,643	4,615	28
Arkansas	1,479	0	597	655	45	0	36	170	1,332	1,294	38
California	2,390	-117	598	345	48	0	13	255	2,332	453	1,879
Coastal Region Onshore	176	-40	49	54	0	0	0	13	118	2	116
Los Angeles Basin Onshore	146	-11	40	25	1	0	12	9	154	1	153
San Joaquin Basin Onshore	2,012	-74	509	254	47	0	1	225	2,016	445	1,571
State Offshore	56	8	0	12	0	0	0	8	44	5	39
Colorado	7,160	-162	2,006	461	366	0	0	701	8,208	7,436	772
Florida	112	0	0	0	0	0	0	6	106	0	106
Kansas	7,328	-120	537	322	24	1	2	588	6,862	6,802	60
Kentucky	1,429	-83	15	43	21	0	23	67	1,295	1,275	20
Louisiana	10,036	-287	2,250	2,105	656	59	326	1,455	9,480	8,569	911
North	3,156	-48	847	736	130	0	0	406	2,943	2,760	183
South Onshore	6,137	-159	1,302	1,255	521	47	289	916	5,966	5,336	630
State Offshore	743	-80	101	114	5	12	37	133	571	473	98
Michigan	2,256	100	552	294	12	6	0	246	2,386	2,158	228
Mississippi	583	-18	178	112	110	0	0	79	662	615	47
Montana	769	-12	120	44	6	1	0	51	789	737	52
New Mexico	16,700	77	2,200	2,067	896	1	7	1,555	16,259	14,816	1,443
East	3,008	-15	703	495	311	1	7	481	3,039	1,694	1,345
West	13,692	92	1,497	1,572	585	0	0	1,074	13,220	13,122	98
New York	224	-26	18	7	0	0	25	16	218	217	1
North Dakota	531	-29	52	30	28	0	0	51	501	240	261
Ohio	985	-178	276	118	1	0	19	95	890	548	342
Oklahoma	14,311	99	3,187	2,125	638	5	44	1,642	14,517	13,321	1,196
Pennsylvania	1,861	-11	219	115	20	1	4	131	1,848	1,769	79
Texas	41,108	-790	8,150	6,824	3,561	273	557	5,242	40,793	33,429	7,364
RRC District 1	1,018	120	181	175	113	7	5	117	1,152	1,101	51
RRC District 2 Onshore	1,732	-93	246	274	196	3	144	234	1,720	1,516	204
RRC District 3 Onshore	4,418	-256	1,145	820	402	45	100	829	4,205	3,275	930
RRC District 4 Onshore	8,483	-371	1,676	1,636	1,784	45	229	1,386	8,824	8,430	394
RRC District 5	1,749	26	704	568	282	17	13	228	1,995	1,906	89
RRC District 6	6,194	-73	1,517	1,074	331	1	1	626	6,271	5,691	580
RRC District 7B	559	-62	33	94	0	143	0	69	510	306	204
RRC District 7C	3,843	-139	450	341	79	4	0	400	3,496	2,939	557
RRC District 8	6,030	-15	875	902	137	5	35	618	5,547	2,727	2,820
RRC District 8A	1,247	-35	137	147	5	0	0	92	1,115	18	1,097
RRC District 9	932	-5	118	93	31	0	0	119	864	665	199
RRC District 10	4,613	90	926	622	199	3	0	465	4,744	4,510	234
State Offshore	290	23	142	78	2	0	30	59	350	345	5
Utah	2,005	29	674	117	139	0	0	228	2,502	2,293	209
Virginia	2,446	-495	111	79	45	0	6	61	1,973	1,973	0
West Virginia	2,946	-12	307	186	16	0	73	176	2,968	2,925	43
Wyoming	14,321	-104	2,006	1,869	880	7	13	883	14,371	13,577	794
Federal Offshore[a]	29,011	691	4,850	5,059	1,097	748	1,092	5,004	27,426	19,931	7,495
Pacific (California)	556	-12	19	44	1	0	6	37	489	52	437
Gulf of Mexico (Louisiana)[a]	22,428	637	3,265	3,629	868	598	911	3,817	21,261	15,427	5,834
Gulf of Mexico (Texas)	6,027	66	1,566	1,386	228	150	175	1,150	5,676	4,452	1,224
Miscellaneous	44	-17	16	1	0	0	0	3	39	22	17
U.S. Total	**175,721**	**-1,624**	**29,401**	**23,419**	**8,630**	**1,116**	**2,240**	**19,622**	**172,443**	**141,783**	**30,660**

[a]Includes Federal offshore Alabama.
[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.
[c]Indicates the estimate is associated with a sampling error (95 percent confidence interval) that exceeds 20 percent of the estimated value.
Note: The production estimates in this table are based on data reported on Form EIA-23. They may differ from the official Energy Information Administration production data for natural gas for 1998 contained in the *Natural Gas Annual 1998,* DOE/EIA-0131(98).
Source: Energy Information Administration, Office of Oil and Gas.

Table 10. Nonassociated Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Published Proved Reserves 12/31/97	Changes in Reserves During 1998							Proved Reserves 12/31/98
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	2,957	-14	105	77	1	0	0	204	2,768
Lower 48 States	**140,382**	**-904**	**24,291**	**19,405**	**7,902**	**1,009**	**2,022**	**16,282**	**139,015**
Alabama	4,983	1	301	308	19	10	0	391	4,615
Arkansas	1,423	3	582	638	45	0	36	157	1,294
California	570	-43	73	102	5	0	1	51	453
Coastal Region Onshore	47	-46	1	0	0	0	0	0	2
Los Angeles Basin Onshore	3	0	0	3	1	0	0	0	1
San Joaquin Basin Onshore	518	-1	72	99	4	0	1	50	445
State Offshore	2	4	0	0	0	0	0	1	5
Colorado	6,627	-159	1,658	404	361	0	0	647	7,436
Florida	0	0	0	0	0	0	0	0	0
Kansas	7,277	-118	509	313	21	1	2	577	6,802
Kentucky	1,403	-82	15	40	21	0	23	65	1,275
Louisiana	9,020	-278	1,868	1,718	621	43	298	1,285	8,569
North	2,869	-129	774	525	116	0	0	345	2,760
South Onshore	5,538	-91	1,010	1,094	500	36	264	827	5,336
State Offshore	613	-58	84	99	5	7	34	113	473
Michigan	1,975	94	506	218	10	6	0	215	2,158
Mississippi	532	-12	157	100	110	0	0	72	615
Montana	727	-13	106	37	0	0	0	46	737
New Mexico	15,280	57	1,824	1,818	809	1	2	1,339	14,816
East	1,694	-3	340	290	225	1	2	275	1,694
West	13,586	60	1,484	1,528	584	0	0	1,064	13,122
New York	223	-26	18	7	0	0	25	16	217
North Dakota	274	-17	10	10	0	0	0	17	240
Ohio	594	-164	221	78	1	0	16	42	548
Oklahoma	13,296	-27	2,808	1,899	603	5	41	1,506	13,321
Pennsylvania	1,769	-2	213	105	12	1	4	123	1,769
Texas	33,322	-739	6,783	5,672	3,337	268	526	4,396	33,429
RRC District 1	950	114	173	151	113	7	5	110	1,101
RRC District 2 Onshore	1,497	-72	220	257	191	3	144	210	1,516
RRC District 3 Onshore	3,539	-211	816	727	354	43	97	636	3,275
RRC District 4 Onshore	8,115	-357	1,584	1,616	1,734	45	229	1,304	8,430
RRC District 5	1,681	40	657	563	282	17	9	217	1,906
RRC District 6	5,616	-127	1,465	994	323	1	1	594	5,691
RRC District 7B	299	-35	14	69	0	143	0	46	306
RRC District 7C	3,247	-126	339	264	70	2	0	329	2,939
RRC District 8	2,886	-38	486	317	44	4	11	349	2,727
RRC District 8A	41	-28	16	3	0	0	0	8	18
RRC District 9	785	-4	34	84	29	0	0	95	665
RRC District 10	4,386	81	841	557	195	3	0	439	4,510
State Offshore	280	24	138	70	2	0	30	59	345
Utah	1,695	31	664	31	138	0	0	204	2,293
Virginia	1,923	28	111	79	45	0	6	61	1,973
West Virginia	2,887	-8	305	176	16	0	73	172	2,925
Wyoming	13,471	-133	1,930	1,739	832	1	8	793	13,577
Federal Offshore[a]	21,098	698	3,623	3,913	896	673	961	4,105	19,931
Pacific (California)	58	0	1	6	0	0	1	2	52
Gulf of Mexico (Louisiana)[a]	16,241	533	2,479	2,762	681	523	786	3,054	15,427
Gulf of Mexico (Texas)	4,799	165	1,143	1,145	215	150	174	1,049	4,452
Miscellaneous	13	5	6	0	0	0	0	2	22
U.S. Total	**143,339**	**-918**	**24,396**	**19,482**	**7,903**	**1,009**	**2,022**	**16,486**	**141,783**

[a]Includes Federal offshore Alabama.

[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.

Note: The production estimates in this table are based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves." They may differ from the official Energy Information Administration production data for natural gas for 1998 contained in the *Natural Gas Annual 1998*, DOE/EIA-0131(98).

Source: Energy Information Administration, Office of Oil and Gas.

Table 11. Associated-Dissolved Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Published Proved Reserves 12/31/97	Changes in Reserves During 1998							Proved Reserves 12/31/98
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	7,716	-149	65	48	1	4	0	314	7,275
Lower 48 States	**24,666**	**-557**	**4,940**	**3,889**	**726**	**103**	**218**	**2,822**	**23,385**
Alabama	30	3	11	8	0	0	0	8	28
Arkansas	56	-3	15	17	0	0	0	13	38
California	1,820	-74	525	243	43	0	12	204	1,879
Coastal Region Onshore	129	6	48	54	0	0	0	13	116
Los Angeles Basin Onshore	143	-11	40	22	0	0	12	9	153
San Joaquin Basin Onshore	1,494	-73	437	155	43	0	0	175	1,571
State Offshore	54	4	0	12	0	0	0	7	39
Colorado	533	-3	348	57	5	0	0	54	772
Florida	112	0	0	0	0	0	0	6	106
Kansas	51	-2	28	9	3	0	0	11	60
Kentucky	26	-1	0	3	0	0	0	2	20
Louisiana	1,016	-9	382	387	35	16	28	170	911
North	287	81	73	211	14	0	0	61	183
South Onshore	599	-68	292	161	21	11	25	89	630
State Offshore	130	-22	17	15	0	5	3	20	98
Michigan	281	6	46	76	2	0	0	31	228
Mississippi	51	-6	21	12	0	0	0	7	47
Montana	42	1	14	7	6	1	0	5	52
New Mexico	1,420	20	376	249	87	0	5	216	1,443
East	1,314	-12	363	205	86	0	5	206	1,345
West	106	32	13	44	1	0	0	10	98
New York	1	0	0	0	0	0	0	0	1
North Dakota	257	-12	42	20	28	0	0	34	261
Ohio	391	-14	55	40	0	0	3	53	342
Oklahoma	1,015	126	379	226	35	0	3	136	1,196
Pennsylvania	92	-9	6	10	8	0	0	8	79
Texas	7,786	-51	1,367	1,152	224	5	31	846	7,364
RRC District 1	68	6	8	24	0	0	0	7	51
RRC District 2 Onshore	235	-21	26	17	5	0	0	24	204
RRC District 3 Onshore	879	-45	329	93	48	2	3	193	930
RRC District 4 Onshore	368	-14	92	20	50	0	0	82	394
RRC District 5	68	-14	47	5	0	0	4	11	89
RC District 6	578	54	52	80	8	0	0	32	580
RRC District 7B	260	-27	19	25	0	0	0	23	204
RRC District 7C	596	-13	111	77	9	2	0	71	557
RRC District 8	3,144	23	389	585	93	1	24	269	2,820
RRC District 8A	1,206	-7	121	144	5	0	0	84	1,097
RRC District 9	147	-1	84	9	2	0	0	24	199
RRC District 10	227	9	85	65	4	0	0	26	234
State Offshore	10	-1	4	8	0	0	0	0	5
Utah	310	-2	10	86	1	0	0	24	209
Virginia	523	-523	0	0	0	0	0	0	0
West Virginia	59	-4	2	10	0	0	0	4	43
Wyoming	850	29	76	130	48	6	5	90	794
Federal Offshore[a]	7,913	-7	1,227	1,146	201	75	131	899	7,495
Pacific (California)	498	-12	18	38	1	0	5	35	437
Gulf of Mexico (Louisiana)[a]	6,187	104	786	867	187	75	125	763	5,834
Gulf of Mexico (Texas)	1,228	-99	423	241	13	0	1	101	1,224
Miscellaneous[b]	31	-22	10	1	0	0	0	1	17
U.S. Total	**32,382**	**-706**	**5,005**	**3,937**	**727**	**107**	**218**	**3,136**	**30,660**

[a] Includes Federal offshore Alabama.

[b] Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.

Note: The production estimates in this table are based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves." They may differ from the official Energy Information Administration production data for natural gas for 1998 contained in the *Natural Gas Annual 1998*, DOE/EIA-0131(98).

Source: Energy Information Administration, Office of Oil and Gas.

the Gulf of Mexico Federal Offshore, Kansas, New Mexico, Louisiana, and Alabama.

Discoveries

NA wet natural gas *total discoveries* of 10,934 billion cubic feet decreased 20 percent (2,784 billion cubic feet) in 1998. Texas, the Gulf of Mexico Federal Offshore, Louisiana, Wyoming, and New Mexico and accounted for 9,275 billion cubic feet or 85 percent of U.S. NA wet natural gas *total discoveries* in 1998.

Production

U.S. production of NA wet natural gas decreased by 4 percent (626 billion cubic feet) in 1998 (**Table 10**). The five leading producing areas, Texas, the Gulf of Mexico Federal Offshore, Oklahoma, New Mexico and Louisiana, all reported production declines in 1998. As in 1997, Texas (with 27 percent of 1998 U.S. NA gas production) and the Gulf of Mexico Federal Offshore (with 25 percent) were the leading producers of NA wet natural gas in 1998.

Associated-Dissolved Natural Gas

Proved Reserves

Proved reserves of associated-dissolved (AD) natural gas, wet after lease separation, in the United States decreased by 5 percent (1,722 billion cubic feet) to 30,660 billion cubic feet in 1998 (**Table 11**). Proved reserves of AD wet natural gas in the lower 48 States decreased by 5 percent (1,281 billion cubic feet) to 23,385 billion cubic feet, and Alaska declined 6 percent to 7,275 billion cubic feet in 1998. Those areas of the country with the largest AD wet natural gas reserves and their percentage of the total were:

- Texas (24 percent)
- Alaska (24 percent)
- Gulf of Mexico Federal Offshore (23 percent)
- California (6 percent)
- New Mexico (5 percent).

These areas logically correspond to the areas of the country with the largest volumes of crude oil reserves.

Production

U.S. production of AD wet natural gas increased by 4 percent in 1998 (**Table 11**), and production of AD wet natural gas in the lower 48 States increased by 3 percent (70 billion cubic feet). Those areas of the country with the largest AD wet natural gas production and their percentage of the total were:

- Gulf of Mexico Federal Offshore (28 percent)
- Texas (27 percent)
- Alaska (10 percent)
- New Mexico (7 percent)
- California (7 percent).

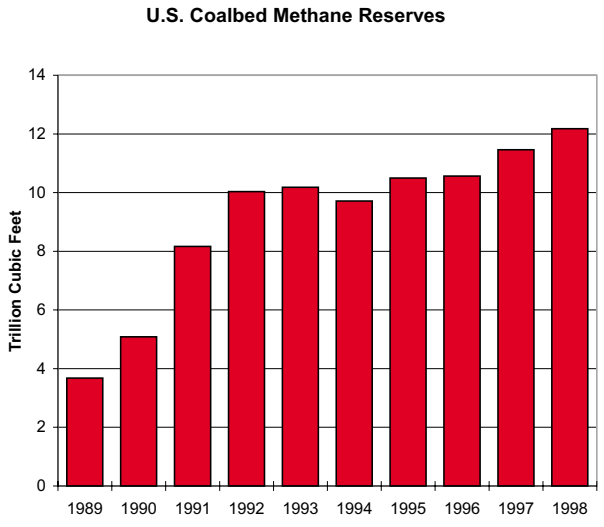
Again, these areas logically correspond to the areas of the country with the largest volumes of crude oil production.

Coalbed Methane

Proved Reserves

In 1998, reserves of coalbed methane increased 6 percent to 12,179 billion cubic feet from 1997's level (11,462 billion cubic feet), and now account for 7 percent of all 1998 dry natural gas reserves (**Table 12**). Federal tax incentives for new coalbed methane wells expired at the end of 1992. The EIA estimates that the 1998 proved gas reserves of fields identified as having

Figure 21. Coalbed Methane Proved Reserves 1989-1998



Source: Energy Information Administration, Office of Oil and Gas.

Table 12. U.S. Coalbed Methane Proved Reserves and Production, 1991-1998
(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Year	Alabama		Colorado		New Mexico		Others[a]		Total	
	Reserves	Production	Reserves	Production	Reserves	Production	Reserves	Production	Reserves	Production
1991	1,714	68	2,076	48	4,206	229	167	3	**8,163**	**348**
1992	1,968	89	2,716	82	4,724	358	626	10	**10,034**	**539**
1993	1,237	103	3,107	125	4,775	486	1,065	18	**10,184**	**752**
1994	976	108	2,913	179	4,137	530	1,686	34	**9,712**	**851**
1995	972	109	3,461	226	4,299	574	1,767	47	**10,499**	**956**
1996	823	98	3,711	274	4,180	575	1,852	56	**10,566**	**1,003**
1997	1,077	111	3,890	312	4,351	597	2,144	70	**11,462**	**1,090**
1998	1,029	123	4,211	401	4,232	571	2,707	99	**12,179**	**1,194**

[a]Includes Oklahoma, Pennsylvania, Utah, Virginia, West Virginia, and Wyoming.
Source: Energy Information Administration, Office of Oil and Gas.

coalbed methane are now more than triple the volume reported in 1989 (**Figure 21**). Coalbed methane proved reserves are principally located in New Mexico, Colorado, and Alabama. Estimates of proved coalbed methane reserves increased in Colorado and Alabama, but decreased slightly in New Mexico in 1998.

Production

Coalbed methane production grew by about 10 percent in 1998 to 1,194 billion cubic feet—about 6 percent of U.S. dry gas production. Most of the 1998 production increase (104 billion cubic feet) occurred in Colorado (the San Juan Basin).

Areas of Note: Large Discoveries and Reserves Additions

The following State or area discussions summarize notable activities during the year concerning expected new field reserves, development plans, and possible production rates as extracted from various trade publications and company reports. The citations do not necessarily reflect EIA's concurrence, but are considered important enough to be brought to the reader's attention.

Colorado

Colorado had a net increase of 1,053 billion cubic feet of dry natural gas proved reserves in 1998. The largest net gas reserves increase of all States in 1998, it was mostly from net revisions.

Development of existing fields in the Piceance and Denver - Julesburg Basins - mostly done through less expensive recompletions, rather than more expensive new wells—boosted the reserves additions for this State.

Utah

Utah had a net increase of 549 billion cubic feet of dry natural gas proved reserves in 1998. This was the result of development of large existing coalbed methane fields and gas fields within the Uinta Basin.

Texas

Although the State of Texas had a net decline in dry natural gas proved reserves in 1998, the largest volume of new discoveries in 1998 was nevertheless made there.

South Texas: As in 1997, operators remain active in the Lobo Trend in the lower Rio Grande Valley of south Texas (RRC District 4). The trend occurs primarily in Webb and Zapata counties and contains the four producing horizons, Wilcox, Expanded Wilcox, Frio, and Lobo. Unlike some other parts of the country, one or two fields do not dominate the area. RRC District 4 increased its dry natural gas reserves by 330 billion cubic feet in 1998. Operators in RRC District 4 reported more *extensions* (51 percent of the State total) than any other district in Texas. This district accounts for 22 percent of all of the reserves of dry natural gas in the State and leads the State in gas production (27 percent of the State total). RRC District 4's dry gas production increased 2 percent in 1998.

Similarly, RRC District 5 had an increase in dry natural gas reserves of 243 billion cubic feet in 1998—mostly from *extensions* of existing gas fields and *revisions*. RRC District 5's dry gas production increased 2 percent in 1998.

Oklahoma

Oklahoma had a net increase of 206 billion cubic feet of dry natural gas proved reserves in 1998. It was third overall in State total dry gas reserves additions. About two-thirds of Oklahoma's gain was from net revisions and adjustments of existing fields, but a large volume of reported extensions also boosted Oklahoma's total in 1998.

Areas of Note: Large Reserves Declines

The following areas had large declines in dry natural gas proved reserves due to downward revisions or unreplaced production.

Gulf of Mexico Federal Offshore

This area's proved dry natural gas reserves decreased by 5 percent (1,500 billion cubic feet) in 1998. Dry gas production from the Gulf of Mexico Federal Offshore declined by 5 percent (261 billion cubic feet) from 1997 to 1998.

Alaska

This State's proved dry natural gas reserves decreased by 6 percent (635 billion cubic feet) in 1998.

Kansas

This State's proved dry natural gas reserves decreased by 8 percent (587 billion cubic feet) in 1998.

New Mexico

This State's proved dry natural gas reserves decreased by 3 percent (527 billion cubic feet) in 1998.

Reserves in Nonproducing Reservoirs

Nonproducing proved natural gas reserves (wet after lease separation) of 36,047 billion cubic feet were reported in 1998 (**Appendix D, Table D10**). This was 9 percent (2,923 billion cubic feet) more gas than in 1997. About 33 percent of the reserves in nonproducing reservoirs are located in the Gulf of Mexico Federal Offshore area. Much of the new deepwater reserves are in the nonproducing category. Wells or reservoirs are nonproducing due to any of several operational reasons. These include:

- waiting for well workovers
- waiting for additional development or replacement wells to be drilled
- production or pipeline facilities not yet installed
- awaiting depletion of other zones or reservoirs before recompletion in reservoirs not currently open to production (called "behind pipe" reserves).

5. Natural Gas Liquids Statistics

Natural Gas Liquids

Proved Reserves

U.S. natural gas liquids proved reserves decreased 6 percent to 7,524 million barrels in 1998 (**Table 13**). A reassessment of natural gas liquids in Alaska represents the bulk of the 1998 change. Reserve additions replaced only 46 percent of 1998 natural gas liquids production.

The reserves of six areas account for 81 percent of the Nation's natural gas liquids proved reserves.

Area	Percent of U.S. NGL Reserves
Texas	34
Gulf of Mexico Federal Offshore	12
New Mexico	12
Utah-Wyoming	9
Oklahoma	9
Louisiana	5
Area Total	**81**

The volumes of natural gas liquids proved reserves and production shown in **Table 13** are the sum of the natural gas plant liquid volumes listed in **Table 14** and the lease condensate volumes listed in **Table 15**.

Discoveries

Total discoveries of natural gas liquids reserves decreased by 27 percent from 1997 to 1998. Areas with the largest *total discoveries* were:

- Texas (39 percent)
- Gulf of Mexico Federal Offshore (21 percent)
- New Mexico (13 percent)
- Louisiana (11 percent)
- Utah and Wyoming (7 percent)
- Oklahoma (6 percent).

New field discoveries in 1998 (66 million barrels) were 42 percent lower than in 1997. Areas with the largest *new field discoveries* were the Gulf of Mexico Federal Offshore (56 percent of 1998 new field discoveries) and Texas (32 percent).

New reservoir discoveries in old fields (88 million barrels) were 2 percent less than what they were in 1997. Areas with the largest *new reservoir discoveries in old fields* were the Gulf of Mexico Federal Offshore (44 percent of 1998 new reservoir discoveries in old fields), Texas (28 percent), and Louisiana (20 percent).

Extensions were 383 million barrels, a decrease of 28 percent from 1997 to 1998. Areas with the largest *extensions* were Texas (43 percent of 1998 extensions), New Mexico (18 percent), Utah-Wyoming (10 percent), and the Gulf of Mexico Federal Offshore (10 percent).

Production

Natural gas liquids production was an estimated 833 million barrels in 1998. Alaska production decreased 31 percent to 24 million barrels in 1998, while lower 48 States production decreased 2 percent to 809 million barrels in 1998.

Six areas accounted for about 87 percent of the Nation's natural gas liquids production.

- Texas (38 percent)
- Gulf of Mexico Federal Offshore (17 percent)
- New Mexico (9 percent)
- Oklahoma (9 percent)
- Louisiana (8 percent)
- Utah-Wyoming (6 percent).

Natural Gas Plant Liquids

Proved Reserves

Natural gas plant liquids proved reserves decreased 7 percent in 1998 to 6,188 million barrels (**Table 14**). Six areas accounted for about 82 percent of the Nation's natural gas plant liquids proved reserves:

Table 13. Natural Gas Liquids Proved Reserves, Reserves Changes, and Production, 1998

(Million Barrels of 42 U.S. Gallons)

State and Subdivision	Published Proved Reserves 12/31/97	Changes in Reserves During 1998							Proved Reserves 12/31/98
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	631	-287	1	1	0	0	0	24	320
Lower 48 States	**7,342**	**-74**	**1,301**	**1,093**	**383**	**66**	**88**	**809**	**7,204**
Alabama	93	0	4	8	0	0	0	8	81
Arkansas	7	0	1	3	0	0	0	0	5
California	95	-20	20	17	1	0	0	7	72
Coastal Region Onshore	9	1	4	4	0	0	0	1	9
Los Angeles Basin Onshore	4	1	1	1	0	0	0	0	5
San Joaquin Basin Onshore	82	-22	15	12	1	0	0	6	58
State Offshore	0	0	0	0	0	0	0	0	0
Colorado	264	-54	86	20	4	0	0	20	260
Florida	17	2	0	0	0	0	0	1	18
Kansas	271	81	27	18	1	0	0	28	334
Kentucky	48	8	1	2	1	0	1	3	54
Louisiana	437	-36	103	85	33	7	18	66	411
North	80	-24	22	15	2	0	0	8	57
South Onshore	333	-12	69	66	31	6	17	53	325
State Offshore	24	0	12	4	0	1	1	5	29
Michigan	50	-1	13	7	0	1	0	5	51
Mississippi	6	4	2	4	1	0	0	1	8
Montana	5	-1	1	0	0	0	0	0	5
New Mexico	869	84	121	135	68	0	1	79	929
East	273	-18	63	43	28	0	1	42	262
West	596	102	58	92	40	0	0	37	667
North Dakota	47	1	4	2	2	0	0	4	48
Oklahoma	685	1	166	109	32	0	2	79	698
Texas	2,687	-90	479	425	163	21	25	316	2,544
RRC District 1	54	-15	6	6	3	0	0	4	38
RRC District 2 Onshore	87	-1	13	15	9	0	6	14	85
RRC District 3 Onshore	286	-18	64	66	20	3	6	49	246
RRC District 4 Onshore	347	-17	75	69	71	2	10	56	363
RRC District 5	35	-4	13	10	5	0	0	4	35
RRC District 6	260	7	72	51	16	0	0	28	276
RRC District 7B	59	-11	3	10	0	16	0	6	51
RRC District 7C	327	-27	38	29	7	0	0	34	282
RRC District 8	459	72	79	80	13	0	3	55	491
RRC District 8A	290	-44	28	30	1	0	0	19	226
RRC District 9	98	2	13	10	3	0	0	13	93
RRC District 10	382	-32	71	48	15	0	0	34	354
State Offshore	3	-2	4	1	0	0	0	0	4
Utah and Wyoming	761	-85	99	91	39	0	0	48	675
West Virginia	71	0	7	4	0	0	2	4	72
Federal Offshore[a]	920	35	165	163	38	37	39	140	931
Pacific (California)	14	0	0	1	0	0	0	1	12
Gulf of Mexico (Louisiana)[a]	785	17	132	130	31	34	27	120	776
Gulf of Mexico (Texas)	121	18	33	32	7	3	12	19	143
Miscellaneous[b]	9	-3	2	0	0	0	0	0	8
U.S. Total	**7,973**	**-361**	**1,302**	**1,094**	**383**	**66**	**88**	**833**	**7,524**

[a]Includes Federal offshore Alabama.

[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, New York, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, and Virginia.

Note: The production estimates in this table are based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production." They may differ from the official Energy Information Administration production data for natural gas and natural gas liquids for 1998 contained in the publications *Petroleum Supply Annual 1998*, DOE/EIA-0340(98) and *Natural Gas Annual 1998* DOE/EIA-0131(98).

Source: Energy Information Administration, Office of Oil and Gas.

Table 14. Natural Gas Plant Liquids Proved Reserves and Production, 1998

(Million Barrels of 42 U.S. Gallons)

State and Subdivision	1998 Reserves	1998 Production
Alaska	320	24
Lower 48 States	**5,868**	**631**
Alabama	31	4
Arkansas	3	0
California	71	7
Coastal Region Onshore	9	1
Los Angeles Basin Onshore	5	0
San Joaquin Basin Onshore	57	6
State Offshore	0	0
Colorado	235	18
Florida	18	1
Kansas	331	28
Kentucky	53	3
Louisiana	234	37
North	34	5
South Onshore	187	29
State Offshore	13	3
Michigan	43	4
Mississippi	3	0
Montana	5	0
New Mexico	876	74
East	243	39
West	633	35
North Dakota	41	4
Oklahoma	613	69
Texas	2,262	270
RRC District 1	32	5
RRC District 2 Onshore	75	10
RRC District 3 Onshore	169	33
RRC District 4 Onshore	267	42
RRC District 5	31	4
RRC District 6	235	23
RRC District 7B	48	6
RRC District 7C	266	31
RRC District 8	479	53
RRC District 8A	226	19
RRC District 9	91	13
RRC District 10	342	33
State Offshore	1	0
Utah and Wyoming	600	40
West Virginia	71	4
Federal Offshore[a]	370	68
Pacific (California)	8	1
Gulf of Mexico (Louisiana)[a]	341	63
Gulf of Mexico (Texas)	21	4
Miscellaneous[b]	8	0
U.S. Total	**6,188**	**655**

[a]Includes Federal Offshore Alabama.

[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, New York, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, and Virginia.

Note: The production estimates in this table are based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production." They may differ from the official Energy Information Administration production data for natural gas plant liquids for 1998 contained in the publications *Petroleum Supply Annual 1998,* DOE/EIA-0340(98) and *Natural Gas Annual 1998*, DOE/EIA-0131(98).

Source: Energy Information Administration, Office of Oil and Gas.

Table 15. Lease Condensate Proved Reserves and Production, 1998

(Million Barrels of 42 U.S. Gallons)

State and Subdivision	1998 Reserves	1998 Production
Alaska	0	0
Lower 48 States	**1,336**	**178**
Alabama	50	4
Arkansas	2	0
California	1	0
Coastal Region Onshore	0	0
Los Angeles Basin Onshore	0	0
San Joaquin Basin Onshore	1	0
State Offshore	0	0
Colorado	25	2
Florida	0	0
Kansas	3	0
Kentucky	1	0
Louisiana	177	29
North	23	3
South Onshore	138	24
State Offshore	16	2
Michigan	8	1
Mississippi	5	1
Montana	0	0
New Mexico	53	5
East	19	3
West	34	2
North Dakota	7	0
Oklahoma	85	10
Texas	282	46
RRC District 1	6	1
RRC District 2 Onshore	10	4
RRC District 3 Onshore	77	16
RRC District 4 Onshore	96	14
RRC District 5	4	0
RRC District 6	41	5
RRC District 7B	3	0
RRC District 7C	16	3
RRC District 8	12	2
RRC District 8A	0	0
RRC District 9	2	0
RRC District 10	12	1
State Offshore	3	0
Utah and Wyoming	75	8
West Virginia	1	0
Federal Offshore[a]	561	72
Pacific (California)	4	0
Gulf of Mexico (Louisiana)[a]	435	57
Gulf of Mexico (Texas)	122	15
Miscellaneous[b]	0	0
U.S. Total	**1,336**	**178**

[a]Includes Federal Offshore Alabama.

[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, New York, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, and Virginia.

Note: The estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves” 1998.

Source: Energy Information Administration, Office of Oil and Gas.

Area	Percent of U.S. Gas Plant Liquids
Texas	37
New Mexico	14
Utah-Wyoming	10
Oklahoma	10
Gulf of Mexico Federal Offshore	6
Kansas	5
Area Total	**82**

Production

Natural gas plant liquids production decreased 5 percent in 1998—from 690 million barrels in 1997 to 655 million barrels of production (**Table 14**). The top six areas for proved reserves of natural gas plant liquids accounted for about 83 percent of the Nation's natural gas plant liquids production:

- Texas (41 percent)
- New Mexico (11 percent)
- Oklahoma (11 percent)
- Gulf of Mexico Federal Offshore (10 percent)
- Utah and Wyoming (6 percent)
- Kansas (4 percent).

Natural gas processing plants are usually located in the same general area where the natural gas is produced. Table E4 in Appendix E lists the volumes of natural gas produced and processed in the same State, and the volumes of liquids extracted.

Lease Condensate

Proved Reserves

Proved reserves of lease condensate in the United States were 1,336 million barrels in 1998 (**Table 15**). This was less than 1 percent less than the volume reported in 1997. The reserves of five areas account for about 88 percent of the Nation's lease condensate proved reserves.

Area	Percent of U.S. Condensate Reserves
Gulf of Mexico Federal Offshore	42
Texas	21
Louisiana	13
Oklahoma	6
Utah-Wyoming	6
Area Total	**88**

Production

Production of lease condensate was 178 million barrels, an increase of 4 million barrels, or 2 percent, in 1998. The production of five areas account for about 92 percent of the Nation's lease condensate production.

- Gulf of Mexico Federal Offshore (40 percent)
- Texas (26 percent)
- Louisiana (16 percent)
- Oklahoma (6 percent)
- Utah-Wyoming (4 percent).

Reserves in Nonproducing Reservoirs

Like crude oil and natural gas, not all lease condensate proved reserves were contained in reservoirs that were producing during 1998. Proved reserves of 530 million barrels of lease condensate, an increase of 6 percent from 1997, were reported in nonproducing reservoirs in 1998 (**Appendix D, Table D10**). These reserves were reported by Category I and Category II operators who collectively accounted for more than 97 percent of total lease condensate production. About 63 percent of the nonproducing lease condensate reserves were located in the Gulf of Mexico Federal Offshore.

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Appendix A

Operator Data by Size Class

Appendix A

Operator Data by Size Class

To remain competitive in the domestic oil and gas industry, companies have to reduce costs and look for areas of profitable growth. Over the past few years, we have seen companies restructure to focus on their core areas of profit. This restructuring has taken many forms, for example, mega-mergers, laying off employees, early retirements and buyouts, flattening management structure, selective sales of marginally profitable properties, and acquisitions. Documenting some of these changes is important.

Appendix A is a series of tables of the proved reserves and production by production size class for the years 1993 through 1998 for oil and gas well operators. The tables show the volumetric change and percent change from the previous year and from 1993. In addition they show the 1998 average per operator in each class. All companies that reported to EIA were ranked by production size for each of the 6 years. We computed company production size classes as the sum of the barrel oil equivalent of the crude oil production, lease condensate production, and wet gas production for each operator. The companies were then placed in the following production size classes: 1–10, 11–20, 21–100, 101–500, and all "other" oil and gas operators. The "other" category contains 23,120 small operators. We estimate production and reserves for small operators each year from a sample of approximately 8 percent or less of these operators.

Class 1–10 contains the 10 highest producing companies each year on a barrel oil equivalent basis. These companies are not necessarily the same 10 companies each year.

We also include statistics for operator Category sizes at the bottom portion of tables in this appendix. These are the categories used by EIA in processing and assessing reserves surveys and are presented here as additional perspective. For further explanation of categories sizes see definitions and descriptions in Appendix E.

Natural Gas

Proved Reserves

The wet natural gas proved reserves reported for 1993 through 1998 have changed from 170.5 trillion cubic feet to 172.4 trillion cubic feet (Table A1). These proved reserves are highly concentrated in the larger companies. In 1998, the top 20 operators (Class 1–10 and Class 11–20) producing companies had 54 percent of the proved reserves of natural gas. The next two size classes contain 80 and 400 companies and account for 27 and 14 percent of the U.S. natural gas proved reserves, respectively. The top 20 operators had a decline of 7 percent in their natural gas proved reserves from 1993 to 1998. While the rest of the operators in (Class 21–100, Class 101–500, and Class Other) had an increase of 13 percent in their reserves. In 1998, the top 20 operators' natural gas reserves increased by 4 percent from 1997.

Production

Wet natural gas production has decreased from 20.1 trillion cubic feet to 19.6 trillion cubic feet in 1998 (Table A2). In 1998, the top 20 producing companies had 52 percent of the production of wet natural gas, while having 54 percent of the proved reserves. The next two size classes have 29 and 14 percent of the wet natural gas production, respectively. The top 20 operators had an increase of 6 percent in their wet natural gas production from 1993 to 1998. The rest of the operators had an increase of 4 percent from 1993 to 1998. The top 20 operators' wet natural gas production had a decrease of 2 percent in 1998, while the rest of the operators had a decrease of 3 percent.

Crude Oil

Proved Reserves

Proved reserves of crude oil are more highly concentrated in a few companies than those of natural gas. The 20 largest oil and gas producing companies in 1998 had 68 percent of U.S. proved reserves of crude oil (Table A3), in contrast to wet natural gas where these same companies operated only 54 percent of the total proved reserves. These companies have tended in the past few years to concentrate their domestic operations in fewer fields and focus more of their resources on their foreign operations.

U.S. proved reserves of crude oil decreased 7 percent in 1998. The top 20 producing companies remained essentially the same in their domestic proved reserves of crude oil during 1998. The top 20 class had a decline of 17 percent in their crude oil proved reserves from 1993 to 1998. The class "other" had a 34 percent decrease from 1993 to 1998. During the 1993–1998 period, many operators were continuing to actively buy, sell, and restructure their oil property positions.

Production

Crude oil production reported for 1993 through 1998 has decreased from 2.3 billion barrels to 2.0 billion barrels (Table A4). The 20 largest oil and gas producing companies had 64 percent of U.S. production of crude oil in 1998, while in 1993 they accounted for 68 percent of production. This is in contrast to wet natural gas where these same companies produced only 52 percent of the total. U.S. production of crude oil declined by 15 percent from 1993 to 1998. The top 20 operators had a decline of 19 percent in their oil production during the same period. U.S. production of crude oil declined by 7 percent from 1997 to 1998, while the top 20 operators production decreased by 2 percent. The next two size classes account for 17 and 10 percent of the U.S. crude oil pr oduction, respectively.

