

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

1997 Annual Report

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Preface

The *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1997 Annual Report* is the 21st 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, 1997, as well as production volumes for the United States and selected States and State subdivisions for the year 1997. 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 1997 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 1997; 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.

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Contents

	Page
Executive Summary	ix
1. Introduction	1
Background	1
Survey Overview	1
Form EIA-23	1
Form EIA-64A	2
Data Collection Operations	2
2. Overview	3
National Summary	3
Crude Oil	3
Natural Gas	3
Natural Gas Liquids	7
Reserves Changes Since 1977	7
Economics and Drilling	10
Reserve-to-Production Ratios and Ultimate Recovery	11
R/P Ratios	11
Proved Ultimate Recovery	14
International Perspective	14
International Reserves	14
Petroleum Consumption	17
Dependence on Imports	17
List of Appendices	17
3. Crude Oil Statistics	19
Proved Reserves	19
Discussion of Reserves Changes	19
Total Discoveries	19
Extensions	22
New Field Discoveries	22
New Reservoir Discoveries in Old Fields	22
Revisions and Adjustments	22
Production	22
Areas of Note: Large Discoveries and Reserve Additions	22
Gulf of Mexico Federal Offshore	23
California	23
Texas	24
Alaska	24
Louisiana	24
Other Gain Areas	24
Areas of Note: Large Reserve Declines	24
Alaska	24
Texas	24
Other Decline Areas	25
Reserves in Nonproducing Reservoirs	25
Indicated Additional Reserves	25
4. Natural Gas Statistics	27
Dry Natural Gas	27
Proved Reserves	27
Discussion of Reserves Changes	27
Revisions and Adjustments	27
Discoveries	30
Production	30
Wet Natural Gas	30
Nonassociated Natural Gas	30
Proved Reserves	30
Discoveries	30

Production	34
Associated-Dissolved Natural Gas	34
Proved Reserves	34
Production	34
Coalbed Methane	34
Proved Reserves	34
Production	34
Areas of Note: Large Discoveries and Reserves Additions	35
Alaska	35
Gulf of Mexico	35
Texas	35
Wyoming	36
Areas of Note: Large Reserves Declines	36
New Mexico	36
Colorado	36
Kansas	37
Reserves in Nonproducing Reservoirs	37
5. Natural Gas Liquids Statistics	39
Natural Gas Liquids	39
Proved Reserves	39
Discoveries	39
Production	39
Natural Gas Plant Liquids	39
Proved Reserves	39
Production	43
Lease Condensate	43
Proved Reserves	43
Production	43
Reserves in Nonproducing Reservoirs	43
References	45
Appendices	
A. Operator Data by Size Class	49
B. Top 100 Oil and Gas Fields for 1997	59
C. Conversion to the Metric System	67
D. Historical Reserves Statistics	71
E. Summary of Data Collection Operations	97
F. Statistical Considerations	105
G. Estimation of Reserves and Resources	125
H. Maps of Selected State Subdivisions	135
I. Annual Survey Forms for Domestic Oil and Gas Reserves	145
Glossary	153
Tables	
1. U.S. Proved Reserves of Crude Oil, Dry Natural Gas, and Natural Gas Liquids, 1987-1997	4
2. Reserves Changes, 1977-1997	9
3. U.S. Average Annual Domestic Wellhead Prices for Crude Oil and Natural Gas, and the Average Number of Active Rotary Drilling Rigs, 1970-1997	10
4. U.S. Exploratory and Development Well Completions, 1970-1997	12
5. International Oil and Natural Gas Reserves as of December 31, 1997	16
6. Crude Oil Proved Reserves, Reserves Changes, and Production, 1997	20
7. Reported Indicated Additional Crude Oil Reserves, 1997	26
8. Dry Natural Gas Proved Reserves, Reserves Changes, and Production, 1997	28

9. Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 1997	31
10. Nonassociated Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 1997	32
11. Associated-Dissolved Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 1997	33
12. U.S. Coalbed Methane Proved Reserves and Production, 1993-1997	35
13. Reported Reserves of Natural Gas, Wet After Lease Separation, in Nonproducing Reservoirs, 1997	38
14. Natural Gas Liquids Proved Reserves, Reserves Changes, and Production, 1997	40
15. Natural Gas Plant Liquids Proved Reserves and Production, 1997.	41
16. Lease Condensate Proved Reserves and Production, 1997	42

Figures

1. U.S. Crude Oil Proved Reserves, 1986-1997	5
2. Components of Reserves Changes for Crude Oil, 1986-1997	5
3. U.S. Dry Natural Gas Proved Reserves, 1986-1997	6
4. Components of Reserves Changes for Dry Natural Gas, 1986-1997	6
5. U.S. Natural Gas Liquids Proved Reserves, 1986-1997	8
6. Components of Reserves Changes for Natural Gas Liquids, 1986-1997	8
7. U.S. Exploratory Gas Well Completions, 1977-1997	13
8. U.S. Exploratory Oil Well Completions, 1977-1997	13
9. U.S. Total Discoveries of Dry Natural Gas per Exploratory Gas Well Completion, 1977-1997	13
10. U.S. Total Discoveries of Crude Oil per Exploratory Oil Well Completion, 1977-1997	13
11. Reserves-to-Production Ratios for Crude Oil, 1945-1997.	15
12. Reserves-to-Production Ratios for Wet Natural Gas, 1945-1997	15
13. Components of Ultimate Recovery for Crude Oil and Lease Condensate, 1977-1997	15
14. Components of Ultimate Recovery for Wet Natural Gas, 1977-1997	15
15. Reserve Additions Nearly Replace U.S. Oil Production in 1997	19
16. 1997 Crude Oil Proved Reserves by Area	21
17. Changes in Crude Oil Proved Reserves by Area, 1996 to 1997	21
18. Reserve Additions Exceed U.S. Natural Gas Production 3 Years in a Row	27
19. 1997 Dry Natural Gas Proved Reserves by Area	29
20. Changes in Dry Natural Gas Proved Reserves by Area, 1996 to 1997	29
21. Coalbed Methane Proved Reserves, 1990-1997	34

Executive Summary

U.S. proved reserves of crude oil increased in 1997 for the first time in a decade. Natural gas reserves were up for the fourth year in a row. Surprisingly large revisions in some of California's old and heavy oil fields provided over half the oil increase. Oil and gas discoveries in the Federal offshore—several in deep water—also played a major role in the oil reserves increase and the continuation of gas reserves increases. Successful oil and gas well completions were up.

As of December 31, proved reserves were:

Dry Natural Gas (billion cubic feet)	
1996	166,474
1997	167,223
Increase	+0.4%
Crude Oil (million barrels)	
1996	22,017
1997	22,546
Increase	+2.4%
Natural Gas Liquids (million barrels)	
1996	7,823
1997	7,973
Increase	+1.9%

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 1997 U.S. proved reserves of crude oil, natural gas, and natural gas liquids is the 21st in the annual series prepared by the Energy Information Administration.

Natural Gas

Gas reserve additions replaced gas production again in 1997. Lower 48 States natural gas reserves declined slightly in 1997, but increases in Alaskan reserves due to *revisions and adjustments* more than made up for it. Gas production has trended up since 1986 and is now 3.6 trillion cubic feet higher, yet, in each of the last four years reserve additions replaced production. The largest gas reserve additions were in the Federal Offshore closely followed by those in

Texas. For 1997, *revisions and adjustments* to reserves in existing fields were the lowest in the past decade and half of 1996's. In contrast, total gas discoveries were the highest in the past decade.

U.S. *total discoveries* of dry gas reserves were 15,648 billion cubic feet in 1997, up 27 percent from a very good 1996. Texas and the Gulf of Mexico Federal Offshore accounted for over three-fifths of them. *Total discoveries*, which equaled 81 percent of 1997 gas production, are those reserves attributable to field *extensions*, *new field discoveries*, and *new reservoir discoveries in old fields*. They result from drilling exploratory wells.

- *New field discoveries* were 2,681 billion cubic feet, up substantially from 1996 and twice the prior 10-year average.
- *Field extensions* were 10,585 billion cubic feet, up from 1996 and 68 percent above the prior 10-year average.
- *New reservoir discoveries in old fields* were 2,382 billion cubic feet, down from 1996.

Coalbed methane reserves continued to grow faster than conventional natural gas reserves, accounting for nearly 7 percent of 1997's proved gas reserves. Coalbed methane production, now over 5 percent of the U.S. total, also increased faster.

Other 1997 natural gas events of note:

- Exploratory gas well completions were down slightly at 538 in 1997.
- Total discoveries per exploratory gas well were up in 1997 and more than four times the rates of the early 1980s.
- Natural gas prices at the wellhead increased slightly to an annual average of \$2.23 per thousand cubic feet.

Crude Oil

Crude oil reserve additions replaced 125 percent of 1997 oil production, a result of the first reserves increase in a decade.

Total discoveries of crude oil were 1,233 million barrels in 1997, roughly twice as high as the prior 10-year average and a third higher than in 1996. The Gulf of Mexico Federal Offshore accounted for over

50 percent, much of it in deep water, Texas had 15 percent, and Alaska 11 percent.

Improved technologies for exploration and deepwater production enhanced the ability to discover and develop offshore fields, especially in deep water. British Borneo's Morpeth project in 1700 feet of water is an example of the use of state-of-the-art engineering and technology that lowers field development cost in deep water. The field needed a way to inject water to maintain reservoir pressure and oil production. A mini-tension leg platform (SeaStar) and the first subsea injection well in the Gulf of Mexico were used to develop this oil field that would otherwise have been uneconomic.

New field discoveries were 637 million barrels, more than twice those of 1996 and over 5 times the prior 10-year average. The Gulf of Mexico Federal Offshore had 79 percent of the new field discoveries, Alaska had 18 percent, and the rest of the country had less than 3 percent. Well over half of the proved reserves of oil in the Gulf of Mexico are now in deep water (water depths greater than 200 meters, about two football fields).

Reserves in new fields are not counted by EIA until they are proved. Many years may elapse between the time an exploratory well locates a new field and the year those oil or gas reserves are accepted as proved. For example, the well that discovered the West Sak Field in Alaska was drilled in 1971. But it was not until 1997 that production facility sharing arrangements and new low-cost drilling and completion technologies made the field economic to develop and hence proved.

- *New reservoir discoveries* in old fields were 119 million barrels, down some from 1996 but still close to the prior 10-year average.
- *Field extensions*, up in 1997, added 477 million barrels of proved oil reserves.
- *Revisions and adjustments* were 1,434 million barrels in 1997. Even in an outstanding discovery year, they still accounted for over half of total oil reserve additions. Texas and California, States with large oil reserves and large enhanced oil recovery projects, had over half of *revisions and adjustments*.

Technology improvements allowed California operators to revise upward the reserves in old fields with viscous heavy oil. For example, more oil is efficiently heated by replacing less efficient steam cycling processes with continuous steam injection

that lowers the oil viscosity allowing it to move more easily to producing wells. This lowers costs and increases production rates.

Alaska's reserves declined in 1997 despite substantial new field discoveries because there were not enough *revisions and adjustments* to replace production.

Other 1997 crude oil events of note:

- The annual average domestic first purchase price for crude oil declined 7 percent during 1997 to \$17.24 per barrel.
- Exploratory oil completions were down some at 418. However, total oil well completions increased to 10,310 owing to an increase in oil development activity.
- Total discoveries per exploratory oil well were up over 50 percent in 1997, and over six times the rates of the early 1980's when oil prices and the drilling boom peaked.

Indicated additional reserves of crude oil increased to 3,207 million barrels in 1997. 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 continue to occur in the future.

Natural Gas Liquids

U.S. natural gas liquids proved reserves increased 2 percent to 7,973 million barrels in 1997. 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 30,525 million barrels in 1997, another increase. Natural gas liquids were about a quarter of total proved reserves of liquid hydrocarbon in 1997.

Data

These estimates are based upon analysis of data from Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," filed by 3480 operators of oil and gas wells, and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production," filed by operators of 697 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 1997. 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 22,678 probable active operators and the Form EIA-64A plant frame contained 654 probable active natural gas processing plants in the United States when the 1997 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 1997.

For the report year 1997, EIA mailed 641 EIA-23 forms to all known large and intermediate size oil and gas well operators that were believed to be active during 1997. Of these, 51 were found to be nonoperators that did not have successor operators in 1997. Data were received from 587 operators, an overall response rate of 100 percent of the active operators in the Form EIA-23 survey. EIA mailed 654 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 652 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 1997, the Form EIA-23 National production estimates were 1.8 percent lower than the comparable *Petroleum Supply Annual 1997* volumes for crude oil and lease condensate combined, and were 1.6 percent higher than the comparable *Natural Gas Annual 1997* volume for 1997 dry natural gas. For report year 1997, the Form EIA-64A National estimates were 4.1 percent higher than the *Petroleum Supply Annual 1997* volume for natural gas plant liquids production.

2. Overview

National Summary

The United States had the following proved reserves as of December 31, 1997:

- **Crude Oil — 22,546 million barrels**
- **Dry Natural Gas — 167,223 billion cubic feet**
- **Natural Gas Liquids — 7,973 million barrels.**

This Overview summarizes the 1997 proved reserves balances of crude oil, dry natural gas, and natural gas liquids on a National level and provides historical comparisons between 1997 and years past.

Table 1 lists the estimated annual reserve balances since 1987. In 1997, proved reserves of crude oil increased by 2.4 percent, the first increase in the last decade. Proved reserves of dry natural gas increased by 0.4 percent over the 1996 proved reserves level, making 1997 the fourth consecutive year that gas reserves have increased.

Crude Oil

Proved reserves of crude oil increased by 529 million barrels in 1997. The largest increase occurred in the Federal Offshore portion of the Gulf of Mexico, where 382 million barrels of crude oil proved reserves were added. California was a close second, where reserves additions in the heavy oil fields raised the State total by 313 million barrels. **Figure 1** shows the crude oil proved reserves levels by major region and **Figure 2** shows the components of reserves changes from 1987 through 1997.

As shown in **Figure 2**, total reserve additions (the positive side of the scale) were up substantially in 1997, due to large increases in the volumes of *new field discoveries* and *revisions and adjustments*. Production of crude oil (the negative side of **Figure 2**'s scale) declined slightly for the sixth 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 1,233 million barrels of *total discoveries* of crude oil proved reserves in 1997. This is 33 percent more than in 1996.

Extensions added 477 million barrels of proved reserves. This is 12 percent less than in 1996 (543

million barrels) and 9 percent more than the average *extensions* in the prior 10 years (436 million barrels).

New field discoveries were 637 million barrels, more than twice the 1996 level and more than five times the average volume discovered in the prior 10 years (122 million barrels). New field discoveries in Alaska and the Gulf of Mexico Federal Offshore made up 98 percent of the 1997 volume.

New reservoir discoveries in old fields added 119 million barrels of proved reserves. This is less than the 1996 level (141 million barrels) and the prior 10-year average for the United States (135 million barrels).

Revisions and adjustments added 1,434 million barrels of proved reserves. This is 57 percent more than the 1996 volume (912 million barrels) and 11 percent more than the average volume in the prior 10 years (1,293 million barrels).

Production removed an estimated 2,138 million barrels of proved reserves from the National total. Production was down 2 percent from 1996's level (2,173 million barrels) and at 86 percent of the prior 10-year average (2,473 million barrels). Reserves additions in 1997 replaced 125 percent of production.

Natural Gas

U.S. proved reserves of dry natural gas increased for the fourth year in a row in 1997—up 0.4 percent from 1996's level to a total of 167,223 billion cubic feet. Dry natural gas reserves declined by 519 billion cubic feet in the Lower 48 States, but reserves additions in Alaska more than made up for that. **Figure 3** shows the dry natural gas proved reserves levels by major region and **Figure 4** shows the components of reserves changes from 1987 through 1997. Dry natural gas production increased for the second consecutive year in 1997, and operators were able to replace 104 percent of 1997's dry gas production with new reserves.

For 1997, U.S. *total discoveries* of dry gas reserves were 15,648 billion cubic feet, up 27 percent from 1996. *Total discoveries* were 78 percent of all reserve additions in 1997, while *revisions and adjustments* provided the remaining 22 percent.

Table 1. U.S. Proved Reserves of Crude Oil, Dry Natural Gas, and Natural Gas Liquids, 1987-1997

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)											
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
Dry Natural Gas (billion cubic feet, 14.73 psia, 60° Fahrenheit)											
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	^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
Natural Gas Liquids (million barrels of 42 U.S. gallons)											
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

^aRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.^bTotal discoveries = Col. 5 + Col. 6 + Col. 7.^cProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.^dAn 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 1997 contained in the *Petroleum Supply Annual 1997*, DOE/EIA-0340(97) and the *Natural Gas Annual 1997*, DOE/EIA-0131(97).Sources: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, 1987 through 1997 annual reports, DOE/EIA-0216.{10-20}

Figure 1. U.S. Crude Oil Proved Reserves, 1987-1997

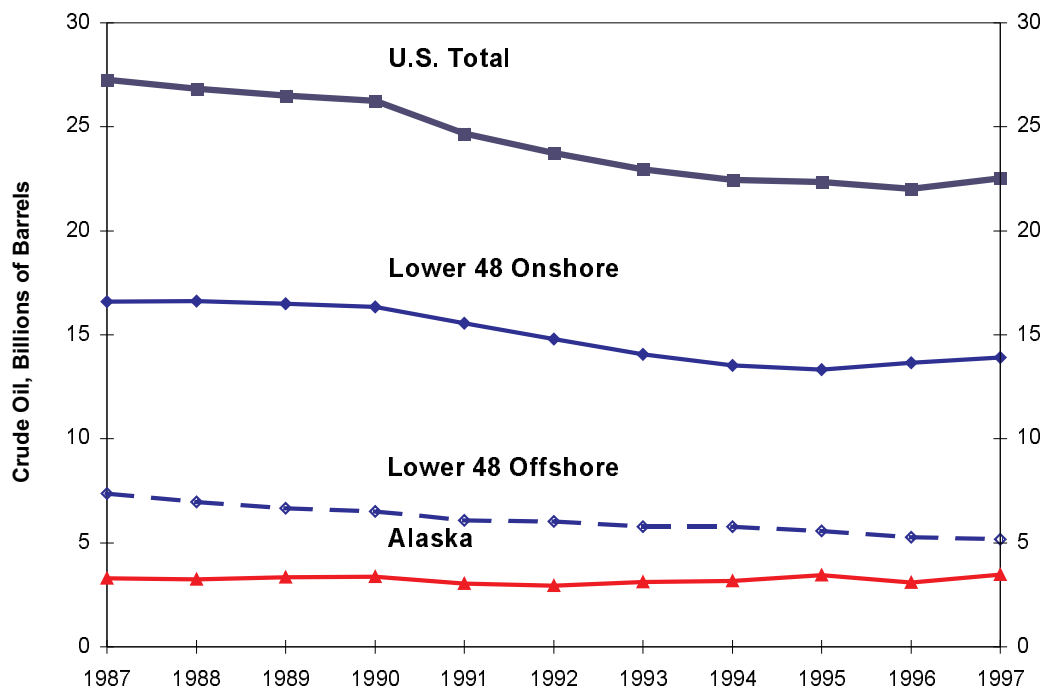
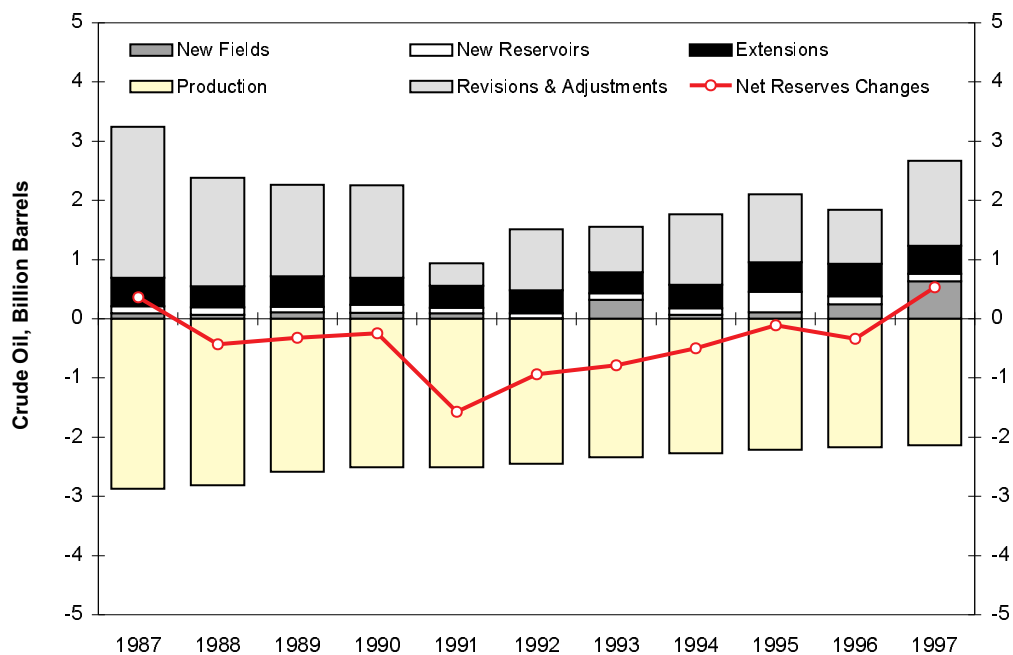


Figure 2. Components of Reserves Changes for Crude Oil, 1987-1997



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1987-1997 annual reports, DOE/EIA-0216.{10-20}

Figure 3. U.S. Dry Natural Gas Proved Reserves, 1987-1997

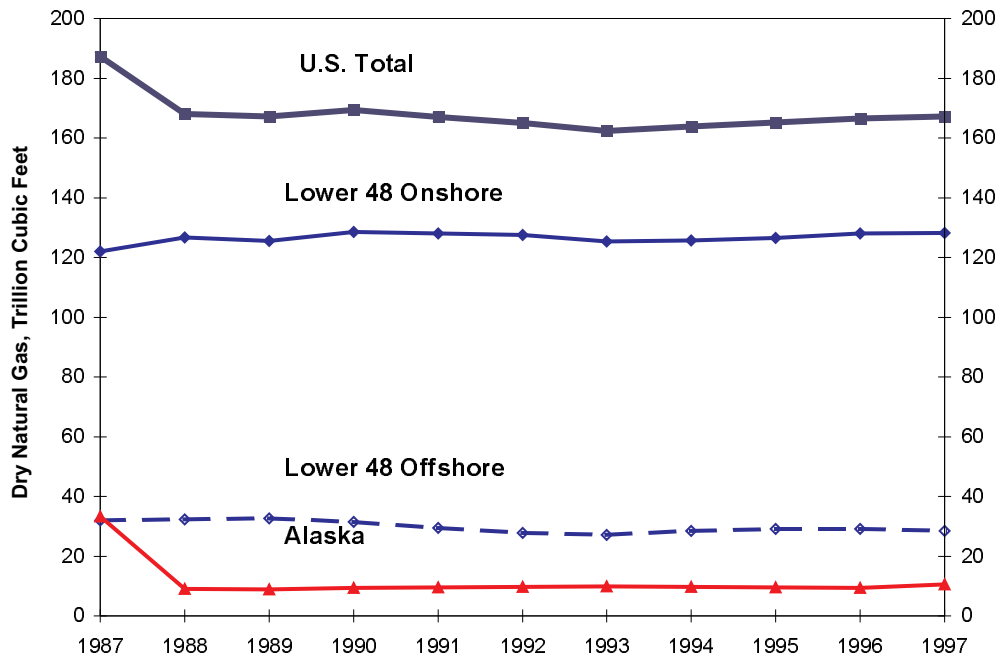
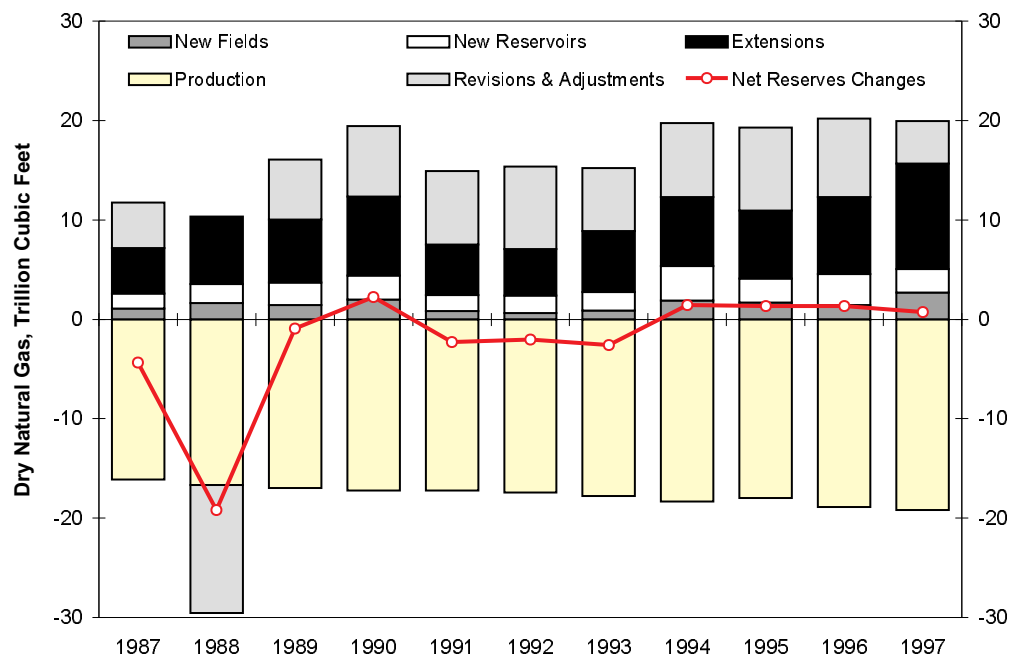


Figure 4. Components of Reserves Changes for Dry Natural Gas, 1987-1997



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1987-1997 annual reports, DOE/EIA-0216.{10-20}

Extensions added 10,585 billion cubic feet of proved reserves. This is 36 percent more than 1996's *extensions* and 68 percent more than the average of *extensions* in the prior 10 years (6,309 billion cubic feet).

New field discoveries added 2,681 billion cubic feet of proved reserves. This is 85 percent more than what was discovered in 1996 and 97 percent higher than the average volume discovered in the prior 10 years (1,359 billion cubic feet).

New reservoir discoveries in old fields added 2,382 billion cubic feet of proved reserves. This is 23 percent less than the volume discovered in 1996, but 7 percent higher than the prior 10-year average (2,230 billion cubic feet).

Revisions and Adjustments added 4,312 billion cubic feet of proved reserves. This is 45 percent less than 1996's revisions and adjustments and 85 percent of the prior 10-year average.

Production removed an estimated 19,211 billion cubic feet of proved reserves from the National total. Gas production increased compared to 1996, for the second consecutive year.

Coalbed methane gas production and reserves are included in the 1997 totals. However, EIA separately tracks of these reserves in order to record the development and performance of this gas source. Coalbed methane reserves increased in 1997 to a volume of 11,462 billion cubic feet. Coalbed methane accounts for 7 percent of 1997 U.S. dry natural gas reserves and 6 percent of 1997 U.S. dry gas production. No Federal tax incentives for new coalbed methane wells have been available for 4 years.

Natural Gas Liquids

Proved reserves of natural gas liquids increased 150 million barrels to 7,973 million barrels during 1997—2 percent higher than 1996 levels. An increase of 294 million barrels occurred in Alaska, while the lower 48 States' reserves decreased by 144 million barrels. **Figure 5** shows the natural gas liquids proved reserves levels by major region and **Figure 6** shows the components of reserves changes from 1987 through 1997.

Operators replaced 117 percent of their 1997 natural gas liquids production with reserve additions. *Total discoveries* accounted for 73 percent of all reserve

additions, while *revisions and adjustments* accounted for the remaining 27 percent.

Total proved reserves of liquid hydrocarbons (crude oil plus natural gas liquids) were 30,519 million barrels in 1997—an increase of 679 million barrels from the 1996 level. Natural gas liquids represented 26 percent of total liquid hydrocarbon proved reserves in 1997.

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 1977 through 1997. **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 1997 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 813 million barrels per year of new reserves
- revised and adjusted their proved reserves upward by an average of 1,363 million barrels per year from *revisions and adjustments*
- ended each year with an average net reduction in U.S. proved reserves of 522 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 Proved Ultimate Recovery section later in this chapter.), rather than the discovery of new oil fields. Only 7.6 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 63 percent of all crude oil reserves additions. The 17,069 million barrels of *total discoveries* accounted for the remaining 37 percent of reserves additions.

Figure 5. U.S. Natural Gas Liquids Proved Reserves, 1987-1997

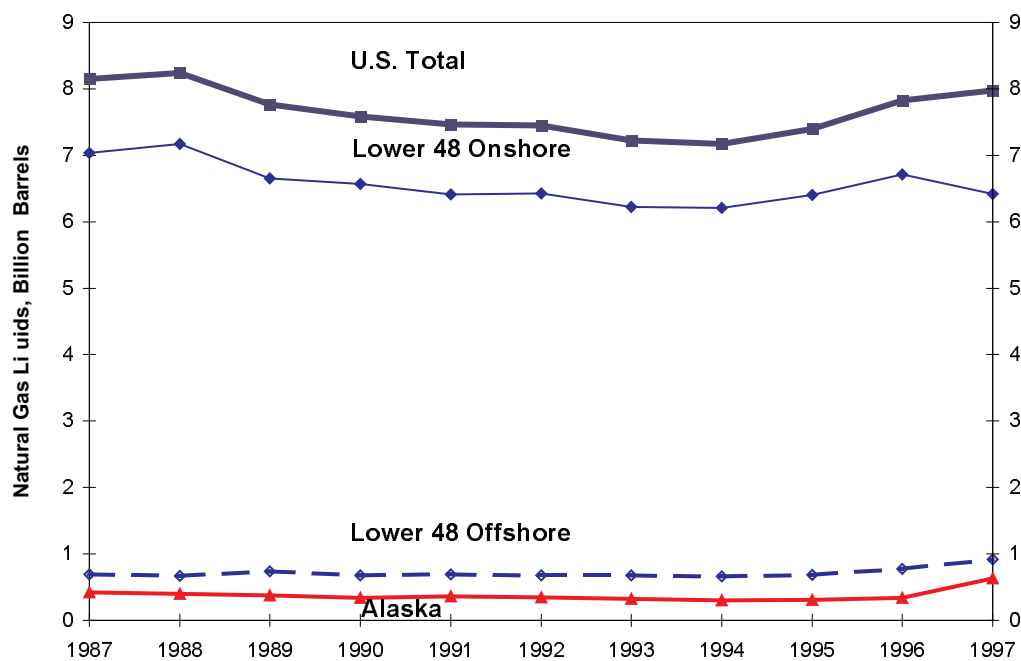
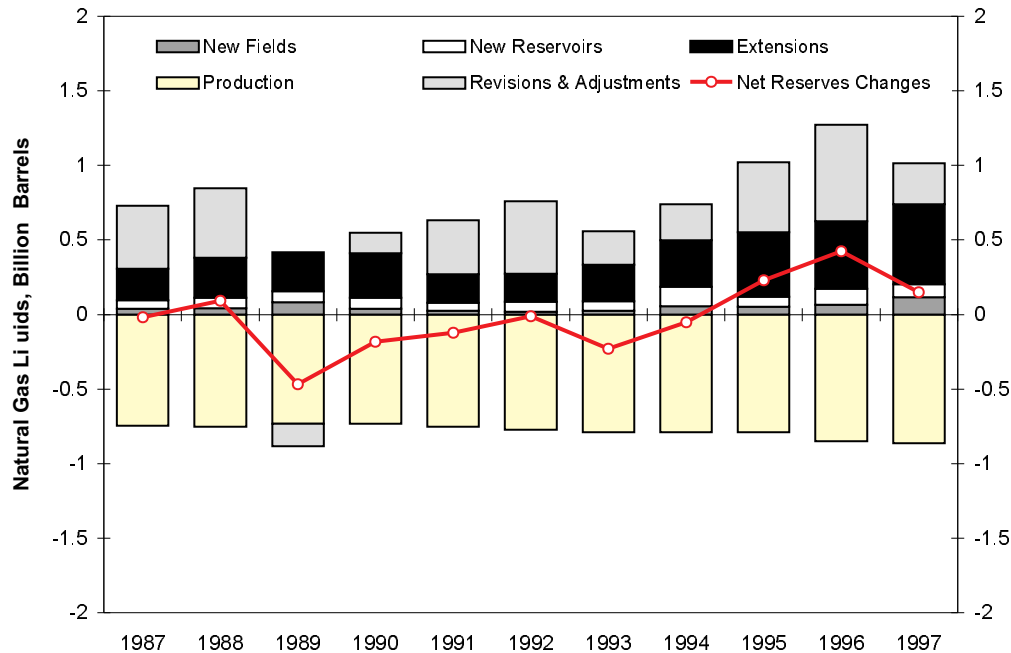


Figure 6. Components of Reserves Changes for Natural Gas Liquids, 1987-1997



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1987-1997 annual reports, DOE/EIA-0216.{10-20}

Table 2. Reserves Changes, 1977-1997

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	2,987	142	8.1	3,482	166	7.6
New Reservoir Discoveries in Old Fields . .	2,879	137	7.8	2,909	139	6.4
Extensions	9,557	455	26.0	10,678	508	23.4
Total Discoveries	15,423	734	41.9	17,069	813	37.4
Revisions and Adjustments	21,348	1,017	58.1	28,620	1,363	62.6
Total Reserve Additions	36,771	1,751	100.0	45,688	2,176	100.0
Production	44,314	2,110	120.5	56,645	2,697	124.0
Net Reserve Change	-7,543	-359	-20.5	-10,956	-522	-24.0
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	41,567	1,979	12.3	41,655	1,984	12.9
New Reservoir Discoveries in Old Fields . .	54,138	2,578	16.0	54,503	2,595	16.8
Extensions	156,060	7,431	46.0	156,975	7,475	48.4
Total Discoveries	251,765	11,989	74.3	253,133	12,054	78.1
Revisions and Adjustments	87,274	4,156	25.7	71,009	3,381	21.9
Total Reserve Additions	339,039	16,145	100.0	324,142	15,435	100.0
Production	363,216	17,296	107.1	370,197	17,628	114.2
Net Reserve Change	-24,177	-1,151	-7.1	-46,055	-2,193	-14.2

Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1977-1997 annual reports, DOE/EIA-0216.{1-20}

Compared to the average reserves changes since 1977, 1997 was a good year for crude oil discoveries. 1997's *total discoveries* of crude oil exceeded the post-1976 U.S. average by 52 percent, while *revisions and adjustments* were 5 percent higher than the post-1976 U.S. average.

Only one component of *total discoveries* exceeded the post-1976 averages—*new field discoveries*. Since 1977, operators have found only an average of 166 million barrels of crude oil proved reserves per year from *new field discoveries*. In 1997, operators discovered 637 million barrels of proved reserves—384 percent of the post-1976 average.

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

- discovered an average of 12,054 billion cubic feet per year of new reserves
- revised and adjusted their proved reserves upward by an average 3,381 billion cubic feet per year
- had an average net reduction in U.S. reserves of 2,193 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 48 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, but in 1997 it matched the National average of 22 percent.

Compared to the average reserves changes since 1977, 1997 was a good year for natural gas reserve additions from *total discoveries*. U.S. total dry natural gas reserves increased for the fourth year in a row. Operators reported 15,648 billion cubic feet of *total discoveries* to their dry natural gas proved reserves—30 percent higher than the post-1976 average (12,054 billion cubic feet). However, compared to the post-1976 U.S. average, *net revisions and adjustments* were lower.

Economics and Drilling

Economics: 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 1997.

The U.S. crude oil first purchase price (less the Alaskan North Slope) started at an average of \$22.68 per barrel in January 1997, but declined to \$17.21 per barrel in April. Prices wavered until October, when they began an unabated five-month decline from \$18.56 in October 1997 to \$11.53 in March 1998. In 1997 constant dollars, this price was approximately the same as the price in

1970. The average U.S. crude oil first purchase price (less the Alaskan North Slope) declined from an average \$19.41 in 1996 to \$17.92 per barrel in 1997.

Oil prices vary by region. In Texas the average 1997 price was \$18.64 per barrel, while in California it was \$15.78 per barrel, and only \$14.84 per barrel on the Alaskan North Slope. The lowest average crude oil first purchase price in 1997 was for Federal Offshore California oil—\$12.97 per barrel{21}.

The average annual wellhead natural gas price increased from \$2.17 in 1996 to \$2.23 per thousand cubic feet in 1997. Gas prices started at \$3.42 per thousand cubic feet in January 1997, but declined to

Table 3. U.S. Average Annual Domestic Wellhead Prices for Crude Oil and Natural Gas, and the Average Number of Active Rotary Drilling Rigs, 1970-1997

Year	Crude Oil		Natural Gas		Number of Rigs
	Current	1997 Constant	Current	1997 Constant	
	(dollars per barrel)		(dollars per thousand cubic feet)		
1970	3.18	11.60	0.17	0.62	1,028
1971	3.39	11.75	0.18	0.62	976
1972	3.39	11.29	0.19	0.63	1,107
1973	3.89	12.26	0.22	0.69	1,194
1974	6.87	19.91	0.30	0.87	1,472
1975	7.67	20.28	0.44	1.16	1,660
1976	8.19	20.49	0.58	1.45	1,658
1977	8.57	20.18	0.79	1.86	2,001
1978	9.00	19.69	0.91	1.99	2,259
1979	12.64	25.51	1.18	2.38	2,177
1980	21.59	39.89	1.59	2.94	2,909
1981	31.77	53.80	1.98	3.35	3,970
1982	28.52	45.40	2.46	3.92	3,105
1983	26.19	39.98	2.59	3.95	2,232
1984	25.88	38.05	2.66	3.91	2,428
1985	24.09	34.20	2.51	3.56	1,980
1986	12.51	17.32	1.94	2.69	964
1987	15.40	20.68	1.67	2.24	936
1988	12.58	16.31	1.69	2.19	936
1989	15.86	19.73	1.69	2.10	869
1990	20.03	23.88	1.71	2.04	1,010
1991	16.54	18.97	1.64	1.88	860
1992	15.99	17.84	1.74	1.94	721
1993	14.25	15.50	2.04	2.22	754
1994	13.19	14.01	1.85	1.96	775
1995	14.62	15.18	1.55	1.61	723
1996	R19.41	19.78	R2.17	2.21	779
1997	17.92	17.92	2.23	2.23	943

R=Revised data.

Sources: Current dollars and number of rigs: *Monthly Energy Review September 1998*, DOE/EIA-0035(98/09). 1997 constant dollars: U.S. Department of Commerce, Bureau of Economic Analysis, Gross Domestic Product Implicit Price Deflators, June 1998.

\$1.61 per thousand cubic feet by March 1997 (the lowest average price of the year). In June, prices rose to \$2.01, but declined to \$1.91 in July. In November, prices reached \$2.77 per thousand cubic feet, yet declined in December to \$2.17 per thousand cubic feet, more than a dollar less than prices of December 1996.{22}

Drilling: From 1996 to 1997, the annual average active rig count increased from 779 to 943 (**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 3,031 exploratory wells drilled in 1997 (**Table 4**). Of these, 14 percent were oil wells, 18 percent were gas wells, and 68 percent were dry holes. The total (which includes dry holes) was 4 percent less than in 1996.

Although the number of active rigs increased in 1997, there were fewer successful exploratory wells. There were 5 percent less exploratory gas wells (**Figure 7**) and 13 percent fewer exploratory oil wells (**Figure 8**) than in 1996. On the other hand, as shown in Table 4, the number of successful development wells increased for both oil and gas.

Figures 9 and 10 show the average volume of discoveries per exploratory well for dry natural gas and oil, respectively, since 1977. The average volume of gas discoveries per exploratory well increased 32 percent in 1997 from the 1996 level. The average volume of oil discoveries per exploratory well in 1997 is 53 percent higher than 1996's level. There were an estimated 27,007 exploratory and development wells drilled in 1997, 19 percent more than in 1996 and slightly higher the average number of wells drilled annually in the prior 10 years (26,893).

Operators completed more oil and gas wells in 1997 than in 1996. For the fifth year in a row, the number of gas well completions exceeded the number of oil well completions in both the exploratory and development categories.

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 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.

In 1997, U.S. crude oil proved reserves increased and oil production decreased—resulting in a slight increase in the National average R/P ratio, from 10.1 to 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 1997 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 (CO₂) injection or

Table 4. U.S. Exploratory and Development Well Completions,^a 1970-1997

Year	Exploratory ^b				Total Exploratory and Development ^b			
	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	2,197	1,521	11,278	14,996	42,605	17,127	25,681	85,413
1985	1,679	1,189	8,924	11,792	35,118	14,168	21,056	70,342
1986	1,084	793	5,549	7,426	19,097	8,512	12,661	40,270
1987	925	753	5,049	6,727	16,164	8,055	11,101	35,320
1988	855	730	4,691	6,276	13,636	8,555	10,041	32,232
1989	607	707	3,924	5,238	10,204	9,539	8,188	27,931
1990	653	691	3,715	5,059	12,198	11,044	8,309	31,551
1991	593	538	3,312	4,443	11,770	9,526	7,599	28,895
1992	496	424	2,510	3,430	8,757	8,209	6,118	23,084
1993	500	544	2,470	3,514	8,365	10,005	6,295	24,665
1994	566	720	2,400	3,686	6,690	9,538	5,279	21,507
1995	541	567	2,198	3,306	7,627	8,337	5,075	21,039
1996	481	560	2,130	3,171	8,301	9,185	5,220	22,706
1997	418	534	2,079	3,031	10,268	11,245	5,494	27,007

^aExcludes service wells and stratigraphic and core testing.

^bAll drilling counts for the years 1973-1996 have been revised.

Notes: Estimates are based on well completions taken from American Petroleum Institute data tapes through June 1997. 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 1973-1997: *Monthly Energy Review* September 1998, DOE/EIA-0035(98/09).

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 decreased in 1997, as the proportional increase in reserves was not as much as the increase in production.

Different marketing, transportation, and production characteristics for gas are seen when looking at regional average R/P ratios, compared to the 1997 U.S. average R/P ratio of about 8.7-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

Figure 7. U.S. Exploratory Gas Well Completions, 1977-1997

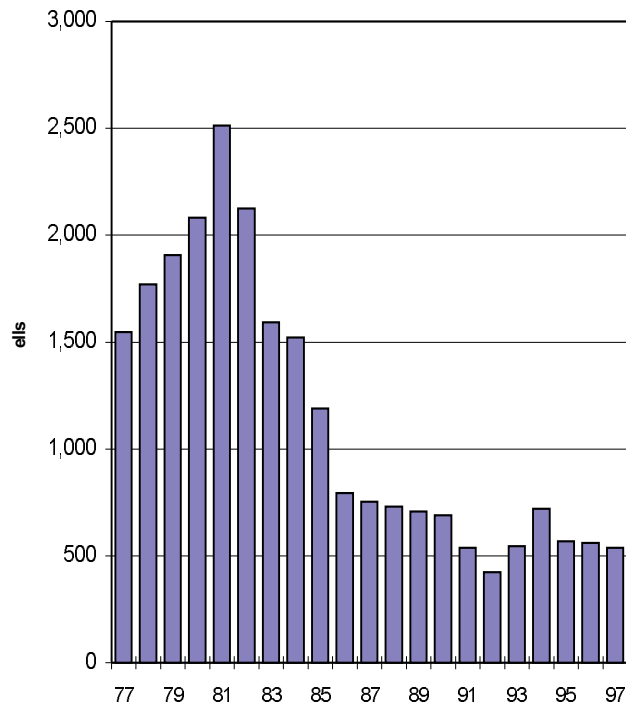


Figure 9. U.S. Total Discoveries of Dry Natural Gas per Exploratory Gas Well Completion, 1977-1997

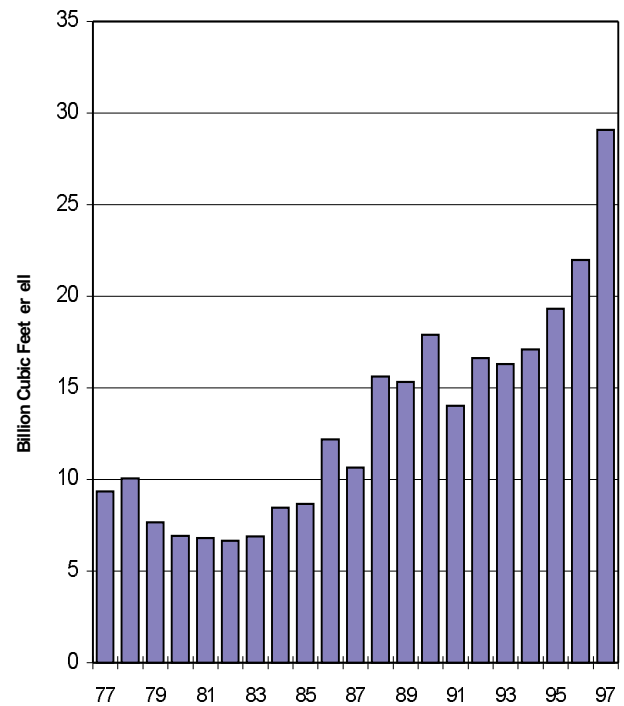


Figure 8. U.S. Exploratory Oil Well Completions, 1977-1997

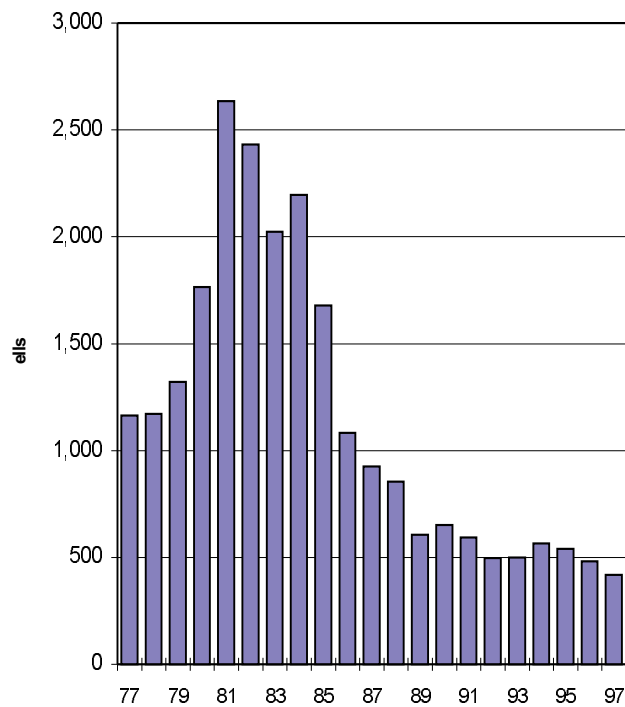
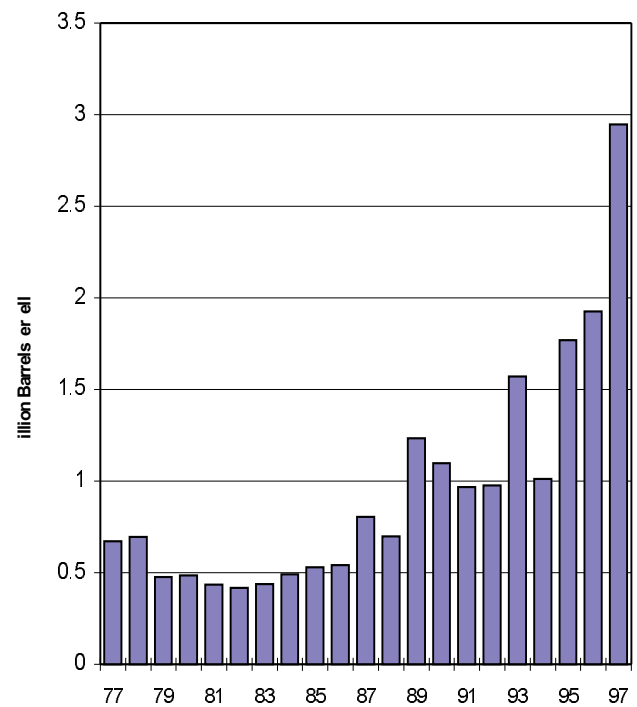


Figure 10. U.S. Total Discoveries of Crude Oil per Exploratory Oil Well Completion, 1977-1997



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

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 decreased from 7.0-to-1 in 1996 to 6.8-to-1 in 1997, and is below the National 1997 average.