Fields

The number of fields in which Category I and Category II operators were active dropped significantly during the 1993–1998 period (Table A5). From 1993 through 1998, the number of fields in which the top 20 operators were active in dropped by 2,292 (35 percent), while in 1998 the number dropped 526 (11 percent) from 1997.

Table A1. Natural Gas Proved Reserves, Wet After Lease Separation, by Operator Production Size Class, 1993–1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Size Class	1993	1994	1995	1996	1997	1998	1997–1998 Volume and Percent Change	1993–1998 Volume and Percent Change	1998 Average Reserves per Operator
Class 1–10	77,552	76,665	75,856	72,606	68,876	64,336	-4,540	-13,216	6,433.577
Percent of Total	45.5%	44.6%	43.7%	41.5%	39.2%	37.3%	-6.6%	-17.0%	
Class 11–20	22,467	22,691	24,648	25,416	27,705	28,338	633	5,871	2,833.802
Percent of Total	13.2%	13.2%	14.2%	14.5%	15.8%	16.4%	2.3%	26.1%	
Class 21–100	39,135	40,566	42,604	43,300	45,593	47,009	1,416	7,874	587.617
Percent of Total	23.0%	23.6%	24.6%	24.7%	25.9%	27.3%	3.1%	20.1%	
Class 101–500	19,870	20,608	20,150	22,483	23,338	24,471	1,133	4,601	61.176
Percent of Total	11.7%	12.0%	11.6%	12.8%	13.3%	14.2%	4.9%	23.2%	
Class Other (23,120)	11,466	11,409	10,218	11,342	10,209	8,289	-1,920	-3,177	0.360
Percent of Total	6.7%	6.6%	5.9%	6.5%	5.8%	4.8%	-18.8%	-27.7%	
Category I (170)	142,892	143,703	148,233	146,601	147,491	146,458	-1,033	3,566	861.520
Percent of Total	83.8%	83.6%	85.4%	83.7%	83.9%	84.9%	-0.7%	2.5%	
Category II (418)	17,305	18,158	15,828	18,382	17,764	18,033	269	728	43.140
Percent of Total	10.2%	10.6%	9.1%	10.5%	10.1%	10.5%	1.5%	4.2%	
Category III (23,032)	10,292	10,078	9,416	10,164	10,466	7,952	-2,515	-2,340	0.345
Percent of Total	6.0%	5.9%	5.4%	5.8%	6.0%	4.6%	-24.0%	-22.7%	
Total Published	**170,490**	**171,939**	**173,476**	**175,147**	**175,721**	**172,443**	**-3,278**	**1,953**	**7.301**
Percent of Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.00%**	**-1.9%**	**1.1%**	

Note: There were 23,032 active Category III operators in the 1998 sample frame. The reserves and production of Category III operators were estimated from an adjusted sample of 2,136 Category III operators (Table E2). The “other” size class represents 23,120 operators in the 1998 frame (23,620 active operators minus the 500 largest operators).

Source: Energy Information Administration, Office of Oil and Gas.

Table A2. Natural Gas Production, Wet After Lease Separation, by Operator Production Size Class, 1993–1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Size Class	1993	1994	1995	1996	1997	1998	1997–1998 Volume and Percent Change	1993–1998 Volume and Percent Change	1998 Average Production per Operator
Class 1–10	6,801	7,216	7,174	7,448	7,178	6,954	-224	153	695.409
Percent of Total	36.5%	37.6%	38.0%	37.5%	35.7%	35.4%	-3.1%	2.2%	
Class 11–20	2,861	3,083	3,101	3,002	3,286	3,317	31	456	331.668
Percent of Total	15.3%	16.0%	16.4%	15.1%	16.3%	16.9%	0.9%	15.9%	
Class 21–100	4,894	4,878	4,871	5,316	5,729	5,595	-134	701	69.941
Percent of Total	26.3%	25.4%	25.8%	26.7%	28.4%	28.5%	-2.3%	14.3%	
Class 101–500	2,597	2,552	2,477	2,623	2,665	2,721	56	124	6.802
Percent of Total	13.9%	13.3%	13.1%	13.2%	13.2%	13.9%	2.1%	4.8%	
Class Other (23,120)	1,488	1,481	1,251	1,484	1,276	1,035	-241	-453	0.045
Percent of Total	8.0%	7.7%	6.6%	7.5%	6.3%	5.3%	-18.9%	-30.4%	
Category I (170)	15,122	15,656	15,800	16,381	16,897	16,619	-278	1,497	97.761
Percent of Total	81.1%	81.5%	83.7%	82.4%	83.9%	84.7%	-1.6%	9.9%	
Category II (418)	2,159	2,221	1,923	2,128	1,979	2,019	40	-140	4.830
Percent of Total	11.6%	11.6%	10.2%	10.7%	9.8%	10.3%	2.0%	-6.5%	
Category III (23,032)	1,360	1,333	1,151	1,364	1,258	984	-274	-376	0.043
Percent of Total	7.3%	6.9%	6.1%	6.9%	6.2%	5.0%	-21.8%	-27.6%	
Total Published	**18,641**	**19,210**	**18,874**	**19,873**	**20,134**	**19,622**	**-512**	**981**	**0.831**
Percent of Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**-2.5%**	**5.3%**	

Note: There were 23,032 active Category III operators in the 1998 sample frame. The reserves and production of Category III operators were estimated from an adjusted sample of 2,136 Category III operators (Table E2). The “other” size class represents 23,120 operators in the 1998 frame (23,620 active operators minus the 500 largest operators).

Source: Energy Information Administration, Office of Oil and Gas.

Table A3. Crude Oil Proved Reserves by Operator Production Size Class, 1993–1998

(Million Barrels of 42 U.S. Gallons)

Size Class	1993	1994	1995	1996	1997	1998	1997–1998 Volume and Percent Change	1993–1998 Volume and Percent Change	1998 Average Reserves per Operator
Class 1–10	14,894	14,351	13,891	13,362	11,434	11,501	67	-3,393	1,150.102
Percent of Total	64.9%	63.9%	62.1%	60.7%	50.7%	54.7%	0.6%	-22.8%	
Class 11–20	2,389	2,276	2,422	2,013	2,977	2,894	-83	505	289.401
Percent of Total	10.4%	10.1%	10.8%	9.1%	13.2%	13.8%	-2.8%	21.1%	
Class 21–100	2,401	2,607	2,623	3,155	4,384	3,677	-707	1,276	45.963
Percent of Total	10.5%	11.6%	11.7%	14.3%	19.4%	17.50%	-16.1%	53.1%	
Class 101–500	1,440	1,512	1,793	1,838	2,111	1,754	-357	314	4.385
Percent of Total	6.3%	6.7%	8.0%	8.3%	9.4%	8.3%	-16.9%	21.8%	
Class Other (23,120)	1,833	1,711	1,622	1,649	1,640	1,208	-432	-625	0.052
Percent of Total	8.0%	7.6%	7.3%	7.5%	7.3%	5.7%	-26.3%	-34.1%	
Category I (170)	20,090	19,648	19,647	19,312	19,461	18,819	-642	-1,271	110.702
Percent of Total	87.5%	87.5%	87.9%	87.7%	86.3	89.5%	-3.3%	-6.3%	
Category II (418)	1,131	1,142	1,103	1,117	1,400	1,018	-381	-113	2.435
Percent of Total	4.9%	5.1%	4.9%	5.1%	6.2	4.8%	-27.2%	-10.0%	
Category III (23,032)	1,737	1,668	1,600	1,588	1,685	1,197	-489	-540	0.052
Percent of Total	7.6%	7.4%	7.2%	7.2%	7.5	5.7%	-29.0%	-31.1%	
Total Published	**22,957**	**22,457**	**22,351**	**22,017**	**22,546**	**21,034**	**-1,512**	**-1,923**	**0.891**
Percent of Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**-6.7%**	**-8.4%**	

Note: There were 23,032 active Category III operators in the 1998 sample frame. The reserves and production of Category III operators were estimated from an adjusted sample of 2,136 Category III operators (Table E2). The “other” size class represents 23,120 operators in the 1998 frame (23,620 active operators minus the 500 largest operators).

Source: Energy Information Administration, Office of Oil and Gas.

Table A4. Crude Oil Production by Operator Production Size Class, 1993–1998
(Million Barrels of 42 U.S. Gallons)

Size Class	1993	1994	1995	1996	1997	1998	1997–1998 Volume and Percent Change	1993–1998 Volume and Percent Change	1998 Average Production per Operator
Class 1–10	1,346	1,310	1,270	1,220	1,047	1,025	-22	-321	102.506
Percent of Total	57.5%	57.8%	57.4%	56.1%	49.0%	51.5%	-2.1%	-23.8%	
Class 11–20	236	224	221	185	262	255	-7	19	25.549
Percent of Total	10.1%	9.9%	10.0%	8.5%	12.3%	12.8%	-2.7%	8.1%	
Class 21–100	276	287	276	307	373	342	-31	66	4.280
Percent of Total	11.8%	12.7%	12.5%	14.1%	17.4%	17.2%	-8.3%	23.9%	
Class 101–500	202	200	214	213	237	206	-31	4	0.514
Percent of Total	8.6%	8.8%	9.7%	9.8%	11.1%	10.3%	-13.1%	2.0%	
Class Other (23,120)	279	247	232	248	219	163	-56	-116	0.007
Percent of Total%	11.9%	10.9%	10.5%	11.4%	10.2%	8.2%	-25.6%	-41.6%	
Category I (170)	1,922	1,879	1,844	1,791	1,760	1,714	-46	-208	10.080
Percent of Total	82.2%	82.8%	83.3%	82.4%	82.3%	86.1%	-2.6%	-10.8%	
Category II (418)	153	150	139	143	157	118	-39	-35	0.283
Percent of Total	6.5%	6.6%	6.3%	6.6%	7.3%	5.9%	-24.8%	-22.9%	
Category III (23,032)	264	239	230	239	221	159	-62	-105	0.007
Percent of Total	11.3%	10.5%	10.4%	11.0%	10.3%	8.0%	-28.1%	-39.8%	
Total Published	**2,339**	**2,268**	**2,213**	**2,173**	**2,138**	**1,991**	**-147**	**-348**	**0.084**
Percent of Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**-6.9%**	**-14.9%**	

Note: There were 23,032 active Category III operators in the 1998 sample frame. The reserves and production of Category III operators were estimated from an adjusted sample of 2,136 Category III operators (Table E2). The “other” size class represents 23,120 operators in the 1998 frame (23,620 active operators minus the 500 largest operators).

Source: Energy Information Administration, Office of Oil and Gas.

Table A5. Operator Field Count by Operator Production Size Class, 1993–1998

Size Class	1993	1994	1995	1996	1997	1998	1997–1998 Number and Percent Change	1993–1998 Number and Percent Change	1998 Average Number of Fields per Operator
Class 1–10	3,591	3,258	3,113	2,800	2,566	2,475	-91	-1,116	247.500
Percent of Total	13.2%	12.2%	11.9%	10.7%	10.4%	9.5%	-3.5%	-31.1%	
Class 11–20	2,998	2,795	2,772	2,441	2,257	1,822	-435	-1,176	182.200
Percent of Total	11.1%	10.5%	10.6%	9.3%	9.1%	7.0%	-19.3%	-39.2%	
Class 21–100	7,600	7,752	7,569	7,526	7,159	7,526	-43	-630	94.075
Percent of Total	28.0%	29.1%	28.9%	28.7%	28.9%	29.0%	-0.6%	-7.7%	
Class 101–500	11,881	11,878	11,886	12,492	12,878	12,817	-61	936	32.043
Percent of Total	43.8%	44.6%	45.4%	47.7%	52.0%	49.4%	-0.5%	7.9%	
Rest	1,715	1,897	1,601	[a]952	1,332	1,524	603	365	14.796
Percent of Total	6.3%	7.1%	6.1%	[a]3.6%	5.4%	5.9%	65.5%	31.5%	
Category I	16,603	16,161	16,256	15,635	15,232	15,666	434	-937	92.153
Percent of Total	61.2%	60.7%	62.1%	59.7%	58.2%	60.4%	2.8%	-5.6%	
Category II	10,516	10,452	9,939	10,576	R9,530	10,271	741	-245	24.572
Percent of Total	38.8%	39.3%	37.9%	40.3%	41.8%	39.6%	7.8%	-2.3%	
Total Reported	**27,119**	**26,613**	**26,195**	**26,211**	**R24,762**	**25,937**	**1,175**	**-1,182**	**40.717**
Percent Change	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.00%**	**4.7%**	**-4.4%**	

[a]The reduced 1996 survey had fewer operators and fields in the "rest" class.

R = Revised

Note: Includes only data from Category I and Category II operators. In 1998, there were 170 Category I operators and 418 Category II operators. The "rest" size class had 88 operators in 1998.

Source: Energy Information Administration, Office of Oil and Gas.

Appendix B

Top 100 Oil and Gas Fields for 1998

Appendix B

Top 100 Oil and Gas Fields for 1998

This appendix presents estimates of the proved reserves and production of the top 100 oil and gas fields. The oil field production and reserve data include both crude oil and lease condensate. The gas field production and reserve data is total wet natural gas (associated-dissolved natural gas and nonassociated natural gas, wet after lease separation).

Table B1. Top 100 Oil Fields for 1998

The top 100 oil fields in the United States as of December 31, 1998, had 14,886 million barrels of proved reserves accounting for 67 percent of the total United States (**Table 6 and Table 16**). Although there is considerable grouping of field–level statistics within the tables, rough orders of magnitude can be estimated for the proved reserves and production of most fields. Many of the fields in the top 100 group are operated by only one or two operators, therefore, the totals for proved reserves are grouped as top 10, top 20, top 50, and top 100 to avoid revealing company proprietary data.

In the top 20 oil fields for 1998 there are three fields, Mississippi Canyon Block 807 (Mars), Green Canyon Block 244 (Troika), and Mississippi Canyon Block 854 (Ursa) which are in the deep water of the Gulf of Mexico Federal Offshore.

The top 100 oil fields in the United States as of December 31, 1998, had 1,143 million barrels of production, or 53 percent of the total (**Table 6 and Table 15**). Many of the oil fields in the top 100 are very old, 50 oil fields were discovered prior to 1950. The oldest, Coalinga in California, was discovered in 1887. The newest, Garden Banks Block 602, in the Gulf of Mexico Federal Offshore was only discovered in 1998.

The oil fields with newer discovery dates are typically located in the Gulf of Mexico Offshore and Alaska. Of the top 100 oil fields 50 percent are equally in the Gulf of Mexico Offshore and Texas, an additional 29 percent are in California and Alaska. There were 15 different fields in this year's tabulation than in last years.

Table B2. Top 100 Gas Fields for 1998

The top 100 gas fields in the United States as of December 31, 1998, had 81,628 billion cubic feet of wet natural gas proved reserves, or 47 percent of the total (**Table 9**).

The top 100 gas fields in the United States as of December 31, 1998, had 6,574 billion cubic feet of production, or 34 percent of the total (**Table 9**). Fewer of the gas fields in the top 100 are as old as the top100 oil fields. There were 20 gas fields that were discovered prior to 1946. Gas fields in the top 100 are newer than the oil fields, 51 gas fields were discovered after 1967.The oldest, Big Sandy in Kentucky, was discovered in 1881. The newest, Mississippi Canyon Block 810, in the Gulf of Mexico Federal Offshore was only discovered in 1996.

The gas fields with newer discovery dates are located in the Gulf of Mexico Offshore, south Texas and Virginia. Several of the same fields are in both tables. Of the top 100 gas fields 28 percent are in Texas, 15 percent in the Gulf of Mexico Offshore, an additional 26 percent are in Oklahoma and Wyoming. There were 9 different fields in this year's tabulation than in last year's table.

Table B1. Top 100 U.S. Fields Ranked by Oil[a] Proved Reserves, from Reported 1998 Field Level Data
(Million Barrels of 42 U.S. Gallons)

Field Name	Location	Discovery Year	Proved Reserves Rank Group	Reported Production Rank Group
Prudhoe Bay	AK	1967	1-10	222.0
Midway-Sunset	CA	1901	1-10	49.6
Kuparuk River	AK	1969	1-10	91.8
Belridge South	CA	1911	1-10	44.9
Yates	TX	1926	1-10	19.3
Kern River	CA	1899	1-10	46.8
Wasson	TX	1937	1-10	16.3
Elk Hills	CA	1919	1-10	19.3
Mississippi Canyon Block 807	GF	1989	1-10	43.2
Milne Point	AK	1982	1-10	20.4
Top 10 Volume Subtotal			**8,084.0**	**573.7**
Top 10 Percentage of U.S. Total			**36.1%**	**26.4%**
Slaughter	TX	1937	11-20	14.9
Hondo	CA	1969	11-20	13.9
Spraberry Trend Area	TX	1950	11-20	20.1
Endicott	AK	1978	11-20	17.0
Point McIntyre	AK	1988	11-20	47.6
Alpine	AK	1994	11-20	0.0
Levelland	TX	1945	11-20	9.3
Green Canyon Block 244	GF	1994	11-20	20.2
Mississippi Canyon Block 810	GF	1992	11-20	0.0
San Ardo	CA	1947	11-20	4.5
Top 20 Volume Subtotal			**10,094.3**	**147.4**
Top 20 Percentage of U.S. Total			**45.1%**	**33.2%**
Cymric	CA	1916	21-50	17.7
Cowden North	TX	1930	21-50	7.1
Wilmington	CA	1932	21-50	19.0
Lost Hills	CA	1910	21-50	11.5
Pescado	CA	1970	21-50	11.1
Sho-Vel-Tum	OK	1905	21-50	9.3
Vacuum	NM	1929	21-50	7.6
East Texas	TX	1930	21-50	13.8
Greater Aneth Area	UT	1956	21-50	6.2
Alaminos Canyon Block 25	GF	1997	21-50	0.0
Rangely	CO	1902	21-50	6.8
Green Canyon Block 205	GF	1988	21-50	0.0
Coalinga	CA	1887	21-50	8.9
Fullerton	TX	1942	21-50	6.4
Seminole	TX	1936	21-50	11.5
Hawkins	TX	1940	21-50	3.4
Mississippi Canyon Block 935	GF	1994	21-50	0.0
Garden Banks Block 260	GF	1995	21-50	0.5
Ventura	CA	1916	21-50	4.9
Garden Banks Block 426	GF	1987	21-50	26.5
Salt Creek	TX	1942	21-50	8.5
Wasson 72	TX	1940	21-50	1.2
Badami	AK	1990	21-50	0.7
Niakuk	AK	1984	21-50	18.5
McElroy	TX	1926	21-50	6.5
Howard-Glasscock	TX	1925	21-50	3.5
Robertson North	TX	1956	21-50	3.3
Jay	FL & AL	1970	21-50	4.6
Wattenberg	CO	1970	21-50	5.1
Viosca Knoll Block 990	GF	1981	21-50	18.6
Top 50 Volume Subtotal			**12,896.3**	**963.8**
Top 50 Percentage of U.S. Total			**57.7%**	**44.4%**

Table B1. Top 100 U.S. Fields Ranked by Oil[a] Proved Reserves, from Reported 1998 Field Level Data (Continued)
(Million Barrels of 42 U.S. Gallons)

Field Name	Location	Discovery Year	Proved Reserves Rank Group	Reported Production Rank Group
Bay Marchand Block 2	GF & LA	1949	51-100	5.6
Monument	NM & UT	1935	51-100	3.1
Green Canyon Block 158	GF	1992	51-100	0.0
Viosca Knoll Block 956	GF	1985	51-100	16.5
Green Canyon Block 112	GF	1992	51-100	0.0
West Delta Block 30	GF	1949	51-100	8.9
Goldsmith	TX	1935	51-100	4.1
Eugene Island SA Block 330	GF	1971	51-100	10.2
West Sak	AK	1969	51-100	0.6
Giddings	TX	1960	51-100	16.7
Ewing Bank Block 873	GF	1991	51-100	18.1
Beverly Hills	CA	1900	51-100	1.6
Bluebell-Altamont	UT	1949	51-100	3.6
Jo-Mill	TX	1953	51-100	2.4
Garden Banks Block 602	GF	1998	51-100	0.0
Ewing Bank Block 921	GF	1993	51-100	1.1
Huntington Beach	CA	1920	51-100	3.8
Dollarhide	TX & NM	1945	51-100	3.6
T X L	TX	1944	51-100	2.5
Eunice Monument	NM	1929	51-100	1.3
Main Pass SA Block 299	GF	1967	51-100	5.1
Viosca Knoll Block 915	GF	1993	51-100	0.0
Cedar Hills	ND	1995	51-100	5.6
Kern Front	CA	1925	51-100	2.0
Viosca Knoll Block 786	GF	1996	51-100	0.0
Brea-Olinda	CA	1897	51-100	1.4
Oregon Basin	WY	1912	51-100	4.0
Lisburne	AK	1967	51-100	2.5
Fitts East	OK	1944	51-100	0.7
Hartzog Draw	WY	1976	51-100	2.1
Tarn	AK	1991	51-100	3.5
Cogdell	TX	1949	51-100	0.3
Pennel	MT	1955	51-100	1.8
Ship Shoal Block 169	GF	1961	51-100	4.9
Viosca Knoll Block 825	GF	1988	51-100	7.8
Grayburg-Jackson	NM	1929	51-100	3.7
Hobbs	NM	1928	51-100	1.7
Arroyo Grande	CA	1906	51-100	0.5
Foster	TX	1932	51-100	1.8
Lake Washington	LA	1931	51-100	1.6
Welch	TX	1942	51-100	2.1
Beta	CA	1976	51-100	2.9
Painter Reservoir East	WY	1979	51-100	3.8
Hamilton Dome	WY	1918	51-100	1.7
South Pass Block 61	GF	1955	51-100	7.0
Justis	NM	1957	51-100	0.8
Golden Trend	OK	1945	51-100	2.3
Cedar Lake	TX	1939	51-100	2.3
Postle	OK	1958	51-100	1.8
Green Canyon Block 254	GF	1994	51-100	0.0
Top 100 Volume Subtotal			**14,886.3**	**1,143.1**
Top 100 Percentage of U.S. Total			**66.5%**	**52.7%**

[a]Includes lease condensate.

Notes: The U.S. total production estimate of 2,169 million barrels and the U.S. total reserves estimate of 22,370 million barrels, used to calculate the percentages in this table, are from the combined totals of Table 6 and Table 15 in this publication. Column totals may not add due to independent rounding.

Source: Energy Information Administration, Office of Oil and Gas.

Table B2. Top 100 U.S. Fields Ranked by Gas[a] Proved Reserves, from Reported 1998 Field Level Data
(Billion Cubic Feet)

Field Name	Location	Discovery Year	Proved Reserves Rank Group	Reported Production Rank Group
Blanco / Ignacio-Blanco	NM & CO	1927	1-10	718.1
Basin	NM	1947	1-10	662.6
Hugoton Gas Area	KS & OK & TX	1922	1-10	468.6
Prudhoe Bay	AK	1967	1-10	252.7
Madden	WY	1968	1-10	55.1
Carthage	TX	1936	1-10	222.7
Mobile Bay	AL	1979	1-10	149.4
Big Piney-Labarge	WY	1924	1-10	39.1
Oakwood	VA	1990	1-10	32.1
Wattenburg	CO	1970	1-10	100.9
Top 10 Volume Subtotal			**39,974.0**	**2,701.4**
Top 10 Percentage of U.S. Total			**23.2%**	**13.8%**
Antrim	MI	1965	11-20	136.0
Panhandle West	TX	1918	11-20	123.2
Fogarty Creek	WY	1975	11-20	30.8
Big Sandy	KY	1881	11-20	48.7
Giddings	TX	1960	11-20	225.6
Natural Buttes	UT	1940	11-20	55.4
Red-Oak Norris	OK	1910	11-20	64.6
Cook Inlet North	AK	1962	11-20	53.7
Panoma Gas Area	KS	1956	11-20	92.7
Beluga River	AK	1962	11-20	33.2
Top 20 Volume Subtotal			**50,448.6**	**863.8**
Top 20 Percentage of U.S. Total			**29.3%**	**18.2%**
Elk Hills	CA	1919	21-50	98.0
Spraberry Trend Area	TX	1953	21-50	69.2
Oak Hill	TX	1967	21-50	66.5
Lake Ridge	WY	1981	21-50	15.2
Whitney Canyon-Carter Creek	WY	1978	21-50	76.2
Gomez	TX	1963	21-50	63.5
Strong City District	OK	1972	21-50	70.5
East Breaks Block 945	TX	1994	21-50	0.0
Mocane-Laverne Gas Area	OK & KS & TX	1947	21-50	66.3
Lower Mobile Bay-Mary Ann	AL	1979	21-50	35.8
Mobile Block 823	GF	1983	21-50	54.2
Sawyer	TX	1960	21-50	48.6
Golden Trend	OK	1946	21-50	41.9
Mississippi Canyon Block 731	GF	1987	21-50	43.9
Mississippi Canyon Block 810	GF	1996	21-50	0.0
Vaquillas Ranch	TX	1978	21-50	71.6
Viosca Knoll Block 956	GF	1985	21-50	74.6
Knox	OK	1916	21-50	51.3
Wasson	TX	1937	21-50	8.4
Ozona	TX	1953	21-50	48.9
Watonga-Chickasha Trend	OK	1948	21-50	64.6
Judge Digby	LA	1977	21-50	21.9
McArthur River	AK	1968	21-50	72.5
Bruff	WY	1969	21-50	47.7
Bob West	TX	1990	21-50	74.3
Garden Banks Block 426	GF	1987	21-50	92.8
Wilburton	OK	1941	21-50	52.3
Drunkards Wash	UT	1989	21-50	30.1
Raton	CO	1994	21-50	10.0
Viosca Knoll Block 915	GF	1993	21-50	0.0
Top 50 Volume Subtotal			**67,420.2**	**5,036.0**
Top 50 Percentage of U.S. Total			**39.1%**	**25.7%**

Table B2. Top 100 U.S. Fields Ranked by Gas[a] Proved Reserves, from Reported 1998 Field Level Data (Continued)
(Billion Cubic Feet)

Field Name	Location	Discovery Year	Proved Reserves Rank Group	Reported Production Rank Group
Anschutz Ranch East	UT & WY	1980	51-100	80.1
McAllen Ranch	TX	1960	51-100	84.7
Indian Basin	NM	1963	51-100	73.4
Mississippi Canyon Block 807	GF	1989	51-100	44.5
Kuparuk River	AK	1969	51-100	28.1
Elk City	OK	1947	51-100	38.8
Wamsutter	WY	1958	51-100	28.2
Kinta	OK	1914	51-100	42.9
Fairway	AL	1986	51-100	29.6
Nora	VA	1949	51-100	23.6
A W P	TX	1987	51-100	24.7
Garden Banks Block 260	GF	1992	51-100	2.8
Painter Reservoir East	WY	1979	51-100	34.1
Viosca Knoll Block 783	GF	1985	51-100	54.8
Rulison	CO	1956	51-100	21.3
Waltman	WY	1959	51-100	56.6
South Pass SA Block 89	GF	1969	51-100	34.1
Grand Valley	CO	1985	51-100	15.6
Hondo	CA	1969	51-100	21.3
Tip Top	WY	1928	51-100	18.3
Belridge South	CA	1911	51-100	17.4
Mississippi Canyon Block 354	GF	1977	51-100	37.1
Standard Draw	WY	1979	51-100	23.0
Pegasus	TX	1949	51-100	24.4
Green Canyon Block 244	GF	1994	51-100	31.8
Newark East	TX	1981	51-100	30.7
Verden	OK	1961	51-100	36.1
Willow Springs	TX	1938	51-100	25.6
Matagorda Island Block 623	GF	1980	51-100	100.3
Sarita East	TX	1967	51-100	36.6
Lake Arthur South	LA	1955	51-100	25.7
Moorewood NE	OK	1979	51-100	30.2
Double A Wells	TX	1980	51-100	36.0
Cedar Cove Coal Degas	AL	1983	51-100	31.1
Sugg Ranch	TX	1985	51-100	9.7
Boonsville	TX	1945	51-100	30.4
Jeffress NE	TX	1975	51-100	28.8
Trawick	TX	1949	51-100	22.1
Endicott	AK	1978	51-100	9.1
Mississippi Canyon Block 194	GF	1975	51-100	35.3
Stratton	TX	1937	51-100	15.2
Lost Hills	CA	1910	51-100	17.9
Cochranton	PA	1980	51-100	9.4
Blanco South	NM	1951	51-100	15.9
Kenai	AK	1959	51-100	9.0
Mississippi Canyon Block 292	GF	1996	51-100	0.0
Monte Christo	TX	1953	51-100	9.5
Sho-Vel-Tum	OK	1912	51-100	23.1
Carpenter	OK	1951	51-100	23.1
Puckett	TX	1952	51-100	35.9
Top 100 Volume Subtotal			**81,628.0**	**6,573.8**
Top 100 Percentage of U.S. Total			**47.3%**	**33.5%**

[a]Total wet gas after lease separation.

Note: The U.S. total production estimate of 19,622 billion cubic feet and the U.S. total reserves estimate of 172,443 billion cubic feet, used to calculate the percentages in this table, are from Table 9 in this publication. Column totals may not add due to independent rounding.

Source: Energy Information Administration, Office of Oil and Gas.

Appendix C

Conversion to the Metric System

Appendix C

Conversion to the Metric System

Public Law 100–418, the Omnibus Trade and Competitiveness Act of 1988, states: "It is the declared policy of the United States—

> (1) to designate the metric system of measurement as the preferred system of weights and measures for United States trade and commerce. . . .
>
> (2) to require that each Federal agency, by the end of Fiscal Year 1992, use the metric system of measurement in its procurements, grants, and other business–related activities."{39}

Table C1 is in keeping with the spirit of this law. The petroleum industry in the United States is slowly moving in the direction prescribed by this law and the data collected by EIA are collected in the units that are still common to the U.S. petroleum industry, namely barrels and cubic feet. Standard metric conversion factors were used to convert the National level volumes in **Table 1** to the metric equivalents in **Table C1**. Barrels were multiplied by 0.1589873 to convert to cubic meters and cubic feet were multiplied by 0.02831685 to convert to cubic meters.

Table C1. U.S. Proved Reserves of Crude Oil, Dry Natural Gas, and Natural Gas Liquids, in Metric Units, 1988 – 1998

Year	Adjustments (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[a] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[b] Discoveries (8)	Production (9)	Proved[c] Reserves 12/31 (10)	Change from Prior Year (11)
					Crude Oil (million cubic meters)						
1988	57.8	426.7	194.1	290.4	56.4	11.3	20.2	87.9	446.9	4,264.8	–68.6
1989	33.9	428.9	217.0	245.8	81.7	17.8	14.3	113.8	411.1	4,213.3	–51.5
1990	13.7	394.8	159.0	249.5	72.5	15.6	21.5	109.6	398.3	4,174.1	–39.2
1991	25.9	333.4	297.9	61.4	58.0	15.4	14.6	88.0	399.4	3,924.1	–250.0
1992	46.2	286.8	170.0	163.0	62.2	1.3	13.5	77.0	388.9	3,775.2	–148.9
1993	43.1	319.7	241.0	121.8	56.6	50.7	17.5	124.8	371.9	3,649.9	–125.3
1994	30.1	375.8	215.7	190.2	63.1	10.2	17.6	90.9	360.6	3,570.4	–79.5
1995	19.4	289.8	126.4	182.8	79.5	18.1	54.5	152.1	351.8	3,553.5	–16.9
1996	28.0	273.9	156.8	145.1	86.3	38.6	22.4	147.3	345.5	3,500.4	–53.1
1997	82.7	317.7	172.3	228.0	75.8	101.3	18.9	196.0	339.9	3,584.2	83.8
1998	–101.5	437.5	355.2	–19.2	52.0	24.2	19.1	95.3	316.5	3,344.1	–240.4
					Dry Natural Gas (billion cubic meters)						
1988	62.09	661.68	[d]1,088.13	–364.36	192.64	46.38	54.06	293.08	472.04	[d]4,757.91	–543.32
1989	85.33	755.30	669.50	171.13	179.50	41.06	63.51	284.07	480.91	4,732.20	–25.71
1990	44.08	537.48	380.66	200.90	225.18	56.75	68.30	350.23	487.98	4,795.35	63.15
1991	83.82	563.22	438.17	208.87	144.13	24.01	45.42	213.56	487.11	4,730.67	–64.68
1992	63.29	511.26	338.73	235.82	132.38	18.38	48.82	199.58	493.36	4,672.71	–57.96
1993	27.51	498.29	346.82	178.98	172.82	25.46	52.84	251.12	503.73	4,599.08	–73.63
1994	55.08	604.99	449.70	210.37	196.55	53.63	98.54	348.72	518.82	4,639.35	40.27
1995	16.42	579.50	360.50	235.42	193.77	47.18	69.43	310.38	508.74	4,676.41	37.06
1996	107.18	485.12	369.42	222.88	219.65	41.09	88.07	348.81	534.08	4,714.02	37.61
1997	–16.70	613.28	474.47	122.10	299.73	75.92	67.45	443.10	544.00	4,735.22	21.22
1998	–46.30	792.96	630.42	116.24	232.11	30.41	61.22	323.74	530.09	4,645.12	–90.11
					Natural Gas Liquids (million cubic meters)						
1988	1.8	185.7	113.7	73.8	42.6	6.5	11.4	60.5	119.9	1,309.7	14.4
1989	–44.0	181.7	162.2	–24.5	41.2	13.2	11.8	66.2	116.2	1,235.2	–74.5
1990	–13.2	131.5	96.3	22.0	47.5	6.2	11.6	65.3	116.4	1,206.1	–29.1
1991	37.1	131.2	110.5	57.8	30.0	4.0	8.7	42.7	119.9	1,186.7	–19.4
1992	35.7	128.1	86.6	77.2	30.2	3.2	10.2	43.6	122.9	1,184.6	–2.1
1993	16.2	121.5	101.8	35.9	39.0	3.8	10.2	53.0	125.3	1,148.2	–36.4
1994	6.9	138.8	107.5	38.2	49.9	8.6	20.8	79.3	125.8	1,139.9	–8.3
1995	30.5	153.9	109.9	74.5	68.7	8.3	10.7	87.7	125.8	1,176.3	36.4
1996	75.5	134.2	106.4	103.3	71.7	10.3	17.3	99.3	135.1	1,243.8	67.5
1997	–2.4	190.6	144.7	43.6	85.1	18.1	14.3	117.5	137.4	1,267.6	23.8
1998	–57.4	207.0	173.9	-24.3	60.9	10.5	14.0	85.4	132.4	1,196.2	–71.4

[a]Revisions and adjustments = Col. 1 + Col. 2 – Col. 3.

[b]Total discoveries = Col. 5 + Col. 6 + Col. 7.

[c]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 – Col. 9.

[d]An unusually large revision decrease to North Slope dry natural gas reserves was made in 1988. It recognizes some 696.59 billion cubic meters of downward revisions reported during prior years by operators because of economic and market conditions. EIA in previous years carried these reserves in the proved category.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA–23, “Annual Survey of Domestic Oil and Gas Reserves” and Form EIA–64A, “Annual Report of the Origin of Natural Gas Liquids Production.” The following conversion factors were used to convert data in Columns 2, 3, 5, 6, 7, 9, and 10: barrels = 0.1589873 per cublic meter, cubic feet = 0.02831685 per cublc meter. Number of decimal digits varies in order to accurately reproduce corresponding equivalents shown on Table 1 in Chapter 2.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, 1988–1998 annual reports, DOE/EIA–0216.{12–21}

Appendix D

Historical Reserves Statistics

Appendix D

Historical Reserves Statistics

These are selected historical data presented at the State and National level. All historical statistics included have previously been published in the annual reports of 1977 through 1998 of the EIA publication *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves,* DOE EIA-0216.{1-21}

Liquid volumes are in million barrels of 42 U.S. gallons. Gas volumes are in billion cubic feet (Bcf), at 14.73 psia and 60° Fahrenheit. NA appears in this appendix wherever data are not available or are withheld to avoid disclosure of data which may be proprietary. An asterisk (*) marks those estimates associated with sampling errors (95 percent confidence interval) greater than 20 percent of the value estimated.

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Alabama				
1977	85	0	530	NA
1978	*74	0	514	NA
1979	45	NA	652	213
1980	54	NA	636	226
1981	55	NA	648	192
1982	54	NA	[a]648	193
1983	51	NA	[a]785	216
1984	*68	NA	[a]961	200
1985	69	NA	[a]821	182
1986	55	20	[b]951	177
1987	55	20	[b]842	166
1988	54	20	[b]809	166
1989	43	20	[b]819	168
1990	44	<1	[c]4,125	170
1991	43	<1	[c]5,414	145
1992	41	0	[c]5,802	171
1993	41	0	[c]5,140	158
1994	44	0	[c]4,830	142
1995	43	0	[c]4,868	120
1996	45	0	[c]5,033	119
1997	47	0	[c]4,968	93
1998	39	0	[c]4,604	81

[a]Onshore only; offshore included in Louisiana.
[b]Onshore only; offshore included in Federal Offshore - Gulf of Mexico (Louisiana).
[c]Includes State Offshore: 2,519 Bcf in 1990; 3,191 Bcf in 1991; 3,233 Bcf in 1992; 3,364 Bcf in 1993; 3,297 Bcf in 1994; 3,432 Bcf in 1995; 3,509 Bcf in 1996; 3,422 Bcf in 1997; 3,144 Bcf in 1998.

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Alaska				
1977	8,413	846	32,243	NA
1978	9,384	398	32,045	NA
1979	8,875	398	32,259	23
1980	8,751	0	33,382	11
1981	8,283	0	33,037	10
1982	7,406	60	34,990	9
1983	7,307	576	34,283	8
1984	7,563	369	34,476	19
1985	7,056	379	33,847	383
1986	6,875	902	32,664	381
1987	7,378	566	33,225	418
1988	6,959	431	9,078	401
1989	6,674	750	8,939	380
1990	6,524	969	9,300	340
1991	6,083	1,456	9,553	360
1992	6,022	1,331	9,638	347
1993	5,775	1,161	9,907	321
1994	5,767	1,022	9,733	301
1995	5,580	582	9,497	306
1996	5,274	952	9,294	337
1997	5,161	832	10,562	631
1998	5,052	832	9,927	320

Note: See 1988 Chapter 4 discussion “Alaskan North Slope Natural Gas Reserves”.