Proved Ultimate Recovery

EIA in past reports has 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 1997. 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 for 1977 through 1997 was 57,258 million barrels. This substantially exceeds the 1977 proved reserves, but at the end of 1997 there were still 23,887 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 7.6 percent of proved reserves additions of crude oil were booked as *new field discoveries* from 1976 through 1997. 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 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 1997.

Similarly, the 1977 wet natural gas proved reserves were 209,490 billion cubic feet, and cumulative wet gas production from 1977 through 1997 was 371,368 billion cubic feet. Cumulative wet gas production exceeded the 1977 reserves by 161,878 billion cubic feet, but at the end of 1997 there were still 175,721 billion cubic feet of wet natural gas proved reserves, for the same reasons. Only 12.9 percent of proved reserve additions of natural gas were booked as *new field discoveries* from 1976 through 1997.

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 11th in the world for proved reserves of crude oil and 6th for natural gas in 1997, unchanged from 1996. 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 1997. There are sometimes substantial differences between the estimates from these sources. The *Oil & Gas Journal* reported oil reserves for the United Arab Emirates at

Figure 11. Reserves-to-Production Ratios for Crude Oil, 1945-1997

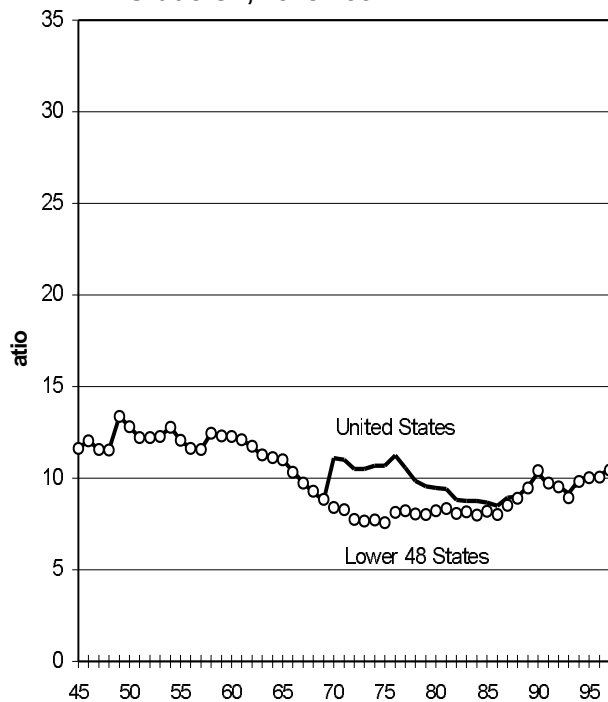


Figure 13. Components of Proved Ultimate Recovery for Crude Oil and Lease Condensate, 1977-1997

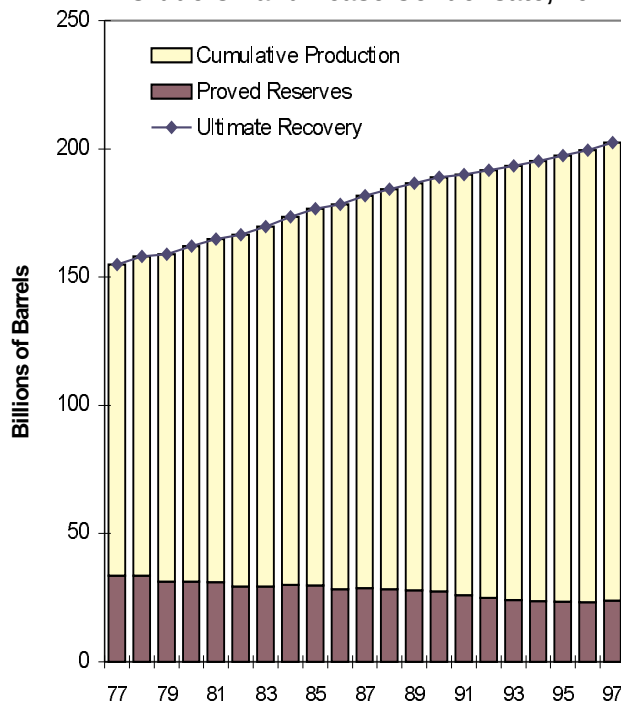


Figure 12. Reserves-to-Production Ratios for Wet Natural Gas, 1945-1997

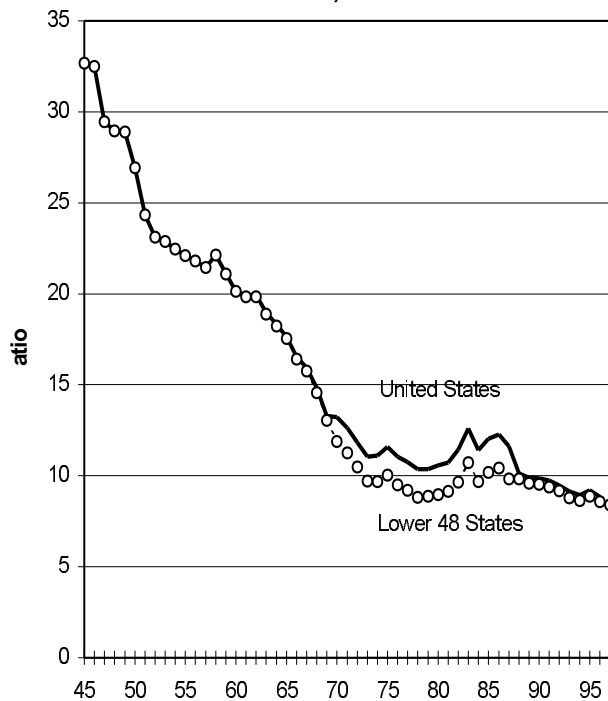
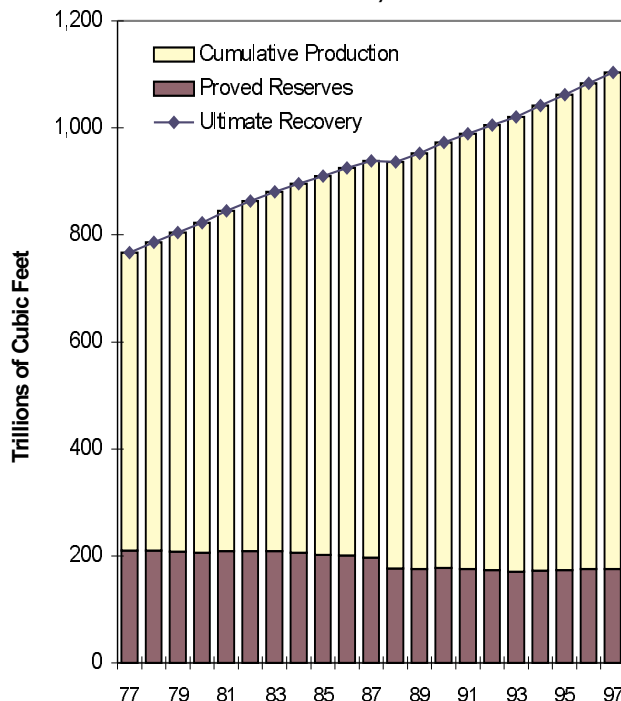


Figure 14. Components of Proved Ultimate Recovery for Wet Natural Gas, 1977-1997



Sources: Annual reserves and production - American Petroleum Institute and American Gas Association (1945-1976){23} and Energy Information Administration, Office of Oil and Gas (1977-1997){1-20}. Cumulative production: *U.S. Oil and Gas Reserves by Year of Field Discovery* (1977-1988){24}

Table 5. International Oil and Natural Gas Reserves as of December 31, 1997

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 263,800	1	Former U.S.S.R.	1,977,000	1,891,308
2	Iraq ^c	112,500	99,665	2	Iran ^c	810,000	812,239
3	Kuwait ^c	^d 96,500	^d 93,480	3	Qatar ^c	300,000	270,000
4	Iran ^c	93,000	89,700	4	Saudi Arabia ^c	^d 190,000	^d 230,363
5	United Arab Emirates ^c	97,800	63,642	5	United Arab Emirates ^c	205,400	208,843
6	Former U.S.S.R.	57,000	63,065	6	United States	^e166,474	^f168,055
7	Venezuela ^c	71,669	45,500	7	Venezuela ^c	143,078	145,522
8	Mexico	40,000	40,822	8	Algeria ^c	130,600	139,500
9	China	24,000	34,030	9	Nigeria ^c	114,852	109,200
10	Libya ^c	29,500	26,900	10	Iraq ^c	109,800	112,600
Top 10 Total		883,679	820,604	Top 10 Total		4,151,804	4,087,630
11	United States	^e22,217	^f21,685	11	Indonesia ^c	72,268	137,794
12	Nigeria ^c	16,786	21,225	12	Malaysia	79,300	87,011
13	Algeria ^c	9,200	13,800	13	Canada	65,020	67,500
14	Norway	10,422	11,665	14	Mexico	63,900	63,456
15	Indonesia ^c	4,980	8,092	15	Netherlands	61,306	63,081
16	Brazil	4,800	7,106	16	Kuwait ^c	^d 52,900	^d 66,725
17	Canada	4,893	5,475	17	Norway	52,301	41,407
18	United Kingdom	5,003	5,191	18	Libya ^c	46,300	45,500
19	Angola	5,412	3,900	19	China	41,000	42,360
20	Oman	5,238	3,760	20	Australia	19,429	51,904
21	Malaysia	3,900	4,981	21	Egypt	27,622	28,765
22	Qatar ^c	3,700	4,153	22	United Kingdom	26,839	27,005
23	India	4,340	3,511	23	Oman	27,450	21,250
24	Egypt	3,835	3,720	24	Argentina	24,308	24,198
25	Yemen	4,000	3,100	25	India	17,356	13,477
Top 25 Total		992,405	941,968	Top 25 Total		4,829,103	4,869,063
OPEC Total		797,135	729,957	OPEC Total		2,175,198	2,278,286
World Total		1,019,546	974,179	World Total		4,829,103	5,096,027

^aRank is based on an average of oil reserves reported by *Oil & Gas Journal* and *World Oil*.

^bRank is based on an average of natural gas reserves reported by *Oil & Gas Journal* and *World Oil*.

^cMember of the Organization of Petroleum Exporting Countries (OPEC).

^dIncludes one-half of the reserves in the Neutral Zone.

^eEnergy Information Administration proved reserves as of December 31, 1996 were published by the *Oil & Gas Journal* as its estimates as of December 31, 1997.

^f*World Oil* estimate.

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 29, 1997, pps. 38-39. Gulf Publishing Company, *World Oil*, August, 1998, p. 29.

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*{25} estimate for world oil reserves remained about the same in 1997, while the *World Oil*{26} estimate decreased 16 percent, mostly due to *World Oil*'s re-evaluation of Venezuela and the former Soviet Union's proved reserves.{27} For world gas reserves, the *Oil & Gas Journal* reported a 3 percent increase, while *World Oil* reported a 2 percent decrease.

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 more than double and Mexico has around 84 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*.{28} In 1997:

- The U.S. consumed 94,209,000,000,000 Btu of energy (94.21 quadrillion Btu).
- 63 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 (24 percent).
- U.S. petroleum consumption was about 18.6 million barrels of oil and natural gas liquids and 60.3 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 1996, the U.S. was dependent on net petroleum imports for 46 percent of energy consumption. In 1997, it increased to a 20-year high of 53 percent.

Net gas imports increased slightly in 1997 to 2.8 trillion cubic feet, which is approximately 13 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 a very small amount of liquefied natural gas was imported from Algeria and Australia.

Venezuela, Saudi Arabia, Canada, Mexico, and Nigeria were the primary foreign suppliers of petroleum to the United States. Price-competitive Canadian gas exports continue to capture an increasing share of the U.S. market.{29}

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 1992-1997, due to expressed interest from the industry regarding this area. Table D9 contains the production and proved reserves for 1992-1997 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 maintenance.

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 -

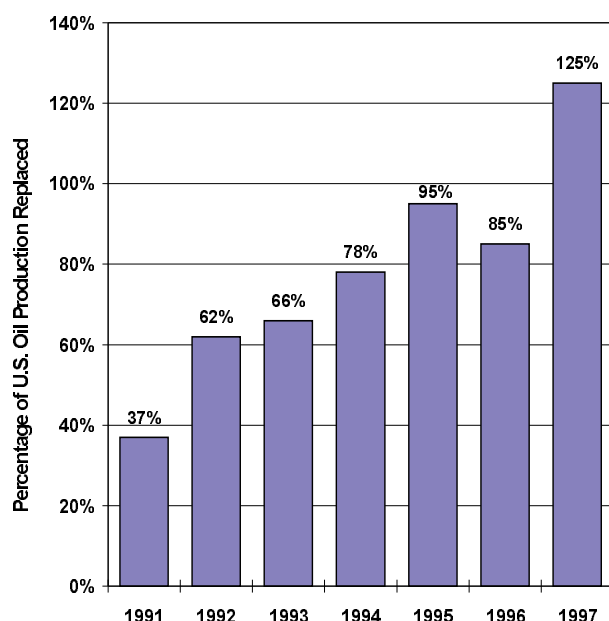
Samples of Form EIA-23 and Form EIA-64A are presented in Appendix I.

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

3. Crude Oil Statistics

The United States had 22,546 million barrels of crude oil proved reserves as of December 31, 1997. This is 2 percent (529 million barrels) more than in 1996 and is the first time in 10 years that crude oil proved reserves have increased. *Reserves additions* of crude oil replaced 125 percent of 1997 oil production (**Figure 15**).

Figure 15. Reserve Additions Replace 125 Percent of U.S. Oil Production in 1997



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

Continued exploration and development in the Gulf of Mexico Federal Offshore (especially in deep water), field extensions in Texas, new field discoveries in Alaska, and large upward revisions in California's heavy oil fields all combined in 1997 to create the first increase in crude oil proved reserves in a decade. Lower-48 States crude oil proved reserves increased almost 4 percent (642 million barrels) in 1997.

Over the past decade, U.S. crude oil proved reserves had been declining (**Figure 1**) an average of 2 percent per year. The 1997 increase interrupts this trend, although it remains to be seen if the application of new technology can sustain this level of reserves additions. It is expected that the declining trend will reestablish itself in the future.

Proved Reserves

Table 6 presents the U.S. proved reserves of crude oil as of December 31, 1997, by selected States and State subdivisions.

Figure 16 maps 1997 crude oil proved reserves by area. The following four areas account for 78 percent of U.S. crude oil proved reserves:

Area	Percent of U.S. Oil Reserves
Texas	25
Alaska	23
California	17
Gulf of Mexico Federal Offshore	13
Area Total	78

Of these four areas, California and the Gulf of Mexico Federal Offshore increased their reserves in 1997, while Alaska and Texas had small decreases in crude oil proved reserves.

Discussion of Reserves Changes

Figure 17 maps the change in crude oil proved reserves from 1996 to 1997 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	-49
Alaska	-113
California	+313
Gulf of Mexico Federal Offshore	+382
Area Total	+533
U.S. Total	+529

Figure 2 in Chapter 2 shows the components of the changes in crude oil proved reserves for 1997 and the preceding 10 years.

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.

Table 6. Crude Oil Proved Reserves, Reserves Changes, and Production, 1997
(Million Barrels of 42 U.S. Gallons)

State and Subdivision	Published Proved Reserves 12/31/96	Changes in Reserves During 1997						Estimated Production (-)	Proved Reserves 12/31/97
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)		
Alaska	5,274	6	274	55	18	117	0	473	5,161
Lower 48 States	16,743	514	1,724	1,029	459	520	119	1,665	17,385
Alabama	45	0	16	4	0	0	0	10	47
Arkansas	58	-8	5	4	0	0	0	6	45
California	3,437	277	324	49	38	0	8	285	3,750
Coastal Region Onshore	425	21	5	15	16	0	1	23	430
Los Angeles Basin Onshore	234	45	24	15	0	0	0	20	268
San Joaquin Basin Onshore	2,597	203	282	19	22	0	7	221	2,871
State Offshore	181	8	13	0	0	0	0	21	181
Colorado	231	13	9	37	3	0	0	21	198
Florida	97	-1	5	4	0	0	0	6	91
Illinois	94	-9	24	6	0	0	0	11	92
Indiana	11	3	1	3	0	0	0	2	^b ₁₀
Kansas	266	19	51	66	6	0	0	38	238
Kentucky	21	0	2	1	0	0	0	2	^b ₂₀
Louisiana	658	59	118	86	50	5	10	100	714
North	128	-7	35	23	21	0	0	18	136
South Onshore	382	70	51	49	22	5	6	60	427
State Offshore	148	-4	32	14	7	0	4	22	151
Michigan	74	5	6	15	7	0	1	10	68
Mississippi	164	3	24	10	13	0	7	18	183
Montana	168	-2	8	8	6	1	1	15	159
Nebraska	28	-3	2	3	0	0	0	3	^b ₂₁
New Mexico	744	14	64	44	18	1	1	63	735
East	731	8	62	41	18	1	1	61	719
West	13	6	2	3	0	0	0	2	16
North Dakota	248	-3	71	15	12	0	0	34	279
Ohio	53	-3	4	6	1	0	0	6	^b ₄₃
Oklahoma	632	-20	100	46	15	0	0	76	605
Pennsylvania	10	0	0	1	9	0	0	1	17
Texas	5,736	109	450	325	177	6	8	474	5,687
RRC District 1	86	5	4	5	3	0	0	10	83
RRC District 2 Onshore	63	12	4	4	0	0	0	9	66
RRC District 3 Onshore	281	-27	36	24	39	0	0	46	259
RRC District 4 Onshore	51	24	9	14	3	6	0	9	70
RRC District 5	29	13	22	12	8	0	3	9	54
RRC District 6	359	24	16	15	3	0	0	39	348
RRC District 7B	136	6	26	6	11	0	0	18	155
RRC District 7C	219	1	23	21	25	0	1	21	227
RRC District 8	2,079	21	184	93	63	0	3	157	2,100
RRC District 8A	2,207	12	95	103	14	0	0	127	2,098
RRC District 9	144	12	16	15	5	0	1	19	144
RRC District 10	74	10	13	12	3	0	0	9	79
State Offshore	8	-4	2	1	0	0	0	1	4
Utah	237	-8	34	14	1	0	0	16	234
West Virginia	25	4	1	3	1	0	0	2	26
Wyoming	603	54	54	28	11	0	0	67	627
Federal Offshore	3,085	4	351	246	90	507	83	397	3,477
Pacific (California)	518	-24	128	42	2	1	0	55	528
Gulf of Mexico (Louisiana)	2,357	26	197	176	82	318	81	298	2,587
Gulf of Mexico (Texas)	210	2	26	28	6	188	2	44	362
Miscellaneous ^a	18	7	0	5	1	0	0	2	19
U.S. Total	22,017	520	1,998	1,084	477	637	119	2,138	22,546

^aIncludes Arizona, Missouri, Nevada, New York, South Dakota, Tennessee, and Virginia.

^bIndicates 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 1997 contained in the *Petroleum Supply Annual 1997*, DOE/EIA-0340(97).