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Arkansas				
1977	116	17	1,660	NA
1978	111	8	1,681	NA
1979	107	8	1,703	17
1980	107	11	1,774	16
1981	113	11	1,801	16
1982	107	4	1,958	15
1983	120	4	2,069	11
1984	114	6	2,227	12
1985	97	11	2,019	11
1986	88	9	1,992	16
1987	82	0	1,997	16
1988	77	<1	1,986	13
1989	66	1	1,772	9
1990	60	1	1,731	9
1991	*70	0	1,669	5
1992	58	<1	1,750	4
1993	65	0	1,552	4
1994	51	0	1,607	6
1995	48	0	1,563	6
1996	58	0	1,470	4
1997	45	0	1,475	7
1998	47	0	1,328	5

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
California - Coastal Region Onshore				
1977	679	NA	334	NA
1978	602	NA	350	NA
1979	578	NA	365	22
1980	652	NA	299	23
1981	621	NA	306	14
1982	580	NA	362	16
1983	559	NA	381	17
1984	628	140	265	15
1985	631	152	256	16
1986	592	164	255	15
1987	625	298	238	13
1988	576	299	215	13
1989	731	361	224	11
1990	588	310	217	12
1991	554	327	216	12
1992	522	317	203	10
1993	528	313	189	12
1994	480	238	194	11
1995	456	234	153	8
1996	425	261	156	9
1997	430	43	164	9
1998	354	40	106	9

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
California - Total				
1977	5,005	1,047	4,737	NA
1978	4,974	968	4,947	NA
1979	5,265	960	5,022	111
1980	5,470	891	5,414	120
1981	5,441	660	5,617	82
1982	5,405	616	5,552	154
1983	5,348	576	5,781	151
1984	5,707	674	5,554	141
1985	[d]4,810	590	[d]4,325	[d]146
1986	[d]4,734	[d]616	[d]3,928	[d]134
1987	[d]4,709	[d]1,493	[d]3,740	[d]130
1988	[d]4,879	[d]1,440	[d]3,519	[d]123
1989	[d]4,816	[d]1,608	[d]3,374	[d]113
1990	[d]4,658	[d]1,425	[d]3,185	[d]105
1991	[d]4,217	[d]1,471	[d]3,004	[d]92
1992	[d]3,893	[d]1,299	[d]2,778	[d]99
1993	[d]3,764	[d]965	[d]2,682	[d]104
1994	[d]3,573	[d]835	[d]2,402	[d]92
1995	[d]3,462	[d]823	[d]2,243	[d]92
1996	[d]3,437	[d]905	[d]2,082	[d]92
1997	[d]3,750	[d]1,264	[d]2,273	[d]95
1998	[d]3,843	[d]1,297	[d]2,244	[d]72

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
California - Los Angeles Basin Onshore				
1977	910	NA	255	NA
1978	493	NA	178	NA
1979	513	NA	163	10
1980	454	NA	193	15
1981	412	NA	154	6
1982	370	NA	96	6
1983	343	NA	107	6
1984	373	126	156	5
1985	420	86	181	6
1986	330	66	142	8
1987	361	105	148	8
1988	391	106	151	7
1989	342	32	137	4
1990	316	3	106	5
1991	272	4	115	4
1992	236	4	97	5
1993	238	4	102	6
1994	221	4	103	5
1995	227	4	111	4
1996	234	0	109	3
1997	268	0	141	4
1998	207	0	149	5

[d]Excludes Federal offshore; now included in Federal Offshore-Pacific (California).

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
California - San Joaquin Basin Onshore				
1977	2,965	NA	3,784	NA
1978	3,099	NA	3,960	NA
1979	3,294	NA	3,941	77
1980	3,360	NA	4,344	81
1981	3,225	NA	4,163	57
1982	3,081	NA	3,901	124
1983	3,032	NA	3,819	117
1984	3,197	384	3,685	105
1985	3,258	350	3,574	120
1986	3,270	368	3,277	109
1987	3,208	1,070	3,102	107
1988	3,439	1,029	2,912	101
1989	3,301	1,210	2,782	95
1990	3,334	1,109	2,670	86
1991	3,126	1,139	2,614	75
1992	2,898	977	2,415	83
1993	2,772	648	2,327	85
1994	2,647	593	2,044	75
1995	2,577	585	1,920	80
1996	2,597	644	1,768	80
1997	2,871	1,221	1,912	82
1998	3,127	1,257	1,945	58
California - State Offshore				
1977	181	NA	114	NA
1978	519	NA	213	NA
1979	632	NA	231	2
1980	604	NA	164	1
1981	NA	NA	NA	NA
1982	NA	NA	NA	NA
1983	NA	NA	NA	NA
1984	NA	25	NA	NA
1985	501	0	314	4
1986	542	18	254	2
1987	515	18	252	2
1988	473	6	241	2
1989	442	5	231	3
1990	420	3	192	2
1991	265	1	59	1
1992	237	1	63	1
1993	226	0	64	1
1994	225	0	61	1
1995	202	0	59	0
1996	181	0	49	0
1997	181	0	56	0
1998	155	0	44	0
California-State and Federal Offshore				
1977	451	NA	364	NA
1978	780	NA	457	NA
1979	880	NA	553	2
1980	1,004	NA	578	1
1981	1,183	NA	994	5
1982	1,374	NA	1,193	8
1983	1,414	NA	1,474	11
1984	1,509	25	1,448	16
1985	1,492	2	1,433	16
1986	1,516	19	1,579	17
1987	1,552	20	1,704	19
1988	1,497	6	1,793	23
1989	1,429	5	1,727	28
1990	1,382	3	1,646	20
1991	1,050	1	1,221	19
1992	971	1	1,181	21
1993	899	0	1,163	26
1994	878	0	1,231	22
1995	773	0	1,324	25
1996	699	0	1,293	23
1997	709	0	600	14
1998	623	0	524	12
California - Federal Offshore				
1977	270	NA	250	NA
1978	261	NA	246	NA
1979	248	NA	322	0
1980	400	NA	414	0
1981	NA	NA	NA	NA
1982	NA	NA	NA	NA
1983	NA	NA	NA	NA
1984	NA	0	NA	NA
1985	991	2	1,119	12
1986	974	1	1,325	15
1987	1,037	2	1,452	17
1988	1,024	0	1,552	21
1989	987	0	1,496	25
1990	962	0	1,454	18
1991	785	0	1,162	18
1992	734	<1	1,118	20
1993	673	0	1,099	25
1994	653	0	1,170	21
1995	571	0	1,265	25
1996	518	0	1,244	23
1997	528	0	544	14
1998	468	0	480	12

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Colorado				
1977	230	73	2,512	NA
1978	194	75	2,765	NA
1979	159	43	2,608	177
1980	*183	46	2,922	194
1981	147	47	2,961	204
1982	169	100	3,314	186
1983	186	113	3,148	183
1984	198	119	*2,943	155
1985	198	119	2,881	173
1986	207	95	3,027	148
1987	272	67	2,942	166
1988	257	67	3,535	181
1989	359	8	4,274	209
1990	305	8	4,555	169
1991	329	33	5,767	197
1992	304	34	6,198	226
1993	284	22	6,722	214
1994	271	22	6,753	248
1995	252	24	7,256	273
1996	231	22	7,710	287
1997	198	22	6,828	264
1998	212	21	7,881	260

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Illinois				
1977	*150	1	NA	NA
1978	*158	1	NA	NA
1979	*136	1	NA	NA
1980	113	2	NA	NA
1981	129	1	NA	NA
1982	150	1	NA	NA
1983	135	1	NA	NA
1984	153	1	NA	NA
1985	136	1	NA	NA
1986	135	1	NA	NA
1987	153	5	NA	NA
1988	143	<1	NA	NA
1989	123	<1	NA	NA
1990	131	0	NA	NA
1991	128	52	NA	NA
1992	138	0	NA	NA
1993	116	0	NA	NA
1994	117	0	NA	NA
1995	119	0	NA	NA
1996	94	0	NA	NA
1997	92	0	NA	NA
1998	81	0	NA	NA

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Florida				
1977	213	1	151	NA
1978	168	1	119	NA
1979	128	1	77	21
1980	134	1	84	27
1981	109	1	69	NA
1982	97	1	64	17
1983	78	4	49	11
1984	82	2	65	17
1985	77	2	55	17
1986	67	2	49	14
1987	61	0	49	9
1988	59	0	51	16
1989	50	0	46	10
1990	42	0	45	8
1991	37	0	38	7
1992	36	0	47	8
1993	40	0	50	9
1994	71	0	98	18
1995	71	0	92	17
1996	97	0	96	22
1997	91	0	96	17
1998	71	0	88	18

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Indiana				
1977	*20	0	NA	NA
1978	*29	0	NA	NA
1979	*40	0	NA	NA
1980	23	0	NA	NA
1981	23	0	NA	NA
1982	28	1	NA	NA
1983	34	3	NA	NA
1984	*33	2	NA	NA
1985	*35	2	NA	NA
1986	*32	2	NA	NA
1987	23	2	NA	NA
1988	*22	0	NA	NA
1989	*16	0	NA	NA
1990	12	0	NA	NA
1991	*16	0	NA	NA
1992	17	0	NA	NA
1993	15	0	NA	NA
1994	15	0	NA	NA
1995	13	0	NA	NA
1996	11	0	NA	NA
1997	*10	0	NA	NA
1998	13	0	NA	NA

Kansas

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	*349	3	11,457	NA
1978	303	3	10,992	NA
1979	*377	3	10,243	402
1980	310	2	9,508	389
1981	371	2	9,860	409
1982	378	13	9,724	302
1983	344	13	9,553	443
1984	377	2	9,387	424
1985	423	<1	9,337	373
1986	312	<1	10,509	440
1987	357	<1	10,494	462
1988	327	<1	10,104	345
1989	338	3	10,091	329
1990	321	<1	9,614	313
1991	300	<1	9,358	428
1992	310	0	9,681	444
1993	271	0	9,348	380
1994	260	0	9,156	398
1995	275	<1	8,571	369
1996	266	<1	7,694	338
1997	238	0	6,989	271
1998	246	0	6,402	334

Kentucky

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	30	0	451	NA
1978	*40	0	545	NA
1979	25	0	468	26
1980	*35	12	508	25
1981	29	13	530	25
1982	*36	13	551	35
1983	35	12	554	31
1984	*41	0	613	24
1985	*42	0	766	27
1986	*31	0	841	29
1987	25	0	909	23
1988	*34	0	923	24
1989	33	0	992	16
1990	33	0	1,016	25
1991	*31	0	1,155	24
1992	34	0	1,084	32
1993	26	0	1,003	26
1994	26	0	969	39
1995	24	0	1,044	43
1996	21	0	983	46
1997	*20	0	1,364	48
1998	23	0	1,222	54

Louisiana - Total

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	3,600	139	57,010	NA
1978	3,448	143	55,725	NA
1979	2,780	76	50,042	1,424
1980	2,751	62	47,325	1,346
1981	2,985	50	47,377	1,327
1982	2,728	49	e44,916	1,295
1983	2,707	45	e42,561	1,332
1984	2,661	55	e41,399	1,188
1985	f883	35	f14,038	f546
1986	f826	f47	f12,930	f524
1987	f807	f56	f12,430	f525
1988	f800	f69	f12,224	f517
1989	f745	f63	f12,516	f522
1990	f705	f22	f11,728	f538
1991	f679	f44	f10,912	f526
1992	f668	f35	f9,780	f495
1993	f639	f338	f9,174	f421
1994	f649	f340	f9,748	f434
1995	f637	f475	f9,274	f601
1996	f658	f331	f9,543	f543
1997	f714	f313	f9,673	f437
1998	f551	f316	f9,147	f411

eIncludes State and Federal offshore Alabama.
fExcludes Federal offshore; now included in Federal Offshore-Gulf of Mexico (Louisiana).

Louisiana - North

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	244	78	3,135	NA
1978	255	78	3,203	NA
1979	216	NA	2,798	96
1980	248	NA	3,076	95
1981	*317	NA	3,270	99
1982	*240	NA	2,912	85
1983	223	NA	2,939	74
1984	165	9	2,494	57
1985	196	5	2,587	65
1986	160	7	2,515	57
1987	175	3	2,306	50
1988	154	23	2,398	56
1989	123	22	2,652	60
1990	120	<1	2,588	58
1991	127	<1	2,384	59
1992	125	<1	2,311	60
1993	108	0	2,325	57
1994	108	0	2,537	69
1995	108	0	2,788	79
1996	128	0	3,105	85
1997	136	<1	3,093	80
1998	101	0	2,898	57

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Louisiana - South Onshore				
1977	1,382	46	18,580	NA
1978	1,242	38	17,755	NA
1979	682	NA	13,994	676
1980	682	NA	13,026	540
1981	642	NA	12,645	544
1982	611	NA	11,801	501
1983	569	NA	11,142	527
1984	585	20	10,331	454
1985	565	16	9,808	442
1986	547	30	9,103	428
1987	505	22	8,693	429
1988	511	35	8,654	421
1989	479	30	8,645	411
1990	435	11	8,171	431
1991	408	33	7,504	417
1992	417	26	6,693	380
1993	382	329	5,932	334
1994	391	331	6,251	337
1995	387	324	5,648	495
1996	382	322	5,704	411
1997	427	309	5,855	333
1998	353	307	5,698	325
Louisiana - State Offshore				
1977	1,974	15	35,295	NA
1978	1,951	27	34,767	NA
1979	1,882	14	33,250	652
1980	1,821	13	31,223	711
1981	2,026	16	31,462	684
1982	1,877	21	[e]30,203	709
1983	1,915	15	[e]28,480	731
1984	1,911	27	[e]28,574	677
1985	[f]122	2	[f]1,643	[f]39
1986	[f]119	[f]10	[f]1,312	[f]39
1987	[f]127	[f]22	[f]1,431	[f]46
1988	[f]135	[f]11	[f]1,172	[f]40
1989	[f]143	[f]11	[f]1,219	[f]51
1990	[f]150	[f]11	[f]969	[f]49
1991	[f]144	[f]11	[f]1,024	[f]50
1992	[f]126	[f]9	[f]776	[f]55
1993	[f]149	[f]9	[f]917	[f]30
1994	[f]150	[f]9	[f]960	[f]28
1995	[f]142	[f]151	[f]838	[f]27
1996	[f]148	[f]9	[f]734	[f]47
1997	[f]151	[f]4	[f]725	[f]24
1998	[f]97	[f]2	[f]551	[f]29

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Michigan				
1977	*233	0	*1,386	NA
1978	*220	9	*1,422	NA
1979	159	23	1,204	112
1980	*205	14	*1,406	112
1981	*240	17	1,118	102
1982	184	34	1,084	97
1983	209	48	1,219	105
1984	180	46	1,112	84
1985	191	37	985	67
1986	146	34	1,139	88
1987	151	27	1,451	111
1988	132	27	1,323	99
1989	128	8	1,342	97
1990	124	3	1,243	81
1991	119	0	1,334	72
1992	102	0	1,223	68
1993	90	0	1,160	57
1994	91	1	1,323	54
1995	76	1	1,294	45
1996	74	0	2,061	53
1997	68	2	2,195	50
1998	44	0	2,328	51
Mississippi				
1977	241	9	1,437	NA
1978	*250	27	1,635	NA
1979	238	24	1,504	16
1980	202	36	1,769	20
1981	209	93	2,035	18
1982	223	85	1,796	18
1983	205	77	1,596	19
1984	201	50	1,491	15
1985	184	53	1,360	12
1986	199	16	1,300	11
1987	202	12	1,220	11
1988	221	10	1,143	12
1989	218	6	1,104	12
1990	227	8	1,126	11
1991	194	8	1,057	10
1992	165	7	869	9
1993	133	44	797	11
1994	151	40	650	9
1995	140	6	663	8
1996	164	6	631	7
1997	183	0	582	6
1998	141	0	658	8

[e]Includes State and Federal offshore Alabama.
[f]Excludes Federal offshore; now included in Federal Offshore-Gulf of Mexico (Louisiana).

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Montana				
1977	175	27	*887	NA
1978	158	27	926	NA
1979	152	38	825	10
1980	179	13	*1,287	16
1981	186	11	*1,321	11
1982	216	6	847	18
1983	234	8	896	19
1984	224	4	802	18
1985	232	3	857	21
1986	248	27	803	16
1987	246	<1	780	16
1988	241	0	819	11
1989	225	<1	867	16
1990	221	0	899	15
1991	201	0	831	14
1992	193	0	859	12
1993	171	0	673	8
1994	175	0	717	8
1995	178	0	782	8
1996	168	0	796	7
1997	159	1	762	5
1998	167	0	782	5
Nebraska				
1977	22	0	NA	NA
1978	30	1	NA	NA
1979	25	0	NA	NA
1980	*46	0	NA	NA
1981	41	0	NA	NA
1982	*32	0	NA	NA
1983	44	0	NA	NA
1984	*46	0	NA	NA
1985	42	0	NA	NA
1986	*45	7	NA	NA
1987	33	0	NA	NA
1988	42	0	NA	NA
1989	32	0	NA	NA
1990	26	0	NA	NA
1991	26	0	NA	NA
1992	26	0	NA	NA
1993	20	0	NA	NA
1994	22	0	NA	NA
1995	25	0	NA	NA
1996	28	0	NA	NA
1997	*21	0	NA	NA
1998	18	0	NA	NA

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
New Mexico - Total				
1977	605	97	12,000	NA
1978	579	90	12,688	NA
1979	563	77	13,724	530
1980	547	58	13,287	541
1981	555	93	13,870	560
1982	563	76	12,418	531
1983	576	75	11,676	551
1984	660	87	11,364	511
1985	688	99	10,900	445
1986	644	225	11,808	577
1987	654	235	11,620	771
1988	661	241	17,166	1,023
1989	665	256	15,434	933
1990	687	256	17,260	990
1991	721	275	18,539	908
1992	757	293	18,998	1,066
1993	707	211	18,619	996
1994	718	215	17,228	1,011
1995	732	185	17,491	943
1996	744	148	16,485	1,059
1997	735	146	15,514	869
1998	620	168	14,987	929
New Mexico - East				
1977	576	95	3,848	NA
1978	554	88	3,889	NA
1979	542	77	4,031	209
1980	518	58	3,530	209
1981	522	93	3,598	214
1982	537	76	3,432	209
1983	542	75	3,230	232
1984	625	87	3,197	221
1985	643	98	3,034	209
1986	593	225	2,694	217
1987	608	230	2,881	192
1988	621	235	2,945	208
1989	619	252	3,075	196
1990	633	253	3,256	222
1991	694	275	3,206	205
1992	731	293	3,130	223
1993	688	211	3,034	233
1994	702	215	3,021	234
1995	713	185	2,867	247
1996	731	148	2,790	299
1997	719	146	2,642	273
1998	610	168	2,693	262

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
New Mexico - West				
1977	*29	2	8,152	NA
1978	*25	2	8,799	NA
1979	21	0	9,693	321
1980	*29	0	9,757	332
1981	*33	0	10,272	346
1982	26	0	8,986	322
1983	34	0	8,446	319
1984	35	0	8,167	290
1985	45	1	7,866	236
1986	51	0	9,114	360
1987	46	5	8,739	579
1988	40	6	14,221	815
1989	46	4	12,359	737
1990	54	3	14,004	768
1991	27	0	15,333	703
1992	26	0	15,868	843
1993	19	0	15,585	763
1994	16	0	14,207	777
1995	19	0	14,624	696
1996	13	0	13,695	760
1997	16	0	12,872	596
1998	10	0	12,294	667

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
North Dakota				
1977	155	10	361	NA
1978	162	4	374	NA
1979	211	6	439	47
1980	214	6	537	61
1981	223	8	581	68
1982	237	8	629	71
1983	258	53	600	69
1984	260	54	566	73
1985	255	34	569	74
1986	218	35	541	69
1987	215	33	508	67
1988	216	39	541	52
1989	246	31	561	59
1990	285	0	586	60
1991	232	4	472	56
1992	237	3	496	64
1993	226	7	525	55
1994	226	2	507	55
1995	233	6	463	53
1996	248	6	462	48
1997	279	6	479	47
1998	245	1	447	48

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
New York				
1977	NA	NA	165	NA
1978	NA	NA	193	NA
1979	NA	NA	211	0
1980	NA	NA	208	0
1981	NA	NA	*264	0
1982	NA	NA	229	NA
1983	NA	NA	295	NA
1984	NA	NA	389	NA
1985	NA	NA	*369	NA
1986	NA	NA	*457	NA
1987	NA	NA	410	NA
1988	NA	NA	351	NA
1989	NA	NA	368	NA
1990	NA	NA	354	NA
1991	NA	NA	331	NA
1992	NA	NA	329	NA
1993	NA	NA	*264	NA
1994	NA	NA	242	NA
1995	NA	NA	197	NA
1996	NA	NA	232	NA
1997	NA	NA	*224	NA
1998	NA	NA	218	NA

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Ohio				
1977	*74	0	495	NA
1978	69	0	684	NA
1979	*82	0	*1,479	0
1980	*116	0	*1,699	0
1981	*112	0	965	0
1982	111	0	1,141	NA
1983	130	0	2,030	NA
1984	*116	0	1,541	NA
1985	79	0	1,331	NA
1986	72	0	1,420	NA
1987	66	0	1,069	NA
1988	64	0	1,229	NA
1989	56	0	1,275	NA
1990	65	0	1,214	NA
1991	66	0	1,181	NA
1992	58	0	1,161	NA
1993	54	0	1,104	NA
1994	58	0	1,094	NA
1995	53	0	1,054	NA
1996	53	0	1,113	NA
1997	*43	0	985	NA
1998	40	0	890	NA

Oklahoma

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	1,109	69	13,889	NA
1978	979	33	14,417	NA
1979	1,014	35	13,816	583
1980	930	27	13,138	604
1981	950	43	14,699	631
1982	971	25	16,207	745
1983	931	27	16,211	829
1984	940	40	16,126	769
1985	935	37	16,040	826
1986	874	35	16,685	857
1987	788	56	16,711	781
1988	796	79	16,495	765
1989	789	63	15,916	654
1990	734	37	16,151	657
1991	700	54	14,725	628
1992	698	54	13,926	629
1993	680	40	13,289	643
1994	689	47	13,487	652
1995	676	48	13,438	674
1996	632	43	13,074	684
1997	605	20	13,439	685
1998	599	59	13,645	698

Pennsylvania

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	*57	0	769	NA
1978	27	0	899	NA
1979	33	0	*1,515	1
1980	35	0	951	0
1981	32	0	*1,264	0
1982	37	0	1,429	NA
1983	41	0	1,882	NA
1984	*40	0	1,575	NA
1985	*38	0	*1,617	NA
1986	*26	0	*1,560	1
1987	26	0	1,647	NA
1988	*27	0	2,072	NA
1989	26	0	1,642	NA
1990	22	0	1,720	NA
1991	15	0	1,629	NA
1992	16	0	1,528	NA
1993	14	0	1,717	NA
1994	15	0	1,800	NA
1995	11	0	1,482	NA
1996	10	0	1,696	NA
1997	17	0	1,852	NA
1998	15	0	1,840	NA

Texas - Total

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	9,751	637	56,422	NA
1978	8,911	533	55,583	NA
1979	8,284	471	53,021	2,482
1980	8,206	384	50,287	2,452
1981	8,093	459	50,469	2,646
1982	7,616	377	49,757	2,771
1983	7,539	421	50,052	3,038
1984	7,557	735	49,883	3,048
1985	[g]7,782	609	[g]41,775	[g]2,981
1986	[g]7,152	1,270	[g]40,574	[g]2,964
1987	[g]7,112	1,028	[g]38,711	[g]2,822
1988	[g]7,043	1,099	[g]38,167	[g]2,617
1989	[g]6,966	805	[g]38,381	[g]2,563
1990	[g]7,106	618	[g]38,192	[g]2,575
1991	[g]6,797	756	[g]36,174	[g]2,493
1992	[g]6,441	[g]612	[g]35,093	[g]2,402
1993	[g]6,171	[g]581	[g]34,718	[g]2,469
1994	[g]5,847	[g]491	[g]35,974	[g]2,414
1995	[g]5,743	[g]395	[g]36,542	[g]2,524
1996	[g]5,736	[g]358	[g]38,270	[g]2,606
1997	[g]5,687	[g]479	[g]37,761	[g]2,687
1998	[g]4,927	[g]400	[g]37,584	[g]2,544

[g]Excludes Federal offshore; now included in Federal Offshore-Gulf of Mexico (Texas).

Texas - RRC District 1

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	*174	0	1,319	NA
1978	111	2	986	NA
1979	110	0	919	23
1980	*150	0	829	24
1981	127	5	*1,022	26
1982	129	6	892	29
1983	165	6	1,087	43
1984	173	4	838	39
1985	177	8	967	40
1986	144	1	913	35
1987	143	1	812	27
1988	136	1	1,173	30
1989	139	1	1,267	25
1990	252	0	1,048	26
1991	227	0	1,030	28
1992	185	0	933	27
1993	133	0	698	26
1994	100	1	703	26
1995	90	6	712	26
1996	86	1	906	46
1997	83	<1	953	54
1998	61	0	1,104	38

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Texas - RRC District 2 Onshore				
1977	395	80	3,162	NA
1978	334	1	2,976	NA
1979	292	1	2,974	64
1980	252	1	2,502	64
1981	229	1	2,629	88
1982	206	0	2,493	75
1983	192	0	2,534	99
1984	192	<1	2,512	103
1985	168	0	2,358	100
1986	148	<1	2,180	89
1987	137	0	2,273	102
1988	117	0	2,037	92
1989	107	0	1,770	72
1990	91	0	1,737	80
1991	90	0	1,393	75
1992	86	0	1,389	80
1993	77	0	1,321	86
1994	74	0	1,360	86
1995	61	0	1,251	93
1996	63	<1	1,322	93
1997	66	0	1,634	87
1998	45	<1	1,614	85
Texas - RRC District 3 Onshore				
1977	937	33	7,518	NA
1978	794	22	7,186	NA
1979	630	32	6,315	231
1980	581	11	5,531	216
1981	552	11	5,292	230
1982	509	22	4,756	265
1983	517	27	4,680	285
1984	522	25	4,708	270
1985	471	6	4,180	260
1986	420	3	3,753	237
1987	386	4	3,632	241
1988	360	16	3,422	208
1989	307	11	3,233	213
1990	275	13	2,894	181
1991	300	28	2,885	208
1992	304	27	2,684	211
1993	327	31	2,972	253
1994	330	61	3,366	254
1995	267	27	3,866	272
1996	281	27	4,349	289
1997	259	28	4,172	286
1998	211	28	3,961	246

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Texas - RRC District 4 Onshore				
1977	145	7	9,621	NA
1978	123	3	9,031	NA
1979	113	4	8,326	248
1980	96	3	8,130	252
1981	97	6	8,004	260
1982	87	7	8,410	289
1983	96	3	8,316	292
1984	99	3	8,525	295
1985	98	2	8,250	269
1986	87	2	8,274	281
1987	80	2	7,490	277
1988	65	1	7,029	260
1989	77	<1	7,111	260
1990	67	<1	7,475	279
1991	52	<1	7,048	273
1992	50	<1	6,739	272
1993	59	<1	7,038	278
1994	41	<1	7,547	290
1995	50	<1	7,709	287
1996	51	0	7,769	323
1997	70	<1	8,099	347
1998	40	0	8,429	363
Texas - RRC District 5				
1977	68	0	931	NA
1978	*68	0	*1,298	NA
1979	55	1	1,155	34
1980	52	0	1,147	44
1981	49	0	1,250	49
1982	45	0	1,308	53
1983	42	0	1,448	73
1984	36	<1	1,874	74
1985	*59	1	2,058	77
1986	*53	1	2,141	86
1987	54	0	2,119	88
1988	48	0	1,996	81
1989	46	0	1,845	80
1990	47	0	1,875	81
1991	46	0	1,863	71
1992	56	0	1,747	71
1993	52	0	1,867	64
1994	49	0	2,011	59
1995	34	0	1,862	54
1996	29	0	2,079	54
1997	54	0	1,710	35
1998	40	0	1.953	35

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Texas - RRC District 6				
1977	1,568	12	3,214	NA
1978	1,444	3	3,240	NA
1979	1,177	6	3,258	272
1980	1,115	6	4,230	321
1981	1,040	7	4,177	308
1982	947	6	4,326	278
1983	918	5	4,857	342
1984	889	5	4,703	298
1985	851	4	4,822	293
1986	750	2	4,854	277
1987	733	3	4,682	264
1988	685	5	4,961	263
1989	631	4	5,614	266
1990	605	6	5,753	247
1991	504	7	5,233	243
1992	442	7	5,317	251
1993	406	<1	5,508	248
1994	424	<1	5,381	265
1995	409	1	5,726	271
1996	359	1	5,899	290
1997	348	1	5,887	260
1998	308	0	5,949	276
Texas - RRC District 7B				
1977	250	NA	699	NA
1978	190	NA	743	NA
1979	208	NA	*751	64
1980	196	NA	*745	85
1981	254	NA	804	102
1982	199	NA	805	105
1983	217	NA	1,027	133
1984	218	62	794	106
1985	239	63	708	104
1986	193	64	684	109
1987	200	46	697	92
1988	205	42	704	98
1989	204	11	459	73
1990	198	8	522	76
1991	184	8	423	82
1992	163	11	455	68
1993	*171	7	477	79
1994	145	5	425	62
1995	126	4	440	70
1996	136	4	520	65
1997	155	3	478	59
1998	115	0	442	51

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Texas - RRC District 7C				
1977	191	NA	2,831	NA
1978	202	NA	2,821	NA
1979	206	NA	2,842	182
1980	207	NA	2,378	135
1981	230	NA	2,503	186
1982	229	NA	2,659	199
1983	228	NA	2,568	219
1984	240	24	2,866	233
1985	243	21	2,914	256
1986	213	22	2,721	246
1987	220	25	2,708	243
1988	212	31	2,781	238
1989	247	16	3,180	238
1990	274	8	3,514	256
1991	253	9	3,291	241
1992	255	33	3,239	289
1993	199	15	3,215	273
1994	221	14	3,316	265
1995	204	8	3,107	274
1996	219	5	3,655	303
1997	227	4	3,407	327
1998	173	1	3,113	282
Texas - RRC District 8				
1977	2,915	127	11,728	NA
1978	2,795	102	11,093	NA
1979	2,686	88	10,077	505
1980	2,597	86	9,144	498
1981	2,503	105	8,546	537
1982	2,312	75	8,196	588
1983	2,350	99	8,156	681
1984	2,342	363	7,343	691
1985	2,333	325	7,330	665
1986	2,183	592	7,333	717
1987	2,108	399	6,999	640
1988	2,107	412	7,058	547
1989	2,151	366	6,753	554
1990	2,152	282	6,614	558
1991	2,114	328	6,133	477
1992	2,013	260	5,924	444
1993	2,057	262	5,516	439
1994	2,002	256	5,442	414
1995	2,032	187	5,441	444
1996	2,079	217	5,452	429
1997	2,100	308	5,397	459
1998	1,865	272	4,857	491

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Texas - RRC District 8A				
1977	2,626	291	1,630	NA
1978	2,439	330	1,473	NA
1979	2,371	270	1,055	351
1980	2,504	196	1,057	290
1981	2,538	247	1,071	335
1982	2,481	200	1,041	296
1983	2,366	203	966	262
1984	2,413	217	907	282
1985	2,711	147	958	283
1986	2,618	559	845	331
1987	2,735	525	876	307
1988	2,800	569	832	326
1989	2,754	377	1,074	332
1990	2,847	285	1,036	354
1991	2,763	363	1,073	333
1992	2,599	273	1,239	257
1993	2,435	264	1,043	298
1994	2,223	154	1,219	267
1995	2,233	156	941	284
1996	2,207	99	931	262
1997	2,098	131	847	290
1998	1,895	99	807	226
Texas - RRC District 9				
1977	260	28	724	NA
1978	190	27	*908	NA
1979	200	30	*700	79
1980	218	37	649	92
1981	225	34	953	86
1982	219	17	*1,103	119
1983	220	18	932	121
1984	214	25	900	119
1985	285	27	892	111
1986	237	19	868	119
1987	206	21	834	115
1988	202	18	783	106
1989	200	16	703	94
1990	193	12	776	104
1991	162	11	738	101
1992	176	1	670	92
1993	168	2	688	92
1994	159	<1	728	98
1995	149	<1	738	94
1996	144	0	705	119
1997	144	0	794	98
1998	111	0	734	93

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Texas - RRC District 10				
1977	*120	4	7,744	NA
1978	90	0	7,406	NA
1979	97	2	6,784	375
1980	89	2	6,435	369
1981	107	2	6,229	364
1982	112	2	6,210	391
1983	105	6	5,919	413
1984	108	6	5,461	440
1985	*140	5	5,469	433
1986	*104	5	5,276	428
1987	102	2	4,962	417
1988	99	4	4,830	363
1989	97	3	4,767	342
1990	99	3	4,490	328
1991	95	2	4,589	356
1992	89	<1	4,409	336
1993	83	<1	4,040	329
1994	75	<1	4,246	326
1995	80	6	4,436	353
1996	74	4	4,391	332
1997	79	4	4,094	382
1998	62	0	4,273	354
Texas - State and Federal Offshore				
1977	102	0	5,301	NA
1978	131	1	6,422	NA
1979	139	0	7,865	54
1980	149	0	7,510	62
1981	142	0	7,989	75
1982	141	0	7,558	84
1983	123	0	7,562	75
1984	111	0	8,452	98
1985	119	0	8,129	90
1986	103	0	8,176	109
1987	96	0	7,846	98
1988	85	0	7,802	94
1989	75	0	7,573	84
1990	77	0	7,758	87
1991	67	0	7,150	84
1992	197	0	7,344	122
1993	196	0	6,996	119
1994	209	10	6,613	105
1995	257	16	6,838	136
1996	218	5	6,288	133
1997	366	5	6,277	124
1998	311	0	5,996	147

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Texas - State Offshore				
1977	NA	NA	NA	NA
1978	NA	NA	NA	NA
1979	NA	NA	NA	NA
1980	NA	NA	NA	12
1981	NA	NA	NA	13
1982	NA	NA	NA	18
1983	NA	NA	NA	11
1984	NA	NA	NA	10
1985	7	0	869	10
1986	2	0	732	9
1987	8	0	627	9
1988	7	0	561	5
1989	6	0	605	6
1990	6	0	458	5
1991	7	0	475	5
1992	5	0	348	4
1993	4	0	335	4
1994	4	0	230	2
1995	8	0	313	2
1996	8	0	292	1
1997	4	0	289	3
1998	1	0	348	4
Utah				
1977	252	6	877	NA
1978	188	7	925	NA
1979	201	NA	948	59
1980	198	NA	1,201	127
1981	190	NA	1,912	277
1982	173	NA	2,161	(h)
1983	187	NA	2,333	(h)
1984	172	8	2,080	(h)
1985	276	13	1,999	(h)
1986	269	14	1,895	(h)
1987	284	22	1,947	(h)
1988	260	21	1,298	(h)
1989	246	50	1,507	(h)
1990	249	44	1,510	(h)
1991	233	66	1,702	(h)
1992	217	65	1,830	(h)
1993	228	54	2,040	(h)
1994	231	70	1,789	(h)
1995	216	50	1,580	(h)
1996	237	46	1,633	(h)
1997	234	70	1,839	(h)
1998	201	56	2,388	(h)

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Virginia				
1977	NA	NA	NA	NA
1978	NA	NA	NA	NA
1979	NA	NA	NA	NA
1980	NA	NA	NA	NA
1981	NA	NA	118	NA
1982	NA	NA	122	NA
1983	NA	NA	175	NA
1984	NA	NA	216	NA
1985	NA	NA	235	NA
1986	NA	NA	253	NA
1987	NA	NA	248	NA
1988	NA	NA	230	NA
1989	NA	NA	217	NA
1990	NA	NA	138	NA
1991	NA	NA	225	NA
1992	NA	NA	904	NA
1993	NA	NA	1,322	NA
1994	NA	NA	1,833	NA
1995	NA	NA	1,836	NA
1996	NA	NA	1,930	NA
1997	NA	NA	2,446	NA
1998	NA	NA	1,973	NA
West Virginia				
1977	21	0	1,567	NA
1978	*30	0	1,634	NA
1979	*48	0	1,558	74
1980	30	8	*2,422	97
1981	30	8	1,834	85
1982	48	8	2,148	79
1983	49	0	2,194	91
1984	*76	0	2,136	80
1985	40	0	2,058	85
1986	37	0	2,148	87
1987	34	0	2,242	87
1988	33	0	2,306	92
1989	30	0	2,201	100
1990	*31	0	2,207	86
1991	26	0	2,528	103
1992	27	0	2,356	97
1993	24	0	2,439	108
1994	25	0	2,565	93
1995	28	0	2,499	62
1996	25	0	2,703	61
1997	26	0	2,846	71
1998	17	0	2,868	72

[h] Included with Wyoming.

Wyoming

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1977	851	31	6,305	NA
1978	845	36	7,211	NA
1979	841	40	7,526	285
1980	928	28	9,100	341
1981	840	53	9,307	384
1982	856	58	9,758	[i]681
1983	957	61	10,227	[i]789
1984	954	71	10,482	[i]860
1985	951	18	10,617	[i]949
1986	849	126	9,756	[i]950
1987	854	27	10,023	[i]924
1988	815	35	10,308	[i]1,154
1989	825	46	10,744	[i]896
1990	794	42	9,944	[i]812
1991	757	24	9,941	[i]748
1992	689	18	10,826	[i]660
1993	624	12	10,933	[i]600
1994	565	13	10,879	[i]564
1995	605	12	12,166	[i]593
1996	603	14	12,320	[i]727
1997	627	11	13,562	[i]761
1998	547	10	13,650	[i]675

[i]Utah and Wyoming are combined.

Federal Offshore - Pacific (California)

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
1985	991	NA	1,119	12
1986	974	2	1,325	15
1987	1,037	2	1,452	17
1988	1,024	0	1,552	21
1989	987	0	1,496	25
1990	962	0	1,454	18
1991	785	0	1,162	16
1992	734	0	1,118	20
1993	673	0	1,099	25
1994	653	0	1,170	21
1995	571	0	1,265	25
1996	518	0	1,244	23
1997	528	0	544	14
1998	468	0	480	12

Note: Data not tabulated for years 1977-1984.