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

Figure 16. 1997 Crude Oil Proved Reserves by Area

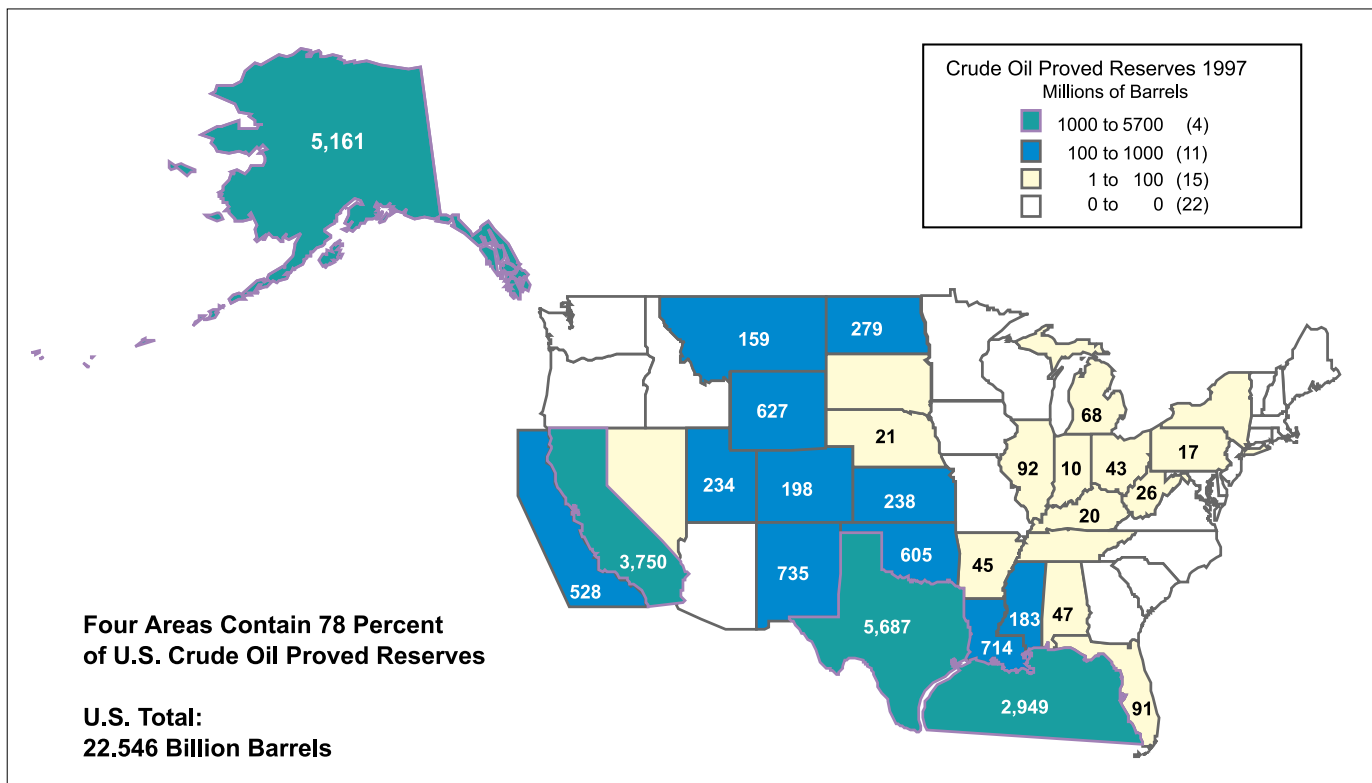
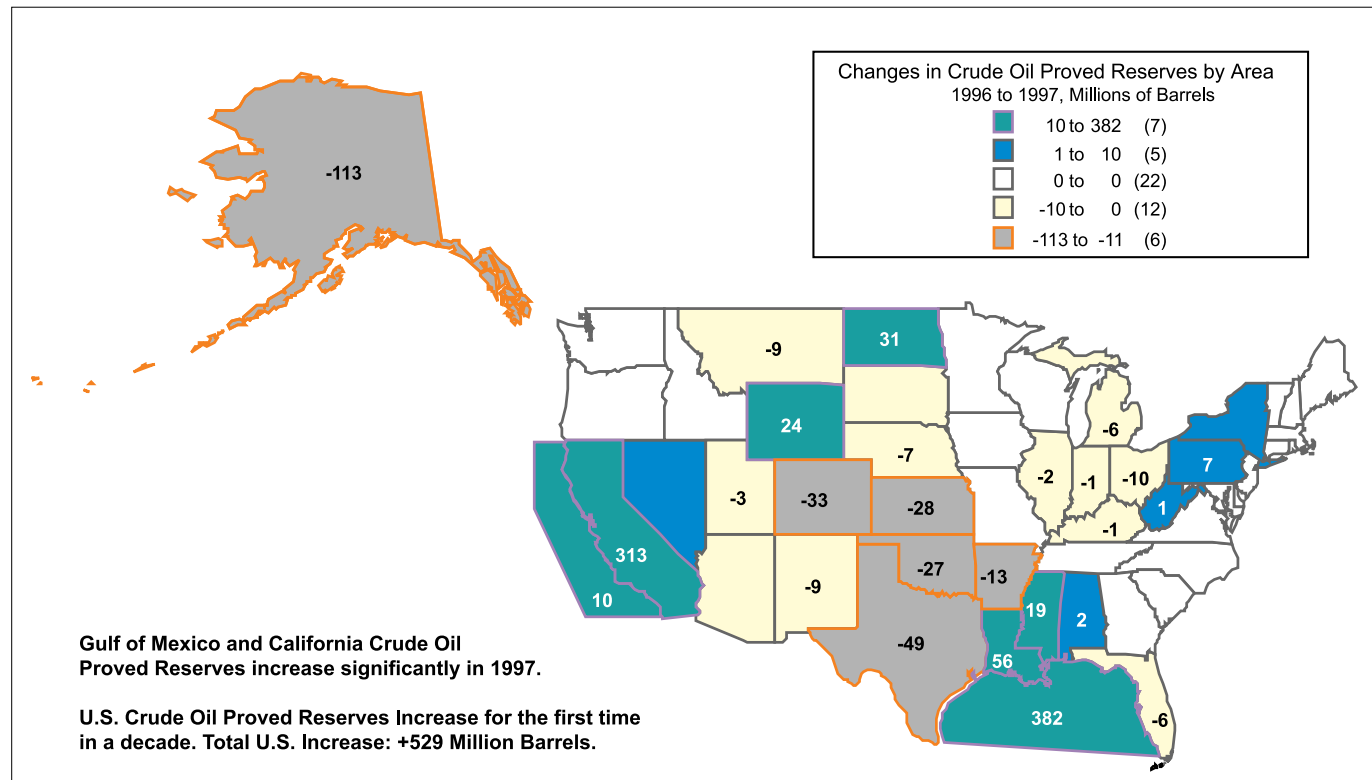


Figure 17. Changes in Crude Oil Proved Reserves by Area, 1996 to 1997



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

Total discoveries of crude oil were 1,233 million barrels in 1997, the highest in a decade, and 33 percent higher than in 1996. Only five areas had *total discoveries* exceeding 35 million barrels:

- The Gulf of Mexico Federal Offshore had 677 million barrels of *total discoveries*, 55 percent of the National total.
- Texas had 191 million barrels of *total discoveries*, 15 percent of the National total.
- Alaska had 135 million barrels of *total discoveries*, 11 percent of the National total.
- Louisiana had 65 million barrels of *total discoveries*, 5 percent of the National total.
- California had 46 million barrels of *total discoveries*, 4 percent of the National total.

The United States discovered an average of 693 million barrels of new crude oil proved reserves per year in the prior 10 years (1987 through 1996). *Total discoveries* in 1997 were 178 percent of that average.

Extensions

Operators reported 477 million barrels of *extensions* in 1997. The highest volume of *extensions* was reported in Texas (177 million barrels). The Gulf of Mexico Federal Offshore had 88 million barrels of *extensions*. Louisiana was third with 50 million barrels, followed by California with 38 million barrels.

In the prior 10 years, U.S. operators reported an average of 436 million barrels of *extensions* per year. The 1997 *extensions* were 109 percent of that average.

New Field Discoveries

There were 637 million barrels of *new field discoveries* reported in 1997. Only eight areas in the United States reported any *new field discoveries*, and only two contributed more than 1 percent to the total:

- Gulf of Mexico Federal Offshore (79 percent; 506 million barrels))
- Alaska (18 percent; 117 million barrels).

In the prior 10 years, U.S. operators reported an average of 122 million barrels of reserves from *new field discoveries* per year. Reserves from *new field discoveries* in 1997 were more than 5 times that average volume.

New Reservoir Discoveries in Old Fields

Operators in the United States reported 119 million barrels of crude oil reserves from *new reservoir discoveries in old fields* in 1997. 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—83 million barrels or 70 percent of the total. Louisiana had 10 million barrels (8 percent), and California and Texas each had 8 million barrels (7 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 1997 were 88 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 1,434 million barrels of net *revisions and adjustments* for crude oil in 1997, 57 percent more than in 1996. California alone had 552 million barrels (38 percent) of net *revisions and adjustments* in 1997—466 million barrels of these were in the San Joaquin Basin Area. Average *revisions and adjustments* for the prior 10 years were 1,293 million barrels, and those for 1997 were 11 percent higher than this average.

Production

U.S. *production* of crude oil in 1997 was 2,138 million barrels. This was 2 percent lower than 1996's total of 2,173 million barrels. U.S. crude oil *production* has declined in 11 of the last 12 years. Texas and Alaska are still the largest producers of crude oil in the United States with 22 percent of the total each, the Gulf of Mexico Federal Offshore is third with 16 percent, and California has 13 percent.

Areas of Note: Large Discoveries and Reserves Additions

The following State and area discussions summarize notable activities during 1997 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 1997.

Gulf of Mexico Federal Offshore

Projects in the Gulf of Mexico Federal Offshore were the biggest success stories for oil exploration during 1997. Most of the United States' crude oil reserve additions from *new field discoveries* and from *new reservoir discoveries in old fields* came from this area. The net increase of crude oil proved reserves in the Gulf of Mexico Federal Offshore was 382 million barrels. The Gulf of Mexico produced about 342 million barrels of crude oil in 1997, an increase of 13 percent (39 million barrels) over 1996's production.

Deepwater Production and Reserves: In 1997, just as in 1996, major U.S. operators continue to evaluate and develop large prospects in the deepwater areas of the Gulf of Mexico. An example of the newest deepwater technology is shown on the cover of this year's report—an artist's rendering of the installation of the SeaStar platform planned for British-Borneo Petroleum Inc.'s Morpeth Project. Notable fields in the Gulf of Mexico Federal Offshore in 1997 include:

- **Hoover-Diana:** In the Gulf of Mexico Federal Offshore (Texas), in East Breaks Block 945, Exxon is developing the Hoover-Diana fields using a deep-draft caisson vessel (EIA also refers to caisson vessels as "spars"), which began construction in Finland in 1997. In the year 2000, Exxon plans to launch the 62,000 ton Hoover caisson vessel and anchor it in 1,570 meters of water. Exxon estimates that Hoover-Diana holds 400 million barrels of oil equivalent.{30}
- **Europa:** In the Gulf of Mexico Federal Offshore (Louisiana), in Mississippi Canyon Block 935, Shell is developing a new oil field in 3,900 feet of water—the Europa Field. Shell and its partners announced in March 1998 their plans to develop Europa utilizing a subsea system capable of accommodating eight wells, tied back 20 miles to the Mars Tension-Leg Platform in Mississippi Canyon Block 807. Total development costs are approximately \$500 million, excluding lease costs. Production is scheduled to begin in early 2000 and peak production rates are anticipated to be 60,000

barrels of oil per day and 45 million cubic feet of gas per day by early 2001. Total gross ultimate recovery is estimated at about 160 million barrels of oil equivalent.{31}

- **Macaroni:** In the Gulf of Mexico Federal Offshore (Texas), in Garden Banks Block 602, Shell is developing a new field in 3,700 feet of water—the Macaroni Field. Shell announced in March 1998 that it would develop Macaroni using a subsea system of three satellite wells clustered around a four-well subsea manifold, tied back 12 miles to the Auger Tension-Leg Platform in Garden Banks Block 426. Total development cost is approximately \$270 million, excluding lease and exploration costs. Production is scheduled to begin in mid-year 1999 and peak production rates are anticipated to be 35,000 barrels of oil per day and 65 million cubic feet of gas per day by late 1999. Total gross ultimate recovery is estimated at about 78 million barrels of oil equivalent.{32}
- **Marlin:** In the Gulf of Mexico Federal Offshore (Louisiana), in Viosca Knoll Block 915, Amoco is developing the Marlin field in 3,240 feet of water. Amoco and Shell Deepwater Development Inc. announced in January 1997 plans to develop Marlin using a tension leg platform (TLP). Total development cost is approximately \$500 million. Production is scheduled to begin in mid-year 1999 and peak production rates are anticipated to be 250 million cubic feet of gas and 40,000 barrels of oil daily. Amoco is the operator and has a 75-percent working interest in the field which is located some 100 miles south of Mobile, Alabama. Construction of the TLP's hull began in 1997 in Taranto, Italy. It will be towed to Corpus Christi, where the topside facilities are being built. The hull will be fastened to the seafloor with steel tendons.{33}

California

California's proved oil reserves increased by 313 million barrels in 1997. 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 274 million barrels. California's production also increased by about 3 percent from 1996's level.

A key player in California's heavy oil industry is Texaco, Inc., which contributed to the surge of proved

reserves in California by acquiring Monterey Resources, a California independent oil and gas producer, in November 1997. Texaco expects that application of the continuous-injection steam flood process it used at its Kern River Field, in comparison to Monterey's less efficient cyclic steam flood process, will raise production while simultaneously lowering per-barrel production costs. Over the next 3 years, Texaco's strategic goal is to more than double production from former Monterey Resources fields to 119,000 barrels of oil equivalent per day.{34}

Texas

Onshore in the lower 48 States, Texas had the most *total discoveries* of crude oil proved reserves in 1997 (191 million barrels). Enhancements in drilling technology, coupled with improved economics (due to reductions in development well costs and higher oil prices), caused increased operator activity.

Alaska

Alaska reported 135 million barrels of *total discoveries* of crude oil proved reserves in 1997, third in the Nation following the Gulf of Mexico Federal Offshore and Texas. Most of Alaska's *total discoveries* were from new fields on the North Slope. These fields are "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.

In late December 1997, ARCO began commercial production from West Sak, a heavy oil accumulation. Commercial development of West Sak has become feasible because of lower costs, new drilling technologies, and a production facility sharing agreement with the Kuparuk production facility. The first phase of West Sak development has resulted in proved gross reserves of 50 million barrels of oil (25 net to ARCO). ARCO also had success drilling in a number of satellite accumulations, including the Tarn field.{35}

Louisiana

Louisiana's proved oil reserves increased by 56 million barrels. The largest increase was from *revisions and adjustments* in the South Onshore region. Louisiana's production also increased by about 4 percent from 1996's level.

Other Gain Areas

North Dakota: North Dakota's proved oil reserves increased by 31 million barrels. There were 53 million barrels of net *revisions and adjustments* in North Dakota in 1997, plus 12 million barrels of *extensions*.

Wyoming: Wyoming's proved oil reserves increased by 24 million barrels. Although there were no new fields reported, several operators increased their reserves with *extensions* and *revisions and adjustments*.

Mississippi: Mississippi's proved oil reserves increased by 19 million barrels. The boost came from a combination of *extensions, revisions and adjustments*, and *new reservoirs discovered in old fields*.

Areas of Note: Large Reserves Declines

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

Alaska

Alaska's proved oil reserves declined by 113 million barrels in 1997—the greatest decline in any state. This is because Alaska's massive production rate far exceeds its reserves replacement rate. Alaska's 1997 production was approximately 473 million barrels, 7 percent less than what Alaska produced in 1996.

No Production Decline in 1999: In 1997, ARCO started several projects and had several successes that it believes will stop the decline in its Alaskan production after 1999. The Prudhoe Bay Miscible Injection Expansion ("MIX") Project was approved by ARCO and its partners. This \$160 million expansion of the gas handling facilities is expected to add 50 million gross barrels of petroleum liquids and 20 thousand net barrels of petroleum liquids per day to the field when it becomes operational, targeted for 1999.{35}

Texas

Texas' proved oil reserves declined by 49 million barrels in 1997. Texas' production also declined about 4 percent from 1996 levels. The largest reserves decline (109 million barrels) was in RRC District 8A. In this district, the net revisions and extensions were exceeded by production. Other areas where oil reserves significantly decreased were RRC District 3 Onshore

(22 million barrels) and RRC District 6 (11 million barrels).

These declines were counterbalanced somewhat by reserves increases in other RRC Districts. In RRC Districts 5 and 8, net positive reserves additions of 25 and 21 million barrels of proved reserves, respectively, were added.

Other Decline Areas

In the following areas of the United States, development of existing or new oil fields was outpaced by crude oil production, which remained at roughly the same level as the previous year.

Colorado: Proved oil reserves decreased by 14 percent (33 million barrels).

Kansas: Proved oil reserves decreased by 11 percent (28 million barrels).

Oklahoma: Proved oil reserves decreased by 4 percent (27 million barrels).

Reserves in Nonproducing Reservoirs

Not all proved reserves of crude oil were contained in reservoirs that were producing. Operators reported 3,755 million barrels of proved reserves in

nonproducing reservoirs, 8 percent more than reported in 1996 (3,474 million barrels).

The reasons for the nonproducing status of these proved reserves are not collected by the EIA. However, previous surveys showed that most were not being produced for operational reasons. These included 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 1997 volume, 3,207 million barrels, is about 12 percent more than was reported in 1996 (2,876 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 1997
(Million Barrels of 42 U.S. Gallons)

State and Subdivision	Indicated Additional Reserves	State and Subdivision	Indicated Additional Reserves
Alaska	832	North Dakota	6
Lower 48 States	2,375	Ohio	0
Alabama	0	Oklahoma	20
Arkansas	0	Pennsylvania	0
California	1,264	Texas	479
Coastal Region Onshore	43	RRC District 1	<1
Los Angeles Basin Onshore	0	RRC District 2 Onshore	0
San Joaquin Basin Onshore	1,221	RRC District 3 Onshore	28
State Offshore	0	RRC District 4 Onshore	<1
Colorado	22	RRC District 5	0
Florida	0	RRC District 6	1
Illinois	0	RRC District 7B	3
Indiana	0	RRC District 7C	4
Kansas	0	RRC District 8	308
Kentucky	0	RRC District 8A	131
Louisiana	313	RRC District 9	0
North	<1	RRC District 10	4
South Onshore	309	State Offshore	0
State Offshore	4	Utah	70
Michigan	2	West Virginia	0
Mississippi	0	Wyoming	11
Montana	1	Federal Offshore	41
Nebraska	0	Pacific (California)	0
New Mexico	146	Gulf of Mexico (Louisiana)	36
East	146	Gulf of Mexico (Texas)	5
West	0	Miscellaneous ^b	0
		U.S. Total	3,207

^aIncludes 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).

^bIncludes Arizona, Missouri, Nevada, New York, South Dakota, Tennessee, and Virginia.
Source: Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," 1997.

4. Natural Gas Statistics

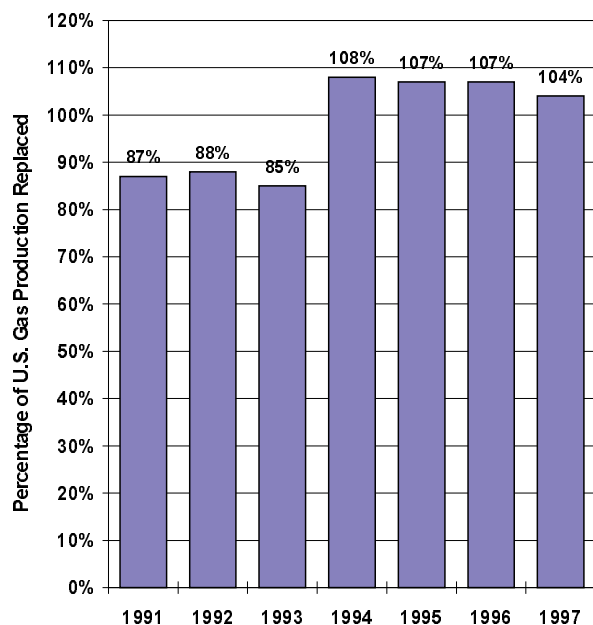
Dry Natural Gas

Proved Reserves

The Nation's 1997 proved reserves of dry natural gas were 167,223 billion cubic feet, 0.4 percent (749 billion cubic feet) more than in 1996 (**Table 8**). This is the fourth consecutive year that natural gas reserves have increased. Gas production increased for the second consecutive year.

Additions to reserves replaced 104 percent of gas production in 1997 (**Figure 18**). New gas discoveries in the Gulf of Mexico Federal Offshore, Texas, Wyoming, and Louisiana, combined with upward revisions of gas reserves in Alaska and Oklahoma, were responsible for this. Lower 48 States gas reserves declined slightly in 1997 after increasing in 1995 and 1996. The decrease in the Lower 48 in 1997 was more than made up for by the Alaskan gas reserves additions.

Figure 18. Reserve Additions Exceed U.S. Natural Gas Production 4 Years in a Row



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

Proved reserves by State are shown on the map in **Figure 19**. Six areas account for 71 percent of the Nation's dry natural gas proved reserves:

Area	Percent of U.S. Gas Reserves
Texas	23
Gulf of Mexico Federal Offshore	17
New Mexico	9
Wyoming	8
Oklahoma	8
Alaska	6
Area Total	71

Of these six areas, the Gulf of Mexico Federal Offshore, Alaska, Wyoming, and Oklahoma had increased reserves in 1997, while Texas and New Mexico had decreases in dry natural gas proved reserves.

Discussion of Reserves Changes

Figure 20 maps the change in dry gas proved reserves from 1996 to 1997 by area. Here's how the top six areas fared, compared to the total United States:

Area	Change in U.S. Gas Reserves (billion cubic feet)
Texas	-509
Gulf of Mexico Federal Offshore	+70
New Mexico	-971
Wyoming	+1,242
Oklahoma	+365
Alaska	+1,268
Area Total	+1,465
U.S. Total	+749

Figure 4 in Chapter 2 shows the components of the changes in dry natural gas proved reserves for 1997 and the preceding 10 years.

Revisions and Adjustments

Revisions and adjustments declined 45 percent in 1997, compared to 1996's level. The net volume of *revisions and adjustments* was 4,312 billion cubic feet. Alaska had the largest increase in *revisions and adjustments* (1,729 billion cubic feet). Alaska actually has substantially greater total resources of natural gas than proved reserves, but no economic market presently exists for Alaskan gas.

Table 8. Dry Natural Gas Proved Reserves, Reserves Changes, and Production, 1997
(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Published Proved Reserves 12/31/96	Changes in Reserves During 1997							Proved Reserves 12/31/97
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	9,294	19	1,809	99	14	0	0	475	10,562
Lower 48 States	157,180	-609	19,849	16,657	10,571	2,681	2,382	18,736	156,661
Alabama	5,033	-31	348	54	34	0	14	376	4,968
Arkansas	1,470	-21	205	101	96	0	15	189	1,475
California	2,082	19	358	52	68	0	10	212	2,273
Coastal Region Onshore	156	18	10	19	15	0	1	17	164
Los Angeles Basin Onshore	109	21	27	6	0	0	0	10	141
San Joaquin Basin Onshore	1,768	-31	318	27	53	0	9	178	1,912
State Offshore	49	11	3	0	0	0	0	7	56
Colorado	7,710	-563	959	826	108	2	0	562	6,828
Florida	96	5	1	0	0	0	0	6	96
Kansas	7,694	69	307	510	54	0	4	629	6,989
Kentucky	983	321	107	3	18	0	17	79	1,364
Louisiana	9,543	203	1,606	1,360	754	11	412	1,496	9,673
North	3,105	6	607	378	175	0	2	424	3,093
South Onshore	5,704	157	887	859	548	11	318	911	5,855
State Offshore	734	40	112	123	31	0	92	161	725
Michigan	2,061	177	252	124	50	0	0	221	2,195
Mississippi	631	-16	66	56	48	0	2	93	582
Montana	796	33	99	133	22	0	0	55	762
New Mexico	16,485	-664	2,459	1,868	641	2	6	1,547	15,514
East	2,790	12	392	334	192	2	6	418	2,642
West	13,695	-676	2,067	1,534	449	0	0	1,129	12,872
New York	232	-12	60	42	0	0	4	^c 18	^c 224
North Dakota	462	-2	57	17	25	0	0	46	479
Ohio	1,113	-71	101	75	5	0	17	105	985
Oklahoma	13,074	82	2,396	1,282	638	2	84	1,555	13,439
Pennsylvania	1,696	60	519	381	82	0	5	129	1,852
Texas	38,270	-495	4,660	4,447	3,949	373	393	4,942	37,761
RRC District 1	906	-85	118	55	149	25	0	105	953
RRC District 2 Onshore	1,322	102	248	209	305	50	30	214	1,634
RRC District 3 Onshore	4,349	-310	784	505	488	193	59	886	4,172
RRC District 4 Onshore	7,769	57	1,155	1,179	1,452	32	105	1,292	8,099
RRC District 5	2,079	68	163	636	69	25	152	210	1,710
RRC District 6	5,899	112	503	592	553	0	11	599	5,887
RRC District 7B	520	-110	106	40	46	23	0	67	478
RRC District 7C	3,655	-87	305	356	248	4	10	372	3,407
RRC District 8	5,452	-210	754	373	316	8	22	572	5,397
RRC District 8A	931	-22	35	54	12	0	0	55	847
RRC District 9	705	110	47	74	111	0	1	106	794
RRC District 10	4,391	-142	384	340	183	2	3	387	4,094
State Offshore	292	22	58	34	17	11	0	77	289
Utah	1,633	-40	293	34	164	0	0	177	1,839
Virginia	1,930	344	142	15	113	0	0	68	2,446
West Virginia	2,703	182	156	80	12	0	40	167	2,846
Wyoming	12,320	207	1,191	1,368	2,047	39	17	891	13,562
Federal Offshore ^a	29,096	-380	3,486	3,803	1,643	2,252	1,342	5,170	28,466
Pacific (California)	1,244	-69	6	602	1	1	0	37	544
Gulf of Mexico (Louisiana) ^a	21,856	-390	2,705	2,250	1,246	1,511	1,151	3,895	21,934
Gulf of Mexico (Texas)	5,996	79	775	951	396	740	191	1,238	5,988
Miscellaneous ^b	67	-16	21	26	0	0	0	^c 3	^c 43
U.S. Total	166,474	-590	21,658	16,756	10,585	2,681	2,382	19,211	167,223

^aIncludes Federal offshore Alabama.

^bIncludes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.

^cIndicates 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 1997 contained in the *Natural Gas Annual 1997*, DOE/EIA-0131(97).

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

Figure 19. 1997 Dry Natural Gas Proved Reserves by Area

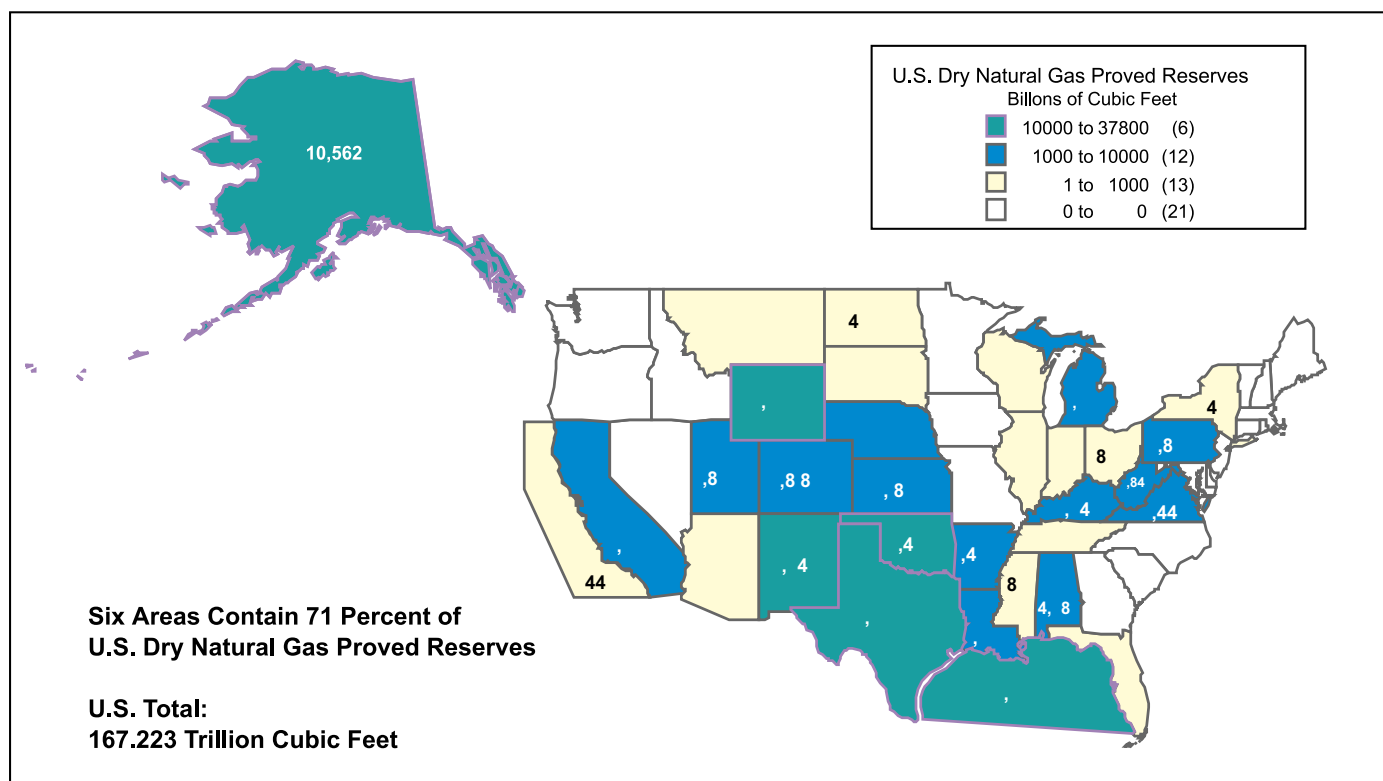
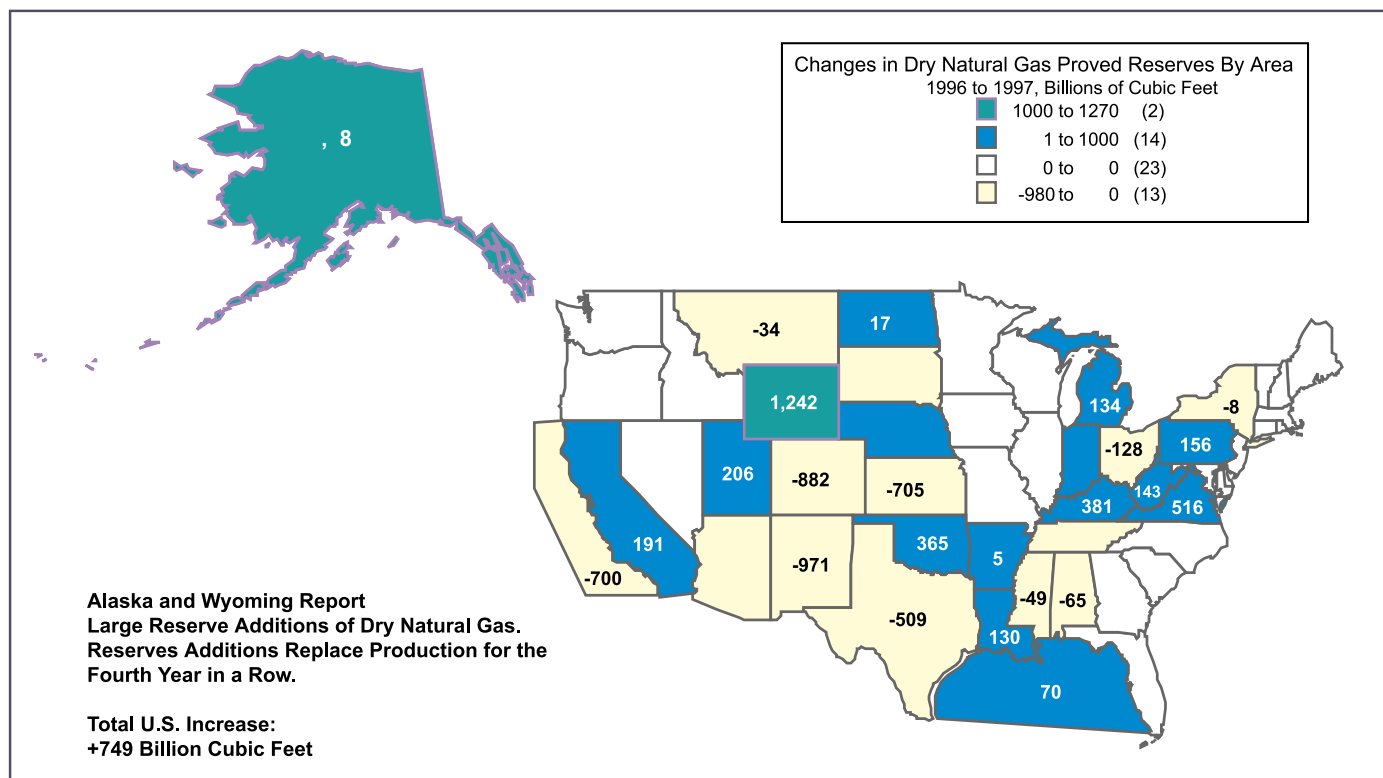


Figure 20. Changes in Dry Natural Gas Proved Reserves by Area, 1996 to 1997



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

Discoveries

Total discoveries were up from 1996. *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 15,648 billion cubic feet, an increase of 27 percent from the level reported in 1996 and equivalent to 81 percent of 1997 gas production. About 64 percent of the *total discoveries* were in the Gulf of Mexico Federal Offshore and Texas.

Extensions were 10,585 billion cubic feet, 36 percent higher than in 1996. Areas with the largest *extensions* were:

- Texas (37 percent)
- Wyoming (19 percent)
- Gulf of Mexico Federal Offshore (16 percent)
- Louisiana (7 percent)
- New Mexico (6 percent)
- Oklahoma (6 percent).

In the prior 10 years, U.S. operators reported an average of 6,309 billion cubic feet of reserves from *extensions* per year. Reserves from *extensions* in 1997 were 68 percent higher than that average volume.

New field discoveries were 2,681 billion cubic feet—85 percent higher than in 1996. Those areas with the largest *new field discoveries* were the Gulf of Mexico Federal Offshore (with 84 percent of the total) and Texas (14 percent). In the prior 10 years, U.S. operators reported an average of 1,359 billion cubic feet of reserves from *new field discoveries* per year. Reserves from *new field discoveries* in 1997 were almost twice that.

New reservoir discoveries in old fields were 2,382 billion cubic feet, 23 percent lower than 1996. Among the areas with the largest *new reservoir discoveries in old fields* were:

- Gulf of Mexico Federal Offshore (56 percent)
- Louisiana (17 percent)
- Texas (16 percent).

In the prior 10 years, U.S. operators reported an average of 2,230 billion cubic feet of reserves from *new reservoirs discovered in old fields* per year. Reserves from *new reservoirs discovered in old fields* in 1997 were 7 percent higher than that average volume.

Production

Dry natural gas production increased 2 percent in 1997 (**Table 8**). U.S. gas production has increased during 8 of the last 10 years. As in 1996, the Gulf of Mexico Federal Offshore and the State of Texas were the leading producers of dry natural gas in 1997, each with over one-fourth of the U.S. total. The next three States combined, Oklahoma (8 percent), Louisiana (8 percent), and New Mexico (8 percent), added another one-fourth of the production.

Wet Natural Gas

U. S. proved reserves of wet natural gas, as of December 31, 1997, were 175,721 billion cubic feet, an increase of 0.3 percent, or 574 billion cubic feet, from that reported in 1996 (**Table 9**). At year-end 1997 proved wet natural gas reserves for the lower 48 States had decreased by 0.5 percent (803 billion cubic feet) compared to 1996, while those of Alaska had increased by 15 percent (1,377 billion cubic feet).

The volumetric differences between the estimates reported in **Table 8** (dry) and **Table 9** (wet) results from the removal of natural gas liquids at natural gas processing plants. A discussion of the methodology used in this report is in 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 0.7 percent (1,013 billion cubic feet) in 1997 to 143,339 billion cubic feet (**Table 10**). The lower 48 States' NA wet natural gas proved reserves decreased by 0.5 percent (754 billion cubic feet). Those areas with the largest increases in NA wet natural gas reserves were Wyoming, Texas RRC District 1, and Kentucky. There were large decreases in NA wet natural gas reserves in New Mexico, the Gulf of Mexico Federal Offshore, and Kansas.

Discoveries

NA wet natural gas *total discoveries* of 13,718 billion cubic feet increased 21 percent (2,380 billion cubic feet) in 1997. Texas, the Gulf of Mexico Federal Offshore,

Table 9. Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 1997 (Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Published Proved Reserves 12/31/96	Changes in Reserves During 1997							Proved Reserves 12/31/97		
		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	9,296	105	1,834	99	14	0	0	477	10,673	2,957	7,716
Lower 48 States	165,851	-835	20,878	17,556	11,165	2,747	2,455	19,657	165,048	140,382	24,666
Alabama	5,100	-48	351	56	34	0	14	382	5,013	4,983	30
Arkansas	1,472	-19	206	101	96	0	15	190	1,479	1,423	56
California	2,193	17	377	56	72	0	10	223	2,390	570	1,820
Coastal Region Onshore	168	19	11	22	16	0	1	17	176	47	129
Los Angeles Basin Onshore .	112	22	29	6	0	0	0	11	146	3	143
San Joaquin Basin Onshore .	1,864	-35	334	28	56	0	9	188	2,012	518	1,494
State Offshore	49	11	3	0	0	0	0	7	56	2	54
Colorado	8,064	-533	1,004	901	114	2	0	590	7,160	6,627	533
Florida	119	-1	1	0	0	0	0	7	112	0	112
Kansas	8,145	-5	322	535	57	0	4	660	7,328	7,277	51
Kentucky	1,046	320	112	3	19	0	18	83	1,429	1,403	26
Louisiana	10,077	29	1,665	1,410	785	11	430	1,551	10,036	9,020	1,016
North	3,189	-17	620	385	179	0	2	432	3,156	2,869	287
South Onshore	6,105	37	930	900	575	11	334	955	6,137	5,538	599
State Offshore	783	9	115	125	31	0	94	164	743	613	130
Michigan	2,125	174	259	127	52	0	0	227	2,256	1,975	281
Mississippi	634	-18	66	56	48	0	2	93	583	532	51
Montana	806	31	100	134	22	0	0	56	769	727	42
New Mexico	17,925	-878	2,639	2,043	704	2	6	1,655	16,700	15,280	1,420
East	3,197	-4	445	381	219	2	6	476	3,008	1,694	1,314
West	14,728	-874	2,194	1,662	485	0	0	1,179	13,692	13,586	106
New York	232	-12	60	42	0	0	4	^c 18	^c 224	223	1
North Dakota	512	-2	63	19	28	0	0	51	531	274	257
Ohio	1,114	-71	101	76	5	0	17	105	985	594	391
Oklahoma	13,952	56	2,553	1,365	680	2	89	1,656	14,311	13,296	1,015
Pennsylvania	1,702	63	5 22	383	82	0	5	130	1,861	1,769	92
Texas	41,592	-451	5,032	4,771	4,229	398	411	5,332	41,108	33,322	7,786
RRC District 1	969	-93	126	59	160	27	0	112	1,018	950	68
RRC District 2 Onshore	1,430	80	263	221	323	53	31	227	1,732	1,497	235
RRC District 3 Onshore	4,652	-375	830	535	516	205	63	938	4,418	3,539	879
RRC District 4 Onshore	8,123	75	1,210	1,235	1,520	33	110	1,353	8,483	8,115	368
RRC District 5	2,141	55	166	651	71	26	156	215	1,749	1,681	68
RRC District 6	6,252	73	529	622	582	0	11	631	6,194	5,616	578
RRC District 7B	610	-130	124	46	54	26	0	79	559	299	260
RRC District 7C	4,063	-39	344	401	279	5	11	419	3,843	3,247	596
RRC District 8	6,050	-194	842	416	354	9	24	639	6,030	2,886	3,144
RRC District 8A	1,294	45	51	80	18	0	0	81	1,247	41	1,206
RRC District 9	870	87	56	87	129	0	1	124	932	785	147
RRC District 10	4,845	-58	433	383	206	3	4	437	4,613	4,386	227
State Offshore	293	23	58	35	17	11	0	77	290	280	10
Utah	1,747	7	305	37	178	0	0	195	2,005	1,695	310
Virginia	1,930	344	142	15	113	0	0	68	2,446	1,923	523
West Virginia	2,793	192	162	82	13	0	41	173	2,946	2,887	59
Wyoming	13,084	150	1,257	1,446	2,160	39	18	941	14,321	13,471	850
Federal Offshore ^a	29,419	-162	3,556	3,872	1,674	2,293	1,371	5,268	29,011	21,098	7,913
Pacific (California)	1,266	-66	6	614	1	1	0	38	556	58	498
Gulf of Mexico (Louisiana) ^a ..	22,119	-177	2,770	2,301	1,275	1,547	1,179	3,984	22,428	16,241	6,187
Gulf of Mexico (Texas)	6,034	81	780	957	398	745	192	1,246	6,027	4,799	1,228
Miscellaneous ^b	68	-18	23	26	0	0	0	3	44	13	31
U.S. Total	175,147	-730	22,712	17,655	11,179	2,747	2,455	20,134	175,721	143,339	32,382

^aIncludes Federal offshore Alabama.

^bIncludes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.

^cIndicates 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 1997 contained in the *Natural Gas Annual 1997*, DOE/EIA-0131(97).

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

Table 10. Nonassociated Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 1997
(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Published Proved Reserves 12/31/96	Changes in Reserves During 1997							Proved Reserves 12/31/97
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	3,216	-1	42	93	0	0	0	207	2,957
Lower 48 States	141,136	-991	17,745	14,321	10,063	1,387	2,268	16,905	140,382
Alabama	5,062	-47	346	54	34	0	14	372	4,983
Arkansas	1,383	0	196	94	96	0	15	173	1,423
California	610	-8	41	28	11	0	9	65	570
Coastal Region Onshore	48	9	2	6	0	0	0	6	47
Los Angeles Basin Onshore	0	3	1	0	0	0	0	1	3
San Joaquin Basin Onshore	560	-21	38	22	11	0	9	57	518
State Offshore	2	1	0	0	0	0	0	1	2
Colorado	7,009	-474	987	463	99	2	0	533	6,627
Florida	0	0	0	0	0	0	0	0	0
Kansas	8,063	-9	308	497	55	0	4	647	7,277
Kentucky	1,022	319	109	2	18	0	18	81	1,403
Louisiana	9,038	-44	1,515	1,204	681	5	415	1,386	9,020
North	2,934	-94	597	318	136	0	2	388	2,869
South Onshore	5,478	22	837	783	520	5	321	862	5,538
State Offshore	626	28	81	103	25	0	92	136	613
Michigan	1,778	199	225	74	39	0	0	192	1,975
Mississippi	587	-18	58	48	36	0	2	85	532
Montana	755	36	96	130	21	0	0	51	727
New Mexico	16,232	-875	2,455	1,773	660	0	4	1,423	15,280
East	1,612	9	275	128	175	0	4	253	1,694
West	14,620	-884	2,180	1,645	485	0	0	1,170	13,586
New York	229	-11	60	41	0	0	4	18	223
North Dakota	257	-7	23	4	25	0	0	20	274
Ohio	715	-63	36	64	5	0	13	48	594
Oklahoma	12,929	148	2,348	1,268	589	2	80	1,532	13,296
Pennsylvania	1,655	53	512	382	49	0	5	123	1,769
Texas	33,432	-81	4,036	4,041	3,719	395	387	4,525	33,322
RRC District 1	523	285	119	49	149	27	0	104	950
RRC District 2 Onshore	1,178	51	252	184	317	53	31	201	1,497
RRC District 3 Onshore	3,612	-226	643	430	467	205	63	795	3,539
RRC District 4 Onshore	7,877	-47	1,193	1,207	1,448	32	110	1,291	8,115
RRC District 5	2,088	50	134	637	69	26	155	204	1,681
RRC District 6	5,690	-10	514	580	580	0	11	589	5,616
RRC District 7B	378	-83	55	32	1	26	0	46	299
RRC District 7C	3,371	-34	263	294	271	5	3	338	3,247
RRC District 8	3,069	-119	355	155	82	7	10	363	2,886
RRC District 8A	18	35	10	15	0	0	0	7	41
RRC District 9	749	50	46	79	119	0	0	100	785
RRC District 10	4,592	-55	398	344	199	3	4	411	4,386
State Offshore	287	22	54	35	17	11	0	76	280
Utah	1,446	17	248	22	175	0	0	169	1,695
Virginia	1,930	-134	75	15	113	0	0	46	1,923
West Virginia	2,722	193	159	73	13	0	41	168	2,887
Wyoming	12,260	96	1,171	1,404	2,145	39	18	854	13,471
Federal Offshore ^a	21,982	-252	2,738	2,640	1,480	944	1,239	4,393	21,098
Pacific (California)	115	-53	0	2	0	0	0	2	58
Gulf of Mexico (Louisiana) ^a	16,627	-365	2,075	1,751	1,089	797	1,056	3,287	16,241
Gulf of Mexico (Texas)	5,240	166	663	887	391	147	183	1,104	4,799
Miscellaneous ^b	40	-29	3	0	0	0	0	1	13
U.S. Total	144,352	-992	17,787	14,414	10,063	1,387	2,268	17,112	143,339

^aIncludes Federal offshore Alabama.

^bIncludes 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 1997 contained in the *Natural Gas Annual 1997*, DOE/EIA-0131(97).