Federal Offshore - Total

1985	2,862	11	[j]34,492	702
1986	2,715	16	[j]34,223	681
1987	2,639	21	[j]31,931	638
1988	2,629	21	[j]32,264	622
1989	2,747	32	[j]32,651	678
1990	2,805	49	31,433	619
1991	2,620	18	29,448	640
1992	2,569	31	27,767	610
1993	2,745	18	27,143	630
1994	2,780	53	28,388	624
1995	3,089	62	29,182	655
1996	3,085	45	29,096	776
1997	3,477	41	28,466	920
1998	3,261	0	26,902	931

[j]Includes State offshore Alabama.
Note: Data not tabulated for years 1977-1984.

Federal Offshore - Gulf of Mexico (Louisiana)

1985	1,759	11	[f]26,113	610
1986	1,640	14	[f]25,454	566
1987	1,514	19	[f]23,260	532
1988	1,527	21	[f]23,471	512
1989	1,691	32	[f]24,187	575
1990	1,772	49	[k]22,679	[k]519
1991	1,775	18	[k]21,611	[k]545
1992	1,643	31	[k]19,653	[k]472
1993	1,880	18	[k]19,383	[k]490
1994	1,922	43	[k]20,835	[k]500
1995	2,269	46	[k]21,392	[k]496
1996	2,357	40	[k]21,856	[k]621
1997	2,587	36	[k]21,934	[k]785
1998	2,483	7	[k]20,774	[k]776

[f]Includes State and Federal offshore Alabama.
[k]Includes Federal offshore Alabama.
Note: Data not tabulated for years 1977-1984.

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Federal Offshore - Gulf of Mexico (Texas)				
1985	112	0	7,260	80
1986	101	0	7,444	100
1987	88	0	7,219	89
1988	78	0	7,241	89
1989	69	0	6,968	78
1990	71	0	7,300	82
1991	60	0	6,675	79
1992	192	0	6,996	118
1993	192	0	6,661	115
1994	205	10	6,383	103
1995	249	16	6,525	134
1996	210	5	5,996	132
1997	362	5	5,988	121
1998	310	0	5,648	143

Note: Data not tabulated for years 1977- 1984.

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Miscellaneous				
1977	23	0	102	NA
1978	24	0	109	NA
1979	22	1	*153	2
1980	*38	0	176	3
1981	40	7	191	21
1982	33	0	69	4
1983	30	8	78	5
1984	23	0	75	5
1985	35	0	76	3
1986	33	0	133	2
1987	30	0	65	4
1988	34	0	83	5
1989	39	0	83	5
1990	43	1	*70	3
1991	42	5	75	8
1992	29	0	92	8
1993	34	0	94	8
1994	20	0	65	8
1995	*22	0	*69	7
1996	18	0	67	7
1997	19	0	*43	9
1998	14	0	38	8

Note: States included may vary for different report years and hydrocarbon types.

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Lower 48 States				
1977	23,367	2,168	175,170	NA
1978	21,971	1,964	175,988	NA
1979	20,935	1,878	168,738	6,592
1980	21,054	1,622	165,639	6,717
1981	21,143	1,594	168,693	7,058
1982	20,452	1,478	166,522	7,212
1983	20,428	1,548	165,964	7,893
1984	20,883	1,956	162,987	7,624
1985	21,360	1,662	159,522	7,561
1986	20,014	2,597	158,922	7,784
1987	19,878	3,084	153,986	7,729
1988	19,866	3,169	158,946	7,837
1989	19,827	2,999	158,177	7,389
1990	19,730	2,514	160,046	7,246
1991	18,599	2,810	157,509	7,104
1992	17,723	2,451	155,377	7,104
1993	17,182	2,292	152,508	6,901
1994	16,690	2,129	154,104	6,869
1995	16,771	2,087	155,649	7,093
1996	16,743	1,924	157,180	7,486
1997	17,385	2,375	156,661	7,342
1998	15,982	2,328	154,114	7,204

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
U.S. Total				
1977	31,780	3,014	207,413	NA
1978	31,355	2,362	208,033	NA
1979	29,810	2,276	200,997	6,615
1980	29,805	1,622	199,021	6,728
1981	29,426	1,594	201,730	7,068
1982	27,858	1,478	201,512	7,221
1983	27,735	2,124	200,247	7,901
1984	28,446	2,325	197,463	7,643
1985	28,416	2,041	193,369	7,944
1986	26,889	3,499	191,586	8,165
1987	27,256	3,649	187,211	8,147
1988	26,825	3,600	168,024	8,238
1989	26,501	3,749	167,116	7,769
1990	26,254	3,483	169,346	7,586
1991	24,682	4,266	167,062	7,464
1992	23,745	3,782	165,015	7,451
1993	22,957	3,453	162,415	7,222
1994	22,457	3,151	163,837	7,170
1995	22,351	2,669	165,146	7,399
1996	22,017	2,876	166,474	7,823
1997	22,546	3,207	167,223	7,973
1998	21,034	3,160	164,041	7,524

Table D1. U.S. Proved Reserves of Crude Oil, 1976–1998

(Million Barrels of 42 U.S. Gallons)

Year	Adjustments[a] (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[b] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[c] Discoveries (8)	Production (9)	Proved[d] Reserves 12/31 (10)	Change from Prior Year (11)
1976	–	–	–	–	–	–	–	–	–	[e]33,502	–
1977	[f]–40	1,503	1,117	346	496	168	130	794	2,862	31,780	–1,722
1978	366	2,799	1,409	1,756	444	267	116	827	3,008	31,355	–425
1979	337	2,438	2,001	774	424	108	104	636	2,955	29,810	–1,545
1980	219	2,883	994	2,108	572	143	147	862	2,975	29,805	–5
1981	138	2,151	880	1,409	750	254	157	1,161	2,949	29,426	–379
1982	–83	2,245	1,811	351	634	204	193	1,031	2,950	27,858	–1,568
1983	462	2,810	1,299	1,973	629	105	190	924	3,020	27,735	–123
1984	159	3,672	1,227	2,604	744	242	158	1,144	3,037	28,446	+711
1985	429	3,037	1,439	2,027	742	84	169	995	3,052	28,416	–30
1986	57	2,724	1,869	912	405	48	81	534	2,973	26,889	–1,527
1987	233	3,687	1,371	2,549	484	96	111	691	2,873	27,256	+367
1988	364	2,684	1,221	1,827	355	71	127	553	2,811	26,825	–431
1989	213	2,698	1,365	1,546	514	112	90	716	2,586	26,501	–324
1990	86	2,483	1,000	1,569	456	98	135	689	2,505	26,254	–247
1991	163	2,097	1,874	386	365	97	92	554	2,512	24,682	–1,572
1992	290	1,804	1,069	1,025	391	8	85	484	2,446	23,745	–937
1993	271	2,011	1,516	766	356	319	110	785	2,339	22,957	–788
1994	189	2,364	1,357	1,196	397	64	111	572	2,268	22,457	–500
1995	122	1,823	795	1,150	500	114	343	957	2,213	22,351	–106
1996	175	1,723	986	912	543	243	141	927	2,173	22,017	–334
1997	520	1,998	1,084	1,434	477	637	119	1,233	2,138	22,546	+529
1998	–638	2,752	2,234	–120	327	152	120	599	1,991	21,034	–1,512

[a]Includes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.
[b]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.
[c]Total discoveries = Col. 5 + Col. 6 + Col. 7.
[d]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.
[e]Based on following year data only.
[f]Consists only of operator reported corrections and no other adjustments.
– = Not applicable.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves”. They may differ from the official Energy Information Administration production data for crude oil contained in the *Petroleum Supply Annual*, DOE/EIA-0340.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, 1977 through 1998 annual reports, DOE/EIA-0216.{1-21}

Table D2. U.S. Lower 48 Proved Reserves of Crude Oil, 1976–1998

(Million Barrels of 42 U.S. Gallons)

Year	Adjustments[a] (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[b] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[c] Discoveries (8)	Production (9)	Proved[d] Reserves 12/31 (10)	Change from Prior Year (11)
1976	–	–	–	–	–	–	–	–	–	[e]24,928	–
1977	[f]–40	1,499	1,116	343	496	168	130	794	2,698	23,367	–1,561
1978	–48	1,909	1,400	461	444	142	116	702	2,559	21,971	–1,396
1979	342	2,404	1,975	771	424	108	104	636	2,443	20,935	–1,036
1980	210	2,505	981	1,734	479	143	147	769	2,384	21,054	+119
1981	276	1,887	878	1,285	750	254	157	1,161	2,357	21,143	+89
1982	–82	2,146	1,462	602	633	204	193	1,030	2,323	20,452	–691
1983	462	2,247	1,298	1,411	625	105	190	920	2,355	20,428	–24
1984	160	2,801	1,214	1,747	742	207	158	1,107	2,399	20,883	+455
1985	361	2,864	1,197	2,028	581	84	169	834	2,385	21,360	+477
1986	70	2,001	1,642	429	399	48	81	528	2,303	20,014	–1,346
1987	233	2,566	1,213	1,586	294	38	101	433	2,155	19,878	–136
1988	359	2,399	1,218	1,540	340	43	127	510	2,062	19,866	–12
1989	214	2,438	1,325	1,327	342	108	87	537	1,903	19,827	–39
1990	151	1,997	996	1,152	371	98	135	604	1,853	19,730	–97
1991	164	1,898	1,848	214	327	97	87	511	1,856	18,599	–1,131
1992	297	1,343	1,066	574	279	8	84	371	1,821	17,723	–876
1993	250	1,712	1,514	448	343	319	109	771	1,760	17,182	–541
1994	187	1,873	1,346	714	316	64	111	491	1,697	16,690	–492
1995	117	1,521	765	873	434	114	333	881	1,673	16,771	+81
1996	172	1,654	926	900	479	115	141	735	1,663	16,743	–28
1997	514	1,724	1,029	1,209	459	520	119	1,098	1,665	17,385	+642
1998	–639	2,485	2,170	–324	299	56	120	475	1,554	15,982	–1,403

[a]Includes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.
[b]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.
[c]Total discoveries = Col. 5 + Col. 6 + Col. 7.
[d]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.
[e]Based on following year data only.
[f]Consists only of operator reported corrections and no other adjustments.
– = Not applicable.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves”. They may differ from the official Energy Information Administration production data for crude oil contained in the *Petroleum Supply Annual*, DOE/EIA-0340.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves,* 1977 through 1998 annual reports, DOE/EIA-0216.{1-21}

Table D3. U.S. Proved Reserves of Dry Natural Gas, 1976–1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Year	Adjustments[a] (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[b] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[c] Discoveries (8)	Production (9)	Proved[d] Reserves 12/31 (10)	Change from Prior Year (11)
1976	–	–	–	–	–	–	–	–	–	[e]213,278	–
1977	[f]–20	13,691	15,296	–1,625	8,129	3,173	3,301	14,603	18,843	207,413	–5,865
1978	2,429	14,969	15,994	1,404	9,582	3,860	4,579	18,021	18,805	208,033	+620
1979	–2,264	16,410	16,629	–2,483	8,950	3,188	2,566	14,704	19,257	200,997	–7,036
1980	1,201	16,972	15,923	2,250	9,357	2,539	2,577	14,473	18,699	199,021	–1,976
1981	1,627	16,412	13,813	4,226	10,491	3,731	2,998	17,220	18,737	201,730	+2,709
1982	2,378	19,795	19,340	2,833	8,349	2,687	3,419	14,455	17,506	201,512	–218
1983	3,090	17,602	17,617	3,075	6,909	1,574	2,965	11,448	15,788	200,247	–1,265
1984	–2,241	17,841	14,712	888	8,299	2,536	2,686	13,521	17,193	197,463	–2,784
1985	–1,708	18,775	16,304	763	7,169	999	2,960	11,128	15,985	193,369	–4,094
1986	1,320	21,269	17,697	4,892	6,065	1,099	1,771	8,935	15,610	191,586	–1,783
1987	1,268	17,527	14,231	4,564	4,587	1,089	1,499	7,175	16,114	187,211	–4,375
1988	2,193	23,367	38,427	–12,867	6,803	1,638	1,909	10,350	16,670	[g]168,024	–19,187
1989	3,013	26,673	23,643	6,043	6,339	1,450	2,243	10,032	16,983	167,116	–908
1990	1,557	18,981	13,443	7,095	7,952	2,004	2,412	12,368	17,233	169,346	+2,230
1991	2,960	19,890	15,474	7,376	5,090	848	1,604	7,542	17,202	167,062	–2,284
1992	2,235	18,055	11,962	8,328	4,675	649	1,724	7,048	17,423	165,015	–2,047
1993	972	17,597	12,248	6,321	6,103	899	1,866	8,868	17,789	162,415	–2,600
1994	1,945	21,365	15,881	7,429	6,941	1,894	3,480	12,315	18,322	163,837	+1,422
1995	580	20,465	12,731	8,314	6,843	1,666	2,452	10,961	17,966	165,146	+1,309
1996	3,785	17,132	13,046	7,871	7,757	1,451	3,110	12,318	18,861	166,474	+1,328
1997	–590	21,658	16,756	4,312	10,585	2,681	2,382	15,648	19,211	167,223	+749
1998	–1,635	28,003	22,263	4,105	8,197	1,074	2,162	11,433	18,720	164,041	–3,182

[a]Includes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

[b]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.

[c]Total discoveries = Col. 5 + Col. 6 + Col. 7.

[d]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

[e]Based on following year data only.

[f]Consists only of operator reported corrections and no other adjustments.

[g]An unusually large revision decrease to North Slope dry natural gas reserves was made in 1988. It recognizes some 24.6 trillion cubic feet of downward revisions reported during the last few years by operators because of economic and market conditions. EIA in previous years carried these reserves in the proved category.

– = Not applicable.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves,” and Form EIA-64A, “Annual Report of the Origin of Natural Gas Liquids Production”. They may differ from the official Energy Information Administration production data for natural gas contained in the *Natural Gas Annual,* DOE/EIA-0131.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves,* 1977 through 1998 annual reports, DOE/EIA-0216.{1-21}

Table D4. U.S. Lower 48 Proved Reserves of Dry Natural Gas, 1976–1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Year	Adjustments[a] (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[b] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[c] Discoveries (8)	Production (9)	Proved[d] Reserves 12/31 (10)	Change from Prior Year (11)
1976	–	–	–	–	–	–	–	–	–	[e]180,838	–
1977	[f]–21	13,689	15,229	–1,561	8,056	3,173	3,301	14,530	18,637	175,170	–5,668
1978	2,446	13,912	14,670	1,688	9,582	3,860	4,277	17,719	18,589	175,988	818
1979	–2,202	15,691	16,398	–2,909	8,949	3,173	2,566	14,688	19,029	168,738	–7,250
1980	1,163	15,881	15,819	1,225	9,046	2,539	2,577	14,162	18,486	165,639	–3,099
1981	1,840	16,258	13,752	4,346	10,485	3,731	2,994	17,210	18,502	168,693	3,054
1982	2,367	17,570	19,318	619	8,349	2,687	3,419	14,455	17,245	166,522	–2,171
1983	3,089	17,296	16,875	3,510	6,908	1,574	2,965	11,447	15,515	165,964	–558
1984	–2,245	16,934	14,317	372	8,298	2,536	2,686	13,520	16,869	162,987	–2,977
1985	–1,349	18,252	15,752	1,151	7,098	999	2,960	11,057	15,673	159,522	–3,465
1986	1,618	21,084	16,940	5,762	6,064	1,099	1,761	8,924	15,286	158,922	–600
1987	1,066	16,809	14,164	3,711	4,542	1,077	1,499	7,118	15,765	153,986	–4,936
1988	2,017	22,571	13,676	10,912	6,771	1,638	1,909	10,318	16,270	158,946	4,960
1989	2,997	26,446	23,507	5,936	6,184	1,450	2,243	9,877	16,582	158,177	–769
1990	1,877	17,916	13,344	6,449	7,898	2,004	2,412	12,314	16,894	160,046	+1,869
1991	2,967	19,095	15,235	6,827	5,074	848	1,563	7,485	16,849	157,509	–2,537
1992	1,946	17,878	11,941	7,883	4,621	649	1,724	6,994	17,009	155,377	–2,132
1993	915	16,918	12,139	5,694	6,076	899	1,858	8,833	17,396	152,508	–2,869
1994	1,896	21,121	15,832	7,185	6,936	1,894	3,480	12,310	17,899	154,104	+1596
1995	973	19,903	12,680	8,196	6,801	1,666	2,452	10,919	17,570	155,649	+1,545
1996	3,640	16,930	12,875	7,695	7,751	1,390	3,110	12,251	18,415	157,180	+1,531
1997	–609	19,849	16,657	2,583	10,571	2,681	2,382	15,634	18,734	156,661	–519
1998	–1,463	27,834	22,138	4,233	8,195	1,070	2,162	11,427	18,207	154,114	–2,547

[a]Includes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.
[b]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.
[c]Total discoveries = Col. 5 + Col. 6 + Col. 7.
[d]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.
[e]Based on following year data only.
[f]Consists only of operator reported corrections and no other adjustments.
– = Not applicable.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves,” and Form EIA-64A, “Annual Report of the Origin of Natural Gas Liquids Production”. They may differ from the official Energy Information Administration production data for natural gas contained in the *Natural Gas Annual,* DOE/EIA-0131.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves,* 1977 through 1998 annual reports, DOE/EIA-0216.{1-21}

Table D5. U.S. Proved Reserves of Wet Natural Gas, After Lease Separation, 1978–1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Year	Adjustments[a] (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[b] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[c] Discoveries (8)	Production (9)	Proved[d] Reserves 12/31 (10)	Change from Prior Year (11)
1978	–	–	–	–	–	–	–	–	–	[e]208,033	–
1979	5,356	17,077	17,300	5,133	9,332	3,279	2,637	15,248	20,079	208,335	+302
1980	1,253	17,668	16,531	2,390	9,757	2,629	2,648	15,034	19,500	206,259	–2,076
1981	2,057	17,156	14,413	4,800	10,979	3,870	3,080	17,929	19,554	209,434	+3,175
1982	2,598	20,596	20,141	3,053	8,754	2,785	3,520	15,059	18,292	209,254	–180
1983	4,363	18,442	18,385	4,420	7,263	1,628	3,071	11,962	16,590	209,046	–208
1984	–2,413	18,751	15,418	920	8,688	2,584	2,778	14,050	18,032	205,984	–3,062
1985	–1,299	19,732	17,045	1,388	7,535	1,040	3,053	11,628	16,798	202,202	–3,782
1986	2,137	22,392	18,557	5,972	6,359	1,122	1,855	9,336	16,401	201,109	–1,093
1987	1,199	18,455	14,933	4,721	4,818	1,128	1,556	7,502	16,904	196,428	–4,681
1988	2,180	24,638	[f]39,569	–12,751	7,132	1,677	1,979	10,788	17,466	[f]176,999	–19,429
1989	2,537	27,844	24,624	5,757	6,623	1,488	2,313	10,424	17,752	175,428	–1,571
1990	1,494	19,861	14,024	7,331	8,287	2,041	2,492	12,820	18,003	177,576	+2,148
1991	3,368	20,758	16,189	7,937	5,298	871	1,655	7,824	18,012	175,325	–2,251
1992	2,543	18,906	12,532	8,917	4,895	668	1,773	7,336	18,269	173,309	–2,016
1993	1,048	18,394	12,853	6,589	6,376	927	1,930	9,233	18,641	170,490	–2,819
1994	1,977	22,345	16,509	7,813	7,299	1,941	3,606	12,846	19,210	171,939	+1,449
1995	889	21,548	13,457	8,980	7,204	1,709	2,518	11,431	18,874	173,476	+1,537
1996	4,288	18,034	13,757	8,565	8,189	1,491	3,209	12,889	19,783	175,147	+1,671
1997	–730	22,712	17,655	4,327	11,179	2,747	2,455	16,381	20,134	175,721	+574
1998	–3,256	28,281	21,019	4,006	8,591	1,176	2,234	12,001	19,619	172,109	–3,612

[a]Includes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

[b]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.

[c]Total discoveries = Col. 5 + Col. 6 + Col. 7.

[d]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

[e]Based on following year data only.

[f]An unusually large revision decrease to North Slope wet natural gas reserves was made in 1988. It recognizes some 25 trillion cubic feet of downward revisions reported during the last few years by operators because of economic and market conditions. EIA in previous years carried these reserves in the proved category.

– = Not applicable.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves”. They may differ from the official Energy Information Administration production data for natural gas contained in the *Natural Gas Annual,* DOE/EIA-013.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves,* 1979 through 1998 annual reports, DOE/EIA-0216.{2-21}

Table D6. U.S. Lower 48 Proved Reserves of Wet Natural Gas, After Lease Separation, 1978–1998

(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Year	Adjustments[a] (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[b] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[c] Discoveries (8)	Production (9)	Proved[d] Reserves 12/31 (10)	Change from Prior Year (11)
1978	–	–	–	–	–	–	–	–	–	[e]175,988	–
1979	5,402	16,358	17,069	4,691	9,331	3,264	2,637	15,232	19,851	176,060	+72
1980	1,218	16,577	16,427	1,368	9,446	2,629	2,648	14,723	19,287	172,864	–3,196
1981	2,270	17,002	14,352	4,920	10,973	3,870	3,076	17,919	19,318	176,385	+3,521
1982	2,586	18,371	20,119	838	8,754	2,785	3,520	15,059	18,030	174,252	–2,133
1983	4,366	18,136	17,643	4,859	7,262	1,628	3,071	11,961	16,317	174,755	+503
1984	–2,409	17,844	15,023	412	8,687	2,584	2,778	14,049	17,708	171,508	–3,247
1985	–1,313	19,203	16,490	1,400	7,463	1,040	3,053	11,556	16,485	167,979	–3,529
1986	2,114	22,207	17,797	6,524	6,357	1,122	1,845	9,324	16,073	167,754	–225
1987	1,200	17,733	14,865	4,068	4,772	1,116	1,556	7,444	16,553	162,713	–5,041
1988	2,025	23,829	14,439	11,415	7,099	1,677	1,979	10,755	17,063	167,820	+5,107
1989	2,545	27,616	24,488	5,673	6,467	1,485	2,313	10,265	17,349	166,409	–1,411
1990	1,811	18,784	13,925	6,670	8,232	2,041	2,492	12,765	17,661	168,183	+1,774
1991	3,367	19,961	15,948	7,380	5,281	871	1,614	7,766	17,657	165,672	–2,511
1992	2,265	18,728	12,511	8,482	4,840	668	1,773	7,281	17,851	163,584	–2,088
1993	996	17,714	12,743	5,967	6,349	927	1,922	9,198	18,245	160,504	–3,080
1994	1,924	22,071	16,458	7,537	7,294	1,941	3,606	12,841	18,756	162,126	+1,622
1995	1,304	20,928	13,403	8,829	7,162	1,709	2,518	11,389	18,443	163,901	+1,775
1996	4,219	17,832	13,586	8,465	8,183	1,430	3,209	12,822	19,337	165,851	+1,950
1997	–835	20,878	17,556	2,497	11,165	2,747	2,455	16,367	19,657	165,048	–803
1998	–3,093	28,111	20,894	4,124	8,589	1,172	2,234	11,995	19,101	162,066	–2,982

[a]Includes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.
[b]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.
[c]Total discoveries = Col. 5 + Col. 6 + Col. 7.
[d]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.
[e]Based on following year data only.
– = Not applicable.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves”. They may differ from the official Energy Information Administration production data for natural gas contained in the *Natural Gas Annual,* DOE/EIA-0131.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves,* 1979 through 1998 annual reports, DOE/EIA-0216.{2-21}

Table D7. U.S. Proved Reserves of Natural Gas Liquids, 1978–1998

(Million Barrels of 42 U.S. Gallons)

Year	Adjustments[a] (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[b] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[c] Discoveries (8)	Production (9)	Proved[d] Reserves 12/31 (10)	Change from Prior Year (11)
1978	–	–	–	–	–	–	–	–	–	[e]6,772	–
1979	[f]64	677	726	15	364	94	97	555	727	6,615	–157
1980	153	743	639	257	418	90	79	587	731	6,728	+113
1981	231	729	643	317	542	131	91	764	741	7,068	+340
1982	299	811	832	278	375	112	109	596	721	7,221	+153
1983	849	847	781	915	321	70	99	490	725	7,901	+680
1984	–123	866	724	19	348	55	96	499	776	7,643	–258
1985	426	906	744	588	337	44	85	466	753	7,944	+301
1986	367	1,030	807	590	263	34	72	369	738	8,165	+221
1987	231	847	656	422	213	39	55	307	747	8,147	–18
1988	11	1,168	715	464	268	41	72	381	754	8,238	+91
1989	–277	1,143	1,020	–154	259	83	74	416	731	7,769	–469
1990	–83	827	606	138	299	39	73	411	732	7,586	–183
1991	233	825	695	363	189	25	55	269	754	7,464	–122
1992	225	806	545	486	190	20	64	274	773	7,451	–13
1993	102	764	640	226	245	24	64	333	788	7,222	–229
1994	43	873	676	240	314	54	131	499	791	7,170	–52
1995	192	968	691	469	432	52	67	551	791	7,399	+229
1996	474	844	669	649	451	65	109	625	850	7,823	+424
1997	–14	1,199	910	275	535	114	90	739	864	7,973	+150
1998	–361	1,302	1,094	–153	383	66	88	537	833	7,524	–449

[a]Includes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.
[b]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.
[c]Total discoveries = Col. 5 + Col. 6 + Col. 7.
[d]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.
[e]Based on following year data only.
[f]Consists only of operator reported corrections and no other adjustments.
– = Not applicable.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves,” and Form EIA-64A, “Annual Report of the Origin of Natural Gas Liquids Production”. They may differ from the official Energy Information Administration production data for natural gas liquids contained in the *Natural Gas Annual,* DOE/EIA-0131.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves,* 1979 through 1998 annual reports, DOE/EIA-0216.{2-21}

Table D8. U.S. Lower 48 Proved Reserves of Natural Gas Liquids, 1978–1998

(Million Barrels of 42 U.S. Gallons)

Year	Adjustments[a] (1)	Revision Increases (2)	Revision Decreases (3)	Revisions[b] and Adjustments (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total[c] Discoveries (8)	Production (9)	Proved[d] Reserves 12/31 (10)	Change from Prior Year (11)
1978	–	–	–	–	–	–	–	–	–	[e]6,749	–
1979	[f]63	677	726	14	364	94	97	555	726	6,592	–157
1980	165	743	639	269	418	90	79	587	731	6,717	+125
1981	233	728	643	318	542	131	91	764	741	7,058	+341
1982	300	811	832	279	375	112	109	596	721	7,212	+154
1983	850	847	781	916	321	70	99	490	725	7,893	+681
1984	–115	847	724	8	348	55	96	499	776	7,624	–269
1985	70	883	731	222	334	44	85	463	748	7,561	–63
1986	363	1,030	804	589	263	34	72	369	735	7,784	+223
1987	179	846	655	370	212	39	55	306	731	7,729	–55
1988	10	1,167	715	462	267	41	72	380	734	7,837	+108
1989	–273	1,141	1,018	–150	259	83	74	416	714	7,389	–448
1990	–60	827	606	161	298	39	73	410	714	7,246	–143
1991	183	815	677	321	187	25	55	267	730	7,104	–142
1992	225	796	542	479	183	20	64	267	746	7,104	0
1993	101	755	631	225	245	24	64	333	761	6,901	–203
1994	38	872	676	234	314	54	131	499	765	6,869	–32
1995	204	918	688	434	432	52	67	551	761	7,093	+224
1996	417	832	654	595	450	56	109	615	817	7,486	+393
1997	–107	965	910	–52	533	114	90	737	829	7,342	–144
1998	–74	1,301	1,093	134	383	66	88	671	809	7,204	–138

[a]Includes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.
[b]Revisions and adjustments = Col. 1 + Col. 2 - Col. 3.
[c]Total discoveries = Col. 5 + Col. 6 + Col. 7.
[d]Proved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.
[e]Based on following year data only.
[f]Consists only of operator reported corrections and no other adjustments.
– = Not applicable.

Notes: Old means discovered in a prior year. New means discovered during the report year. The production estimates in this table are based on data reported on Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves,” and Form EIA-64A, “Annual Report of the Origin of Natural Gas Liquids Production”. They may differ from the official Energy Information Administration production natural gas liquids contained in the *Natural Gas Annual,* DOE/EIA-0131.

Source: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, 1979 through 1998 annual reports, DOE/EIA-0216.{2-21}

Table D9. Deepwater Production and Proved Reserves of the Gulf of Mexico Federal Offshore, 1992-1998

Year	Gulf of Mexico			Depth		
	Total	Louisiana[a]	Texas	Greater than 200 meters[b]	Less than 200 meters[b]	Deepwater Percentage[b]
	Crude Oil (million barrels of 42 U.S. gallons)					
Production						
1992	267	253	14	46	221	17.2
1993	266	252	14	46	220	17.3
1994	265	245	20	53	212	20.1
1995	292	262	30	77	215	26.4
1996	303	265	38	90	213	29.7
1997	342	298	44	123	219	36.0
1998	372	336	36	171	201	46.0
Reserves						
1992	1,835	1,643	192	557	1,278	30.4
1993	2,072	1,880	192	824	1,248	39.8
1994	2,127	1,922	205	877	1,250	41.2
1995	2,518	2,269	249	1,241	1,277	49.3
1996	2,567	2,357	210	1,311	1,256	51.1
1997	2,949	2,587	362	1,682	1,267	57.0
1998	2,793	2,483	310	1,611	1,182	57.8
	Natural Gas, Wet After Lease Separation (billion cubic feet at 14.73 psia and 60° Fahrenheit)					
Production						
1992	4,576	3,292	1,284	166	4,410	3.6
1993	4,651	3,383	1,268	229	4,422	4.9
1994	4,797	3,505	1,292	294	4,503	6.1
1995	4,679	3,421	1,258	354	4,315	7.8
1996	5,045	3,752	1,293	549	4,496	10.9
1997	5,230	3,984	1,246	577	4,653	11.0
1998	4,967	3,817	1,150	724	4,243	14.6
Reserves						
1992	27,050	20,006	7,044	3,273	23,777	12.1
1993	26,463	19,751	6,712	3,495	22,968	13.2
1994	27,626	21,208	6,418	4,772	22,854	17.3
1995	28,229	21,664	6,565	5,811	22,418	20.6
1996	28,153	22,119	6,034	6,389	21,764	22.7
1997	28,455	22,428	6,027	7,491	20,964	26.3
1998	26,937	21,261	5,676	7,575	19,362	28.1
	Natural Gas Liquids (million barrels of 42 U.S. gallons)					
Production						
1992	91	76	15	4	87	4.4
1993	97	80	17	6	91	6.2
1994	98	83	15	6	92	6.1
1995	85	71	14	12	73	14.1
1996	101	84	17	13	88	12.9
1997	140	123	17	17	123	12.1
1998	139	120	19	26	113	18.7
Reserves						
1992	590	472	118	91	499	15.4
1993	605	490	115	97	508	16.0
1994	603	500	103	110	493	18.2
1995	630	496	134	294	336	46.7
1996	753	621	132	300	453	39.8
1997	906	785	121	349	557	38.5
1998	919	776	143	387	532	42.1

[a]Includes Federal Offshore Alabama.
[b]Revisions result from reclassing all field depths to match Minerals Management Service assignments.
Source: Based on data reported on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves."

Table D10. 1998 Reported Reserves in Nonproducing Reservoirs for Crude Oil, Lease Condensate, and Natural Gas[a]

State and Subdivision	Crude Oil (mbbls)	Lease Condensate (mbbls)	Nonassociated Gas (bcf)	Associated Dissolved Gas (bcf)	Total Gas (bcf)
Alaska	806	-	497	70	567
Lower 48 States	3,341	530	30,073	5,407	35,480
Alabama	4	6	477	2	479
Arkansas	2	-	96	3	99
California	937	-	120	311	431
Coastal Region Onshore	137	-	0	17	17
Los Angeles Basin Onshore	53	-	0	48	48
San Joaquin Basin Onshore	740	-	120	244	364
State Offshore	7	-	0	2	2
Colorado	26	8	1,300	331	1,631
Florida	6	-	-	-	-
Illinois	4	-	-	-	-
Indiana	-	-	-	-	-
Kansas	11	-	108	9	117
Kentucky	-	-	183	-	183
Louisiana	198	55	3,049	296	3,345
North	18	8	967	22	989
South Onshore	143	44	1,870	239	2,109
State Offshore	37	3	212	35	247
Michigan	3	-	68	6	74
Mississippi	49	1	117	9	126
Montana	6	-	89	3	92
Nebraska	-	-	-	-	-
New Mexico	97	11	1,776	109	1,885
East	97	4	261	105	366
West	-	7	1,515	4	1,519
New York	-	-	12	-	12
North Dakota	17	3	68	19	87
Ohio	-	-	38	5	43
Oklahoma	98	20	1,499	103	1,602
Pennsylvania	-	-	222	14	236
Texas	448	74	6,453	599	7,052
RRC District 1	4	3	297	3	300
RRC District 2 Onshore	5	2	392	8	400
RRC District 3 Onshore	24	23	884	62	946
RRC District 4 Onshore	7	28	2,153	88	2,241
RRC District 5	5	1	575	3	578
RRC District 6	60	10	1,134	35	1,169
RRC District 7B	12	-	4	15	19
RRC District 7C	10	1	247	29	276
RRC District 8	168	1	310	281	591
RRC District 8A	143	-	5	52	57
RRC District 9	4	-	6	4	10
RRC District 10	6	4	368	19	387
State Offshore	-	2	78	-	78
Utah	36	1	595	74	669
Virginia	-	-	878	-	878
West Virginia	3	-	439	1	440
Wyoming	31	9	4,089	35	4,124
Federal Offshore[b]	1,364	340	8,396	3,476	11,872
Pacific (California)	21	4	47	18	65
Gulf of Mexico (Louisiana)[b]	1,128	278	6,602	2,473	9,075
Gulf of Mexico (Texas)	215	58	1,747	985	2,732
Miscellaneous[c]	1	-	1	2	3
Total	**4,147**	**530**	**30,570**	**5,477**	**36,047**

[a]Includes only those operators who produced during the report year 400,000 barrels of crude oil or 2 billion cubic feet of wet natural gas, or more (Category I and Category II operators).

[b]Includes Federal offshore Alabama.

[c]Includes Arizona, Maryland, Missouri, Nevada, Oregon, South Dakota and Tennessee.

Source: Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," 1998.

Appendix E

Summary of Data Collection Operations

Appendix E

Summary of Data Collection Operations

Form EIA-23 Survey Design

The data collected on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," were used to produce this report. This section provides information concerning the survey design, response statistics, reporting requirements, and frame maintenance.

Form EIA-23 is mailed annually to all known large and intermediate size operators, and a scientifically selected sample of small operators. Operator size categories were based upon their annual production as indicated in various Federal, State, and commercial records. The term **State/subdivision** refers to an individual subdivision within a State or an individual State that is not subdivided. Operators were divided into the three size categories shown below.

- **Category I** - ***Large Operators***: Operators who produced 1.5 million barrels or more of crude oil, or 15 billion cubic feet or more of natural gas, or both.
- **Category II** - ***Intermediate Operators***: Operators who produced at least 400,000 barrels of crude oil or 2 billion cubic feet of natural gas, or both, but less than Category I operators.
- **Category III** - ***Small Operators:*** Operators who produced less than the Category II operators.

Category III operators were further subdivided into operators sampled with Certainty (**Certainty**) and operators that were randomly sampled (**Noncertainty**).

Data were filed for calendar year 1998 by crude oil or natural gas well operators who were active as of December 31, 1998. EIA defines an operator as an organization or person responsible for the management and day-to-day operation of crude oil or natural gas wells. The purpose of this definition is to eliminate responses from royalty owners, working interest owners (unless they are also operators), and others not directly responsible for operations. An operator need not be a separately incorporated entity. To minimize reporting burden, corporations are permitted to report on the basis of operating units of the company convenient for them. A large corporation may be represented by a single form or by several forms.

Table E1 shows a comparison of the EIA-23 sample and sampling frame between 1991 and 1998, and depicts the number of active operators, 1991 showing the largest in the series. The 1998 sampling frame consisted of 178 Category I, 420 Category II, 862 Category III Certainty, and 22,160 Category III Noncertainty operators, for a total of 23,620 active operators. The survey sample consisted of 1,460 operators selected with certainty that included all of the Category I and II Certainty operators, the 862 smaller operators that were selected with certainty because of their size in relation to the area or areas in which they operated, and 1,459 Noncertainty operators selected as a systematic random sample of the remaining operators.

Form EIA-23 Response Statistics

Each company and its parent company or subsidiaries were required to file Form EIA-23 if they met the survey specifications. Response to the 1998 survey is summarized in **Table E2**. EIA makes a considerable effort to gain responses from all operators. About 7 percent of those selected turned out to be nonoperators (those that reported being nonoperators during the report year and operators that could not be located). Of the 200 nonoperators, 5 had successor operators that had taken over the production of the nonoperator. These successor operators were subsequently sampled. The overall response rate for the 1998 survey was 99.7 percent. This compares with a 99.8 percent overall response rate for all operators in 1997.

Form EIA-23 Reporting Requirements

The collection format for Form EIA-23 actually consists of two forms. The form the respondent is required to file is dependent upon the annual production levels of crude oil, natural gas, and lease condensate. Category I and Category II operators file a more detailed field

Table E1. Comparison of the EIA-23 Sample and Sampling Frame, 1991-1998

Operator Category	Number of Operators							
	1991	1992	1993	1994	1995	1996	1997	1998
Certainty								
Category I	144	157	160	161	161	176	180	178
Category II	484	480	500	482	476	486	461	420
Category III	2,074	1,896	1,723	1,694	1,596	3	1,194	862
Sampled	2,702	2,533	2,383	2,337	2,233	665	1,835	1,460
Percent Sampled	100	100	100	100	100	100	100	100
Noncertainty								
Sampled	1,760	1,724	1,691	1,737	1,632	0	1,645	1,459
Percent Sampled	8	8	8	8	8	0	8	7
Total								
Active Operators	R24,846	R24,173	R23,656	R24,222	22,766	23,410	22,678	23,620
Not Sampled	20,384	19,916	19,791	20,148	18,901	22,745	19,198	20,701
Sampled	4,462	4,257	4,074	4,074	3,865	665	3,480	2,919
Percent Sampled	18	18	17	17	17	3	15	12

R=Revised data.
Note: Active operators in 1998 include 10 operators added after December 29, 1998 and not included in Table E3.
Source: Energy Information Administration, Office of Oil and Gas.