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, 1997
(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Published Proved Reserves 12/31/96	Changes in Reserves During 1997							Proved Reserves 12/31/97
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	6,080	106	1,792	6	14	0	0	270	7,716
Lower 48 States	24,715	156	3,133	3,235	1,102	1,360	187	2,752	24,666
Alabama	38	-1	5	2	0	0	0	10	30
Arkansas	89	-19	10	7	0	0	0	17	56
California	1,583	25	336	28	61	0	1	158	1,820
Coastal Region Onshore	120	10	9	16	16	0	1	11	129
Los Angeles Basin Onshore	112	19	28	6	0	0	0	10	143
San Joaquin Basin Onshore	1,304	-14	296	6	45	0	0	131	1,494
State Offshore	47	10	3	0	0	0	0	6	54
Colorado	1,055	-59	17	438	15	0	0	57	533
Florida	119	-1	1	0	0	0	0	7	112
Kansas	82	4	14	38	2	0	0	13	51
Kentucky	24	1	3	1	1	0	0	2	26
Louisiana	1,039	73	150	206	104	6	15	165	1,016
North	255	77	23	67	43	0	0	44	287
South Onshore	627	15	93	117	55	6	13	93	599
State Offshore	157	-19	34	22	6	0	2	28	130
Michigan	347	-25	34	53	13	0	0	35	281
Mississippi	47	0	8	8	12	0	0	8	51
Montana	51	-5	4	4	1	0	0	5	42
New Mexico	1,693	-3	184	270	44	2	2	232	1,420
East	1,585	-13	170	253	44	2	2	223	1,314
West	108	10	14	17	0	0	0	9	106
New York	3	-1	0	1	0	0	0	0	1
North Dakota	255	5	40	15	3	0	0	31	257
Ohio	399	-8	65	12	0	0	4	57	391
Oklahoma	1,023	-92	205	97	91	0	9	124	1,015
Pennsylvania	47	10	10	1	33	0	0	7	92
Texas	8,160	-370	996	730	510	3	24	807	7,786
RRC District 1	446	-378	7	10	11	0	0	8	68
RRC District 2 Onshore	252	29	11	37	6	0	0	26	235
RRC District 3 Onshore	1,040	-149	187	105	49	0	0	143	879
RRC District 4 Onshore	246	122	17	28	72	1	0	62	368
RRC District 5	53	5	32	14	2	0	1	11	68
RRC District 6	562	83	15	42	2	0	0	42	578
RRC District 7B	232	-47	69	14	53	0	0	33	260
RRC District 7C	692	-5	81	107	8	0	8	81	596
RRC District 8	2,981	-75	487	261	272	2	14	276	3,144
RRC District 8A	1,276	10	41	65	18	0	0	74	1,206
RRC District 9	121	37	10	8	10	0	1	24	147
RRC District 10	253	-3	35	39	7	0	0	26	227
State Offshore	6	1	4	0	0	0	0	1	10
Utah	301	-10	57	15	3	0	0	26	310
Virginia	0	478	67	0	0	0	0	22	523
West Virginia	71	-1	3	9	0	0	0	5	59
Wyoming	824	54	86	42	15	0	0	87	850
Federal Offshore ^a	7,437	90	818	1,232	194	1,349	132	875	7,913
Pacific (California)	1,151	-13	6	612	1	1	0	36	498
Gulf of Mexico (Louisiana) ^a	5,492	188	695	550	186	750	123	697	6,187
Gulf of Mexico (Texas)	794	-85	117	70	7	598	9	142	1,228
Miscellaneous ^b	28	11	20	26	0	0	0	2	31
U.S. Total	30,795	262	4,925	3,241	1,116	1,360	187	3,022	32,382

^aIncludes Federal offshore Alabama.

^bIncludes 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 1997 contained in the *Natural Gas Annual 1997*, DOE/EIA-0131(97).

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

Wyoming, and Louisiana accounted for 11,467 billion cubic feet or 84 percent of U.S. NA wet natural gas *total discoveries* in 1997.

Production

U.S. production of NA wet natural gas increased by 2 percent (267 billion cubic feet) in 1997 (**Table 10**). Of the five leading producing areas, Texas, the Gulf of Mexico Federal Offshore, and New Mexico increased production, while Louisiana and Oklahoma had slight declines in production. As in 1996, the Gulf of Mexico Federal Offshore and the State of Texas, each with over one-fourth of the U.S. total, were the leading producers of NA wet natural gas in 1997.

Associated-Dissolved Natural Gas

Proved Reserves

Proved reserves of associated-dissolved (AD) natural gas, wet after lease separation, in the United States increased by 5 percent (1,587 billion cubic feet) to 32,382 billion cubic feet in 1997 (**Table 11**). Proved reserves of AD wet natural gas in the lower 48 States decreased by 49 billion cubic feet to 24,666 billion cubic feet. Those areas of the country with the largest AD wet natural gas reserves were:

- Texas (24 percent)
- Alaska (24 percent)
- Gulf of Mexico Federal Offshore (23 percent)
- California (6 percent)
- New Mexico (4 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 3 percent in 1997 (**Table 11**), and production of AD wet natural gas in the lower 48 States increased by 2 percent (49 billion cubic feet). Those areas of the country with the largest AD wet natural gas production were:

- Gulf of Mexico Federal Offshore (28 percent)
- Texas (28 percent)
- Alaska (9 percent)
- New Mexico (8 percent)
- California (5 percent).

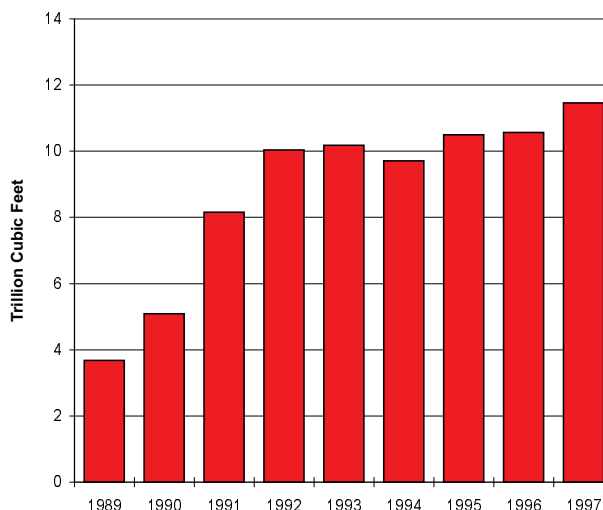
Again, these areas logically correspond to the areas of the country with the largest volumes of crude oil production.

Coalbed Methane

Proved Reserves

Reserves of coalbed methane increased in 1997 to account for about 7 percent of 1997 dry natural gas reserves (**Table 12**). Federal tax incentives for new coalbed methane wells expired at the end of 1992. Reserves in coalbed methane fields increased to 11,462 billion cubic feet, 8 percent more than in 1996. The EIA estimates that the 1997 proved gas reserves of fields identified as having coalbed methane are about double those reported in 1990 (**Figure 21**). Coalbed methane proved reserves are principally located in New Mexico, Colorado, Alabama, and Virginia. Estimates of proved coalbed methane reserves increased in all these States in 1997.

Figure 21. Coalbed Methane Proved Reserves 1989-1997



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

Production

Coalbed methane production grew by about 9 percent in 1997 to 1,090 billion cubic feet—about 6 percent of U.S. dry gas production. Most of the 1997 production increase (87 billion cubic feet) occurred in the San Juan Basin of Colorado and New Mexico.

Table 12. U.S. Coalbed Methane Proved Reserves and Production, 1994-1997
(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State	1994 Reserves	1994 Production	1995 Reserves	1995 Production	1996 Reserves	1996 Production	1997 Reserves	1997 Production
Alabama	976	108	972	109	823	98	1,077	111
Colorado	2,913	179	3,461	226	3,711	274	3,890	312
New Mexico	4,137	530	4,299	574	4,180	575	4,351	597
Others ^a	1,686	34	1,767	47	1,852	56	2,144	70
Total	9,712	851	10,499	956	10,566	1,003	11,462	1,090

^aIncludes Oklahoma, Pennsylvania, Utah, Virginia, West Virginia, and Wyoming.
Source: Energy Information Administration, Office of Oil and Gas.

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.

Alaska

Alaska had a net increase of 1,268 billion cubic feet of dry natural gas proved reserves in 1997. The largest net gas reserves increase of all States in 1997, it was from adjustments and net revisions.

Gulf of Mexico

Deep Water: Advances in 3-D seismic technology and previous deepwater successes have encouraged the oil and gas industry to search and drill for hydrocarbons farther offshore. Drilling in the deepwater portions of the Outer Continental Shelf (OCS) of the Gulf of Mexico has greatly increased in the past few years, and is now at an all-time high.

Mensa: Production began in July 1997 from the deepest producing field in the Gulf of Mexico, the Mensa Field in Mississippi Canyon Blocks 686, 687, 730 and 731. Shell produces gas from a subsea system of three wells connected to a subsea manifold five miles away, all in 5,300 feet of water. The subsea manifold is tied back to a shallow water platform in West Delta Block 143 via a 63-mile 12-inch diameter flowline. This 68-mile tieback

is currently the longest in the world. Shell estimates that the Mensa Field has an ultimate recovery of 720 billion cubic feet of gas and will have peak production rates of 300 million cubic feet of gas per day in the third quarter of 1998.{36}

Marlin: In the Gulf of Mexico Federal Offshore (Louisiana), in Viosca Knoll Block 915, Amoco is developing the Marlin Field in 3,240 feet of water. Amoco plans in late 1998 to install a tension-leg platform, five producing wells, and full on-deck processing capacity for 40,000 barrels of oil, 250 million cubic feet of gas, and 20,000 barrels of water, per day. The development system will also include two deepwater pipelines to transport the produced oil and gas. Production is expected to begin in 1999.{33}

Gemini: At the Gemini Field in Mississippi Canyon Block 292, Texaco applied sophisticated 3D imaging to locate and drill into reservoirs that lie below a 2,900-foot-thick salt sheet which initially defied scientific exploration. Texaco owns 60% of this subsalt gas and condensate discovery. Texaco expects the Gemini Field to reach a peak rate of about 180 million cubic feet per day by mid-1999.{37}

Texas

Although the State of Texas had a net decline in dry natural gas proved reserves in 1997, the second largest volume of new discoveries in 1997 was nevertheless made there.

South Texas: 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 1997. Operators in RRC District 4 reported more *extensions* (37 percent of the State total) than any other district in Texas. This district accounts for 21 percent of all of the reserves of dry natural gas in the State and leads the State in gas production (26 percent of the State total). RRC District 4's dry gas production increased 2 percent in 1997.

Similarly, RRC District 2 had an increase in dry natural gas reserves of 312 billion cubic feet in 1997—mostly from *extensions* of existing gas fields. RRC District 2's dry gas production increased 13 percent in 1997.

Wyoming

In 1997, Burlington Resources acquired Louisiana Land and Exploration Company, which consolidated Burlington Resources' holdings in the Madden Field in Fremont County, Wyoming. On March 19, Louisiana Land and Exploration Company (LL&E) announced a major extension to the reserves of the Madden Field. Open hole log analysis of the new Big Horn 4-36 well indicated a gross gas column of 260 feet in the Madison formation with no water and excellent reservoir quality. As a result, LL&E increased its estimate of proved and probable, recoverable natural gas reserves in the Madison reservoir to more than one trillion cubic feet. The Big Horn 4-36 well, with a total depth of 24,600 feet, was drilled to a location in the gas-bearing Madison formation 1,000 feet downdip from the crest of a subsurface structure which has a minimum areal extent of 23 square miles.

The Big Horn 4-36 well was drilled as a step-out from the Big Horn 1-5 and the Big Horn 2-3 wells. These wells are currently completed in the Madison formation and are together producing about 52 million cubic feet a day into the Lost Cabin Gas Plant (the current inlet capacity of the plant). Each well is capable of sustained production levels in excess of 30 million cubic feet a day. Carbon dioxide and hydrogen sulfide are removed prior to the sale of the gas and residual gas sales average approximately 34 million cubic feet a day.{38}

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.

New Mexico

This State's proved dry natural gas reserves decreased by 6 percent (971 billion cubic feet). Two fields (Basin and Blanco) accounted for about one-fourth of the production and about one-half of the total reserves of gas in New Mexico.

Colorado

This State's proved dry natural gas reserves decreased by 11 percent (882 billion cubic feet). However, the stage is set for a future increase in reserves due to a strategic acquisition by operator HS Resources. Near the end of 1997, HS Resources acquired Amoco's Denver- Julesburg Basin properties (in and surrounding Colorado's large Wattenberg field), capping an effort that spanned many years. For HS Resources, the compelling reason for the acquisition was the extraordinary abundance of reserves that could be unlocked by combining the Amoco properties with its own. For example, in many instances HS Resources owns the right to produce from formations which are "behind pipe" in an Amoco producing well. Bringing these reserves into production by recompleting an existing well generates substantially better economics than can be achieved by drilling a new well. In other instances, Amoco owned the right to produce from formations located deeper than horizons from which HS Resources was already producing, and deepening an existing well is substantially more economic than drilling a new well. Without these efficiencies, many potential proved reserves were economically "stranded" because drilling a new well could not be justified. The re-aggregation of reserves and value created by the Amoco acquisition gives HS Resources a substantial inventory of projects with virtually no risk and exceptional rates of return.{39}

Kansas

This State's proved dry natural gas reserves decreased by 9 percent (705 billion cubic feet).

Reserves in Nonproducing Reservoirs

Nonproducing proved natural gas reserves (wet after lease separation) of 33,124 billion cubic feet were reported in 1997 (**Table 13**). This was 75 billion cubic feet higher than in 1996. About 37 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).

Table 13. Reported Reserves of Natural Gas, Wet After Lease Separation, in Nonproducing Reservoirs, 1997^a
(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

State and Subdivision	Nonassociated Gas	Associated-Dissolved Gas	Total
Alaska	232	82	314
Lower 48 States	27,294	5,549	32,843
Alabama	359	4	363
Arkansas	136	10	146
California	103	130	233
Coastal Region Onshore	2	7	9
Los Angeles Basin Onshore	0	34	34
San Joaquin Basin Onshore	101	89	190
State Offshore	0	1	1
Colorado	600	74	674
Florida	0	0	0
Kansas	144	2	146
Kentucky	137	0	137
Louisiana	2,946	362	3,308
North	896	86	982
South Onshore	1,794	225	2,019
South State Offshore	256	51	307
Michigan	77	10	87
Mississippi	56	14	70
Montana	41	2	43
New Mexico	1,700	66	1,766
East	236	63	299
West	1,464	3	1,467
New York	2	0	2
North Dakota	109	10	119
Ohio	6	0	6
Oklahoma	1,219	107	1,326
Pennsylvania	24	0	24
Texas	5,734	712	6,446
RRC District 1	244	2	246
RRC District 2 Onshore	339	65	404
RRC District 3 Onshore	730	39	769
RRC District 4 Onshore	2,024	80	2,104
RRC District 5	323	3	326
RRC District 6	862	128	990
RRC District 7B	15	20	35
RRC District 7C	255	30	285
RRC District 8	398	261	659
RRC District 8A	0	74	74
RRC District 9	38	2	40
RRC District 10	444	8	452
State Offshore	62	0	62
Utah	347	94	441
Virginia	838	0	838
West Virginia	375	4	379
Wyoming	3,709	94	3,803
Federal Offshore ^b	8,629	3,856	12,485
Pacific (California)	47	19	66
Gulf of Mexico (Louisiana) ^b	6,809	2,960	9,769
Gulf of Mexico (Texas)	1,773	877	2,650
Miscellaneous ^c	1	2	3
U.S. Total	27,526	5,631	33,157

^aIncludes 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).

^bIncludes Federal Offshore Alabama.

^cIncludes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, Oregon, South Dakota, and Tennessee.

Source: Form EIA-23, "Annual Survey of Domestic Oil and Gas Reserves," 1997.

5. Natural Gas Liquids Statistics

Natural Gas Liquids

Proved Reserves

U.S. natural gas liquids proved reserves increased 2 percent to 7,973 million barrels in 1997 (**Table 14**). This was the third annual increase in a row. The 150 million barrel increase was predominantly in Alaska, which nearly doubled its natural gas liquids reserves level in 1997. Overall, reserve additions replaced 117 percent of 1997 natural gas liquids production.

The reserves of six areas account for 83 percent of the Nation's natural gas liquids proved reserves.

Area	Percent of U.S. NGL Reserves
Texas	34
Gulf of Mexico Federal Offshore	11
New Mexico	11
Utah-Wyoming	10
Oklahoma	9
Alaska	8
Area Total	83

The volumes of natural gas liquids proved reserves and production shown in **Table 14** are the sum of the natural gas plant liquid volumes listed in **Table 15** and the lease condensate volumes listed in **Table 16**.

Discoveries

Total discoveries of natural gas liquids reserves increased by 18 percent in 1997 to 739 million barrels, the second highest level ever recorded by EIA. Areas with the largest *total discoveries* were:

- Texas (44 percent)
- Gulf of Mexico Federal Offshore (22 percent)
- Utah and Wyoming (13 percent)
- Louisiana (7 percent)
- New Mexico (6 percent)
- Oklahoma (5 percent).

New field discoveries in 1997 (114 million barrels) were 75 percent higher than in 1996. Areas with the largest *new*

field discoveries were the Gulf of Mexico Federal Offshore (54 percent of 1997 new field discoveries) and Texas (46 percent).

New reservoir discoveries in old fields (90 million barrels) were 17 percent less than what they were in 1996. Areas with the largest *new reservoir discoveries in old fields* were the Gulf of Mexico Federal Offshore (53 percent of 1997 new reservoir discoveries in old fields), Louisiana (21 percent), and Texas (16 percent).

Extensions were 535 million barrels, an increase of 19 percent over 1996. Areas with the largest *extensions* were Texas (48 percent of 1997 extensions), Utah-Wyoming (18 percent), and the Gulf of Mexico Federal Offshore (10 percent).

Production

Natural gas liquids production was an estimated 864 million barrels in 1997. Alaska production increased 6 percent to 35 million barrels in 1997, while lower 48 States production increased 1 percent to 829 million barrels in 1997.

Seven areas accounted for about 90 percent of the Nation's natural gas liquids production.

- Texas (37 percent)
- Gulf of Mexico Federal Offshore (16 percent)
- New Mexico (9 percent)
- Oklahoma (9 percent)
- Louisiana (8 percent)
- Utah-Wyoming (7 percent)
- Alaska (4 percent).

Natural Gas Plant Liquids

Proved Reserves

Natural gas plant liquids proved reserves increased 2 percent in 1997 to 6,632 million barrels (**Table 15**). Six areas accounted for about 83 percent of the Nation's natural gas plant liquids proved reserves:

Table 14. Natural Gas Liquids Proved Reserves, Reserves Changes, and Production, 1997
(Million Barrels of 42 U.S. Gallons)

State and Subdivision	Published Proved Reserves 12/31/96	Changes in Reserves During 1997							Proved Reserves 12/31/97
		Adjustments (+,-)	Revision Increases (+)	Revision Decreases (-)	Extensions (+)	New Field Discoveries (+)	New Reservoir Discoveries in Old Fields (+)	Estimated Production (-)	
Alaska	337	93	234	0	2	0	0	35	631
Lower 48 States	7,486	-107	965	910	533	114	90	829	7,342
Alabama	119	-13	3	6	0	0	0	10	93
Arkansas	4	2	2	0	0	0	0	1	7
California	92	-5	15	2	3	0	0	8	95
Coastal Region Onshore	9	0	1	1	1	0	0	1	9
Los Angeles Basin Onshore	3	0	1	0	0	0	0	0	4
San Joaquin Basin Onshore	80	-5	13	1	2	0	0	7	82
State Offshore	0	0	0	0	0	0	0	0	0
Colorado	287	25	34	64	5	0	0	23	264
Florida	22	-4	0	0	0	0	0	1	17
Kansas	338	-39	16	21	2	0	0	25	271
Kentucky	46	-1	4	0	1	0	1	3	48
Louisiana	543	-109	82	63	35	0	19	70	437
North	85	-6	18	11	6	0	0	12	80
South Onshore	411	-81	57	45	28	0	16	53	333
State Offshore	47	-22	7	7	1	0	3	5	24
Michigan	53	1	6	6	1	0	0	5	50
Mississippi	7	0	0	1	1	0	0	1	6
Montana	7	-2	1	1	0	0	0	0	5
New Mexico	1,059	-156	132	134	47	0	1	80	869
East	299	-11	42	36	21	0	1	43	273
West	760	-145	90	98	26	0	0	37	596
North Dakota	48	-2	5	2	2	0	0	4	47
Oklahoma	684	-21	134	68	31	0	4	79	685
Texas	2,606	81	336	341	255	53	14	317	2,687
RRC District 1	46	0	7	3	9	1	0	6	54
RRC District 2 Onshore	93	-15	14	12	16	2	1	12	87
RRC District 3 Onshore	289	-32	47	37	24	45	3	53	286
RRC District 4 Onshore	323	15	75	105	88	1	4	54	347
RRC District 5	54	-7	3	15	1	0	3	4	35
RRC District 6	290	-18	24	34	25	0	0	27	260
RRC District 7B	65	-15	14	5	5	3	0	8	59
RRC District 7C	303	39	33	36	23	0	1	36	327
RRC District 8	429	17	63	33	29	1	2	49	459
RRC District 8A	262	50	12	19	4	0	0	19	290
RRC District 9	119	-18	6	9	13	0	0	13	98
RRC District 10	332	64	37	33	18	0	0	36	382
State Offshore	1	1	1	0	0	0	0	0	3
Utah and Wyoming	727	-4	73	77	97	0	2	57	761
West Virginia	61	11	4	2	0	0	1	4	71
Federal Offshore ^a	776	128	116	121	53	61	48	141	920
Pacific (California)	23	3	0	11	0	0	0	1	14
Gulf of Mexico (Louisiana) ^a	621	125	105	89	45	56	45	123	785
Gulf of Mexico (Texas)	132	0	11	21	8	5	3	17	121
Miscellaneous ^b	7	1	2	1	0	0	0	0	9
U.S. Total	7,823	-14	1,199	910	535	114	90	864	7,973

^aIncludes Federal offshore Alabama.

^bIncludes 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 1997 contained in the publications *Petroleum Supply Annual 1997*, DOE/EIA-0340(97) and *Natural Gas Annual 1997* DOE/EIA-0131(97).

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

Table 15. Natural Gas Plant Liquids Proved Reserves and Production, 1997
(Million Barrels of 42 U.S. Gallons)

State and Subdivision	1997 Reserves	1997 Production	State and Subdivision	1997 Reserves	1997 Production
Alaska	631	35	North Dakota	40	4
Lower 48 States	6,001	655	Oklahoma	610	71
Alabama	34	4	Texas	2,376	275
Arkansas	3	0	RRC District 1	46	5
California	92	8	RRC District 2 Onshore	75	10
Coastal Region Onshore	9	1	RRC District 3 Onshore	170	36
Los Angeles Basin Onshore	4	0	RRC District 4 Onshore	261	42
San Joaquin Basin Onshore	79	7	RRC District 5	31	4
State Offshore	0	0	RRC District 6	221	22
Colorado	244	17	RRC District 7B	57	8
Florida	17	1	RRC District 7C	309	34
Kansas	263	24	RRC District 8	447	47
Kentucky	47	3	RRC District 8A	290	19
Louisiana	261	41	RRC District 9	96	13
North	50	7	RRC District 10	372	35
South Onshore	199	31	State Offshore	1	0
State Offshore	36	3	Utah and Wyoming	680	49
Michigan	12	4	West Virginia	70	4
Mississippi	45	0	Federal Offshore ^a	389	71
Montana	5	0	Pacific (California)	10	1
New Mexico	814	75	Gulf of Mexico (Louisiana) ^a	352	64
East	253	40	Gulf of Mexico (Texas)	27	6
West	561	35	Miscellaneous ^b	9	0
			U.S. Total	6,632	690

^aIncludes Federal Offshore Alabama.

^bIncludes 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 1997 contained in the publications *Petroleum Supply Annual 1997*, DOE/EIA-0340(97) and *Natural Gas Annual 1997*, DOE/EIA-0131(97).

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

Table 16. Lease Condensate Proved Reserves and Production, 1997
(Million Barrels of 42 U.S. Gallons)

State and Subdivision	1997 Reserves	1997 Production	State and Subdivision	1997 Reserves	1997 Production
Alaska	0	0	North Dakota	7	0
Lower 48 States.	1,341	174	Oklahoma	75	8
Alabama	59	6	Texas	311	42
Arkansas	4	1	RRC District 1	8	1
California	3	0	RRC District 2 Onshore	12	2
Coastal Region Onshore	0	0	RRC District 3 Onshore	116	17
Los Angeles Basin Onshore	0	0	RRC District 4 Onshore	86	12
San Joaquin Basin Onshore	3	0	RRC District 5	4	0
State Offshore	0	0	RRC District 6	39	5
Colorado	20	2	RRC District 7B	2	0
Florida	0	0	RRC District 7C	18	2
Kansas	8	1	RRC District 8	12	2
Kentucky	1	0	RRC District 8A	0	0
Louisiana	176	29	RRC District 9	2	0
North	30	5	RRC District 10	10	1
South Onshore	134	22	State Offshore	2	0
State Offshore	12	2	Utah and Wyoming	81	8
Michigan	5	1	West Virginia	1	0
Mississippi	4	1	Federal Offshore ^a	531	70
Montana	0	0	Pacific (California)	4	0
New Mexico	55	5	Gulf of Mexico (Louisiana) ^a	433	59
East	20	3	Gulf of Mexico (Texas)	94	11
West	35	2	Miscellaneous ^b	0	0
			U.S. Total	1,341	174

^aIncludes Federal Offshore Alabama.

^bIncludes 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" 1997.

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

Area	Percent of U.S. Gas Plant Liquids
Texas	36
New Mexico	12
Utah-Wyoming	10
Alaska	10
Oklahoma	9
Gulf of Mexico Federal Offshore	6
Area Total	83

Production

Natural gas plant liquids production increased only slightly in 1997—from 688 million barrels in 1996 to 690 million barrels of production (**Table 15**). 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 (40 percent)
- New Mexico (11 percent)
- Oklahoma (10 percent)
- Gulf of Mexico Federal Offshore (10 percent)
- Utah and Wyoming (7 percent)
- Alaska (5 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 1,341 million barrels in 1997 (**Table 16**). This was 34 million barrels or 3 percent higher than in

1996. The reserves of four areas account for about 81 percent of the Nation's lease condensate proved reserves.

Area	Percent of U.S. Condensate Reserves
Gulf of Mexico Federal Offshore	39
Texas	23
Louisiana	13
Utah-Wyoming	6
Area Total	81

Production

Production of lease condensate was 174 million barrels, an increase of 12 million barrels, or 7 percent, in 1997. The production of four areas account for about 86 percent of the Nation's lease condensate production.

- Gulf of Mexico Federal Offshore (40 percent)
- Texas (24 percent)
- Louisiana (17 percent)
- Utah-Wyoming (5 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 1997. Proved reserves of 501 million barrels of lease condensate, an increase of 1 percent from 1996, were reported in nonproducing reservoirs in 1997. 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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Operator Data by Size Class

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, 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 1992 through 1997 for oil and gas well operators. The tables show the volumetric change and percent change from the previous year and from 1992. In addition they show the 1997 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 22,178 small operators. We estimate production and reserves for small operators each year from a sample of approximately 8 percent 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 1992 through 1997 have changed from 173.3 trillion cubic feet to 175.7 trillion cubic feet (**Table A1**). Reserves have been increasing for the last five years in a row and are above the 1992 level. These proved reserves are highly concentrated in the larger companies. In 1997, the top 20 (Class 1–10 and Class 11–20) producing companies had 55 percent of the proved reserves of natural gas. The next two size classes contain 80 and 400 companies and account for 26 and 13 percent of the U.S. natural gas proved reserves, respectively. The top 20 operators had a decline of 6 percent in their natural gas proved reserves from 1992 to 1997. While the rest of the operators (Class 21–100, Class 101–500, and Class Other) had an increase of 12 percent. In 1997, the top 20 operators' natural gas reserves increased by 15 percent from 1996.

Production

Wet natural gas production has slightly increased from 19.9 trillion cubic feet to 20.1 trillion cubic feet in 1997 (**Table A2**). In 1997, the top 20 producing companies had 52 percent of the production of wet natural gas, while having 55 percent of the proved reserves. The next two size classes have 28 and 13 percent of the wet natural gas production, respectively. The top 20 operators had an increase of 8 percent in their wet natural gas production from 1992 to 1997. The rest of the operators had an increase of 12 percent from 1992 to 1997. The top 20 operators' wet natural gas production had an decrease of 5 percent in 1997, while the rest of the operators remained the same.

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 1997 had 64 percent of U.S. proved reserves of crude oil (**Table A3**), in contrast to wet natural gas where these same companies operated only 55 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 increased 2.4 percent in 1997. The top 20 producing companies had a decline of 6 percent in their domestic proved reserves of crude oil during 1997. The top 20 class had a decline of 20 percent in their crude oil proved reserves from 1992 to 1997. The next two size classes each account for 9 percent of the U.S. crude oil proved reserves. The class “other” had a 15 percent decrease from 1992 to 1997. During the 1992–1997 period, many operators were continuing to actively buy, sell, and restructure their oil property positions.

Production

Crude oil production reported for 1992 through 1997 has decreased from 2.4 billion barrels to 2.1 billion barrels (**Table A4**). The 20 largest oil and gas producing companies had 61 percent of U.S. production of crude oil in 1997, while in 1992 they accounted for 69 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 13 percent from 1992 to 1997. The top 20 operators had a decline of 22 percent in their oil production during the same period. U.S. production of crude oil declined by 2 percent from 1996 to 1997, while the top 20 operators production decreased by 7 percent. The next two size classes account for 17 and 11 percent of the U.S. crude oil production, respectively.

Fields

The number of fields in which Category I and Category II operators were active dropped significantly during the 1992–1997 period. Fields in which these large operators were active dropped by 2,227 or 8 percent (**Table A5**). Most of the changes in operator field counts resulted from the top 20 operators class concentrating their effort in a diminishing number of fields. From 1992 through 1997, the number of fields in which the top 20 operators were active in dropped by 2,798 or 37 percent, while in 1997 the number dropped 8 percent from 1996.

Table A1. Natural Gas Proved Reserves, Wet After Lease Separation, by Operator Production Size Class, 1992–1997
(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Size Class	1992	1993	1994	1995	1996	1997	1996–1997 Volume and Percent Change	1992–1997 Volume and Percent Change	1997 Average Reserves per Operator
Class 1–10	74,350	77,552	76,665	75,856	72,606	68,876	-3,730	-5,474	6,887.600
Percent of Total	42.9%	45.5%	44.6%	43.7%	41.5%	39.2%	-5.1%	-7.4%	
Class 11–20	28,442	22,467	22,691	24,648	25,416	27,705	2,289	-737	2,770.500
Percent of Total	16.4%	13.2%	13.2%	14.2%	14.5%	15.8%	9.0%	-2.6%	
Class 21–100	38,388	39,135	40,566	42,604	43,300	45,593	2,293	7,205	569.913
Percent of Total	22.2%	23.0%	23.6%	24.6%	24.7%	25.9%	5.3%	18.8%	
Class 101–500	19,728	19,870	20,608	20,150	22,483	23,338	855	3,610	58.345
Percent of Total	11.4%	11.7%	12.0%	11.6%	12.8%	13.3%	3.8%	18.3%	
Class Other (22,178)	12,401	11,466	11,409	10,218	11,342	10,209	-1,133	-2,192	0.460
Percent of Total	7.2%	6.7%	6.6%	5.9%	6.5%	5.8%	-10.0%	-17.7%	
Category I (169)	144,351	142,892	143,703	148,233	146,601	147,491	890	3,140	872.728
Percent of Total	83.3%	83.8%	83.6%	85.4%	83.7%	83.9%	0.6%	2.2%	
Category II (418)	17,682	17,305	18,158	15,828	18,382	17,764	-618	82	42.498
Percent of Total	10.2%	10.2%	10.6%	9.1%	10.5%	10.1%	-3.4%	0.5%	
Category III (22,037)	11,276	10,292	10,078	9,416	10,164	10,466	302	-810	0.475
Percent of Total	6.5%	6.0%	5.9%	5.4%	5.8%	6.0%	3.0%	-7.2%	
Total Published	173,309	170,490	171,939	173,476	175,147	175,721	574	2,412	7.749
Percent of Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.3%	1.4%	

Note: There were 22,037 active Category III operators in the 1997 sample frame. The reserves and production of Category III operators were estimated from an adjusted sample of 2,494 Category III operators (Table E2). The “other” size class represents 22,178 operators in the 1997 frame (22,678 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, 1992–1997
(Billion Cubic Feet at 14.73 psia and 60° Fahrenheit)

Size Class	1992	1993	1994	1995	1996	1997	1996–1997 Volume and Percent Change	1992–1997 Volume and Percent Change	1997 Average Production per Operator
Class 1–10	6,625	6,801	7,216	7,174	7,448	7,178	-270	553	717.800
Percent of Total	36.3%	36.5%	37.6%	38.0%	37.5%	35.7%	-3.6%	8.3%	
Class 11–20	3,036	2,861	3,083	3,101	3,002	3,286	284	250	328.600
Percent of Total	16.6%	15.3%	16.0%	16.4%	15.1%	16.3%	9.5%	8.2%	
Class 21–100	4,592	4,894	4,878	4,871	5,316	5,729	413	1,137	71.613
Percent of Total	25.1%	26.3%	25.4%	25.8%	26.7%	28.4%	7.8%	24.8%	
Class 101–500	2,411	2,597	2,552	2,477	2,623	2,665	42	254	6.663
Percent of Total	13.2%	13.9%	13.3%	13.1%	13.2%	13.2%	1.6%	10.5%	
Class Other (22,178)	1,605	1,488	1,481	1,251	1,484	1,276	-208	-329	0.058
Percent of Total	8.8%	8.0%	7.7%	6.6%	7.5%	6.3%	-14.0%	-20.5%	
Category I (169)	14,767	15,122	15,656	15,800	16,381	16,897	516	2,130	99.982
Percent of Total	80.8%	81.1%	81.5%	83.7%	82.4%	83.9%	3.1%	14.4%	
Category II (418)	2,036	2,159	2,221	1,923	2,128	1,979	-149	-57	4.734
Percent of Total	11.1%	11.6%	11.6%	10.2%	10.7%	9.8%	-7.0%	-2.8%	
Category III (22,037)	1,466	1,360	1,333	1,151	1,364	1,258	-106	-208	0.057
Percent of Total	8.0%	7.3%	6.9%	6.1%	6.9%	6.2%	-7.8–	-14.2%	
Total Published	18,269	18,641	19,210	18,874	19,873	20,134	261	1,865	0.888
Percent of Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1.3%	10.2%	

Note: There were 22,037 active Category III operators in the 1997 sample frame. The reserves and production of Category III operators were estimated from an adjusted sample of 2,494 Category III operators (Table E2). The “other” size class represents 22,178 operators in the 1997 frame (22,678 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, 1992–1997
(Million Barrels of 42 U.S. Gallons)

Size Class	1992	1993	1994	1995	1996	1997	1996–1997 Volume and Percent Change	1992–1997 Volume and Percent Change	1997 Average Reserves per Operator
Class 1–10	15,733	14,894	14,351	13,891	13,362	11,434	-1,928	-4,299	1,143.400
Percent of Total	66.3%	64.9%	63.9%	62.1%	60.7%	50.7%	-14.4%	-27.3%	
Class 11–20	2,250	2,389	2,276	2,422	2,013	2,977	964	727	297.700
Percent of Total	9.5%	10.4%	10.1%	10.8%	9.1%	13.2%	47.9%	32.3%	
Class 21–100	2,370	2,401	2,607	2,623	3,155	4,384	1,229	2,014	54.800
Percent of Total	10.0%	10.5%	11.6%	11.7%	14.3%	19.4%	39.0%	85.0%	
Class 101–500	1,463	1,440	1,512	1,793	1,838	2,111	273	648	5.278
Percent of Total	6.2%	6.3%	6.7%	8.0%	8.3%	9.4%	14.9%	44.3%	
Class Other (22,178)	1,929	1,833	1,711	1,622	1,649	1,640	-9	-289	0.074
Percent of Total	8.1%	8.0%	7.6%	7.3%	7.5%	7.3%	-0.5%	-15.0%	
Category I (169)	20,767	20,090	19,648	19,647	19,312	19,461	149	-1,306	115.154
Percent of Total	87.5%	87.5%	87.5%	87.9%	87.7%	86.3	0.8%	-6.3%	
Category II (418)	1,150	1,131	1,142	1,103	1,117	1,400	283	250	3.349
Percent of Total	4.8%	4.9%	5.1%	4.9%	5.1%	6.2	25.3%	21.7%	
Category III (22,037)	1,828	1,737	1,668	1,600	1,588	1,685	97	-959	0.076
Percent of Total	7.7%	7.6%	7.4%	7.2%	7.2%	7.5	6.1%	-5.0%	
Total Published	23,745	22,957	22,457	22,351	22,017	22,546	529	-1,199	0.994
Percent of Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	2.4%	-5.0%	

Note: There were 22,037 active Category III operators in the 1997 sample frame. The reserves and production of Category III operators were estimated from an adjusted sample of 2,494 Category III operators (Table E2). The “other” size class represents 22,178 operators in the 1997 frame (22,678 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, 1992–1997
(Million Barrels of 42 U.S. Gallons)

Size Class	1992	1993	1994	1995	1996	1997	1996–1997 Volume and Percent Change	1992–1997 Volume and Percent Change	1997 Average Production per Operator
Class 1–10	1,458	1,346	1,310	1,270	1,220	1,047	-173	-411	104.700
Percent of Total	59.6%	57.5%	57.8%	57.4%	56.1%	49.0%	-14.2%	-28.2%	
Class 11–20	231	236	224	221	185	262	77	31	26.200
Percent of Total	9.4%	10.1%	9.9%	10.0%	8.5%	12.3%	41.6%	13.4%	
Class 21–100	272	276	287	276	307	373	66	101	4.663
Percent of Total	11.1%	11.8%	12.7%	12.5%	14.1%	17.4%	21.5%	37.1%	
Class 101–500	213	202	200	214	213	237	24	24	0.593
Percent of Total	8.7%	8.6%	8.8%	9.7%	9.8%	11.1%	11.3%	11.3%	
Class Other (22,178)	272	279	247	232	248	219	-29	-53	0.010
Percent of Total	11.1%	11.9%	10.9%	10.5%	11.4%	10.2%	-11.7%	-19.5%	
Category I (169)	2,022	1,922	1,879	1,844	1,791	1,760	-31	-262	10.414
Percent of Total	82.7%	82.2%	82.8%	83.3%	82.4%	82.3%	-1.7%	-13.0%	
Category II (418)	163	153	150	139	143	157	14	-6	0.376
Percent of Total	6.7%	6.5%	6.6%	6.3%	6.6%	7.3%	9.8%	-3.7%	
Category III (22,037)	261	264	239	230	239	221	-18	-40	0.010
Percent of Total	10.7%	11.3%	10.5%	10.4%	11.0%	10.3%	-7.5%	-15.3%	
Total Published	2,446	2,339	2,268	2,213	2,173	2,138	-35	-308	0.094
Percent of Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	-1.6%	-12.6%	

Note: There were 22,037 active Category III operators in the 1997 sample frame. The reserves and production of Category III operators were estimated from an adjusted sample of 2,494 Category III operators (Table E2). The “other” size class represents 22,178 operators in the 1997 frame (22,678 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, 1992–1997

Size Class	1992	1993	1994	1995	1996	1997	1996–1997 Number and Percent Change	1992–1997 Number and Percent Change	1997 Average Number of Fields per Operator
Class 1–10	4,189	3,591	3,258	3,113	2,800	2,566	-234	-1,623	257
Percent of Total	14.7%	13.2%	12.2%	11.9%	10.7%	10.4%	-8.4%	-38.7%	
Class 11–20	3,432	2,998	2,795	2,772	2,441	2,257	-184	-1,175	226
Percent of Total	12.1%	11.1%	10.5%	10.6%	9.3%	9.1%	-7.5%	-34.2%	
Class 21–100	8,003	7,600	7,752	7,569	7,526	7,159	-367	-844	89
Percent of Total	28.2%	28.0%	29.1%	28.9%	28.7%	28.9%	-4.9%	-10.5%	
Class 101–500	11,896	11,881	11,878	11,886	12,492	12,878	386	982	32
Percent of Total	41.9%	43.8%	44.6%	45.4%	47.7%	52.0%	3.1%	8.3%	
Rest	2,059	1,715	1,897	1,601	^a 952	1,332	380	-727	15
Percent of Total	7.2%	6.3%	7.1%	6.1%	^a 3.6%	5.4%	39.9%	-35.3%	
Category I	17,620	16,603	16,161	16,256	15,635	15,232	-403	-2,388	90
Percent of Total	62.0%	61.2%	60.7%	62.1%	59.7%	58.2%	-2.6%	-13.6%	
Category II	10,799	10,516	10,452	9,939	10,576	10,960	384	161	22
Percent of Total	38.0%	38.8%	39.3%	37.9%	40.3%	41.8%	3.6%	1.5%	
Total Reported	28,419	27,119	26,613	26,195	26,211	26,192	-19	-2,227	39
Percent Change	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	-0.1%	-7.8%	

^aThe reduced 1996 survey had fewer operators and fields in the “rest” class.

Note: Includes only data from Category I and Category II operators. In 1997, there were 169 Category I operators and 418 Category II operators. The “rest” size class had 87 operators in 1997.

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

Top 100 Oil and Gas Fields for 1997

Top 100 Oil and Gas Fields for 1997

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 plus nonassociated, wet after lease separation).

The top 100 oil fields in the United States as of December 31, 1997, had 14,940 million barrels of proved reserves (**Table B1**) accounting for 63 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 fields in the top 100 groups 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 1997 there are three fields, Mississippi Canyon Blk 807 (Mars), Green Canyon Blk 244 (Troika), and Mississippi Canyon Blk 854 (Ursa) in the deep water of

the Gulf of Mexico Federal Offshore. The top 100 oil fields in the United States as of December 31, 1997, had 1,176 million barrels of production (**Table B1**) or 51 percent of the total (**Table 6 and Table 16**). Many of the oil fields in the top 100 are very old, 47 oil fields were discovered prior to 1946. The oldest, Coalinga in California, was discovered in 1887. The fields with newer discovery dates are located in the Gulf of Mexico Offshore and Alaska.

The top 100 gas fields in the United States as of December 31, 1997, had 80,698 billion cubic feet of proved reserves (**Table B2**) or 46 percent of the total (**Table 9**). The top 100 gas fields in the United States as of December 31, 1997, had 6,563 billion cubic feet of production (**Table B2**) or 33 percent of the total (**Table 9**). Fewer of the gas fields in the top 100 are very old. There were 19 gas fields that were discovered prior to 1946. The oldest, Big Sandy in Kentucky, was discovered in 1881. The 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.