Table E2. Form EIA-23 Survey Response Statistics, 1998

Operator Category	Original Sample Selected	Successor[a] Operators	Net[b] Category Changes	Non-[c] operators	Adjusted[d] Sample	Responding Operators		Nonresponding Operators	
						Number	Percent	Number	Percent
Certainty									
Category I	178	0	-1	-7	170	170	100.0	0	0.0
Category II	420	2	15	-19	418	418	100.0	0	0.0
Category III	862	3	-14	-44	807	807	100.0	0	0.0
Subtotal	1,460	5	0	-70	1,395	1,395	100.0	0	0.0
Noncertainty	1,459	0	0	-130	1,329	1,321	99.4	8	0.6
Total	2,919	5	0	-200	2,724	2,716	99.7	8	0.3

[a]Successor operators are those, not initially sampled, that have taken over the production of a sampled operator.
[b]Net of recategorized operators in the sample (excluding nonoperators).
[c]Includes former operators reporting that they were not operators during the report year and operators that could not be located who are treated as nonoperators.
[d]Adjusted sample equals original sample plus successor operators plus net category changes minus nonoperators.
Source: Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves" 1998.

level data form. Category III operators file a summary report which is aggregated at a State/subdivision level.

The cover page required of all respondents identifies each operator by name and address (**Figure I1**, Appendix I). The oil and gas producing industry includes a large number of small enterprises. To minimize reporting burden, only a sample of small operators were required to file a summary report of Form EIA-23 (**Figures I2 and I3**, Appendix I). Report year production data were required by State/subdivision areas for crude oil, natural gas, and lease condensate. Proved reserves data for operators were required only for those properties where estimates existed in the respondent's records.

All Category I and Category II operators were required to file field level data on Schedule A, "Operated Proved Reserves, Production, and Related Data by Field," for each oil and/or gas field in which the respondent operated properties (**Figure I4**, Appendix I). All Category I and those Category II operators who had reserve estimates were required to file on a total operated basis for crude oil, nonassociated natural gas, associated-dissolved natural gas, and lease condensate. The following data items were required to be filed: proved reserves at the beginning and the end of the report year, revision increases and revision decreases, extensions, new field discoveries, new reservoirs in old fields, production, indicated additional reserves of crude oil, nonproducing reserves, field discovery year, water depth, and field location information.

Category II operators who did not have reserves estimates were required to file the field location information and report year production for the four hydrocarbon types from properties where reserves were not estimated. These respondents used Schedule B, "Footnotes," to provide clarification of reported data items when required in the instructions, or electively to provide narrative or detail to explain any data item filed (**Figure I5**, Appendix I).

Crude oil and lease condensate volumes were reported rounded to thousands of barrels of 42 U.S. gallons at 60 Fahrenheit, and natural gas volumes were reported rounded to millions of cubic feet. All natural gas volumes were requested to be reported at 60 Fahrenheit and a pressure base of 14.73 pounds per square inch absolute. Other minor report preparation standards were specified to assure that the filed data could be readily processed.

Oil and Gas Field Coding

A major effort to create standardized codes for all identified oil or gas fields throughout the United States was implemented during the 1982 survey year. Information from previous lists was reviewed and reconciled with State lists and a consolidated list was created. The publication of the *Oil and Gas Field Code Master List 1998*, in January of 1999, was the 17th annual report and reflected data collected through October 1998. This publication was mailed to operators to assist in identifying the field code data necessary for the preparation of Form EIA-23. A copy of this publication may be purchased from the National Energy Information Center (see inside cover page).

Form EIA-23 Comparison with Other Data Series

Estimated crude oil, lease condensate, and natural gas production volumes from Form EIA-23 were compared with official EIA production data supplied by Federal and State oil and natural gas regulatory agencies and published in EIA's monthly and annual reports. Reports published by the Federal and State oil and natural gas regulatory agencies were used to compare specific operator production responses to these agencies with Form EIA-23 responses. When significant differences were found, responses were researched to detect and reconcile possible reporting errors.

For 1998, Form EIA-23 National estimates of production were 2,169 million barrels for crude oil and lease condensate or 113 million barrels (5 percent) lower than that reported in the *Petroleum Supply Annual 1998* for crude oil and lease condensate. Form EIA-23 National estimates of production for dry natural gas were 18,720 billion cubic feet or 90 billion cubic feet (.05 percent) lower than the *Natural Gas Annual 1998* for 1998 dry natural gas production.

Form EIA-23 Frame Maintenance

Operator frame maintenance is a major data quality control effort. Extensive effort is expended to keep the frame as current as possible. The Form EIA-23 frame contains a listing of all crude oil and natural gas well operators in the United States and must be maintained and updated regularly in order to ensure an accurate frame from which to draw the sample for the annual crude oil and natural gas reserves survey. The original frame, created in 1977, is revised annually. In addition, outside sources, such as State publications and electronic data, and commercial information data bases such as IHS Energy Group, are used to obtain information on operator status and to update addresses for the frame each year.

A maintenance procedure is utilized, using a postcard form with prepaid return postage, to contact possible active crude oil and natural gas well operators presently listed on EIA's master frame, but for whom the listing had not been updated for 2 years. This procedure identifies active operators and nonoperators which improves the frame for future sample selections for the survey. **Table E3** provides a summary of changes made to the Form EIA-23 frame of crude oil and natural gas well operators for the 1998 survey mailing. These changes resulted from all frame maintenance activities.

The Form EIA-23 operator frame contained a total of 68,468 entries as of December 29, 1998. Of these, 23,392 were confirmed operators. These are operators who have filed in the past or for whom the EIA has recent production data from an outside source. The remaining operators (including both definite and probable nonoperators) exist as a pool of names and addresses that may be added to the active list if review indicates activity.

Table E3. Summary of the 1998 Operator Frame Activity, Form EIA-23

Total 1997 Operator Frame	65,420
Operators	22,668
Nonoperators	42,752
Changes to 1997 Operator Status	2,354
From Nonoperator to Operator	236
From Operator to Nonoperator	2,118
No Changes to 1997 Operator Status	63,066
Operators	20,550
Nonoperators	42,516
Additions to 1997 Operator Frame	3,048
Operator	2,842
Nonoperator	206
Total 1998 Operator Frame	**68,468**
Operators	23,392
Nonoperators	45,076

Note: Includes operator frame activity through December 29, 1998.
Source: Energy Information Administration, Office of Oil and Gas.

Form EIA-64A Survey Design

The data for this report are also collected on Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production." This section provides information concerning the survey design, response statistics, reporting requirements, and frame maintenance for Form EIA-64A.

Form EIA-23 for report years 1977 and 1978 required natural gas well operators to report their natural gas data on a fully dry basis. It was discovered in the course of those surveys that many operators had little or no knowledge of the extraction of liquids from their produced natural gas streams once custody transfer had taken place. Therefore, these operators reverted to reporting the only natural gas volume data they had in their possession. These volume data were for dryer natural gas than that which had passed through the wellhead, but wetter than fully dry natural gas. With reference to **Figure E1**, they reported their volumes either at the wellhead or after removal of lease condensate in their lease or field separation facilities.

Some of the larger operators, however, also owned or operated natural gas processing plants. They reported their volumes after removal of both lease condensate and plant liquids, as required by Form EIA-23. The aggregate volumes resulting from the 1977 and 1978 surveys, therefore, were neither fully dry (as was intended) nor fully wet. They do appear to have been more dry than wet simply because the operators who reported fully dry volumes also operated properties that contained the bulk of proved natural gas reserves.

The EIA recognized that its estimates of proved reserves of natural gas liquids (NGL) had to reflect not only those volumes extractable in the future under current economic and operating conditions at the lease or field (lease condensate), but also volumes (plant liquids) extractable downstream at existing natural gas processing plants. Form EIA-64, which already canvassed these processing plants, did not request that the plants' production volumes be attributed to source areas. Beginning with the 1979 survey, a new form to collect plant liquids production according to the area or areas where their input natural gas stream had been produced was mailed to all of the operating plants. The instructions for filing the Form EIA-23 were altered to collect data from natural gas well operators that reflected those volumes of natural gas dried only through the lease or field separation facilities. The reporting basis of these volumes are referred to as "wet after lease separation." The methodology used to estimate NGL reserves by State and State subdivision is provided in Appendix F.

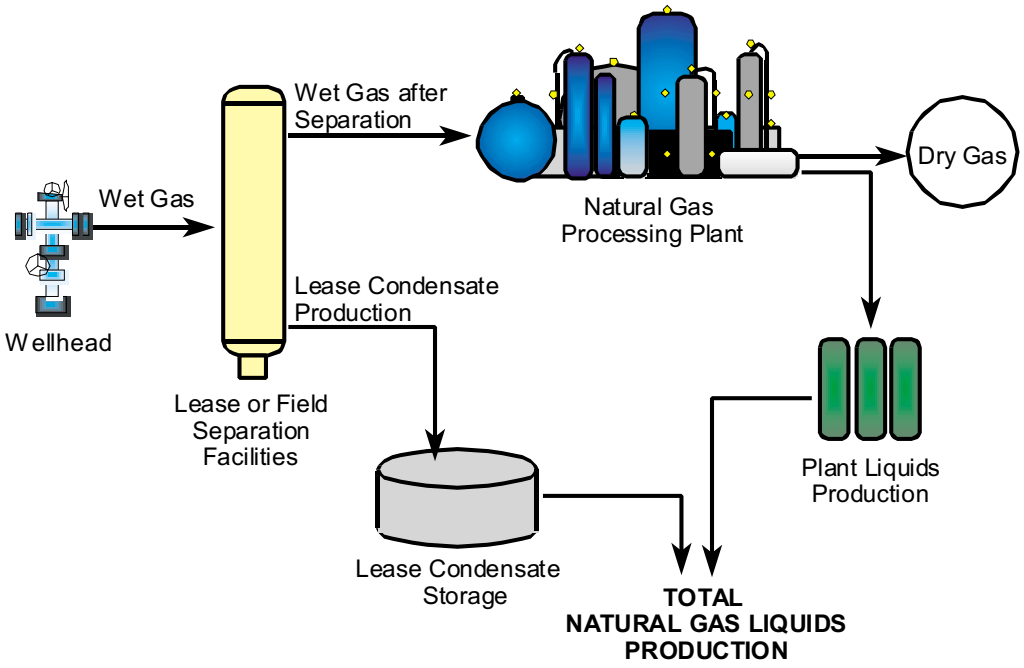
Form EIA-64A Response Statistics

EIA mailed EIA-64A forms to all known natural gas processing plant operators as of February 1, 1999. In addition, plant operators whose plants were shut down or dismantled during 1998 were required to complete forms for the portion of 1998 when the plants were in operation.

Natural gas processing plant operators were requested to file a Form EIA-64A for each of their plants. A total of 262 operators of 605 plants were sent forms. This number included 1 new plant, 2 reactivated plants, and 18 successor plants identified after the initial 1998 survey mailing. A total of 29 plants were reported as nonoperating according to the Form EIA-64A definition. For the eleventh consecutive year the response rate was 100 percent.

Form EIA-64A respondents were requested to report natural gas liquids production data by area of origin. **Table E4** summarizes the responses by plant operators of the volume and origin of natural gas delivered to the

Figure E1. Natural Gas Liquids Extraction Flows



Source: Energy Information Administration, Office of Oil and Gas.

processing plants and the volume of the natural gas liquids extracted by the plants by State. The majority of the plant operators reported only one area of origin for the natural gas that was processed by a plant. The State or area of origin reported is generally also the plant's location.

Form EIA-64A Reporting Requirements

Form EIA-64A consisted of the reporting schedule shown in **Figure I6**, Appendix I. The form identifies the plant, its geographic location, the plant operator's name and address, and the parent company name. The certification was signed by a responsible official of the operating entity. The form pertains to the volume of natural gas received and of natural gas liquids produced at the plant, allocated to each area of origin. Operators also filed the data pertaining to the amount of natural gas shrinkage that resulted from extraction of natural gas liquids at the plant, and the amount of fuel used in processing.

Natural gas liquids volumes were reported rounded to thousands of barrels of 42 U.S. gallons at 60 Fahrenheit, and natural gas volumes were reported rounded to millions of cubic feet. All natural gas volumes were requested to be reported at 60 Fahrenheit and a pressure base of 14.73 pounds per square inch absolute. Other minor report preparation standards were specified to assure that the filed data could be readily processed.

Form EIA-64A Comparison with Other Data Series

Form EIA-64A plant liquids production data were compared with data collected on Form EIA-816, "Monthly Natural Gas Liquids Report." Aggregated production from Form EIA-816 represents the net volume of natural gas processing plant liquid output less input for the report year. These data are published in EIA's *Petroleum Supply Annual* reports. The Form EIA-64A annual responses reflect all corrections and revisions to EIA's monthly estimates. Differences, when found, were reconciled in both sources. For 1998, the Form EIA-64A National estimates were 1 percent (13 million barrels) higher than the *Petroleum Supply Annual 1998* volume for natural gas plant liquids production.

Table E4. Natural Gas Processed and Liquids Extracted at Natural Gas Processing Plants, 1998

Plant Location	Volume of Natural Gas Delivered to Processing Plants			Total Liquids Extracted
	State Production	Out of State Production	Natural Gas Processed	
	(million cubic feet)			(thousand barrels)
Alaska	2,966,461	0	2,966,461	33,889
Lower 48 States	13,321,204	270,114	13,591,318	634,122
Alabama	105,708	1,626	107,334	3,199
Arkansas	198,148	0	198,148	365
California	235,558	0	235,558	8,351
Colorado	424,984	99	425,083	17,467
Florida	5,037	3,137	8,174	1,559
Kansas	600,453	132,375	732,828	32,853
Kentucky	37,929	0	37,929	1,661
Louisiana	4,520,288	90,681	4,610,969	101,358
Michigan	83,052	0	83,052	4,399
Mississippi	3,668	0	3,668	370
Montana	8,715	0	8,715	318
North Dakota	52,777	0	52,777	4,234
New Mexico	867,041	1,168	868,209	74,058
Oklahoma	944,568	2,609	947,177	65,306
Texas	4,045,405	28,334	4,073,739	272,512
Utah	235,896	6,174	242,070	8,280
West Virginia	70,488	153	70,641	5,158
Wyoming	869,726	792	870,518	32,000
Miscellaneous[a]	11,763	2,966	14,729	674
Total	**16,287,665**	**270,114**	**16,557,779**	**668,011**

[a]Includes Illinois, Nebraska, Ohio, Pennsylvania, and Tennessee.
Source: Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production," 1998.

Form EIA-64A Frame Maintenance

The Form EIA-64A plant frame contains data on all known active and inactive natural gas processing plants in the United States. The 1998 plant frame was compared to listings of natural gas processing plants from Form EIA-816, "Monthly Natural Gas Liquids Report"; the *LPG Almanac*; and the *Oil and Gas Journal.* A list of possible additions to the plant frame was compiled. **Table E5** summarizes the Form EIA-64A plant frame changes made as a result of the comparisons as of December 28, 1998.

Table E5. Form EIA-64A 1998 Plant Frame Activity

Frame as of 1997 survey mailing	654
Additions	88
Deletions	–121
Frame as of 1998 survey mailing	621

Note: Includes operator frame activity through December 28, 1998.
Source: Energy Information Administration, Office of Oil and Gas.

Appendix F

Statistical Considerations

Appendix F

Statistical Considerations

Survey Methodology

The Form EIA-23 survey is designed to provide reliable estimates for reserves and production of crude oil, natural gas, and lease condensate for the United States. Operators of crude oil and natural gas wells were selected as the appropriate respondent population because they have access to the most current and detailed information, and therefore, presumably have better reserve estimates than do other possible classes of respondents, such as working interest or royalty owners.

While large operators are quite well known, they comprise only a small portion of all operators. The small operators are not well known and are difficult to identify because they go into and out of business, alter their corporate identities, and change addresses frequently. As a result, EIA conducts extensive frame maintenance activities each year to identify all current operators of crude oil and natural gas wells in the country.

Sampling Strategy

EIA publishes data on reserves and production for crude oil, natural gas, and lease condensate by State for most States, and by State subdivision for the States of California, Louisiana, New Mexico, and Texas. To meet the survey objectives, while minimizing respondent burden, a random sampling strategy has been used since 1977. Each operator reporting on the survey is asked to report production for crude oil, natural gas, and lease condensate for each State/subdivision in which he operates. The term **State/subdivision** refers to an individual subdivision within a State or an individual State that is not subdivided.

The total volume of production varies among the State/subdivisions. To meet the survey objectives while controlling total respondent burden, EIA selected the following target sampling error for the 1998 survey for each product class.

- 1.0 percent for National estimates.
- 1.0 percent for each of the 5 States having subdivisions: Alaska, California, Louisiana, New Mexico, and Texas. For selected subdivisions within these States, targets of 1.0 percent or 1.5 percent as required to meet the State target.
- 2.5 percent for each State/subdivision having 1 percent or more of estimated U.S. reserves or production in 1997 (lower 48 States) for any product class.
- 4 percent for each State/subdivision having less than 1 percent of estimated U.S. reserves or production in 1997 (lower 48 States) for all 3 product classes.
- 8 percent for States not published separately. The combined production from these States was less than 0.2 percent of the U.S. total in 1997 for crude oil and for natural gas.

The volume of production defining the Certainty stratum, referred to as the **cutoff**, varies by product or State/subdivision. The cutoff criteria and sampling rates are shown in **Table F1**. The Certainty stratum, therefore, has three components.

- **Category I** - *Large Operators:* Operators who produced a total of 1.5 million barrels or more of crude, or 15 billion cubic feet or more of natural gas, or both in 1998.
- **Category II** - *Intermediate Operators:* Operators who produced a total of at least 400,000 barrels of crude oil or 2 billion cubic feet of natural gas, or both, but less than Category I operators in 1998.
- **Category III** - *Small Operators:* Operators who produced less than the Category II operators in 1998, but which were selected with certainty. Category III operators were subdivided into operators sampled with certainty (**Certainty**) and operators that were randomly sampled (**Noncertainty**).
  - **Certainty** - A small operators who satisfied any of the following criteria based upon their production shown in the operator frame:

    Operators with annual crude oil production of 200 thousand barrels or more, or reserves of 4 million barrels or more; or annual natural gas production of 1 billion cubic feet or more, or reserves of 20 billion cubic feet or more.

Table F1. 1998 EIA–23 Survey Initial Sample Criteria

State and Subdivision	Production Cutoffs		Noncertainty Sample Number of		
	Crude Oil (mbbls)	Gas (mmcf)	Certainty Operators	Single State Operators	Multi–State Operators
Alabama Onshore	107	1,000	54	4	5
Alaska	0	0	7	0	0
Arkansas	21	1,000	123	25	27
California Unspecified	17	88	2	2	0
California Coastal Region Onshore	200	1,000	24	1	3
California Los Angeles Basin Onshore	200	25	24	4	2
California San Joaquin Basin Onshore	200	1,000	41	5	6
Colorado	200	1,000	134	20	23
Florida Onshore	200	1,000	4	0	1
Illinois	200	27	26	18	19
Indiana	12	1	17	4	14
Kansas	85	1,000	205	140	40
Kentucky	37	1,000	21	15	11
Louisiana Unspecified	73	183	0	0	0
Louisiana North	13	633	234	32	27
Louisiana South Onshore	70	1,000	220	34	38
Michigan	200	1,000	62	10	4
Mississippi Onshore	200	1,000	111	2	17
Montana	200	1,000	117	15	16
Nebraska	13	2	35	5	15
New Mexico Unspecified	10	13	26	1	13
New Mexico East	200	1,000	157	0	6
New Mexico West	21	1,000	58	2	1
New York	3	1,000	23	19	5
North Dakota	200	1,000	103	7	10
Ohio	92	1,000	60	72	19
Oklahoma	143	1,000	350	252	65
Pennsylvania	4	1,000	40	23	13
Texas Unspecified	7	118	2	2	0
Texas-RRC District 1	23	800	197	33	46
Texas-RRC District 2 Onshore	200	1,000	213	17	52
Texas-RRC District 3 Onshore	200	1,000	298	36	78
Texas-RRC District 4 Onshore	91	1,000	213	21	44
Texas-RRC District 5	38	630	139	5	26
Texas-RRC District 6	200	1,000	244	33	50
Texas-RRC District 7B	34	82	269	70	76
Texas-RRC District 7C	200	1,000	214	10	76
Texas-RRC District 8	200	1,000	257	9	76
Texas-RRC District 8A	200	1,000	211	10	45
Texas-RRC District 9	52	1,000	178	29	54
Texas-RRC District 10	200	1,000	172	3	16
Utah	200	1,000	63	4	10
Virginia	200	1,000	13	1	1
West Virginia	5	1,000	48	46	17
Wyoming	200	1,000	151	12	30
Offshore Areas	0	0	267	1	7
Other States[a]	125	49	23	2	8
Total			**[b]1,459**	**1,056**	**[b]412**

[a]Includes Arizona, Connecticut, Delaware, Georgia, Idaho, Iowa, Massachusetts, Maryland, Minnesota, Missouri, North Carolina, New Hampshire, Nevada, New Jersey, Oregon, Rhode Island, South Carolina, South Dakota, Tennessee, Washington, and Wisconsin.

[b]Nonduplicative count of operators by States.

Note: Sampling rate was 8 percent except in Alaska, Florida Onshore, Virginia, and Offshore areas where sampling rate was 100 percent.

— = Not applicable.

Source: Energy Information Administration, Office of Oil and Gas.

All other operators with production or reserves in a State/subdivision that exceed selected cutoff levels for that State/subdivision.

The largest operator in each State/subdivision regardless of level of production or reserves.

Operators with production or reserves of oil or gas for six or more State/subdivisions.

- **Noncertainties** - Small operators not in the certainty stratum were classified in a noncertainty stratum and sampled at a rate of 8 percent.

In each State/subdivision the balance between the number of small certainty operators and the sample size was determined in an iterative procedure designed to minimize the number of total respondents. The iteration for each State/subdivision began with only the Category I and Category II operators in the certainty stratum. The size of the sample of small operators required to meet the target variance was calculated based on the variance of the volumes of those operators. For a number of State/subdivisions with high correlations between frame values across pairs of consecutive years, an adjusted target variance was calculated, that utilized the information about the correlations. This allowed the selection of a smaller sample that still met the target sampling error criteria. At each iteration a small operator, beginning with the largest of the Category III operators, was added to the certainty group and the required sample size was again calculated. The procedure of adding one operator at a time stopped when the proportion of operators to be sampled at random dropped below 8 percent. Independent samples of single location operators (operators who, according to the sampling frame, operate in only one State/subdivision) were selected from each State/subdivision using systematic random sampling.

An additional complexity is introduced because some small operators selected for the sample in another region or regions, sometimes report production volumes in a region in which EIA has no previous record of production.

State/subdivision volume estimates are calculated as the sum of the certainty strata and all of the estimates for the sampling strata in that region. The sampling variance of the estimated total is the sum of the sampling variances for the sampling strata. There is no sampling error associated with the certainty stratum. The square root of the sampling variance is the standard error. It can be used to provide confidence intervals for the State/subdivision totals.

For the States in which subdivision volume estimates are published, the State total is the sum of the individual volume estimates for the subdivisions. The U.S. total is the sum of the State estimates. A sampling variance is calculated for each State subdivision, State, and for the U.S. total.

Total U.S. Reserve Estimates

Conceptually, the estimates of U.S. reserves and production can be thought of as the sum of the estimates for the individual States. Correspondingly, the estimates for the four States for which estimates are published separately by subdivision (California, Louisiana, New Mexico, and Texas) can be thought of as the sum of the estimates by subdivision. The remaining States are not subdivided and may be considered as a single subdivision.

The estimates of year-end proved reserves and annual production for any State/subdivision is the sum of the volumes in the State/subdivision reported by the certainty stratum operators and an estimate of the total volume in the State/subdivision by the noncertainty stratum operators. Mathematically, this may be stated as the following sum:

$$\hat{V}_s \qquad V_{sc} \qquad \hat{V}_{sr}$$

where

$\hat{V}_s$ = estimated total volume in the State/subdivision

V_{sc} = total volume in the State/subdivision reported by Certainty operators

$\hat{V}_{sr}$ = estimated total volume in the State/subdivision of Noncertainty operators.

The total volume of Certainty operators in the State/subdivision is simply the sum of individual operator's volumes:

$$V_{sc} \qquad \sum_{m=1}^{n_{sc}} V_{scm}$$

where

n_{sc} = number of Certainty operators reporting production in the State/subdivision

V_{scm} = volume reported by the *m*-th certainty stratum operator in the State/subdivision.

The estimated total volume of Noncertainty operators in the State/subdivision is the weighted sum of the reports of the noncertainty sample operators:

$$\hat{V}_{sr} \sum_{m=1}^{n_{sr}} W_{srm} V_{srm}$$

where

n_{sr} = number of Noncertainty operators reporting production in the State/subdivision

V_{srm} = volume reported by the *m*-th Noncertainty sample operator in the State/subdivision

W_{srm} = weight for the report by the *m*-th Noncertainty sample operator reporting production in the State/subdivision.

In many State/ subdivisions, the accuracy of the oil and gas estimates was improved by using the probability proportional to size procedure. This procedure took advantage of the correlation between year-to-year production reports. The weights used for estimating the oil production for a State / subdivision were different from the weights used for estimating the gas production.

The weight used for the estimation is the reciprocal of the probability of selection for the stratum from which the sample operator was selected. In making estimates for a State/ subdivision, separate weights are applied as appropriate for noncertainty operators shown in the frame as having had production in only the State/ subdivision, for those shown as having had production in that State/subdivision and up to four other State/ subdivisions, and for operators with no previous record of production in the State/subdivision. National totals were then obtained by summation of the component totals.

Imputation for Operator Nonresponse

The response rate for Noncertainty operators for the 1998 survey was 99.4 percent, therefore an imputation was made for the production and reserves of the 8 nonresponding operators.

Imputation and Estimation for Reserves Data

In order to estimate reserve balances for National and State/subdivision levels, a series of imputation and estimation steps at the operator level must be carried out. Year-end reserves for operators who provided production data only were imputed on the basis of their production volumes. Imputation was also applied to the small and intermediate operators as necessary to provide data on each of the reserve balance categories (i.e., revisions, extensions, or new discoveries). Finally, an imputation was required for the natural gas data of the small operators to estimate their volumes of associated-dissolved and nonassociated natural gas. The final manipulation of the data accounts for the differences caused by different sample frames from year to year. Each of these imputations generated only a small percentage of the total estimates. The methods used are discussed in the following sections.

The data reported by operator category by Form EIA-23 respondents for the report year 1998 are summarized in **Tables F2, F3, F4, and F5**. The reported data in **Table F2** shows that those responding operators accounted for 97.9 percent of the published production for natural gas shown in **Table 9** and 93.9 percent of the reserves. Data shown in **Table F3** indicate that those responding operators accounted for 95.3 percent of the nonassociated natural gas production and 92.7 percent of the reserves published in **Table 10**. The reported data shown in **Table F4** indicate that those responding operators accounted for 96.7 percent of published crude oil production and 94.7 percent of the reserves shown in **Table 6**. Additionally, **Table F5** indicates that those responding operators accounted for 100 percent of the published production and 96 percent of the published proved reserves for lease condensate shown in **Table 16**.

Imputation of Year-End Proved Reserves

Category I operators were required to submit year-end estimates of proved reserves. Category II and Category III operators were required to provide year-end estimates of proved reserves only if such estimates existed in their records. Some of these respondents provided estimates for all of their operated properties, others provided estimates for only a portion of their properties, and still others provided no estimates for any of their properties. All respondents did, however, provide annual production data. The production reported by Noncertainty sample operators and the corresponding imputed reserves were weighted to

Table F2. Summary of Total Natural Gas, Wet After Lease Separation, Used in Estimation Process, Form EIA-23 (Million Cubic Feet at 14.73 psia and 60 Degrees Fahrenheit)

Level of Reporting	Operator Category I	II	Certainty III	Non-certainty III	Total
Field Level Reported and Imputed Data					
Proved Reserves as of 12/31/97	149,878,595	11,753,022	23,033	-	161,654,650
(+) Revision Increases	22,867,374	3,933,811	145,624	-	26,946,809
(–) Revision Decreases	19,981,833	1,640,795	0	-	21,622,628
(+) Extensions	7,245,090	799,803	0	-	8,044,893
(+) New Field Discoveries	835,143	147,710	0	-	982,853
(+) New Reservoirs in Old Fields	1,982,423	92,763	14,235	-	2,089,421
(–) Production With Reserves in 1998	16,594,101	1,472,599	19,321	-	18,086,021
Proved Reserves Reported as of 12/31/98	146,291,686	13,615,360	163,571	-	160,070,617
Production Without Proved Reserves	25,269	531,885	46,974	-	604,128
Reserves Imputed for Production Without Proved Reserves	166,791	4,323,239	326,375		4,816,405
Subtotal Production	**16,619,370**	**2,004,484**	**66,295**	**-**	**18,690,149**
Subtotal Proved Reserves 1998	**146,458,477**	**17,938,599**	**489,946**	**-**	**164,887,022**
State Level Reported and Imputed Data					
Production With Proved Reserves	0	3,859	118,270	77,086	199,215
Production Without Proved Reserves	0	7,046	182,787	133,731	323,564
Subtotal Production	0	10,905	301,057	210,817	522,779
Weighted Subtotal Production	**0**	**10,905**	**301,057**	**619,889**	**931,851**
Proved Reserves Reported	0	21,475	1,085,344	713,771	1,820,590
Reserves Imputed for Reported Production Without Proved Reserves	0	21,482	1,372,175	1,368,707	2,762,364
Subtotal Proved Reserves	0	42,957	2,457,519	2,082,478	4,582,954
Weighted Subtotal Proved Reserves	**0**	**42,957**	**2,457,519**	**5,055,502**	**7,555,978**
Total Production in 1998	**16,619,370**	**2,015,389**	**367,352**	**619,889**	**19,622,000**
Total Proved Reserves as of 12/31/98	**146,458,477**	**17,981,556**	**2,947,465**	**5,055,502**	**172,443,000**

– = Not applicable.

Notes: Table 9 totals include imputed and estimated wet natural gas proved reserves rounded at the State/subdivision level. Field level data are reported volumes and may not balance due to submission of incomplete reserve component records.

Source: Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves,” 1998.

Table F3. Summary of Nonassociated Natural Gas, Wet After Lease Separation, Used in Estimation Process, Form EIA-23 (Million Cubic Feet at 14.73 psia and 60 Degrees Fahrenheit)

Level of Reporting	Operator Category				
	I	II	Certainty III	Non-certainty III	Total
Field Level Detail Report					
Proved Reserves as of 12/31/97	121,784,153	10,230,055	13,678	-	132,027,886
(+) Revision Increases	18,920,040	3,464,824	39,642	-	22,424,506
(–) Revision Decreases	16,774,920	1,262,641	0	-	18,037,561
(+) Extensions	6,632,689	739,359	0	-	7,372,048
(+) New Field Discoveries	731,321	145,942	0	-	877,263
(+) New Reservoirs in Old Fields	1,792,251	73,297	14,235	-	1,879,783
(–) Production With Reserves in 1998	13,907,665	1,296,034	12,168	-	15,215,867
Proved Reserves Reported as of 12/31/98	119,234,863	12,097,445	55,387	-	131,387,695
Production Without Proved Reserves	25,048	423,209	43,778	-	492,035
Reserves Imputed for Production Without Proved Reserves	172,831	2,920,142	302,068	-	3,395,042
Subtotal Production	**13,932,713**	**1,719,243**	**55,946**	**-**	**15,707,902**
Subtotal Proved Reserves 1998	**119,407,694**	**15,017,587**	**357,455**	**-**	**134,782,737**
State Level Reported and Imputed Data					
Production With Proved Reserves	—	—	—	—	—
Production Without Proved Reserves	—	—	—	—	—
Subtotal Production	—	—	—	—	—
Weighted Subtotal Production	—	—	—	—	—
Proved Reserves Reported	—	—	—	—	—
Reserves Imputed for Reported Production Without Proved Reserves	—	—	—	—	—
Subtotal Proved Reserves	—	—	—	—	—
Weighted Subtotal Proved Reserves	—	—	—	—	—
Total Production in 1998	**13,932,713**	**1,719,243**	**55,946**	**-**	**15,707,902**
Total Proved Reserves as of 12/31/98	**119,407,694**	**15,017,587**	**357,455**	**-**	**134,782,737**

– = Not applicable.

Notes: Table 10 totals include imputed and estimated nonassociated wet natural gas proved reserves rounded at the State/subdivision level. Field level data are reported volumes and may not balance due to submission of incomplete reserve component records.

Source: Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves,” 1998.

Table F4. Summary of Crude Oil Used in Estimation Process, Form EIA-23
(Thousand Barrels of 42 U.S. Gallons)

Level of Reporting	Operator Category I	II	Certainty III	Non-certainty III	Total
Field Level Detail Report					
Proved Reserves as of 12/31/97	19,560,638	787,760	6,946	-	20,355,344
(+) Revision Increases	2,163,945	202,379	41,405	-	2,407,729
(–) Revision Decreases	1,720,906	183,522	7,144	-	1,911,572
(+) Extensions	281,464	15,010	0	-	296,474
New Field Discoveries	148,004	2,142	0	-	150,146
(+) New Reservoirs in Old Fields	97,672	19,104	0	-	116,776
(–) Production With Reserves in 1998	1,713,103	80,119	3,570	-	1,796,792
Proved Reserves Reported as of 12/31/98	18,816,152	762,761	37,684	-	19,616,597
Production Without Proved Reserves	514	35,246	3,878	-	39,638
Reserves Imputed for Production Without Proved Reserves	3,189	230,810	26,092		260,091
Subtotal Production	**1,713,617**	**115,365**	**7,448**	**-**	**1,836,430**
Subtotal Proved Reserves 1998	**18,819,341**	**993,571**	**63,776**	**-**	**19,876,688**
State Level Reported and Imputed Data					
Production With Proved Reserves	0	893	19,482	13,832	34,207
Production Without Proved Reserves	0	1,308	30,879	22,733	54,920
Subtotal Production	0	2,201	50,361	36,565	89,127
Weighted Subtotal Production	**0**	**2,201**	**50,361**	**102,008**	**154,570**
Proved Reserves Reported	0	5,270	152,156	152,825	310,251
Reserves Imputed for Reported Production Without Proved Reserves	0	3,384	198,723	200,927	403,034
Subtotal Proved Reserves	0	8,654	350,879	353,752	713,285
Weighted Subtotal Proved Reserves	**0**	**8,654**	**350,879**	**797,779**	**1,157,312**
Total Production in 1998	**1,713,617**	**117,566**	**57,809**	**102,008**	**1,991,000**
Total Proved Reserves as of 12/31/98	**18,819,341**	**1,002,225**	**414,655**	**797,779**	**21,034,000**

– = Not applicable.

Notes: Table 6 totals include imputed and estimated crude oil proved reserves rounded at the State/subdivision level. Field level data are reported volumes and may not balance due to submission of incomplete reserve component records.

Source: Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves,” 1998.

Table F5. Summary of Lease Condensate Used in Estimation Process, Form EIA-23
(Thousand Barrels of 42 U.S. Gallons)

Level of Reporting	Operator Category I	II	Certainty III	Non-certainty III	Total
Field Level Detail Report					
Proved Reserves as of 12/31/97	1,178,325	88,274	21	-	1,266,620
(+) Revision Increases	248,781	41,451	459	-	290,691
(–) Revision Decreases	241,057	17,871	0	-	258,928
(+) Extensions	74,077	6,101	0	-	80,178
(+) New Field Discoveries	32,310	3,753	0	-	36,063
(+) New Reservoirs in Old Fields	34,272	533	251	-	35,056
(–) Production With Reserves in 1998	156,528	15,826	233	-	172,587
Proved Reserves Reported as of 12/31/98	1,170,704	105,963	498	-	1,277,165
Production Without Proved Reserves	497	3,043	424	-	3,964
Reserves Imputed for Production Without Proved Reserves	3,081	19,270	2,638		24,989
Subtotal Production	**157,025**	**18,869**	**657**	**-**	**176,551**
Subtotal Proved Reserves 1998	**1,173,785**	**125,233**	**3,136**	**-**	**1,302,154**
State Level Reported and Imputed Data					
Production With Proved Reserves	0	0	452	202	654
Production Without Proved Reserves	0	36	663	735	1,434
Subtotal Production	0	36	1,115	937	2,088
Weighted Subtotal Production	**0**	**36**	**1,115**	**1,298**	**2,449**
Proved Reserves Reported	0	0	3,395	1,052	4,447
Reserves Imputed for Reported Production Without Proved Reserves	0	223	6,962	5,426	12,611
Subtotal Proved Reserves	0	223	10,357	6,478	17,058
Weighted Subtotal Proved Reserves	**0**	**223**	**10,357**	**23,266**	**33,846**
Total Production in 1998	**157,025**	**18,905**	**1,772**	**1,298**	**179,000**
Total Proved Reserves as of 12/31/98	**1,173,785**	**125,456**	**13,493**	**23,266**	**1,336,000**

– = Not applicable.
Notes: Table 15 totals include imputed and estimated lease condensate proved reserves rounded at the State/subdivision level. Field level data are reported volumes and may not balance due to submission of incomplete reserve component records.
Source: Form EIA-23, “Annual Survey of Domestic Oil and Gas Reserves,” 1998.

estimate the full noncertainty stratum when calculating reserves and production as previously described in the section "Total U.S. Reserves Estimates" in this appendix.

A year-end proved reserves estimate was imputed from reported production data in each case where an estimate was not provided by the respondent. The reported annual production was multiplied by a reserves-to-production (R/P) ratio (**Table F6**) characteristic of operators of similar size in the region where the properties were located. The regional R/P ratios in this report are averages calculated by dividing the mean of reported reserves by the mean of reported production for selected respondents of similar size who did report estimated reserves. A cutoff level for each region was determined based upon the largest Certainty operator that reported production, but did not provide a reserve estimate. Data from respondents whose production in a region exceeded the regional cutoff level was excluded from the R/P ratio calculation for that region. In addition, operators that had R/P ratios that exceeded 25 to 1 and Category I operators were excluded from the respondents selected to calculate the characteristic regional R/P ratio. All other respondents who reported both production and reserves were used to calculate the regional R/P ratio characteristic.

The R/P ratio varied significantly from region to region. This variation was presumably in response to variation in geologic conditions and the degree of development of crude oil and natural gas resources in each area. The average R/P ratio was computed for regional areas similar to the National Petroleum Council regional units (**Figure F1**). These units generally follow the boundaries of geologic provinces wherein the stage of resource development tends to be somewhat similar. **Table F6** lists the R/P ratio calculated for each region that required such imputations and the number of observations on which it was based.

The regional R/P ratio is determined primarily to provide a factor that can be applied to the production reported by operators without reserve estimates to provide an estimate of the reserves of these operators when aggregated to the regional level. The average R/P ratio, when multiplied by each individual production in the distribution of R,P pairs used to calculate it, will exactly reproduce the sum of the reported reserves in the distribution.

Imputation of Annual Changes to Proved Reserves by Component of Change

Category II and Category III operators that do not keep reserves data were not asked to provide estimates of beginning-of-year reserves or annual changes to proved reserves by component of change, i.e., revisions, extensions, and discoveries. When they did not provide estimates, these volumes were estimated by applying an algebraic allocation scheme which preserved the relative relationships between these items within each State/subdivision, as reported by Category I and Category II operators, and also preserved an exact annual reserves balance of the following form:

Table F6. Statistical Parameters of Reserve Estimation Equation by Region for 1998

Region Number	Region	Number of Nonzero R/P Pairs			Characteristic Multipliers		
		Oil	Gas	Lease Condensate	Oil	Gas	Lease Condensate
2	Pacific Coast States	17	16	3	[a]6.6	[a]8.0	[a]6.1
3	Western Rocky Mountains	44	52	13	6.9	10.4	[a]6.1
4	Northern Rocky Mountains	88	67	6	6.7	8.8	[a]6.1
5	West Texas and East New Mexico	196	200	50	7.0	7.1	6.5
6 + 6A	Western Gulf Basin and Gulf of Mexico	273	285	182	6.2	6.6	6.2
7	Mid-Continent	207	193	59	6.6	8.1	8.0
8 + 9	Michigan Basin and Eastern Interior	58	43	6	5.8	9.7	[a]6.1
10 + 11	Appalachians	17	47	1	[a]6.6	13.5	[a]6.1
	United States	900	903	320	6.6	8.0	6.1

[a]Multiplier of the U.S. national average is assumed. Effect of the multiplier on the related natural gas or lease condensate reserves estimate is negligible in these regions.

Source: Based on data filed on Form EIA-23,"Annual Survey of Domestic Oil and Gas Reserves, 1998".

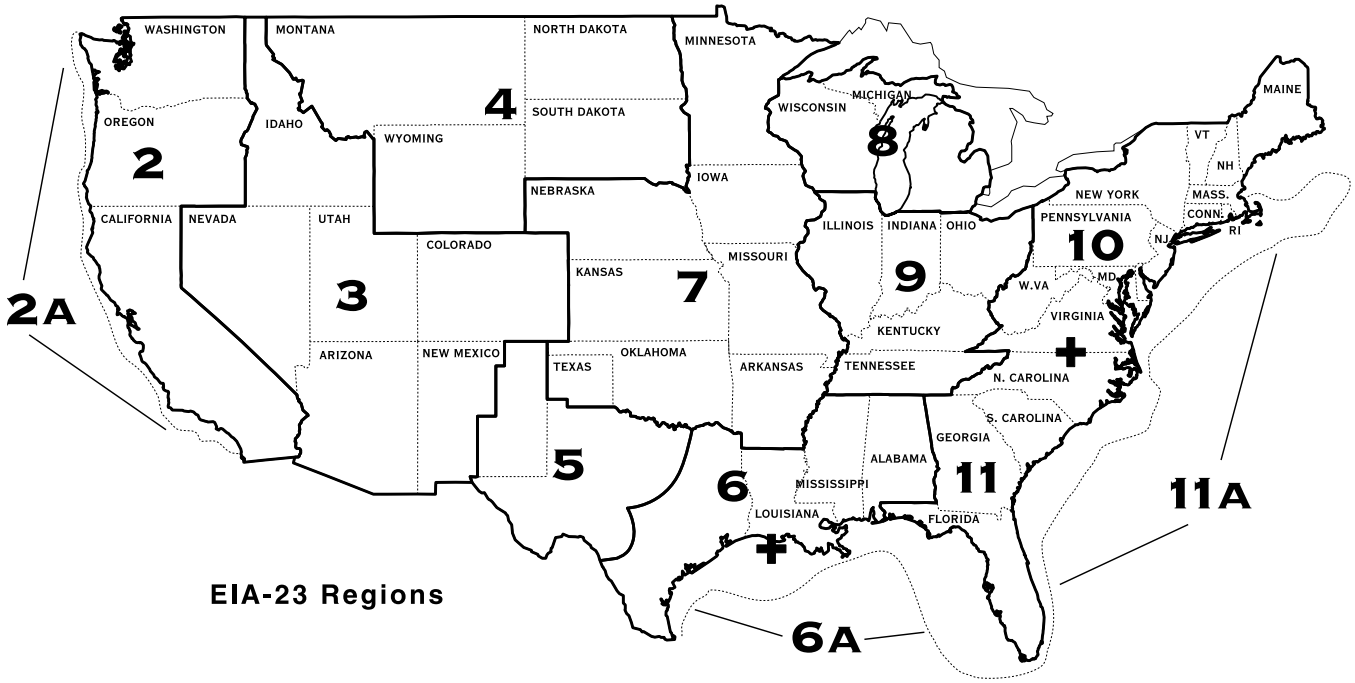
Published Proved Reserves at End of Previous Report Year
+ Adjustments
+ Revision Increases
– Revision Decreases
+ Extensions
+ New Field Discoveries
+ New Reservoir Discoveries in Old Fields
– Report Year Production
= Published Proved Reserves at End of Report Year

A ratio was calculated as the sum of the annual production and year-end proved reserves of those respondents who did not provide the reserves balance components, divided by the sum of year-end proved reserves and annual production of those respondents of similar size who did provide these quantities. This ratio was then multiplied by each of the reserves balance components reported by Category I and some Category II operators, to obtain imputed volumes for the reserves balances of the other Category II operators and Certainty and Noncertainty operators. These were then added to the State/subdivision totals.

Imputation of Natural Gas Type Volumes

Operators in the State/subdivision certainty and noncertainty strata were not asked to segregate their natural gas volumes by type of natural gas, i.e., nonassociated natural gas (NA) and associated-dissolved natural gas (AD). The total estimated year-end proved reserves of natural gas and the total annual production of natural gas reported by, or imputed to, operators in the State/subdivision certainty and noncertainty strata were, therefore, subdivided into the NA and AD categories, by State/subdivision, in the same proportion as was reported by Category I and Category II operators in the same area.

Figure F1. Form EIA-23 Regional Boundaries



Source: Energy Information Administration, Office of Oil and Gas.

Adjustments

The instructions for Schedule A of Form EIA-23 specify that, when reporting reserves balance data, the following arithmetic equation must hold:

Proved Reserves at End of Previous Year
+ Revision Increases
– Revision Decreases
+ Extensions
+ New Field Discoveries
+ New Reservoir Discoveries in Old Fields
– Report Year Production
= Proved Reserves at End of Report Year

Any remaining difference in the State/subdivision annual reserves balance between the published previous year-end proved reserves and current year-end proved reserves not accounted for by the imputed reserves changes was included in the adjustments for the area. One of the primary reasons that adjustments are necessary is the instability of the Noncertainty operators sampled each year. About 24 percent of the Noncertainty stratum operators sampled in 1997 were sampled again in 1998. There is no guarantee that in the smaller producing States/subdivision the same number of small operators will be selected each year, or that the operators selected will be of comparable sizes when paired with operators selected in a prior year. Thus, some instability of this stratum from year to year is unavoidable, resulting in minor adjustments.

Some of the adjustments are, however, more substantial, and could be required for any one or more of the following reasons:

- The frame coverage may or may not have improved between survey years, such that more or fewer Certainty operators were included in 1998 than in 1997.
- One or more operators may have reported data incorrectly on Schedule A in 1997 or 1998, but not both, and the error was not detected by edit processing.
- Operation of properties was transferred during 1998 from operators not in the frame or Noncertainty operators not selected for the sample to Certainty operators or Noncertainty operators selected for the sample.
- Operations of properties was transferred during 1998 to an operator with a different evaluation of the proved reserves associated with the properties than that of the 1997 operator.
- Respondent changed classification of natural gas from NA to AD or vice versa.
- The trend in reserve changes imputed for the small operators, that was based on the trend reported by the large operators, did not reflect the actual trend for the small operators.
- Noncertainty operators, who have grown substantially in size since they were added to the frame, occasionally cause a larger standard error than expected.
- The Noncertainty sample for either year in a state may have been an unusual one.

The causes of adjustments are known for some but not all areas. The only problems whose effects cannot be expected to balance over a period of several years are those associated with an inadequate frame or those associated with any actual trend in reserve changes for small operators not being the same as those for large operators. EIA continues to attempt to improve sources of operator data to resolve problems in frame completeness.

Sampling Reliability of the Estimates

The sample of Noncertainty operators selected is only one of the large number of possible samples that could have been selected and each would have resulted in different estimates. The standard error or sampling error of the estimates provides a measure of this variability. When probability sampling methods are used, as in the EIA-23 survey, the sampling error of estimates can also be estimated from the survey data.

The estimated sampling error can be used to compute a confidence interval around the survey estimate, with a prescribed degree of confidence that the interval covers the value that would have been obtained if all operators in the frame had been surveyed. If the estimated volume is denoted by $\hat{V}_s$ and its sampling error by S.E. ($\hat{V}_s$), the confidence interval can be expressed as:

$$\hat{V}_s \qquad k\,S.E.(\hat{V}_s)$$

where k is a multiple selected to provide the desired level of confidence. For this survey, k was taken equal to 2. Then there is approximately 95 percent confidence that the interval:

$$\hat{V}_s \qquad 2S.E.(\hat{V}_s)$$

includes the universe value, for both the estimates of reserves and production volumes. Correspondingly,

for approximately 95 percent of the estimates in this report, the difference between the published estimate and the value that would be found from a complete survey of all operators is expected to be less than twice the sampling error of the estimate. **Tables F7, F8, F9, and F10** provide estimates for 2S.E. ($\hat{V}_s$) by product. These estimates are directly applicable for constructing approximate 95 percent confidence intervals. For example, the 95 percent confidence interval for dry natural gas proved reserves is 165,146 575 billion cubic feet. The sampling error of $\hat{V}_s$ is equal to the sampling error of the noncertainty estimate $\hat{V}_{sr}$, because the certainty total is not subject to sampling error. The estimated sampling error of a noncertainty estimate is the square root of its estimated sampling variance.

Nonsampling Errors

Several sources of possible error, apart from sampling error, are associated with the Form EIA-23 survey. These include bias due to nonresponse of operators in the sample, proved reserve estimation errors, and reporting errors on the part of the respondents to the survey. On the part of EIA, possible errors include inadequate frame coverage, data processing error, and errors associated with statistical estimates. Each of these sources is discussed below. An estimate of the bias from nonresponse is presented in the section on adjustment for operator nonresponse.

Assessing the Accuracy of the Reserve Data

The EIA maintains an evaluation program to assess the accuracy and quality of proved reserve estimates gathered on Form EIA-23. Field teams consisting of petroleum engineers from EIA's Dallas Field Office conduct technical reviews of reserve estimates and independently estimate the proved reserves of a statistically selected sample of operator properties. The results of these reviews are used to evaluate the accuracy of reported reserve estimates. Operators are apprised of the team's findings to assist them in completing future filings. The magnitude of errors due to differences between reserve volumes submitted by operators on the Form EIA-23 and those estimated by EIA petroleum engineers on their field trips were generally within accepted professional engineering standards.

Respondent Estimation Errors

The principal data elements of the Form EIA-23 survey consist of respondent estimates of proved reserves of crude oil, natural gas, and lease condensate. Unavoidably, the respondents are bound to make some estimation errors, i.e., until a particular reservoir has been fully produced to its economic limit and abandoned, its reserves are not subject to direct measurement but must be inferred from limited, imperfect, or indirect evidence. A more complete discussion of the several techniques of estimating proved reserves, and the many problems inherent in the task, appears in Appendix G.

Reporting Errors and Data Processing Errors

Reporting errors on the part of respondents are of definite concern in a survey of the magnitude and complexity of the Form EIA-23 program. Several steps were taken by EIA to minimize and detect such problems. The survey instrument itself was carefully developed, and included a detailed set of instructions for filing data, subject to a common set of definitions similar to those already used by the industry. Editing software is continually developed to detect different kinds of probable reporting errors and flag them for resolution by analysts, either through confirmation of the data by the respondent or through submission of amendments to the filed data. Data processing errors, consisting primarily of random keypunch errors, are detected by the same software.

Imputation Errors

Some error, generally expected to be small, is an inevitable result of the various estimations outlined. These imputation errors have not yet been completely addressed by EIA and it is possible that estimation methods may be altered in future surveys. Nationally, 5.9 percent of the crude oil proved reserve estimates, 6.1 percent of the natural gas proved reserve estimates, and 0.7 percent of the lease condensate proved reserve estimates resulted from the imputation and estimation of reserves for those Certainty and Noncertainty operators who did not provide estimates for all of their properties, in combination with the expansion of the sample of Noncertainty operators to the full population. Errors for the latter were quantitatively calculated, as discussed in the previous section. Standard errors, for the former, would tend to cancel each other from operator to operator, and are, therefore, expected to be negligible, especially at the

Table F7. Factors for Confidence Intervals (2S.E.) for Dry Natural Gas Proved Reserves and Production, 1998 (Billion Cubic Feet at 14.73 psia and 60 Degrees Fahrenheit)

State and Subdivision	1998 Reserves	1998 Production	State and Subdivision	1998 Reserves	1998 Production
United States	1003	92	Oklahoma	930	84
Alabama	18	3	Pennsylvania	66	2
Alaska	0	0	Texas	173	3
Arkansas	14	2	RRC District 1	186	17
California	0	0	RRC District 2 Onshore	20	3
Coastal Region Onshore	0	0	RRC District 3 Onshore	65	8
Los Angeles Basin Onshore	0	0	RRC District 4 Onshore	31	4
San Joaquin Basin Onshore	27	3	RRC District 5	12	1
State Offshore	0	0	RRC District 6	16	1
Colorado	22	8	RRC District 7B	29	4
Florida	0	0	RRC District 7C	34	3
Kansas	239	30	RRC District 8	36	5
Kentucky	0	0	RRC District 8A	9	1
Louisiana	10	2	RRC District 9	37	5
North	11	2	RRC District 10	212	4
South Onshore	10	1	State Offshore	0	0
State Offshore	0	0	Utah	52	2
Michigan	0	0	Virginia	0	0
Mississippi	8	1	West Virginia	46	3
Montana	3	0	Wyoming	23	3
New Mexico	0	0	Federal Offshore[a]	0	0
East	0	0	Pacific (California)	0	0
West	0	0	Gulf of Mexico (Louisiana)[a]	0	0
New York	15	1	Gulf of Mexico (Texas)	0	0
North Dakota	0	0	Miscellaneous[b]	0	0
Ohio	104	11			

[a]Includes Federal offshore Alabama.
[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.
Notes: Confidence intervals are associated with Table 8 reserves and production data. Factors for confidence intervals for each State subdivision, State, and the United States are independently estimated and do not add.
Source: Factor estimates based on data filed on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," 1998 and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production," 1998.

Table F8. Factors for Confidence Intervals (2S.E.) for Natural Gas Proved Reserves and Production, Wet After Lease Separation, 1998 (Billion Cubic Feet at 14.73 psia and 60 Degrees Fahrenheit)

State and Subdivision	1998 Reserves	1998 Production	State and Subdivision	1998 Reserves	1998 Production
United States	1068	98	Oklahoma	990	89
Alabama	19	3	Pennsylvania	66	2
Alaska	0	0	Texas	192	3
Arkansas	28	3	RRC District 1	194	17
California	50	12	RRC District 2 Onshore	21	4
Coastal Region Onshore	0	0	RRC District 3 Onshore	69	9
Los Angeles Basin Onshore	3	0	RRC District 4 Onshore	32	4
San Joaquin Basin Onshore	28	3	RRC District 5	12	1
State Offshore	0	0	RRC District 6	17	1
Colorado	25	9	RRC District 7B	34	5
Florida	0	0	RRC District 7C	38	3
Kansas	257	32	RRC District 8	41	6
Kentucky	0	0	RRC District 8A	13	1
Louisiana	11	2	RRC District 9	44	6
North	11	2	RRC District 10	235	4
South Onshore	11	2	State Offshore	0	0
State Offshore	0	0	Utah	55	2
Michigan	0	0	Virginia	0	0
Mississippi	8	1	West Virginia	47	3
Montana	3	0	Wyoming	24	3
New Mexico	0	0	Federal Offshore[a]	0	0
East	0	0	Pacific (California)	0	0
West	0	0	Gulf of Mexico (Louisiana)[a]	0	0
New York	15	1	Gulf of Mexico (Texas)	0	0
North Dakota	12	1	Miscellaneous[b]	0	0
Ohio	104	11			

[a]Includes Federal offshore Alabama.
[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.
Notes: Confidence intervals are associated with Table 9 reserves and production data. Factors for confidence intervals for each State subdivision, State, and the United States are independently estimated and do not add.
Source: Factor estimates based on data filed on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," 1998.

Table F9. Factors for Confidence Intervals (2S.E.) for Crude Oil Proved Reserves and Production, 1998
(Million Barrels of 42 U.S. Gallons)

State and Subdivision	1998 Reserves	1998 Production	State and Subdivision	1998 Reserves	1998 Production
United States	102	10	North Dakota	1	0
Alabama	2	0	Ohio	11	1
Alaska	0	0	Oklahoma	47	7
Arkansas	1	0	Pennsylvania	1	0
California	0	0	Texas	10	2
Coastal Region Onshore	0	0	RRC District 1	14	1
Los Angeles Basin Onshore	0	0	RRC District 2 Onshore	0	0
San Joaquin Basin Onshore	0	0	RRC District 3 Onshore	4	1
State Offshore	0	0	RRC District 4 Onshore	1	0
Colorado	15	2	RRC District 5	1	0
Florida	0	0	RRC District 6	4	1
Illinois	5	1	RRC District 7B	4	1
Indiana	3	1	RRC District 7C	3	0
Kansas	57	7	RRC District 8	50	1
Kentucky	11	0	RRC District 8A	22	2
Louisiana	7	1	RRC District 9	10	1
North	7	1	RRC District 10	13	2
South Onshore	5	1	State Offshore	0	0
State Offshore	0	0	Utah	13	0
Michigan	1	0	West Virginia	0	0
Mississippi	11	1	Wyoming	33	0
Montana	1	0	Federal Offshore	0	0
Nebraska	3	0	Pacific (California)	0	0
New Mexico	0	0	Gulf of Mexico (Louisiana)	0	0
East	0	0	Gulf of Mexico (Texas)	0	0
West	0	0	Miscellaneous[a]	3	0

[a]Includes Arizona, Missouri, Nevada, New York, South Dakota, Tennessee, and Virginia.

Notes: Confidence intervals are associated with Table 6 reserves and production data. Factors for confidence intervals for each State subdivision, State, and the United States are independently estimated and do not add.

Source: Factor estimates based on data filed on Form EI-23, "Annual Survey of Domestic Oil and Gas Reserves," 1998.

Table F10. Factors for Confidence Intervals (2S.E.) for Lease Condensate Proved Reserves and Production, 1998 (Million Barrels of 42 U.S. Gallons)

State and Subdivision	1998 Reserves	1998 Production	State and Subdivision	1998 Reserves	1998 Production
United States	6	1	North Dakota	0	0
Alabama	0	0	Oklahoma	5	1
Alaska	0	0	Texas	1	0
Arkansas	0	0	RRC District 1	0	0
California	0	0	RRC District 2 Onshore	1	0
Coastal Region Onshore	0	0	RRC District 3 Onshore	4	1
Los Angeles Basin Onshore	0	0	RRC District 4 Onshore	1	0
San Joaquin Basin Onshore	0	0	RRC District 5	0	0
State Offshore	0	0	RRC District 6	0	0
Colorado	0	0	RRC District 7B	0	0
Florida	0	0	RRC District 7C	0	0
Kansas	1	0	RRC District 8	0	0
Kentucky	0	0	RRC District 8A	0	0
Louisiana	0	0	RRC District 9	0	0
North	0	0	RRC District 10	1	0
South Onshore	1	0	State Offshore	0	0
State Offshore	0	0	Utah and Wyoming	0	0
Michigan	0	0	West Virginia	0	0
Mississippi	0	0	Federal Offshore[a]	0	0
Montana	0	0	Pacific (California)	0	0
New Mexico	0	0	Gulf of Mexico (Louisiana)[a]	0	0
East	0	0	Gulf of Mexico (Texas)	0	0
West	0	0	Miscellaneous[b]	0	0

[a]Includes Federal offshore Alabama.

[b]Includes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, New York, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, and Virginia.

Notes: Confidence intervals are associated with Table 15 reserves and production data. Factors for confidence intervals for each State subdivision, State, and the United States are independently estimated and do not add.

Source: Factor estimates based on data filed on Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," 1998.

National level of aggregation. In States where a large share of total reserves is accounted for by Category III and smaller Category II operators, the errors are expected to be somewhat larger than in States where a large share of total reserves is accounted for by Category I and larger Category II operators.

Frame Coverage Errors

Of all the sources of controllable error connected with the Form EIA-23 survey, errors in the operator frame were expected to be the most important. If the frame does not list all operators in a given State, the sample selected from the frame for the State will not represent the entire operator population, a condition called undercoverage. Undercoverage is a problem with certain States, but it does not appear to be a problem with respect to the National proved reserve estimates for either crude oil or natural gas. While it is relatively straightforward to use existing sources to identify large operators and find addresses for them, such is not the case for small operators. A frame such as that used in the 1998 survey is particularly likely to be deficient in States where a large portion of total reserves and production is accounted for by small operators. These States are not likely to allocate sufficient resources to keep track of all operators on a current basis. Some undercoverage of this type seems to exist, particularly, with reference to natural gas operators. EIA is continuing to work to remedy the undercoverage problem in those States where it occurred.

Calculation of Reserves of Natural Gas Liquids and Dry Natural Gas

Natural Gas Liquids Reserve Balance

The published reserves, production, and reserves change statistics for crude oil, lease condensate, and natural gas, wet after lease separation, were derived from the data reported on Form EIA-23 and the application of the imputation methods discussed previously. The information collected on Form EIA-64A was then utilized in converting the estimates of the wet natural gas reserves into two components: plant liquids reserve data and dry natural gas reserve data. The total natural gas liquids reserve estimates presented in **Table 14** were computed as the sum of plant liquids estimates (**Table 15**) and lease condensate (**Table 16**) estimates.

To generate estimates for each element in the reserves balance for plant liquids in a given producing area, the first step was to group all natural gas processing plants that reported this area as an area-of-origin on their Form EIA-64A, and then sum the liquids production attributed to this area over all respondents. Next, the ratio of the liquids production to the total wet natural gas production for the area was determined. This ratio represented the percentage of the wet natural gas that was recovered as natural gas liquids. Finally, it was assumed that this ratio was applicable to the reserves and each component of reserve changes (except adjustments), as well as production. Therefore, each element in the wet natural gas reserves balance was multiplied by this recovery factor to yield the corresponding estimate for plant liquids. Adjustments of natural gas liquids were set equal to the difference between the end of previous year reserve estimates, based upon the current report year Form EIA-23 and Form EIA-64A surveys, and the end of current year reserve estimates published in the preceding year's annual reserves report.

Natural Gas Reserve Balance

This procedure involved downward adjustments of the natural gas data, wet after lease separation, in estimating the volumes of natural gas on a fully dry basis. These reductions were based on estimates of the gaseous equivalents of the liquids removed (in the case of production), or expected to be removed (in the case of reserves), from the natural gas stream at natural gas processing plants. Form EIA-64A collected the volumetric reduction, or **shrinkage**, of the input natural gas stream that resulted from the removal of the NGL at each natural gas processing plant.

The shrinkage volume was then allocated to the plant's reported area or areas of origin. Because shrinkage is, by definition, roughly in proportion to the NGL recovered, i.e. the NGL produced, the allocation was in proportion to the reported NGL volumes for each area of origin. However, these derived shrinkage volumes were rejected if the ratio between the shrinkage and the NGL production (gas equivalents ratio) fell outside certain limits of physical accuracy. The ratio was expected to range between 1,558 cubic feet per barrel (where NGL consists primarily of ethane) and 900 cubic feet per barrel (where NGL consists primarily of natural gasolines). When the computed gas equivalents ratio fell outside these limits, an imputed ratio was utilized to estimate the plant's natural gas shrinkage allocation to each reported area of origin.

This imputed ratio was that calculated for the aggregate of all other plants reporting production and shrinkage, and having a gas equivalent ratio within the aforesaid limits, from the area in question. The imputed area ratio was applied only if there were at least five plants to base its computation on. If there were less than five plants, the imputed ratio was calculated based on all plants in the survey whose individual gas equivalents ratio was within the acceptable limits. Less than one percent of the liquids production was associated with shrinkage volumes imputed in this manner. Based on the 1998 Form EIA-64A survey, the national weighted average gas equivalents ratio was computed to be 1,404 cubic feet of natural gas shrinkage per barrel of NGL recovered. The total shrinkage volume (reported plus imputed) for all plants reporting a given area of origin was then subtracted from the estimated value of natural gas production, wet after lease separation, yielding dry natural gas production for the area. The amount of the reduction in the wet natural gas production was then expressed as a percentage of the wet natural gas production. Dry natural gas reserves and reserve changes were determined by reducing the wet natural gas reserves and reserve changes by the same percentage reduction factor.

A further refinement of the estimation process was used to generate an estimate of the natural gas liquids reserves in those States with coalbed methane fields. The States where this procedure was applied were Alabama, Colorado, Kansas, New Mexico, Oklahoma, Pennsylvania, Utah, Virginia, West Virginia, and Wyoming. The first step in the process was to identify all Form EIA-23 reported coalbed methane fields. The assumption was made that coalbed methane fields contained little or no extractable natural gas liquids. Therefore, when the normal shrinkage procedure was applied to the wet gas volume reserve components, the estimate of State coalbed methane volumes were excluded and were not reduced for liquid extraction. Following the computation for shrinkage, each coalbed field gas volume reserve components was added back to each of the dry gas volume reserve components in a State. The effect of this is that the large increases in reserves in some States from coalbed methane fields did not cause corresponding increases in the State natural gas liquids proved reserves.

Adjustments of dry natural gas were set equal to the difference between the end of previous year reserves estimates, based upon the current report year Form EIA-23 and Form EIA-64A surveys, and the end of current year reserve estimates published in the preceding year's annual reserves report.

Each estimate of end of year reserves and report year production has associated with it an estimated sampling error. The standard errors for dry natural gas were computed by multiplying the wet natural gas standard errors by these same percentage reduction factors. **Table F7** provides estimates for 2 times the $S.E.(\hat{V}_s)$ for dry natural gas.

Appendix G

Estimation of Reserves and Resources

Appendix G

Estimation of Reserves and Resources

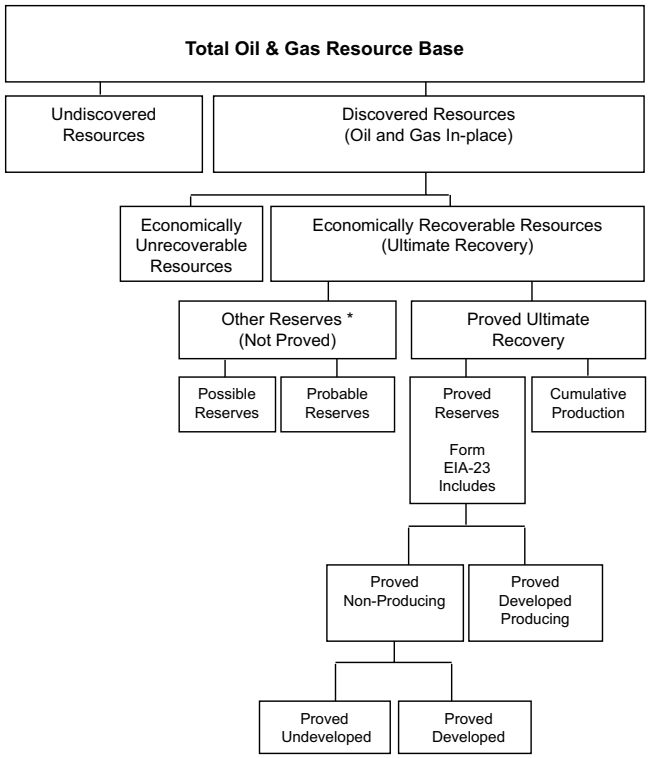
Oil and Gas Resource Base

Universally accepted definitions have not been developed for the many terms used by geologists, engineers, accountants and others to denote various components of overall oil and gas resources. In part, this is because most of these terms describe estimated and therefore uncertain, rather than measured, quantities. The lack of standardized terminology sometimes leads to inaccurate understanding of the meaning and/or import of estimates. Particularly common is an apparently widespread lack of understanding of the substantial difference between the terms "reserves" and "resources", as indicated by the frequent misuse of either term in place of the other.

The total resource base of oil and gas is the entire volume formed and trapped in–place within the Earth before any production. The largest portion of this total resource base is nonrecoverable by current or foreseeable technology. Most of the nonrecoverable volume occurs at very low concentrations throughout the earth's crust and cannot be extracted short of mining the rock or the application of some other approach that would consume more energy than it produced. An additional portion of the total resource base cannot be recovered because currently available production techniques cannot extract all of the in–place oil and gas even when present in commercial concentrations. The inability to recover all of the in–place oil and gas from a producible deposit occurs because of unfavorable economics, intractable physical forces, or a combination of both. Recoverable resources, the subset of the total resource base that is of societal and economic interest, are defined so as to exclude these nonrecoverable portions of the total resource base.

The structure presented in **Figure G1** outlines the total resource base and its components. The total resource base first consists of the recoverable and nonrecoverable portions discussed above. The next level down divides recoverable resources into discovered and undiscovered segments. Discovered resources are further separated into cumulative (i.e., all past) production, and reserves. Reserves are additionally subdivided into proved reserves and "other reserves".

Figure G1. Components of the Oil and Gas Resource Base



[1]Of the numerous other reserve classifications, only "Indicated Additional" reserves are included in this report.

Source: Energy Information Administration, Office of Oil and Gas.

Recoverable Resources

Discovered recoverable resources are those economically recoverable quantities of oil and gas for which specific locations are known. While the specific locations of estimated undiscovered recoverable resources are not yet known, they are believed to exist in geologically favorable settings.

Current estimates of undiscovered recoverable resources merit discussion in order to provide a useful sense of scale relative to proved reserves. The sources of official estimates of domestic undiscovered recoverable resources are two agencies of the Department of the Interior (DOI), the United States Geological Survey (USGS) for onshore areas and those offshore waters subject to State jurisdiction, and the Minerals Management Service (MMS) for those offshore waters under Federal jurisdiction.

The USGS defines undiscovered recoverable conventional resources as those expected to be resident in accumulations of sufficient size and quality that they could be produced using conventional recovery technologies, without regard to present economic viability. Therefore, only part of the USGS undiscovered recoverable conventional resource is economically recoverable now. The USGS also defines a class of resources that occur in "continuous–type" accumulations. Unlike conventional oil and gas accumulations, continuous–type accumulations do not occur in discrete reservoirs of limited areal extent. They include accumulations in low–permeability (tight) sandstones, shales, and chalks, and those in coal beds. Again, only part of the continuous–type technically recoverable resource is economically recoverable now. In fact, only a small portion of the in–place continuous–type resource accumulations are estimated to be technically recoverable now. **Table G1** presents the latest available USGS and MMS estimates, along with the EIA 1997 proved reserves estimates.

Technically recoverable resources of wet natural gas (discovered, both proved and unproved, and undiscovered) are estimated at 1,341 trillion cubic feet (**Table G1**). Subtracting U.S. proved reserves of 175 trillion cubic feet yields an unproven technically recoverable resource target of 1,166 trillion cubic feet. This is about 61 times the 1997 gas production level.

Other organizations have also estimated unproven technically recoverable gas resources. For example, the Potential Gas Committee (PGC), an industry sponsored group, provides detailed geology–based gas resource estimates every 2 years. In 1996 the PGC mean estimate of potential gas resources was 1,067 trillion cubic feet, about 99 trillion cubic feet less than the DOI estimates in **Table G1**. Another recent estimate was made by the National Petroleum Council (NPC), an industry–based group that serves in an advisory capacity to the U.S. Secretary of Energy. The NPC's estimate, based on data available at year–end 1990, was 1,135 trillion cubic feet, 111 trillion cubic feet less than the DOI estimates summarized in **Table G1**. The differences among these estimates are usually due to the availability of newer data, the differences in coverage or resource category definitions, and to legitimate but differing data interpretations. The USGS estimates of reserve growth in known fields are much larger than previous estimates due to the utilization of newer EIA reserves growth data.

While the estimation of undiscovered resources is certainly a more imprecise endeavor than is the estimation of proved reserves, it is clear that substantial volumes of technically recoverable oil and gas resources remain to be found and produced domestically. Current estimates indicate that as much domestic gas remains to be found and then produced as has been to date. Of course, much effort, investment and time will be required to bring this gas to market.

There is a perception that the oil resource base has been more intensively developed than the gas resource base. And in fact, more oil has been produced in the United States than is estimated as remaining recoverable. Nevertheless, the ratio of 1996 unproven technically recoverable oil resources to oil production (**Table G1**) was about 62 to 1, higher than the comparable gas ratio.

Discovered Resources

In addition to cumulative production, which is the sum of current year production and the production in all prior years, estimates of discovered recoverable resources include estimates of reserves. Broadly, reserves are those volumes that are believed to be recoverable in the future from known deposits through the eventual application of present or anticipated technology.

Reserves

Reserves include both **proved reserves** and **other reserves**. Several different reserve classification systems are in use by different organizations, as preferred for operational reasons. These systems utilize and incorporate various definitions of terms such as *measured reserves*, *indicated reserves*, *inferred reserves*, *probable reserves*, and *possible reserves*. As used by the different organizations, the definitions that attach to these terms sometimes overlap, or the terms may require a slightly different interpretation from one organization to the next. Nevertheless, all kinds of "other reserves" are generally less well known and therefore less precisely quantifiable than proved reserves, and their eventual recovery is less assured.

Table G1. Estimated Oil and Gas Reserves and Mean Estimates of Technically Recoverable Oil and Gas Resources

Categories	Crude Oil[a] (million barrels)	Natural Gas (Dry) (billion cubic feet)	Natural Gas Liquids (million barrels)
Lower 48 States			
Discovered			
Proved Reserves (EIA, 1998)	15,982	[b]154,114	7,204
Reserve Growth - conventional, onshore[c] (USGS, 1991)	[d]47,000	290,000	12,900
Reserve Growth - conventional, Federal Offshore (MMS, 1995)	[e]2,238	[e]32,719	NE
Unproved Reserves, Federal Offshore (MMS, 1996)	1,643	4,436	NE
Undiscovered, Technically Recoverable			
Conventional, onshore[c] (USGS, 1993)	21,810	190,280	6,080
Continuous-type - sandstone, shale, chalk; onshore[c] (USGS, 1993)	2,066	308,080	2,119
Continuous-type - coalbeds, onshore[c] (USGS, 1993)	NA	49,910	NA
Federal Offshore - conventional (MMS, 1994)	21,300	142,100	[f]<1,800
Subtotal	**112,039**	**1,171,639**	**NA**
Alaska			
Discovered			
Proved Reserves (EIA, 1998)	5,052	9,927	320
Reserve Growth - conventional, onshore[c] (USGS, 1991)	[g]13,000	32,000	500
Reserve Growth conventional, Federal Offshore (MMS, 1994)	0	0	NE
Unproved Reserves, Federal Offshore (MMS, 1994)	400	700	NE
Undiscovered, Technically Recoverable			
Conventional onshore[c] (USGS, 1993)	8,440	68,410	1,120
Continuous-type - sandstone, shale, chalk; onshore[c] (USGS, 1993)	NE	NE	NE
Continuous-type - coalbeds, onshore[c] (USGS, 1993)	NA	NE	NA
Federal Offshore - conventional (MMS, 1994)	24,300	125,900	[f]<1,800
Subtotal	**51,192**	**236,937**	**NA**
Total Lower 48 States and Alaska	**163,231**	**1,408,576**	**32,043**
Deductions for Production and Proved Reserves Changes, 1991-1998	**-10,778**	**-107,646**	**-5,251**
U.S. Total, 1998	**152,453**	**1,330,930**	**26,792**

[a] Condensate is included with crude oil for MMS estimates in Federal Offshore regions.
[b] Includes 12,179 billion cubic feet of coalbed methane (EIA, 1998).
[c] Includes USGS estimates for all onshore plus State Offshore (near-shore and shallow-water areas under State jurisdiction).
[d] Using USGS definition, 1,924 million barrels of indicated additional oil reserves in the lower 48 States were included (EIA, 1996).
[e] Reserve growth in the Pacific Federal offshore is not included and was not estimated by the MMS. This volume is not dry gas, but wet, after lease separation.
[f] Total undiscovered natural gas liquids for Federal offshore are 1,800 million barrels; MMS source did not separate lower 48 and Alaska estimates of undiscovered natural gas liquids (1986).
[g] Using USGS definition, 952 million barrels of indicated additional oil reserves in Alaska were included (EIA, 1996).

NE = not estimated.
NA = not applicable.

Notes: Federal Offshore indicates MMS estimates for Federal Offshore jurisdictions (Outer Continental Shelf and deeper water areas seaward of State Offshore). Energy Information Administration (EIA), onshore and offshore estimated reserves. U.S. Geological Survey (USGS): 1995 National Assessment mean estimates as of the end of 1993 (onshore and State Offshore). Minerals Management Service (MMS): 1996 National Assessment mean estimates as of the end of 1994. The MMS also has end-1994 estimates for economically recoverable resources. Probable and Possible reserves are considered by USGS definition to be part of USGS Reserve Growth, but are separately considered by the MMS as its Unproved Reserves term. The USGS did not set a time limit for the duration of Reserve Growth; the MMS set the year 2020 as the time limit in its estimates of Reserve Growth in existing fields of the Gulf of Mexico. Excluded from the estimates are undiscovered oil resources in tar deposits and oil shales, and undiscovered gas resources in geopressured brines and gas hydrates.

Sources: Energy Information Administration, Office of Oil and Gas; USGS and MMS - *Estimates of Undiscovered Conventional Oil and Gas Resources in the United States—A Part of the Nation's Energy Endowment* (1989), U.S. Department of the Interior; *1995 National Assessment of United States Oil and Gas Resources*, USGS Circular 1118, U.S. Department of the Interior; and *An Assessment of the Undiscovered Hydrocarbon Potential of the Nation's Outer Continental Shelf* (1996), U.S. Department of the Interior.

Measured reserves are defined by the USGS as that part of the identified (i.e., discovered) economically recoverable resource that is estimated from geologic evidence and supported directly by engineering data.{41} They are similarly defined by the MMS, although its system also subdivides them by degree of development and producing status.{42} Measured reserves are demonstrated with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions, and are essentially equivalent to proved reserves as defined by the EIA. Effectively, estimates of proved reserves may be thought of as reasonable estimates (as opposed to exact measures) of "on–the–shelf inventory".

Inferred reserves and indicated reserves, due to their more uncertain economic or technical recoverability, are included in the "other reserves" category. The USGS defines inferred reserves as that part of the identified economically recoverable resource, over and above both measured and indicated (see below) reserves, that will be added to proved reserves in the future through extensions, revisions, and the discovery of new pay zones in already discovered fields.{41} Inferred reserves are considered equivalent to "probable reserves" by many analysts, for example, those of the PGC.

Indicated additional reserves, a separate category, are defined by both the DOI and the EIA as quantities of crude oil that may become economically recoverable in the future from existing productive reservoirs through the application of currently available but as–yet uninstalled recovery technology. At such time as the technology is successfully applied, indicated additional reserves are reclassified to the proved reserves category. Of all the various "other reserves" categories, only indicated additional reserves are estimated by the EIA and reported herein.

Proved Reserves

The EIA defines proved reserves as those volumes of oil and gas that geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

When deterministic proved reserves estimation methods are used, the term reasonable certainty is intended to express a high degree of confidence that the estimated quantities will be recovered. When probabilistic methods are used there should be at least a 90 percent probability that the actual quantities recovered will exceed the estimate.

Proved reserves are either proved producing or proved nonproducing (i.e., resident in reservoirs that did not produce during the report year). The latter may represent a substantial fraction of total proved reserves.

Reserve Estimation Methodologies

The adoption of a standard definition of proved reserves for each type of hydrocarbon surveyed by the Form EIA–23 program provided a far more consistent response from operators than if each operator had used their own definition. Such standards, however, do not guarantee that the resulting estimates themselves are determinate. Regardless of the definition selected, proved reserves cannot be measured directly. They are estimated quantities that are inferred on the basis of the best geological, engineering, and economic data available to the estimator, who generally uses considerable judgment in the analysis and interpretation of the data. Consequently, the accuracy of a given estimate varies with and depends on the quality and quantity of raw data available, the estimation method used, and the training and experience of the estimator. The element of judgment commonly accounts for the differences among independent estimates for the same reservoir or field.

Data Used in Making Reserve Estimates

The raw data used in estimating proved reserves include the engineering and geological data for reservoir rock and its fluid content. These data are obtained from direct and indirect measurements. The data available for a given reservoir vary in kind, quality, and quantity. When a reservoir is first discovered only data from a single well are available, and prior to flow testing or actual production, proved reserves can only be inferred. As development of the reservoir proceeds, and flow tests are made or actual production commences, more and more data become available, enabling proved reserves estimates to become more accurate.

Many different kinds of data are useful in making reserves estimates. They may include: data on porosity, permeability, and fluid saturations of the reservoir

rocks (obtained directly from core analysis or from various types of electrical measurements taken in a well or several wells); data on the production of fluids from a well or several wells; geologic maps of the areal extent, thickness, and continuity of the reservoir rocks (inferred from well logs, geophysical, and geological data); and reservoir pressure and temperature data. Also involved are economic data including the current price of crude oil and natural gas, and various developmental and operating costs.

Reserve Estimation Techniques

Depending on the kinds and amounts of data available, and a judgment on the reliability of those data, the estimator will select one of several methods of making a proved reserves estimate. Methods based on production performance data are generally more accurate than those based strictly on inference from geological and engineering data. Such methods include the *Production Decline* method (for crude oil or natural gas reservoirs), the *Material Balance* method (for crude oil reservoirs), the *Pressure Decline* method (which is actually a material balance, for natural gas reservoirs), and the *Reservoir Simulation* method (for crude oil or natural gas reservoirs). The reservoir type and production mechanisms and the types and amounts of reliable data available determine which of these methods is more appropriate for a given reservoir. These methods are of comparable accuracy.

Methods not based upon production data include the *Volumetric* method (for crude oil or natural gas reservoirs) and the *Nominal* method. Of these, the *Volumetric* method is the more accurate. Both methods, however, are less accurate than those based on production data. **Table G2** summarizes the various methods.

Table G2. Reserve Estimation Techniques

Method	Comments
Volumetric	Applies to crude oil and natural gas reservoirs. Based on raw engineering and geologic data.
Material Balance	Applies to crude oil and natural gas reservoirs. Is used in estimating reserves. Usually of more value in predicting reserves, and reservoir performance.
Pressure Decline	Applies to nonassociated and associated gas reservoirs. The method is a special case of material balance equation in the absence of water influx.
Production Decline	Applies to crude oil and natural gas reservoirs during production decline (usually in the later stages of reservoir life).
Reservoir Simulation	Applies to crude oil and natural gas reservoirs. Is used in estimating reserves. Usually of more value in predicting reservoir performance. Accuracy increases when matched with past pressure and production data.
Nominal	Applied to crude oil and natural gas reservoirs. Based on rule of thumb or analogy with another reservoir or reservoirs believed to be similar; least accurate of methods used.

Judgmental Factors in Reserve Estimation

The determination of rock and hydrocarbon fluid properties involves judgment and is subject to some uncertainty; however, the construction of the geologic maps and cross sections and the determination of the size of the reservoir are the major judgmental steps in the *Volumetric* method, and are subject to the greatest uncertainty. Estimates made using the *Material Balance* method, the *Reservoir Simulation* method, or the *Pressure Decline* method are based on the estimator's judgment that the type of reservoir drive mechanism has been identified and on the specification of abandonment conditions. Estimates based on the *Production Decline* method are subject to judgment in constructing the trend line, and are based on the estimator's assumption of reservoir performance through abandonment.

Contributing to the degree of uncertainty inherent in the above methods for estimating reserves are other factors associated with economic considerations and the perceived reservoir limits, which together influence the final reserves estimate. A brief discussion of these other factors follows.

Economic considerations: There has been continuing debate about the effects of prices on proved reserves. Although no all–inclusive statement can be made on the impact of price, the points at issue can be discussed and some general remarks can be made about some circumstances where price may be a factor.

- *Developed gas fields* – In a gas reservoir, price affects the economic limit (i.e., the production rate required to meet operating costs) and, therefore, the abandonment pressure. Thus, price change has some effect on the conversion of

noneconomic hydrocarbon resources to the category of proved reserves. In both nearly depleted reservoirs and newly developed reservoirs, the actual increase in the quantity of proved reserves resulting from price rises is generally limited in terms of national volumes (even though the percentage increase for a given reservoir may be great).

- *Developed oil fields* – In developed crude oil reservoirs many of the same comments apply; however, there is an additional consideration. If the price is raised to a level sufficient to justify initiation of an improved recovery project, and if the improved recovery technique is effective, then the addition to ultimate recovery from the reservoir can be significant. Because of the speculative nature of predicting prices and costs many years into the future, proved reserves are estimated on the basis of current prices, costs, and operating practices in effect as of the date the estimation was made.

- *Successful exploration efforts* – Price can have a major impact on whether a new discovery is produced or abandoned. For example, the decision to set casing in a new onshore discovery, or to install a platform as the result of an offshore discovery, are both price–sensitive. If the decision is made to set pipe or to install a platform, the discoveries in both cases will add to the proved reserves total. If such projects are abandoned, they will make no contribution to the proved reserves total.

Effect of operating conditions: Operating conditions are subject to change caused by changes in economic conditions, unforeseen production problems, new production practices or methods, and the operator's financial position. As with economic conditions, operating conditions to be expected at the time of abandonment are speculative. Thus, current operating conditions are used in estimating proved reserves. In considering the effect of operating conditions, a distinction must be made between processes and techniques that would normally be applied by a prudent operator in producing his oil and gas, and initiation of changes in operating conditions that would require substantial new investment.

- *Compression* – Compression facilities are normally installed when the productive capacity or deliverability of a natural gas reservoir or its individual wells declines. In other cases compression is used in producing shallow, low–pressure reservoirs or reservoirs in which the pressure has declined to a level too low for the gas to flow into a higher pressure pipeline. The application of compression increases the pressure and, when economical, is used to make production into the higher pressure pipeline possible. Compression facilities normally require a significant investment and result in a change in operating conditions. It increases the proved reserves of a reservoir, and reasonably accurate estimates of the increase can be made.

- *Well stimulation* – Procedures that increase productive capacity (workovers, such as acidizing or fracturing, and other types of production practices) are routine field operations. The procedures accelerate the rate of production from the reservoir, or extend its life, and they have only small effect on proved reserves. Reasonable estimates of their effectiveness can be made.

- *Improved recovery techniques* – These techniques involve the injection of a fluid or fluids into a reservoir to augment natural reservoir energy. Because the response of a given reservoir to the application of an improved recovery technique cannot be accurately predicted, crude oil production that may ultimately result from the application of these techniques is classified as "indicated additional reserves of crude oil" rather than as proved reserves until response of the reservoir to the technique has been demonstrated. In addition, improved recovery methods are not applicable to all crude oil reservoirs. Initiation of improved recovery techniques may require significant investment.

- *Infill drilling* – Infill drilling (drilling of additional wells within a field/reservoir) may result in a higher recovery factor, and, therefore, be economically justified. Predictions of whether infill drilling will be justified under current economic conditions are generally based on the expected production behavior of the infill wells.

Reservoir limits: The initial proved reserves estimate made from the discovery well is subject to significant uncertainty because one well provides little information on the size of the reservoir. The area proved by a discovery well is frequently estimated on the basis of experience in a given producing region. Where there is continuity of the producing formation over wide geographic areas, a relatively large proved area may be assigned. In some cases where reliable geophysical and geological data are available, a reasonable estimate of the extent of the reservoir can be made by drilling a relatively small number of delineation wells. Conversely, a relatively small proved area may be assigned when the producing

formation is of limited continuity, owing to either structural or lithological factors.

Additional wells provide more information and reduce the uncertainty of the reserves estimate. As additional wells are drilled, the geometry of the reservoir and, consequently, its bulk volume, become more clearly defined. This process accounts for the large extensions to proved reserves typical of the early stages of most reservoir development.

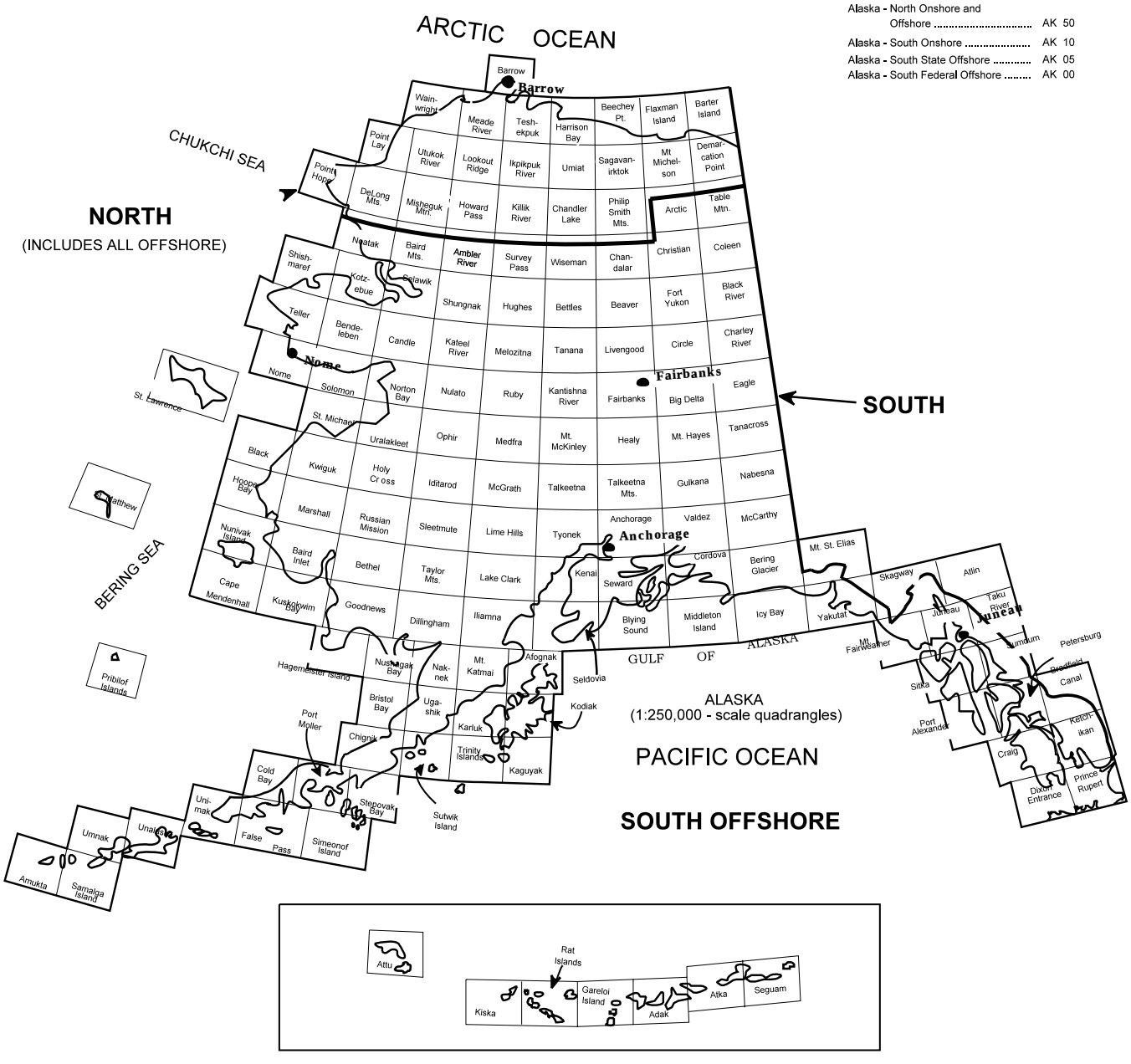
Appendix H

Maps of Selected State Subdivisions

Appendix H

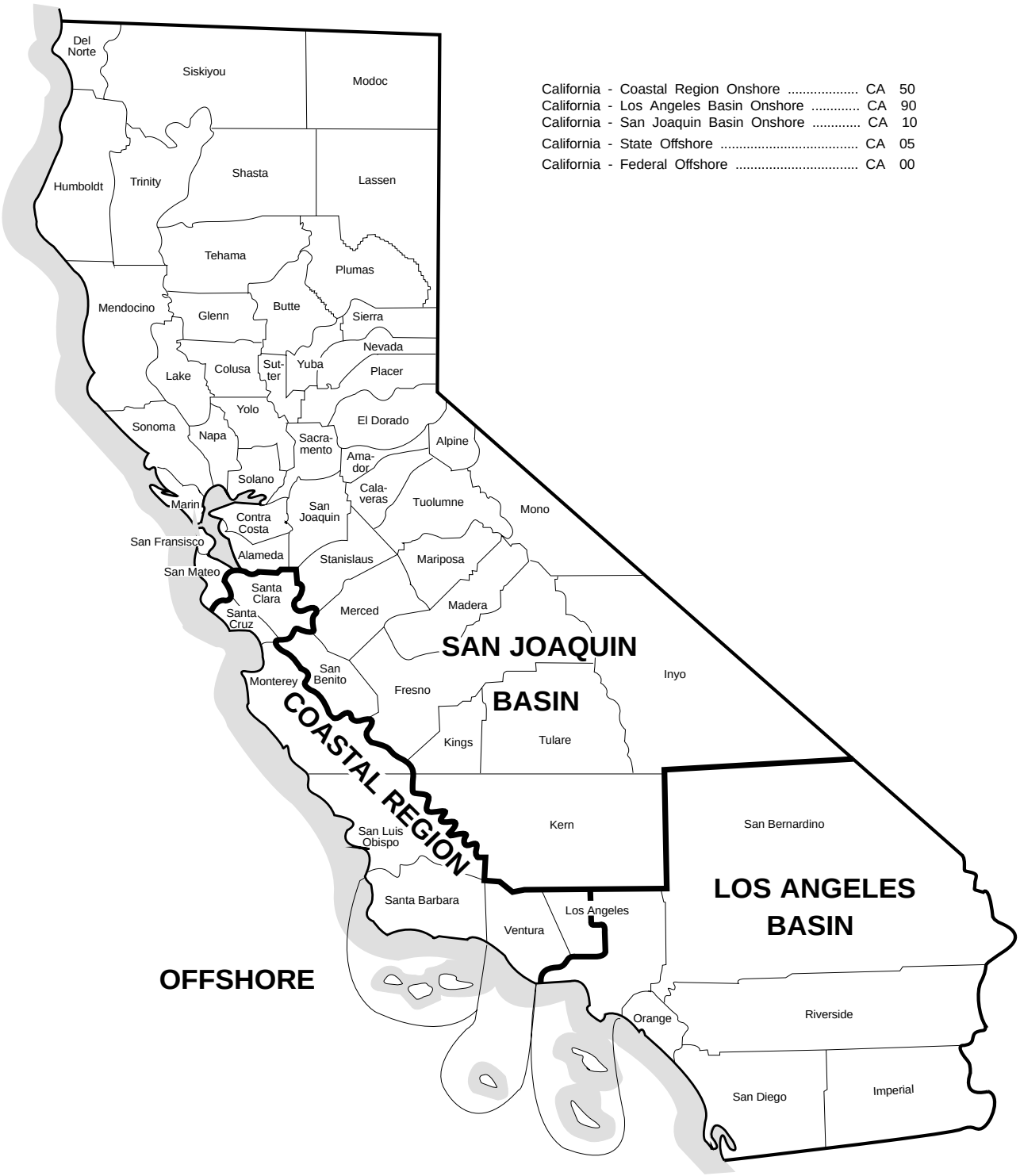
Maps of Selected State Subdivisions

Figure H1. Subdivisions of Alaska



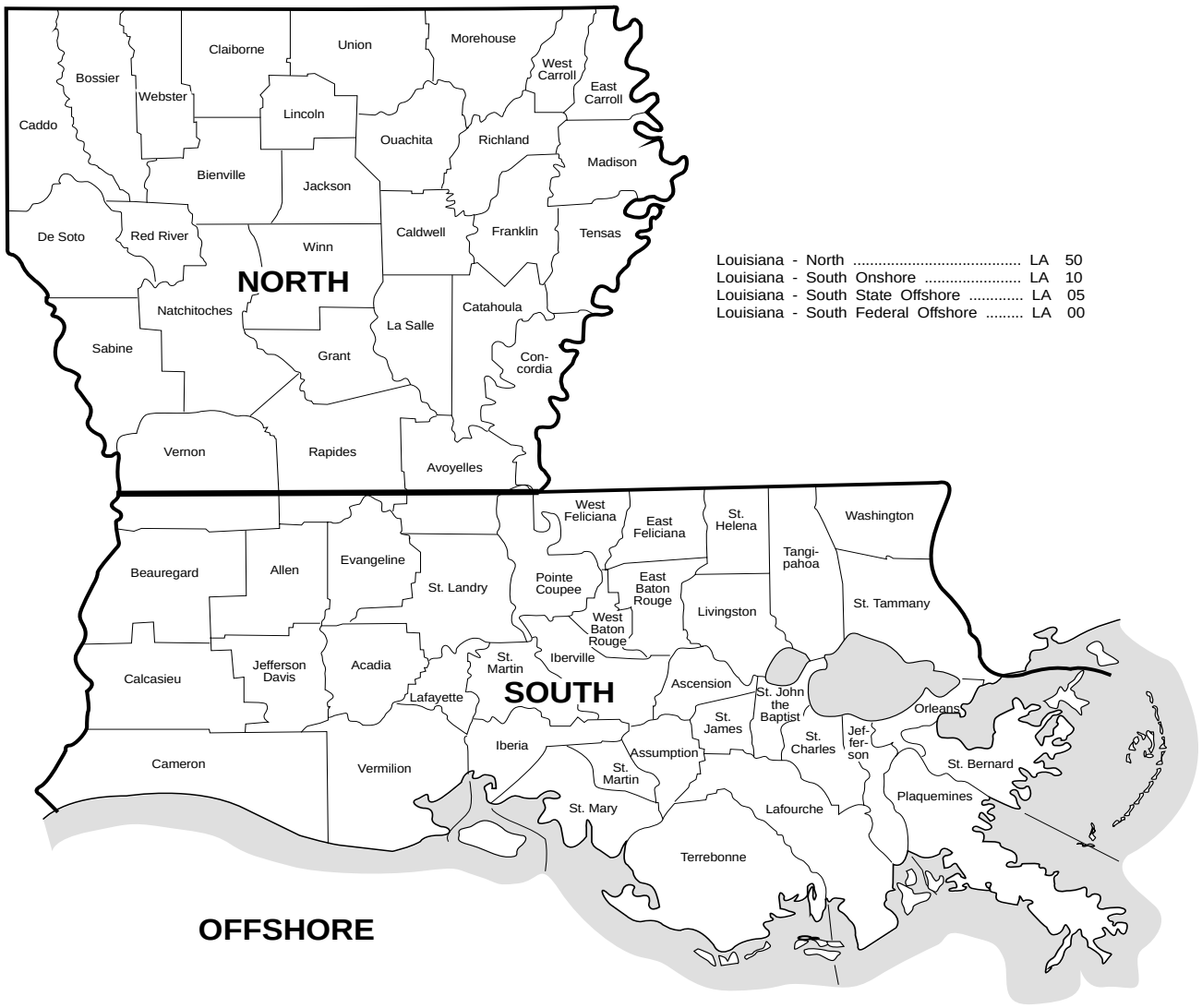
Source: After U.S. Geological Survey.

Figure H2. Subdivisions of California



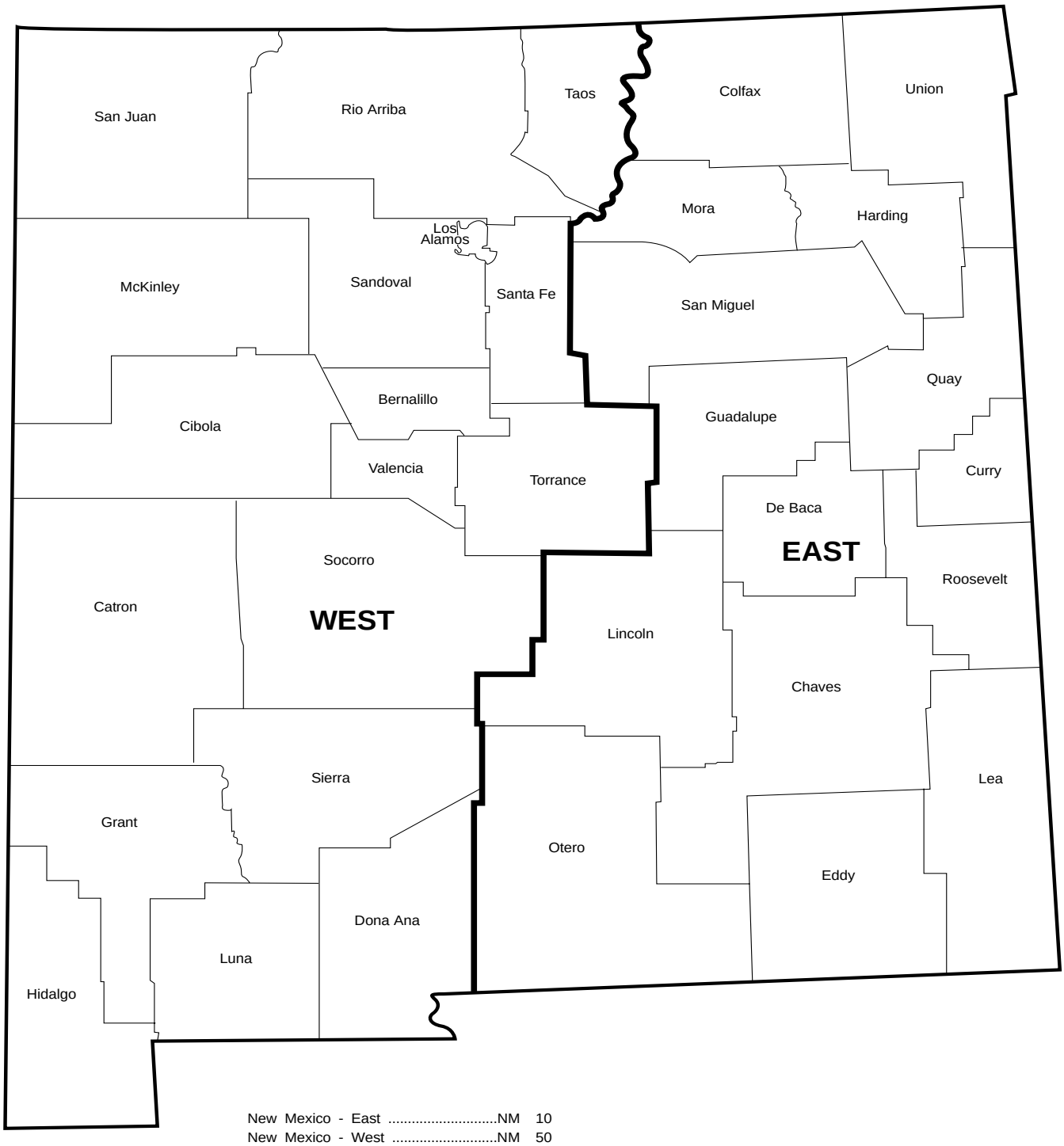
Source: Energy Information Administration, Office of Oil and Gas.

Figure H3. Subdivisions of Louisiana



Source: Energy Information Administration, Office of Oil and Gas.

Figure H4. Subdivisions of New Mexico

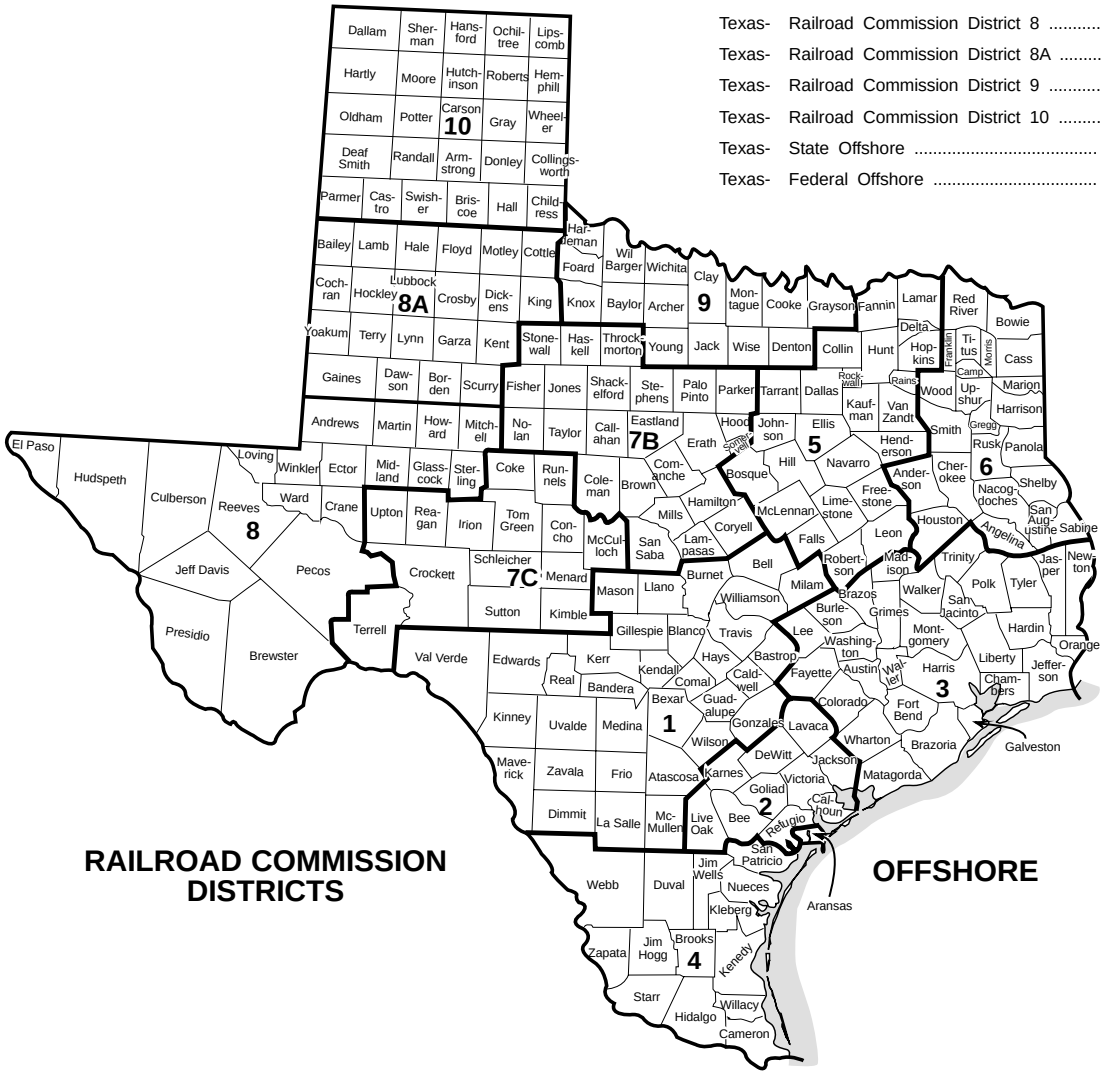


New Mexico - East .....NM 10
New Mexico - West .....NM 50

Source: Energy Information Administration, Office of Oil and Gas.

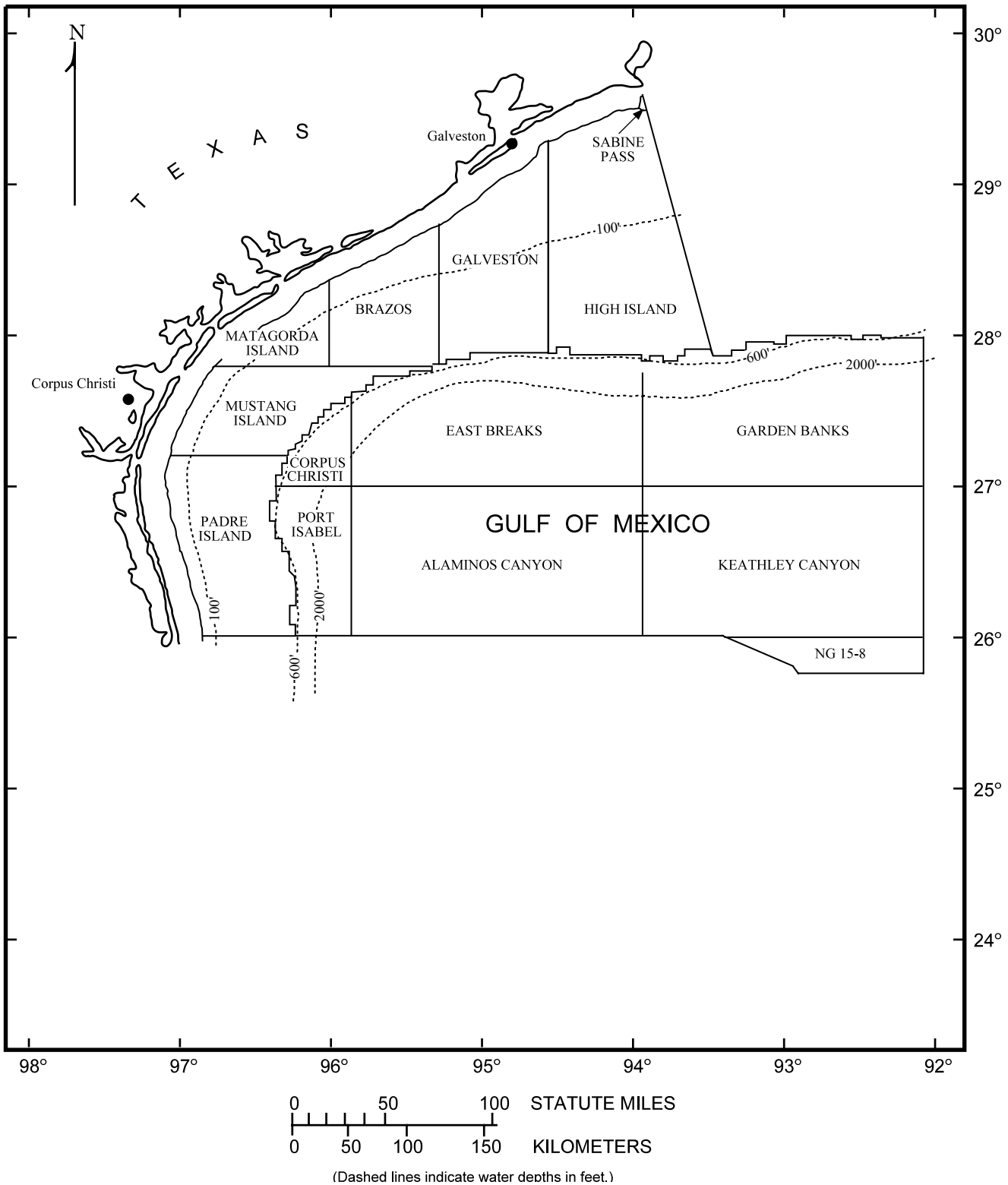
Figure H5. Subdivisions of Texas

Texas-	Railroad Commission District 1	TX 10
Texas-	Railroad Commission District 2 Onshore	TX 20
Texas-	Railroad Commission District 3 Onshore	TX 30
Texas-	Railroad Commission District 4 Onshore	TX 40
Texas-	Railroad Commission District 5	TX 50
Texas-	Railroad Commission District 6	TX 60
Texas-	Railroad Commission District 7B	TX 70
Texas-	Railroad Commission District 7C	TX 75
Texas-	Railroad Commission District 8	TX 80
Texas-	Railroad Commission District 8A	TX 85
Texas-	Railroad Commission District 9	TX 90
Texas-	Railroad Commission District 10	TX 95
Texas-	State Offshore	TX 05
Texas-	Federal Offshore	TX 00



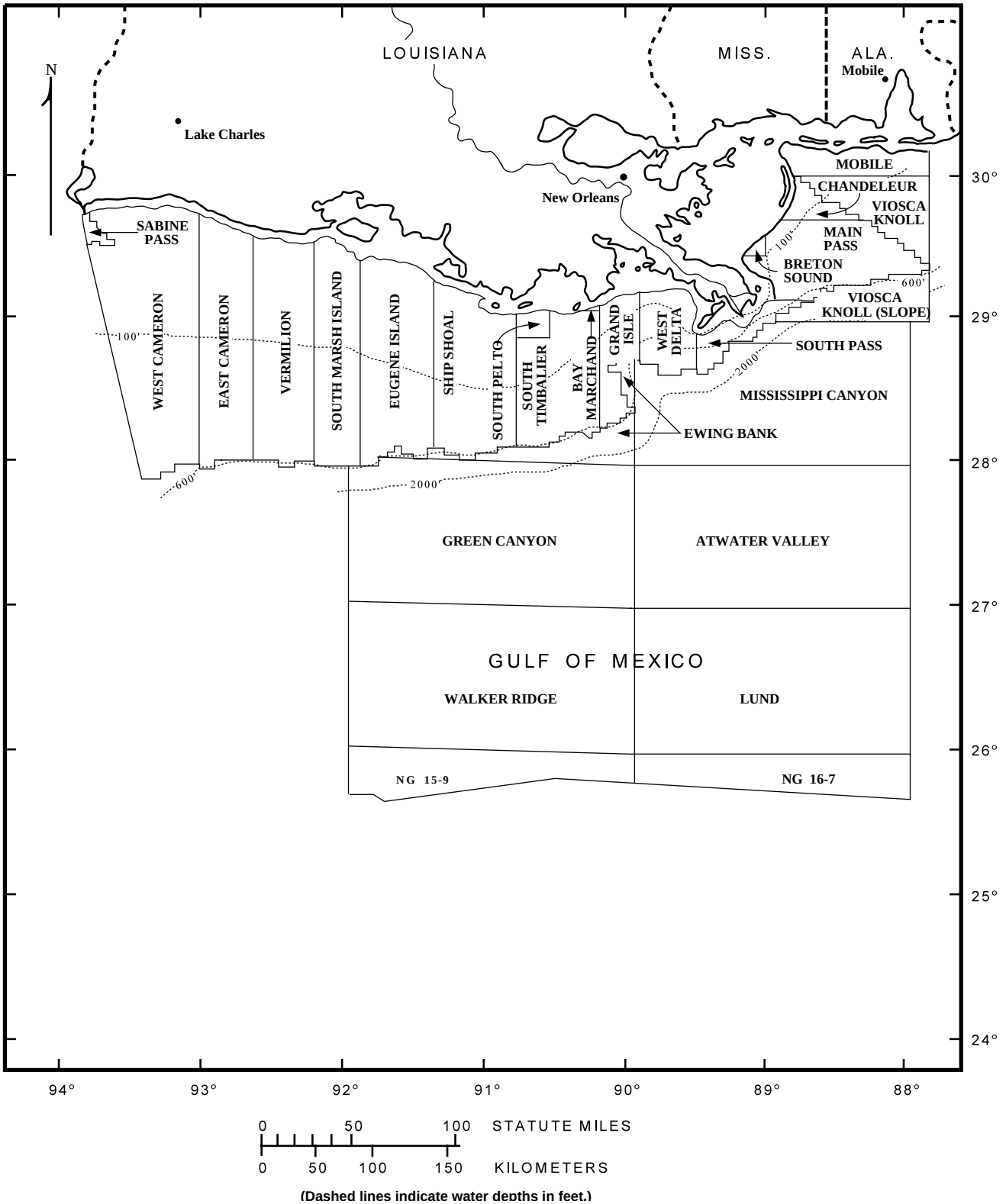
Source: Energy Information Administration, Office of Oil and Gas.

Figure H6. Western Planning Area, Gulf of Mexico Outer Continental Shelf Region



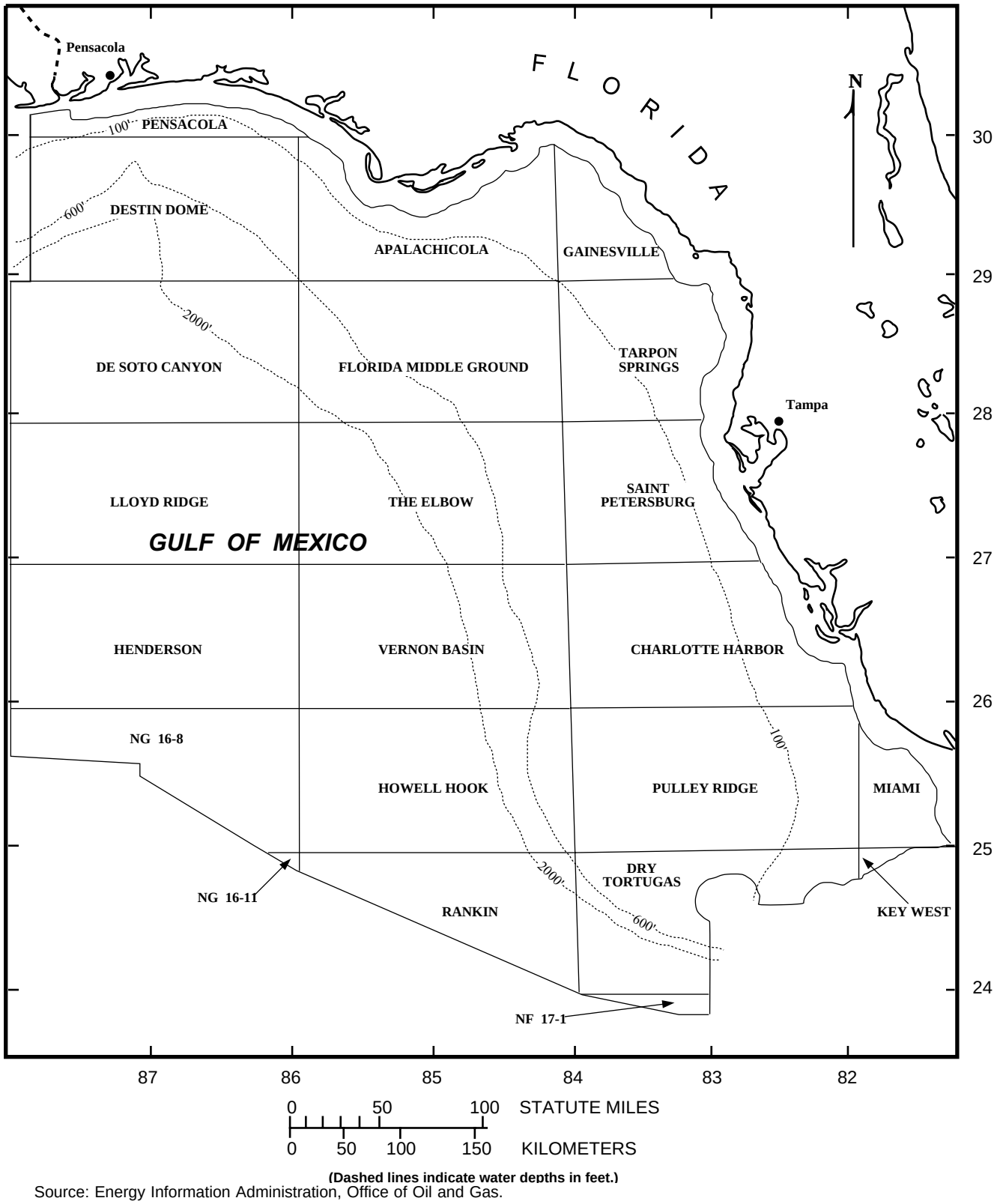
Source: Energy Information Administration, Office of Oil and Gas.

Figure H7. Central Planning Area, Gulf of Mexico Outer Continental Shelf Region



Source: Energy Information Administration, Office of Oil and Gas.

Figure H8. Eastern Planning Area, Gulf of Mexico Outer Continental Shelf Region



Source: Energy Information Administration, Office of Oil and Gas.

Appendix I

Annual Survey Forms for Domestic Oil and Gas Reserves

Figure I1. Form EIA-23, Cover Page

OFFICIAL USE ONLY

ANNUAL SURVEY OF DOMESTIC OIL AND GAS RESERVES
U.S. DEPARTMENT OF ENERGY
CALENDAR YEAR 1998

1998

Form Approved
OMB No. 1905-0057
Expires 12/2000

of Management and Budget, Washington, DC 20503.

COVER PAGE

IDENTIFICATION

1. Were you an operator *(see definition of an operator; p.1)* **of one or more oil or gas wells on December 31, 1998?**
(1)** No... *Complete only items 3 through 22 below and return this page with a letter stating when operations ceased and what became of the wells you operated to* **P.O. Box 1470 Rockville, MD 20849-1470**
(2)** Yes... *Complete the attached forms and return them to* **P.O. Box 1470 Rockville, MD 20849-1470**

2. I.D. Code FOR DOE USE ONLY: 0 0 0 0

If information to the left is incorrect or is missing, enter correct information below.

3. Name

4. Address

5. City | 6. State | 7. Zip Code

8. EIN | Check if Attestor's Social Security Number **

9. Name of Contact Person

10. Telephone Number of Contact Person Area Code ( ) ____ - ____

PARENT COMPANY IDENTIFICATION

11. Is there a parent company which exercises ultimate control over your company?
(1)** No... Answer 18 thru 22
(2)** Yes... Answer 12 thru 22

12. Name

13. Address

14. City | 15. State | 16. Zip Code

17. Parent Company EIN

18. What is the total number of pages (including this page) submitted in this filing?

ATTESTATION

(This report must be attested to by a responsible official of the company.)

appended is true and complete.

19. Name of Attestor *(Please print)* | 21. Signature

20. Title | 22. Date

Title 18 USC 1001 makes it a criminal offense for any person knowingly and willingly to make to any Agency or

FOR ASSISTANCE CALL 1-800-879-1470

Source: Energy Information Administration, Offfice of Oil and Gas.

Figure I2. Form EIA-23, Summary Report – Page 1

OFFICIAL USE ONLY

1998

ANNUAL SURVEY OF DOMESTIC OIL AND GAS RESERVES

Form Approved
OMB No. 1905-0057
Expires 12/2000

SUMMARY REPORT
PAGE 1 OF 2

(Report All Volumes of Crude Oil and Lease Condensate in Thousands of Barrels [Mbbl]:
Report All Volumes of Natural Gas in Millions of Cubic Feet [MMcf] at 14.73 psia and 60 F)

1.0 OPERATOR AND REPORT IDENTIFICATION DATA

1.1 OPERATOR I.D. CODE | 1.2 OPERATOR NAME | REPORT DATE (12 | 31 | 98) | 1.3 ORIGINAL | 1.4 AMENDED

2.0 PRODUCTION AND RESERVES DATA

STATE OR GEOGRAPHIC SUBDIVISION		CRUDE OIL			NATURAL GAS			LEASE CONDENSATE		
		RESERVES	1998 PRODUCTION		RESERVES	1998 PRODUCTION		RESERVES	1998 PRODUCTION	
		Proved Reserves Dec. 31, 1998 (Mbbl) (A)	(From properties for which reserves were Estimated) (Mbbl) (B)	(From properties for which reserves were Not Estimated) (Mbbl) (C)	Proved Reserves Dec. 31, 1998 (MMcf) (D)	(From properties for which reserves were Estimated) (MMcf) (E)	(From properties for which reserves were Not Estimated (MMcf) (F)	Proved Reserves Dec. 31, 1998 (Mbbl) (G)	(From properties for which reserves were Estimated) (Mbbl) (H)	(From properties for which reserves were Not Estimated) (Mbbl) (I)
ALABAMA-ONSHORE	AL									
ALABAMA-STATE OFFSHORE	AL05									
ALASKA-NORTH ONSHORE AND OFFSHORE	AK50									
ALASKA-SOUTH ONSHORE	AK10									
ALASKA-SOUTH STATE OFFSHORE	AK05									
ARIZONA	AZ									
ARKANSAS	AR									
CALIFORNIA-COASTAL REGION ONSHORE	CA50									
CALIFORNIA-LOS ANGELES BASIN ONSHORE	CA90									
CALIFORNIA-SAN JOAQUIN BASIN ONSHORE	CA10									
CALIFORNIA-STATE OFFSHORE	CA05									
COLORADO	CO									
FLORIDA-ONSHORE	FL									
FLORIDA-STATE OFFSHORE	FL05									
ILLINOIS	IL									
INDIANA	IN									
KANSAS	KS									
KENTUCKY	KY									
LOUISIANA-NORTH	LA50									
LOUISIANA-SOUTH ONSHORE	LA10									
LOUISIANA-SOUTH STATE OFFSHORE	LA05									
MARYLAND	MD									
MICHIGAN	MI									
MISSISSIPPI-ONSHORE	MS									
MISSISSIPPI-STATE OFFSHORE	MS05									
MISSOURI	MO									
MONTANA	MT									
NEBRASKA	NE									
NEVADA	NV									
NEW MEXICO-EAST	NM10									
NEW MEXICO-WEST	NM50									
NEW YORK	NY									
NORTH DAKOTA	ND									
OHIO	OH									

SAMPLE

Source: Energy Information Administration, Offfice of Oil and Gas.

Figure I3. Form EIA-23, Summary Report – Page 2

OFFICIAL USE ONLY

1998

ANNUAL SURVEY OF DOMESTIC OIL AND GAS RESERVES

Form Approved
OMB No. 1905-0057
Expires 12/2000

SUMMARY REPORT
PAGE 2 OF 2

(Report All Volumes of Crude Oil and Lease Condensate in Thousands of Barrels [Mbbl];
Report All Volumes of Natural Gas in Millions of Cubic Feet [MMcf] at 14.73 psia and 60 F)

1.0 OPERATOR AND REPORT IDENTIFICATION DATA

1.1 OPERATOR I.D. CODE	1.2 OPERATOR NAME	REPORT DATE	1.3 ORIGINAL	1.4 AMENDED
		12 31 98		

2.0 PRODUCTION AND RESERVES DATA

SAMPLE

STATE OR GEOGRAPHIC SUBDIVISION		CRUDE OIL			NATURAL GAS			LEASE CONDENSATE		
		RESERVES	1998 PRODUCTION		RESERVES	1998 PRODUCTION		RESERVES	1998 PRODUCTION	
		Proved Reserves Dec. 31, 1998 (Mbbl) (A)	(From properties for which reserves were Estimated) (Mbbl) (B)	(From properties for which reserves were Not Estimated) (Mbbl) (C)	Proved Reserves Dec. 31, 1998 (MMcf) (D)	(From properties for which reserves were Estimated) (MMcf) (E)	(From properties for which reserves were Not Estimated (MMcf) (F)	Proved Reserves Dec. 31, 1998 (Mbbl) (G)	(From properties for which reserves were Estimated) (Mbbl) (H)	(From properties for which reserves were Not Estimated) (Mbbl) (I)
OKLAHOMA	OK									
PENNSYLVANIA	PA									
SOUTH DAKOTA	SD									
TENNESSEE	TN									
TEXAS-RRC DISTRICT 1	TX10									
TEXAS-RRC DISTRICT 2 ONSHORE	TX20									
TEXAS-RRC DISTRICT 3 ONSHORE	TX30									
TEXAS-RRC DISTRICT 4 ONSHORE	TX40									
TEXAS-RRC DISTRICT 5	TX50									
TEXAS-RRC DISTRICT 6	TX60									
TEXAS-RRC DISTRICT 7B	TX70									
TEXAS-RRC DISTRICT 7C	TX75									
TEXAS-RRC DISTRICT 8	TX80									
TEXAS-RRC DISTRICT 8A	TX85									
TEXAS-RRC DISTRICT 9	TX90									
TEXAS-RRC DISTRICT 10	TX95									
TEXAS-STATE OFFSHORE	TX05									
UTAH	UT									
VIRGINIA	VA									
WEST VIRGINIA	WV									
WYOMING	WY									
FEDERAL OFFSHORE-GULF OF MEXICO (ALABAMA)	AL00									
FEDERAL OFFSHORE-GULF OF MEXICO (FLORIDA)	FL00									
FEDERAL OFFSHORE-GULF OF MEXICO (LOUISIANA)	LA00									
FEDERAL OFFSHORE-GULF OF MEXICO (MISSISSIPPI)	MS00									
FEDERAL OFFSHORE-GULF OF MEXICO (TEXAS)	TX00									
FEDERAL OFFSHORE-PACIFIC (ALASKA)	AK00									
FEDERAL OFFSHORE-PACIFIC (CALIFORNIA)	CA00									
FEDERAL OFFSHORE-PACIFIC (OREGON)	OR00									
OTHER STATE (SPECIFY)										
TOTAL (SUM EACH COLUMN)	US									

Source: Energy Information Administration, Offfice of Oil and Gas.

Figure I4. Form EIA-23, Detail Report – Schedule A

OFFICIAL USE ONLY

1998

ANNUAL SURVEY OF DOMESTIC OIL AND GAS RESERVES

SCHEDULE A - OPERATED PROVED RESERVES, PRODUCTION, AND RELATED DATA BY FIELD

(Report All Liquid Volumes in Thousands of Barrels [Mbbl] at 60 F;
Report All Volumes of Natural Gas in Millions of Cubic Feet [MMcf] at 60 F and 14.73 psia)

Form Approved
OMB No. 1905-0057
Expires 12/2000

1.0 OPERATOR AND REPORT IDENTIFICATION DATA

1.1 OPERATOR I.D. CODE | 1.2 OPERATOR NAME | REPORT DATE (12 31 98) | 1.3 ORIGINAL | 1.4 AMENDED | 1.5 PAGE | FOR DOE USE ONLY

2.0 FIELD DATA (OPERATED BASIS)

2.1

1. STATE ABBR.	2. SUBDIV. CODE	3. COUNTY CODE	4. FIELD CODE	5. OCS BLOCK NUMBER	6. FIELD NAME

10. FIELD DISCOVERY YEAR

7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED

TYPE HYDROCARBON	RESERVES (a) DECEMBER 31, 1997	REVISION (b) INCREASES	REVISION (c) DECREASES	11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (M bbl) (d) EXTENSIONS	NEW FIELD (e) DISCOVERIES	NEW RESERVOIRS (f) IN OLD FIELDS	CALENDAR YEAR (g) PRODUCTION	RESERVES (h) DECEMBER 31, 1998	NONPRODUCING (i) RESERVES
12. CRUDE OIL (Mbbl)									
13. ASSOCIATED-DISSOLVED GAS(MMcf)									
14. NONASSOCIATED GAS (MMcf)									
15. LEASE CONDENSATE (Mbbl)									

	CRUDE OIL (a) (Mbbl)	ASSOC-DISSOLVED (b) GAS (MMcf)	NONASSOCIATED (c) GAS (MMcf)	LEASE CONDENSATE (d) (Mbbl)
7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED				
11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (M bbl)				

8. FOOTNOTE

2.2

1. STATE ABBR.	2. SUBDIV. CODE	3. COUNTY CODE	4. FIELD CODE	5. OCS BLOCK NUMBER	6. FIELD NAME

10. FIELD DISCOVERY YEAR

7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED

TYPE HYDROCARBON	RESERVES (a) DECEMBER 31, 1997	REVISION (b) INCREASES	REVISION (c) DECREASES	11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (M bbl) (d) EXTENSIONS	NEW FIELD (e) DISCOVERIES	NEW RESERVOIRS (f) IN OLD FIELDS	CALENDAR YEAR (g) PRODUCTION	RESERVES (h) DECEMBER 31, 1998	NONPRODUCING (i) RESERVES
12. CRUDE OIL (Mbbl)									
13. ASSOCIATED-DISSOLVED GAS(MMcf)									
14. NONASSOCIATED GAS (MMcf)									
15. LEASE CONDENSATE (Mbbl)									

	CRUDE OIL (a) (Mbbl)	ASSOC-DISSOLVED (b) GAS (MMcf)	NONASSOCIATED (c) GAS (MMcf)	LEASE CONDENSATE (d) (Mbbl)
7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED				
11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (M bbl)				

8. FOOTNOTE

2.3

1. STATE ABBR.	2. SUBDIV. CODE	3. COUNTY CODE	4. FIELD CODE	5. OCS BLOCK NUMBER	6. FIELD NAME

10. FIELD DISCOVERY YEAR

7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED

TYPE HYDROCARBON	RESERVES (a) DECEMBER 31, 1997	REVISION (b) INCREASES	REVISION (c) DECREASES	11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (M bbl) (d) EXTENSIONS	NEW FIELD (e) DISCOVERIES	NEW RESERVOIRS (f) IN OLD FIELDS	CALENDAR YEAR (g) PRODUCTION	RESERVES (h) DECEMBER 31, 1998	NONPRODUCING (i) RESERVES
12. CRUDE OIL (Mbbl)									
13. ASSOCIATED-DISSOLVED GAS(MMcf)									
14. NONASSOCIATED GAS (MMcf)									
15. LEASE CONDENSATE (Mbbl)									

	CRUDE OIL (a) (Mbbl)	ASSOC-DISSOLVED (b) GAS (MMcf)	NONASSOCIATED (c) GAS (MMcf)	LEASE CONDENSATE (d) (Mbbl)
7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED				
11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (M bbl)				

8. FOOTNOTE

2.4

1. STATE ABBR.	2. SUBDIV. CODE	3. COUNTY CODE	4. FIELD CODE	5. OCS BLOCK NUMBER	6. FIELD NAME

10. FIELD DISCOVERY YEAR

7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED

TYPE HYDROCARBON	RESERVES (a) DECEMBER 31, 1997	REVISION (b) INCREASES	REVISION (c) DECREASES	11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (M bbl) (d) EXTENSIONS	NEW FIELD (e) DISCOVERIES	NEW RESERVOIRS (f) IN OLD FIELDS	CALENDAR YEAR (g) PRODUCTION	RESERVES (h) DECEMBER 31, 1998	NONPRODUCING (i) RESERVES
12. CRUDE OIL (Mbbl)									
13. ASSOCIATED-DISSOLVED GAS(MMcf)									
14. NONASSOCIATED GAS (MMcf)									
15. LEASE CONDENSATE (Mbbl)									

	CRUDE OIL (a) (Mbbl)	ASSOC-DISSOLVED (b) GAS (MMcf)	NONASSOCIATED (c) GAS (MMcf)	LEASE CONDENSATE (d) (Mbbl)
7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED				
11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (M bbl)				

8. FOOTNOTE

SAMPLE

Source: Energy Information Administration, Offfice of Oil and Gas.

Figure I5. Form EIA-23, Detail Report – Schedule B

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ANNUAL SURVEY OF DOMESTIC OIL AND GAS RESERVES

SCHEDULE B - FOOTNOTES

Form Approved
OMB No. 1905-0057
Expires 12/2000

1.0 OPERATOR AND REPORT IDENTIFICATION DATA

1.1 OPERATOR I.D. CODE	1.2 OPERATOR NAME	REPORT DATE	1.3 ORIGINAL	1.4 AMENDED	1.5 PAGE	FOR DOE USE ONLY
		12 31 98				

2.0 FOOTNOTE DATA

Page Number (a)	Item Number (b)	Subitem Number (c)	Column Desig-nation (d)	Sequence Number (e)	Notation (f)	FOR DOE USE ONLY

SAMPLE

Source: Energy Information Administration, Offfice of Oil and Gas.

Figure I6. Form EIA-64A

EIA-64A (Revised 9/91)

OFFICIAL USE ONLY **1998**

Energy Information Administration
U.S. DEPARTMENT OF ENERGY
Calendar Year 1998

Form Approved
OMB No. 1905-0057
Expires 12/31/2000

ANNUAL REPORT OF THE ORIGIN OF NATURAL GAS LIQUIDS PRODUCTION
FORM EIA-64A

This report is mandatory under Public Law 93-275. Failure to comply may result in criminal fines, civil penalties and other sanctions as provided by law. For the sanctions and the provisions concerning the confidentiality of information submitted on this form, see Page 2 of the Instructions. Public reporting burden for this collection of information is estimated to average 5.9 hours per respondent, including the time of reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Energy Information Administration, Statistics and Methods Group EI-70, Washington, DC 20585; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

PLEASE COMPLETE THIS FORM AND RETURN TO

ENERGY INFORMATION ADMINISTRATION, EI-45
1000 INDEPENDENCE AVE, SW, MAIL STATION 2G-024
WASHINGTON, DC 20585

PLANT AND PRODUCTION REPORT IDENTIFICATION

1.0 Does this report reflect active natural gas processing at the facility for the entire year? ¨ Yes ¨ No
Months covered by this report_____ through _____ (Include Explanatory Notes in Section **8.0**)

2.0 *If label is incorrect or information is missing or no label is given, enter correct information to the right*

2.1 Plant Operator's Name
2.2 Contact Person's Name
2.3 Plant Name
2.4 Geographic Location (Use Area of Origin Codes, Page 6) ☐☐☐☐
2.5 Mailing Address
2.6 City State Zip Code
2.7 Telephone Number ( )

3.0 Parent Company's Name

4.0 Submission Status ! Original ! Amended

5.0 Origin of Natural Gas Received and Natural Gas Liquids Produced

Line	Area of Origin Code (A)	Natural Gas Received (MMcf) (B)	Natural Gas Liquids Production (Mbbl) (C)
5.1			
5.2			
5.3			
5.4			
5.5			
5.6			
5.7			
5.8			
5.9			
5.10			
5.11			
5.12			
5.13			
5.14			
5.15			
5.16	**TOTAL**		

SAMPLE

6.0 Gas Shrinkage Resulting from Natural Gas Liquids Extracted (MMcf)

7.0 Natural Gas Used as Fuel in Processing (MMcf)

8.0 Explanatory Notes

9.0 Certification: I certify that the information provided herein and appended hereto is true and accurate to the best of my knowledge.

Name (Please Print) Date

Signature Title

Title 18 USC 1001 makes it a criminal offense for any person knowingly and willingly to make to any Agency or Department of the United States any false, fictitious, or fraudulent statements as to any matter within its jurisdiction.

Source: Energy Information Administration, Offfice of Oil and Gas.

Glossary

Glossary

This glossary contains definitions of the technical terms used in this report and employed by respondents in completing Form EIA--23, "Annual Survey of Domestic Oil and Gas Reserves," or Form EIA--64A, "Annual Report of the Origin of Natural Gas Liquids Production," for the report year 1998.

Adjustments: The quantity which preserves an exact annual reserves balance within each State or State subdivision of the following form:

Published Proved Reserves at End of Previous Report Year
+ Adjustments
+ Revision Increases
– Revision Decreases
+ Extensions
+ New Field Discoveries
+ New Reservoir Discoveries in Old Fields
+ Report Year Production
= Published Proved Reserves at End of Report Year

These adjustments are the yearly changes in the published reserve estimates that cannot be attributed to the estimates for other reserve change categories because of the survey and statistical estimation methods employed. For example, variations as a result of changes in the operator frame, different random samples or imputations for missing or unreported reserve changes, could contribute to adjustments.

Affiliated (**Associated**) **Company:** An "affiliate" of, or a person "affiliated" with, a specific person is a person that directly, or indirectly through one or more intermediaries: controls; or is controlled by; or is under common control with, the person specified. (See **Person and Control**)

Control: The term "control" (including the terms "controlling," "controlled by," and "under common control with") means the possession, direct or indirect, of the power to direct or cause the direction of the management and policies of a person, whether through the ownership of voting shares, by contract, or otherwise. (See **Person**)

Corrections: (See **Revisions**)

Crude Oil: A mixture of hydrocarbons that exists in the liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Crude oil may also include:

1. Small amounts of hydrocarbons that exist in the gaseous phase in natural underground reservoirs but are liquid at atmospheric pressure after being recovered from oil well (casinghead) gas in lease separators, and that subsequently are comingled with the crude stream without being separately measured
2. Small amounts of nonhydrocarbons produced with the oil.

When a State regulatory agency specifies a definition of crude oil which differs from that set forth above, the State definition is to be followed and its use footnoted on Schedule B of Form EIA--23.

Extensions: The reserves credited to a reservoir because of enlargement of its proved area. Normally the ultimate size of newly discovered fields, or newly discovered reservoirs in old fields, is determined by wells drilled in years subsequent to discovery. When such wells add to the proved area of a previously discovered reservoir, the increase in proved reserves is classified as an extension.

Field: An area consisting of a single reservoir or multiple reservoirs all grouped on, or related to, the same individual geological structural feature and/or stratigraphic condition. There may be two or more reservoirs in a field that are separated vertically by intervening impervious strata, or laterally by local geologic barriers, or by both.

Field Area: A geographic area encompassing two or more pools that have a common gathering and metering system, the reserves of which are reported as a single unit. This concept applies primarily to the Appalachian region. (See **Pool**)

Field Discovery Year: The calendar year in which a field was first recognized as containing economically recoverable accumulations of oil and/or gas.

Field Separation Facility: A surface installation designed to recover lease condensate from a

produced natural gas stream frequently originating from more than one lease, and managed by the operator of one or more of these leases. (See **Lease Condensate**)

Gross Working Interest Ownership Basis: Gross working interest ownership is the respondent's working interest in a given property plus the proportionate share of any royalty interest, including overriding royalty interest, associated with the working interest. (See **Working Interest** and **Royalty** (including **Overriding Royalty**) **Interest**)

Indicated Additional Reserves of Crude Oil: Quantities of crude oil (other than proved reserves) which may become economically recoverable from existing productive reservoirs through the application of improved recovery techniques using current technology. These recovery techniques may:

1. Already be installed in the reservoir, but their effects are not yet known to the degree necessary to classify the additional reserves as proved
2. Be installed in another similar reservoir, where the results of that installation can be used to estimate the indicated additional reserves.

Indicated additional reserves are not included in proved reserves due to their uncertain economic recoverability. When economic recoverability is demonstrated, the indicated additional reserves must be transferred to proved reserves as positive revisions.

Lease Condensate: A mixture consisting primarily of pentanes and heavier hydrocarbons which is recovered as a liquid from natural gas in lease or field separation facilities, exclusive of products recovered at natural gas processing plants or facilities.

Lease Separator: A lease separator is a facility installed at the surface for the purpose of (a) separating gases from produced crude oil and water at the temperature and pressure conditions of the separator, and/or (b) separating gases from that portion of the produced natural gas stream which liquefies at the temperature and pressure conditions of the separator.

Natural Gas: A mixture of hydrocarbon compounds and small quantities of various nonhydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions. The principal hydrocarbons normally contained in the mixture are methane, ethane, propane, butane, and pentanes. Typical nonhydrocarbon gases which may be present in reservoir natural gas are water vapor, carbon dioxide, helium, hydrogen sulfide, and nitrogen. Under reservoir conditions, natural gas and the liquefiable portions occur either in a single gaseous phase in the reservoir or in solution with crude oil, and are not distinguishable at the time as separate substances. (See **Natural Gas, Associated--Dissolved** and **Natural Gas, Nonassociated**)

Natural Gas, Associated--Dissolved: The combined volume of natural gas which occurs in crude oil reservoirs either as free gas (associated) or as gas in solution with crude oil (dissolved).

Natural Gas, "Dry": The actual or calculated volumes of natural gas which remain after:

1. The liquefiable hydrocarbon portion has been removed from the gas stream (i.e., gas after lease, field, and/or plant separation)
2. Any volumes of nonhydrocarbon gases have been removed where they occur in sufficient quantity to render the gas unmarketable.

Natural Gas, Nonassociated: Natural gas not in contact with significant quantities of crude oil in a reservoir.

Natural Gas Liquids: Those hydrocarbons in natural gas which are separated from the gas through the processes of absorption, condensation, adsorption, or other methods in gas processing or cycling plants. Generally such liquids consist of propane and heavier hydrocarbons and are commonly referred to as condensate, natural gasoline, or liquefied petroleum gases. Where hydrocarbon components lighter than propane are recovered as liquids, these components are included with natural gas liquids.

Natural Gas Processing Plant: A facility designed to recover natural gas liquids from a stream of natural gas which may or may not have passed through lease separators and/or field separation facilities. Another function of the facility is to control the quality of the processed natural gas stream. Cycling plants are considered natural gas processing plants.

Natural Gas, Wet After Lease Separation: The volume of natural gas remaining after removal of lease condensate in lease and/or field separation

facilities, if any, and after exclusion of nonhydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable. Natural gas liquids may be recovered from volumes of natural gas, wet after lease separation, at natural gas processing plants. **(**See **Lease Condensate, Lease Separator,** and **Field Separation Facility**)

Net Revisions: (See **Revisions**)

New Field: A field discovered during the report year.

New Field Discoveries: The volumes of proved reserves of crude oil, natural gas and/or natural gas liquids discovered in new fields during the report year.

New Reservoir: A reservoir discovered during the report year.

New Reservoir Discoveries in Old Fields: The volumes of proved reserves of crude oil, natural gas, and/or natural gas liquids discovered during the report year in new reservoir(s) located in old fields.

Nonproducing Reservoirs: Reservoirs in which proved liquid or gaseous hydrocarbon reserves have been identified, but which did not produce during the last calendar year regardless of the availability and/or operation of production, gathering, or transportation facilities.

Old Field: A field discovered prior to the report year.

Old Reservoir: A reservoir discovered prior to the report year.

Operator, Gas Plant: The person responsible for the management and day--to--day operation of one or more natural gas processing plants as of December 31 of the report year. The operator is generally a working interest owner or a company under contract to the working interest owner(s). Plants shut down during the report year are also to be considered "operated" as of December 31. (See **Person**)

Operator, Oil and/or Gas Well: The person responsible for the management and day--to--day operation of one or more crude oil and/or natural gas wells as of December 31 of the report year. The operator is generally a working interest owner or a company under contract to the working interest owner(s). Wells included are those which have proved reserves of crude oil, natural gas, and/or lease condensate in the reservoirs associated with them, whether or not they are producing. Wells abandoned during the report year are also to be considered "operated" as of December 31. (See **Person**, **Proved Reserves of Crude Oil**, **Proved Reserves of Natural Gas**, **Proved Reserves of Lease Condensate**, **Report Year**, and **Reservoir**)

Ownership: (See **Gross Working Interest Ownership Basis**)

Parent Company: The parent company of a business entity is an affiliated company which exercises ultimate control over that entity, either directly or indirectly through one or more intermediaries. **(**See **Affiliated** (**Associated**) **Company and Control**)

Person: An individual, a corporation, a partnership, an association, a joint--stock company, a business trust, or an unincorporated organization.

Pool: In general, a reservoir. In certain situations a pool may consist of more than one reservoir. (See **Field Area**)

Plant Liquids: Those volumes of natural gas liquids recovered in natural gas processing plants.

Production, Crude Oil: The volumes of crude oil which are extracted from oil reservoirs during the report year. These volumes are determined through measurement of the volumes delivered from lease storage tanks, (i.e., at the point of custody transfer) with adjustment for (1) net differences between opening and closing lease inventories, and for (2) basic sediment and water. Oil used on the lease is considered production.

Production, Lease Condensate: The volume of lease condensate produced during the report year. Lease condensate volumes include only those volumes recovered from lease or field separation facilities. (See **Lease Condensate**)

Production, Natural Gas, Dry: The volume of natural gas withdrawn from reservoirs during the report year less (1) the volume returned to such reservoirs in cycling, repressuring of oil reservoirs and conservation operations; less (2) shrinkage resulting from the removal of lease condensate and plant liquids; and less (3) nonhydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable. Volumes of gas withdrawn from gas storage reservoirs and native gas, which has been

transferred to the storage category, are not considered production. This is not the same as marketed production, since the latter also excludes vented and flared gas, but contains plant liquids.

Production, Natural Gas, Wet after Lease Separation: The volume of natural gas withdrawn from reservoirs during the report year less (1) the volume returned to such reservoirs in cycling, repressuring of oil reservoirs and conservation operations; less (2) shrinkage resulting from the removal of lease condensate; and less (3) nonhydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable. Volumes of gas withdrawn from gas storage reservoirs and native gas, which has been transferred to the storage category, are not considered production. This is not the same as marketed production, since the latter excludes vented and flared gas.

Production, Natural Gas Liquids: The volume of natural gas liquids removed from natural gas in lease separators, field facilities, gas processing plants or cycling plants during the report year.

Production, Plant Liquids: The volume of liquids removed from natural gas in natural gas processing plants or cycling plants during the report year.

Proved Reserves of Crude Oil: Proved reserves of crude oil as of December 31 of the report year are the estimated quantities of all liquids defined as crude oil, which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

Reservoirs are considered proved if economic producibility is supported by actual production or conclusive formation test (drill stem or wire line), or if economic producibility is supported by core analyses and/or electric or other log interpretations. The area of an oil reservoir considered proved includes (1) that portion delineated by drilling and defined by gas--oil and/or oil--water contacts, if any; and (2) the immediately adjoining portions not yet drilled, but which can be reasonably judged as economically productive on the basis of available geological and engineering data. In the absence of information on fluid contacts, the lowest known structural occurrence of hydrocarbons is considered to be the lower proved limit of the reservoir.

Volumes of crude oil placed in underground storage are not to be considered proved reserves.

Reserves of crude oil which can be produced economically through application of improved recovery techniques (such as fluid injection) are included in the "proved" classification when successful testing by a pilot project, or the operation of an installed program in the reservoir, provides support for the engineering analysis on which the project or program was based.

Estimates of proved crude oil reserves do not include the following: (1) oil that may become available from known reservoirs but is reported separately as "indicated additional reserves"; (2) natural gas liquids (including lease condensate); (3) oil, the recovery of which is subject to reasonable doubt because of uncertainty as to geology, reservoir characteristics, or economic factors; (4) oil that may occur in undrilled prospects; and (5) oil that may be recovered from oil shales, coal, gilsonite, and other such sources. It is not necessary that production, gathering or transportation facilities be installed or operative for a reservoir to be considered proved.

Proved Reserves of Lease Condensate: Proved reserves of lease condensate as of December 31 of the report year are the volumes of lease condensate expected to be recovered in future years in conjunction with the production of proved reserves of natural gas as of December 31 of the report year, based on the recovery efficiency of lease and/or field separation facilities installed as of December 31 of the report year. (See **Lease Condensate** and **Proved Reserves of Natural Gas**)

Proved Reserves of Natural Gas: Proved reserves of natural gas as of December 31 of the report year are the estimated quantities which analysis of geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

Reservoirs are considered proved if economic producibility is supported by actual production or conclusive formation test (drill stem or wire line), or if economic producibility is supported by core analyses and/or electric or other log interpretations.

The area of a gas reservoir considered proved includes: (1) that portion delineated by drilling and defined by gas--oil and/or gas--water contacts, if any; and (2) the immediately adjoining portions not yet drilled, but which can be reasonably judged as economically productive on the basis of available geological and engineering data. In the absence of

information on fluid contacts, the lowest known structural occurrence of hydrocarbons is considered to be the lower proved limit of the reservoir.

Volumes of natural gas placed in underground storage are not to be considered proved reserves.

For natural gas, wet after lease separation, an appropriate reduction in the reservoir gas volume has been made to cover the removal of the liquefiable portions of the gas in lease and/or field separation facilities and the exclusion of nonhydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable.

For dry natural gas, an appropriate reduction in the gas volume has been made to cover the removal of the liquefiable portions of the gas in lease and/or field separation facilities, and in natural gas processing plants, and the exclusion of nonhydrocarbon gases where they occur in sufficient quantity to render the gas unmarketable.

It is not necessary that production, gathering, or transportation facilities be installed or operative for a reservoir to be considered proved. It is to be assumed that compression will be initiated if and when economically justified.

Proved Reserves of Natural Gas Liquids: Proved reserves of natural gas liquids as of December 31 of the report year are those volumes of natural gas liquids (including lease condensate) demonstrated with reasonable certainty to be separable in the future from proved natural gas reserves, under existing economic and operating conditions.

Proved Ultimate Recovery: The sum of proved reserves and cumulative production. It is expected to change over time for any field, group of fields, State, or Country. Proved Ultimate Recovery does not represent the maximum recoverable volume of resources for an area. It is instead a gauge of how much has already been produced plus proved reserves. Proved reserves of crude oil or natural gas are the estimated quantities of petroleum which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions. When deterministic proved reserves estimation methods are used, the term reasonable certainty is intended to express a high degree of confidence that the estimated quantities will be recovered. When probabilistic methods are used there should be at least a 90 percent probability that the actual quantities recovered will exceed the estimate.

Report Year: The calendar year to which data reported in this publication pertain.

Reserves: (See **Proved Reserves**)

Reserve Additions: Consist of adjustments, net revisions, extensions to old reservoirs, new reservoir discoveries in old fields, and new field discoveries.

Reserves Changes: Positive and negative revisions, extensions, new reservoir discoveries in old fields, and new field discoveries, which occurred during the report year.

Reservoir: A porous and permeable underground formation containing an individual and separate natural accumulation of producible hydrocarbons (oil and/or gas) which is confined by impermeable rock or water barriers and is characterized by a single natural pressure system.

Revisions: Changes to prior year--end proved reserves estimates, either positive or negative, resulting from new information other than an increase in proved acreage (extension). Revisions include increases of proved reserves associated with the installation of improved recovery techniques or equipment. They also include correction of prior report year arithmetical or clerical errors and adjustments to prior year--end production volumes to the extent that these alter reported prior year reserves estimates.

Royalty (Including Overriding Royalty) Interests: These interests entitle their owner(s) to a share of the mineral production from a property or to a share of the proceeds therefrom. They do not contain the rights and obligations of operating the property, and normally do not bear any of the costs of exploration, development, and operation of the property.

Subdivision: A prescribed portion of a given State or other geographical region defined in this publication for statistical reporting purposes.

Subsidiary Company: A company which is controlled through the ownership of voting stock, or a corporate joint venture in which a corporation is owned by a small group of businesses as a separate and specific business or project for the mutual benefit of the members of the group. (See **Control**)

Total Discoveries: The sum of extensions, new reservoir discoveries in old fields, and new field discoveries, which occurred during the report year.

Total Liquid Hydrocarbon Reserves: The sum of crude oil and natural gas liquids reserves volumes.

Total Operated Basis: The total reserves or production associated with the wells operated by an individual operator. This is also commonly known as the "gross operated" or "8/8ths" basis.

Working Interest: A working interest permits the owner(s) to explore, develop and operate a property. The working interest owner(s) bear(s) the costs of exploration, development and operation of the property, and in return is (are) entitled to a share of the mineral production from the property or to a share of the proceeds therefrom.