Table B1. Top 100 U.S. Fields Ranked by Oil^a Production within Proved Reserves Group, from Reported 1997 Field Level Data^b
(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	252.3
Kuparuk River	AK	1969	1-10	96.1
Midway-Sunset	CA	1901	1-10	61.6
Kern River	CA	1899	1-10	48.8
Belridge South	CA	1911	1-10	41.1
Mississippi Canyon Blk 807	GF	1989	1-10	31.9
Yates	TX	1926	1-10	20.9
Elk Hills	CA	1919	1-10	20.5
Milne Point	AK	1982	1-10	19.0
Wasson	TX	1937	1-10	15.0
Top 10 Volume Subtotal			8,001.3	607.1
Top 10 Percentage of U.S. Total			33.5%	26.3%
Point McIntyre	AK	1988	11-20	58.8
Spraberry Trend Area	TX	1950	11-20	22.1
Endicott	AK	1978	11-20	21.4
Wilmington	CA	1932	11-20	19.5
Hondo	PF	1969	11-20	16.3
Slaughter	TX	1937	11-20	14.5
Levelland	TX	1945	11-20	9.4
San Ardo	CA	1947	11-20	4.2
Green Canyon Blk 244	GF	1994	11-20	1.1
Mississippi Canyon Blk 854	GF	1992	11-20	0.0
Top 20 Volume Subtotal			10,140.9	774.5
Top 20 Percentage of U.S. Total			42.5%	33.5%
Garden Banks Blk 426	GF	1987	21-50	28.2
Giddings	TX	1960	21-50	20.7
East Texas	TX	1930	21-50	17.1
Viosca Knoll Blk 990	GF	1981	21-50	16.4
Pescado	PF	1970	21-50	15.0
Cymric	CA	1916	21-50	14.0
Seminole	TX	1936	21-50	11.9
Niakuk	AK	1984	21-50	10.6
Lost Hills	CA	1910	21-50	10.2
Coalinga	CA	1887	21-50	9.6
Salt Creek	TX	1942	21-50	9.4
Cowden North	TX	1930	21-50	9.2
Bay Marchand Blk 2	GF & LA	1949	21-50	8.6
Vacuum	NM	1929	21-50	8.0
Sho-Vel-Tum	OK	1905	21-50	7.4
Rangely	CO	1902	21-50	7.4
Mcelroy	TX	1926	21-50	7.3
Fullerton	TX	1942	21-50	7.0
Greater Aneth	UT	1956	21-50	6.0
Ventura	CA	1916	21-50	5.3
Goldsmith	TX	1935	21-50	4.3
Robertson North	TX	1956	21-50	3.6
Hawkins	TX	1940	21-50	3.2
Howard-Glasscock	TX	1925	21-50	2.9
Eunice Monument	NM	1929	21-50	1.3
Viosca Knoll Blk 956	GF	1985	21-50	0.9
Wasson 72	TX	1940	21-50	0.0
East Breaks Blk 945	GF	1994	21-50	0.0
Green Canyon Blk 205	GF	1988	21-50	0.0
Mississippi Canyon Blk 935	GF	1994	21-50	0.0
Top 50 Volume Subtotal			12,989.7	1,019.9
Top 50 Percentage of U.S. Total			54.3%	44.1%

Table B1. Top 100 U.S. Fields Ranked by Oil^a Production within Proved Reserves Group, from Reported 1997 Field Level Data^b (Continued)
(Million Barrels of 42 U.S. Gallons)

Field Name	Location	Discovery Year	Proved Reserves Rank Group	Reported Production Rank Group
Ewing Bank Blk 873	GF	1991	51-100	12.1
Eugene Island Sa Blk 330	GF	1971	51-100	9.5
Ship Shoal Blk 169	GF	1961	51-100	7.2
Main Pass Sa Blk 299	GF	1967	51-100	6.6
West Delta Blk 30	GF	1949	51-100	6.5
South Pass Blk 61	GF	1955	51-100	6.5
Cedar Hills	ND	1995	51-100	6.1
Jay	FL & AL	1970	51-100	5.8
Wattenberg	CO	1970	51-100	5.6
South Timbalier Blk 52	GF	1950	51-100	5.4
Viosca Knoll Blk 825	GF	1988	51-100	5.3
Oregon Basin	WY	1912	51-100	4.4
Means	TX	1934	51-100	4.2
Grayburg-Jackson	NM	1929	51-100	4.0
Huntington Beach	CA	1920	51-100	3.6
Painter Reservoir East	WY	1979	51-100	3.5
Dollarhide	TX & NM	1945	51-100	3.5
Ship Shoal Sa Blk 349	GF	1994	51-100	3.3
Beta	PF	1976	51-100	3.2
T X L	TX	1944	51-100	3.2
Monument	NM & UT	1935	51-100	2.8
Bluebell	UT	1949	51-100	2.7
Cedar Lake	TX	1939	51-100	2.7
Dos Cuadras	PF	1968	51-100	2.6
Stephens County Regular	TX	1915	51-100	2.5
Jo-Mill	TX	1953	51-100	2.5
Inglewood	CA	1924	51-100	2.5
Mabee	TX	1944	51-100	2.4
Elk Basin	WY & MT	1915	51-100	2.3
Hamilton Dome	WY	1918	51-100	2.2
Sand Hills	TX	1930	51-100	2.1
Welch	TX	1942	51-100	2.1
Hartzog Draw	WY	1976	51-100	2.1
Pennel	MT	1955	51-100	2.0
Postle	OK	1958	51-100	1.8
Cowden South	TX	1930	51-100	1.7
Kern Front	CA	1925	51-100	1.7
Cottonwood Creek	WY	1953	51-100	1.5
Beverly Hills	CA	1900	51-100	1.4
Brea-Olinda	CA	1897	51-100	1.4
Hobbs	NM	1928	51-100	1.1
Justis	NM	1957	51-100	1.0
Cote Blanche Bay West	LA	1940	51-100	0.6
Crossett South	TX	1956	51-100	0.5
Green Canyon Blk 254	GF	1994	51-100	0.0
Green Canyon Blk 158	GF	1992	51-100	0.0
Viosca Knoll Blk 915	GF	1993	51-100	0.0
Viosca Knoll Blk 786	GF	1996	51-100	0.0
Garden Banks Blk 260	GF	1995	51-100	0.0
Ewing Bank Blk 921	GF	1993	51-100	0.0
Top 100 Volume Subtotal			14,939.6	1,175.5
Top 100 Percentage of U.S. Total			62.5 %	50.8%

^aIncludes lease condensate.

^bOnly 87 percent of the estimated reserves were surveyed by EIA at the field level from large and intermediate operators.

Notes: Fields are grouped in "proved reserves rank groups" and then listed within that group in descending order by annual production rank. The U.S. total production estimate of 2,312 million barrels and the U.S. total reserves estimate of 23,887 million barrels, used to calculate the percentages in this table, are from the combined totals of Table 6 and Table 16 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 Production within Proved Reserves Group, from Reported 1997 Field Level Data^b
(Billion Cubic Feet)

Field Name	Location	Discovery Year	Proved Reserves Rank Group	Reported Production Rank Group
Basin	NM	1947	1-10	787.2
Blanco	NM & CO	1927	1-10	605.9
Hugoton Gas Area	KS & OK & TX	1922	1-10	507.5
Carthage	TX	1936	1-10	211.7
Prudhoe Bay	AK	1967	1-10	207.8
Mobile Bay	AL	1985	1-10	132.9
Panhandle West	TX	1918	1-10	114.3
Madden	WY	1968	1-10	41.1
Oakwood	VA	1990	1-10	25.5
Big Piney-Labarge	WY	1964	1-10	9.7
Top 10 Volume Subtotal			37,405.0	2,643.6
Top 10 Percentage of U.S. Total			21.3%	13.1%
Giddings	TX	1960	1-20	383.2
Antrim	MI	1965	1-20	122.8
Panoma Gas Area	KS	1956	1-20	100.2
Wattenberg	CO	1970	1-20	94.9
Spraberry Trend Area	TX	1950	1-20	70.8
Red Oak-Norris	OK	1910	1-20	66.5
Cook Inlet North	AK	1962	1-20	52.0
Big Sandy	KY	1881	1-20	49.0
Fogarty Creek	WY	1975	1-20	32.5
Lake Ridge	WY	1981	1-20	14.0
Top 20 Volume Subtotal			47,596.9	3,629.5
Top 20 Percentage of U.S. Total			27.1%	18.0%
Bob West	TX	1990	21-50	106.6
Anschutz Ranch East	UT & WY	1979	21-50	79.1
Strong City District	OK	1966	21-50	73.4
Whitney Canyon-Carter Creek	WY	1978	21-50	73.0
Mocane-Laverne Gas Area	OK & KS & TX	1946	21-50	69.6
Watonga-Chickasha Trend	OK	1948	21-50	67.8
Mcarthur River	AK	1965	21-50	64.4
Gomez	TX	1963	21-50	64.3
Knox	OK	1916	21-50	61.0
Wilburton	OK	1941	21-50	58.6
Elk Hills	CA	1919	21-50	56.5
Bruff	WY	1974	21-50	53.9
Ozona	TX	1953	21-50	53.7
Golden Trend	OK	1945	21-50	52.4
Mobile Blk 823	GF	1983	21-50	52.0
Oak Hill	TX	1958	21-50	48.7
Kinta	OK	1914	21-50	46.4
Natural Buttes	UT	1940	21-50	44.8
Sawyer	TX	1960	21-50	43.1
Nora	VA	1949	21-50	38.8
Lower Mobile Bay-Mary Ann	AL	1979	21-50	36.3
Brady	WY	1972	21-50	35.5
Beluga River	AK	1962	21-50	34.8
Mobile Blk 864	GF	1983	21-50	31.4
Mississippi Canyon Blk 731	GF	1987	21-50	16.8
Judge Digby	LA	1977	21-50	12.2
Viosca Knoll Blk 956	GF	1985	21-50	8.1
Wasson	TX	1937	21-50	2.5
Mississippi Canyon Blk 854	GF	1992	21-50	0
East Breaks Blk 945	GF	1994	21-50	0
Top 50 Volume Subtotal			65,643.7	5,015.2
Top 50 Percentage of U.S. Total			37.4%	24.9%

Table B2. Top 100 U.S. Fields Ranked by Gas^a Production within Proved Reserves Group, from Reported 1997 Field Level Data^b (Continued)
(Billion Cubic Feet)

Field Name	Location	Discovery Year	Proved Reserves Rank Group	Reported Production Rank Group
Garden Banks Blk 426	GF	1987	51-100	81.5
Matagorda Island Blk 623	GF	1980	51-100	78.3
Indian Basin	NM	1963	51-100	71.7
Mcallen Ranch	TX	1960	51-100	65.1
South Timbalier Blk 176	GF	1965	51-100	53.6
Jeffress Ne	TX	1975	51-100	52.5
Double A Wells	TX	1980	51-100	50.9
Waltman	WY	1959	51-100	45.4
Sibley	LA	1929	51-100	45.2
Elk City	OK	1947	51-100	43.2
Port Hudson	LA	1977	51-100	43.0
South Pass Sa Blk 89	GF	1969	51-100	42.4
Mississippi Canyon Blk 354	GF	1977	51-100	40.7
Viosca Knoll Blk 783	GF	1985	51-100	39.8
Boonsville	TX	1945	51-100	39.0
Verden	OK	1948	51-100	38.6
Lake Arthur South	LA	1955	51-100	36.5
Fairway	AL	1986	51-100	34.9
Moorewood Ne	OK	1979	51-100	34.5
Mississippi Canyon Blk 807	GF	1989	51-100	33.7
Puckett	TX	1952	51-100	33.5
Brown-Bassett	TX	1953	51-100	33.2
Painter Reservoir East	WY	1979	51-100	32.7
Big Piney	WY	1964	51-100	32.2
Main Pass Blk 41	GF	1956	51-100	30.9
Mississippi Canyon Blk 194	GF	1975	51-100	29.0
Kuparuk River	AK	1969	51-100	28.5
A W P	TX	1987	51-100	25.6
Newark East	TX	1981	51-100	25.0
Wamsutter	WY	1958	51-100	23.3
Cedar Cove Coal Degas	AL	1983	51-100	22.6
Tip Top	WY	1928	51-100	22.1
Drunkards Wash	UT	1989	51-100	21.3
Lost Hills	CA	1910	51-100	21.2
Standard Draw	WY	1979	51-100	20.5
Hondo	PF	1969	51-100	20.4
Trawick	TX	1949	51-100	19.8
Stratton	TX	1937	51-100	19.0
Rulison	CO	1958	51-100	16.2
Blanco South	NM	1951	51-100	16.0
Belridge South	CA	1911	51-100	15.3
Sarita East	TX	1967	51-100	14.9
Kenai	AK	1959	51-100	12.7
Grand Valley	CO	1985	51-100	12.3
Sugg Ranch	TX	1985	51-100	12.3
Endicott	AK	1978	51-100	9.5
Cochranon	PA	1980	51-100	5.6
Green Canyon Blk 244	GF	1994	51-100	1.4
Viosca Knoll Blk 915	GF	1993	51-100	0.0
Mississippi Canyon Blk 292	GF	1996	51-100	0.0
Top 100 Volume Subtotal			80,698.1	6,562.7
Top 100 Percentage of U.S. Total			45.9%	32.6%

^aWet after lease separation.

^bOnly 87 percent of the estimated reserves were surveyed by EIA at the field level from large and intermediate operators.

– = Not Applicable.

Note: Fields are grouped in "proved reserves rank groups" and then listed within that group in descending order by annual production rank. The U.S. total production estimate of 20,134 billion cubic feet and the U.S. total reserves estimate of 175,721 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.

Conversion to the Metric System

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."

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, 1987 – 1997

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)											
1987	37.2	586.2	218.0	405.4	76.9	15.3	17.6	109.8	456.8	4,333.4	58.4
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
Dry Natural Gas (billion cubic meters)											
1987	35.91	496.31	402.98	129.24	129.89	30.84	42.45	203.18	456.30	5,301.23	-123.88
1988	62.09	661.68	d1,088.13	-364.36	192.64	46.38	54.06	293.08	472.04	d4,757.91	-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
Natural Gas Liquids (million cubic meters)											
1987	36.8	134.7	104.3	67.2	33.9	6.2	8.7	48.8	118.8	1,295.3	-2.8
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

^aRevisions and adjustments = Col. 1 + Col. 2 – Col. 3.

^bTotal discoveries = Col. 5 + Col. 6 + Col. 7.

^cProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 – Col. 9.

^dAn 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 cubic meter, cubic feet = 0.02831685 per cubic 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, 1987–1997 annual reports, DOE/EIA-0216.{10–20}

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 1997 of the EIA publication *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, DOE EIA-0216.{1-20}

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	Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
Alabama					Alaska				
1977	85	0	530	NA	1977	8,413	846	32,243	NA
1978	*74	0	514	NA	1978	9,384	398	32,045	NA
1979	45	NA	652	213	1979	8,875	398	32,259	23
1980	54	NA	636	226	1980	8,751	0	33,382	11
1981	55	NA	648	192	1981	8,283	0	33,037	10
1982	54	NA	^a 648	193	1982	7,406	60	34,990	9
1983	51	NA	^a 785	216	1983	7,307	576	34,283	8
1984	*68	NA	^a 961	200	1984	7,563	369	34,476	19
1985	69	NA	^a 821	182	1985	7,056	379	33,847	383
1986	55	20	^b 951	177	1986	6,875	902	32,664	381
1987	55	20	^b 842	166	1987	7,378	566	33,225	418
1988	54	20	^b 809	166	1988	6,959	431	9,078	401
1989	43	20	^b 819	168	1989	6,674	750	8,939	380
1990	44	<1	^c 4,125	170	1990	6,524	969	9,300	340
1991	43	<1	^c 5,414	145	1991	6,083	1,456	9,553	360
1992	41	0	^c 5,802	171	1992	6,022	1,331	9,638	347
1993	41	0	^c 5,140	158	1993	5,775	1,161	9,907	321
1994	44	0	^c 4,830	142	1994	5,767	1,022	9,733	301
1995	43	0	^c 4,868	120	1995	5,580	582	9,497	306
1996	45	0	^c 5,033	119	1996	5,274	952	9,294	337
1997	47	0	^c 4,968	93	1997	5,161	832	10,562	631

^aOnshore only; offshore included in Louisiana.

^bOnshore only; offshore included in Federal Offshore - Gulf of Mexico (Louisiana).

^cIncludes 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.

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
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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

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

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	d4,810	590	d4,325	d146
1986	d4,734	d616	d3,928	d134
1987	d4,709	d1,493	d3,740	d130
1988	d4,879	d1,440	d3,519	d123
1989	d4,816	d1,608	d3,374	d113
1990	d4,658	d1,425	d3,185	d105
1991	d4,217	d1,471	d3,004	d92
1992	d3,893	d1,299	d2,778	d99
1993	d3,764	d965	d2,682	d104
1994	d3,573	d835	d2,402	d92
1995	d3,462	d823	d2,243	d92
1996	d3,437	d905	d2,082	d92
1997	d3,750	d1,264	d2,273	d95

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

^dExcludes 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
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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

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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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

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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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Kansas				
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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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Louisiana - Total				
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

^eIncludes State and Federal offshore Alabama.

^fExcludes Federal offshore; now included in Federal Offshore-Gulf of Mexico (Louisiana).

Kentucky				
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

Louisiana - North				
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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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

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

^eIncludes State and Federal offshore Alabama.

^fExcludes 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
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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

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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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

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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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Oklahoma				
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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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Texas - Total				
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	⁹ 7,782	609	⁹ 41,775	⁹ 2,981
1986	⁹ 7,152	1,270	⁹ 40,574	⁹ 2,964
1987	⁹ 7,112	1,028	⁹ 38,711	⁹ 2,822
1988	⁹ 7,043	1,099	⁹ 38,167	⁹ 2,617
1989	⁹ 6,966	805	⁹ 38,381	⁹ 2,563
1990	⁹ 7,106	618	⁹ 38,192	⁹ 2,575
1991	⁹ 6,797	756	⁹ 36,174	⁹ 2,493
1992	⁹ 6,441	⁹ 612	⁹ 35,093	⁹ 2,402
1993	⁹ 6,171	⁹ 581	⁹ 34,718	⁹ 2,469
1994	⁹ 5,847	⁹ 491	⁹ 35,974	⁹ 2,414
1995	⁹ 5,743	⁹ 395	⁹ 36,542	⁹ 2,524
1996	⁹ 5,736	⁹ 358	⁹ 38,270	⁹ 2,606
1997	⁹ 5,687	⁹ 479	⁹ 37,761	⁹ 2,687

⁹Excludes Federal offshore; now included in Federal Offshore-Gulf of Mexico (Texas).

Pennsylvania				
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

Texas - RRC District 1				
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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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

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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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

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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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

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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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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

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)

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

^hIncluded with Wyoming.

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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Wyoming				
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	681
1983	957	61	10,227	789
1984	954	71	10,482	860
1985	951	18	10,617	949
1986	849	126	9,756	950
1987	854	27	10,023	924
1988	815	35	10,308	1,154
1989	825	46	10,744	896
1990	794	42	9,944	812
1991	757	24	9,941	748
1992	689	18	10,826	660
1993	624	12	10,933	600
1994	565	13	10,879	564
1995	605	12	12,166	593
1996	603	14	12,320	727
1997	627	11	13,562	761

ⁱUtah and Wyoming are combined.

Year	Crude Oil Proved Reserves	Crude Oil Indicated Additional Reserves	Dry Natural Gas Proved Reserves	Natural Gas Liquids Proved Reserves
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Federal Offshore - Pacific (California)				
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

Note: Data not tabulated for years 1977-1984.

Federal Offshore - Total				
1985	2,862	11	34,492	702
1986	2,715	16	34,223	681
1987	2,639	21	31,931	638
1988	2,629	21	32,264	622
1989	2,747	32	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

^jIncludes State offshore Alabama.

Note: Data not tabulated for years 1977-1984.

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

^fIncludes State and Federal offshore Alabama.

^kIncludes 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
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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

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
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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

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

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

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

Table D1. U.S. Proved Reserves of Crude Oil, 1976–1997

(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

^aIncludes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.^bRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.^cTotal discoveries = Col. 5 + Col. 6 + Col. 7.^dProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.^eBased on following year data only.^fConsists 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 1997 annual reports, DOE/EIA-0216.{1-20}

Table D2. U.S. Lower 48 Proved Reserves of Crude Oil, 1976–1997
(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

^aIncludes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

^bRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.

^cTotal discoveries = Col. 5 + Col. 6 + Col. 7.

^dProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

^eBased on following year data only.

^fConsists 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 1997 annual reports, DOE/EIA-0216.{1-20}

Table D3. U.S. Proved Reserves of Dry Natural Gas, 1976–1997
(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

^aIncludes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

^bRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.

^cTotal discoveries = Col. 5 + Col. 6 + Col. 7.

^dProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

^eBased on following year data only.

^fConsists only of operator reported corrections and no other adjustments.

^gAn 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 1997 annual reports, DOE/EIA-0216.{1-20}

Table D4. U.S. Lower 48 Proved Reserves of Dry Natural Gas, 1976–1997
(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

^aIncludes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

^bRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.

^cTotal discoveries = Col. 5 + Col. 6 + Col. 7.

^dProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

^eBased on following year data only.

^fConsists 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 1997 annual reports, DOE/EIA-0216.{1-20}

Table D5. U.S. Proved Reserves of Wet Natural Gas, After Lease Separation, 1978–1997
(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

^aIncludes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

^bRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.

^cTotal discoveries = Col. 5 + Col. 6 + Col. 7.

^dProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

^eBased on following year data only.

^fAn 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 1997 annual reports, DOE/EIA-0216.{2-20}

Table D6. U.S. Lower 48 Proved Reserves of Wet Natural Gas, After Lease Separation, 1978–1997
(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

^aIncludes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

^bRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.

^cTotal discoveries = Col. 5 + Col. 6 + Col. 7.

^dProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

^eBased 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 1997 annual reports, DOE/EIA-0216.{2-20}

Table D7. U.S. Proved Reserves of Natural Gas Liquids, 1978–1997
(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

^aIncludes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

^bRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.

^cTotal discoveries = Col. 5 + Col. 6 + Col. 7.

^dProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

^eBased on following year data only.

^fConsists 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 1997 annual reports, DOE/EIA-0216.{2-20}

Table D8. U.S. Lower 48 Proved Reserves of Natural Gas Liquids, 1978–1997
(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

^aIncludes operator reported corrections for the years 1978 through 1981. After 1981 operators included corrections with revisions.

^bRevisions and adjustments = Col. 1 + Col. 2 - Col. 3.

^cTotal discoveries = Col. 5 + Col. 6 + Col. 7.

^dProved reserves = Col. 10 from prior year + Col. 4 + Col. 8 - Col. 9.

^eBased on following year data only.

^fConsists 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 1997 annual reports, DOE/EIA-0216.{2-20}

Table D9. Deepwater Production and Proved Reserves of the Gulf of Mexico Federal Offshore, 1992-1997

Year	Gulf of Mexico			Depth		Deepwater Percentage ^b
	Total	Louisiana ^a	Texas	Greater than 200 meters ^b	Less than 200 meters ^b	
	Crude Oil (million barrels of 42 U.S. gallons)					
Production						
1992	267	253	14	R46	R221	R17.2
1993	266	252	14	R46	R220	R17.3
1994	265	245	20	R53	R212	R20.1
1995	292	262	30	R77	R215	R26.4
1996	303	265	38	R90	R213	R29.7
1997	342	298	44	123	219	36.0
Reserves						
1992	1,835	1,643	192	R557	R1,278	R30.4
1993	2,072	1,880	192	R824	R1,248	R39.8
1994	2,127	1,922	205	R877	R1,250	R41.2
1995	2,518	2,269	249	R1,241	R1,277	R49.3
1996	2,567	2,357	210	R1,311	R1,256	R51.1
1997	2,949	2,587	362	1,682	1,267	57.0
	Natural Gas, Wet After Lease Separation (billion cubic feet at 14.73 psia and 60 ^o Fahrenheit)					
Production						
1992	4,576	3,292	1,284	R166	R4,410	R3.6
1993	4,651	3,383	1,268	R229	R4,422	R4.9
1994	4,797	3,505	1,292	R294	R4,503	R6.1
1995	4,679	3,421	1,258	R354	R4,315	R7.8
1996	5,045	3,752	1,293	R549	R4,496	R10.9
1997	5,230	3,984	1,246	577	4,653	11.0
Reserves						
1992	27,050	20,006	7,044	R3,273	R23,777	R12.1
1993	26,463	19,751	6,712	R3,495	R22,968	R13.2
1994	27,626	21,208	6,418	R4,772	R22,854	R17.3
1995	28,229	21,664	6,565	R5,811	R22,418	R20.6
1996	28,153	22,119	6,034	R6,389	R21,764	R22.7
1997	28,455	22,428	6,027	7,491	20,964	26.3
	Natural Gas Liquids (million barrels of 42 U.S. gallons)					
Production						
1992	91	76	15	R4	R87	R4.4
1993	97	80	17	R6	R91	R6.2
1994	98	83	15	R6	R92	R6.1
1995	85	71	14	R12	R73	R14.1
1996	101	84	17	R13	R88	R12.9
1997	140	123	17	17	123	12.1
Reserves						
1992	590	472	118	R91	R499	R15.4
1993	605	490	115	R97	R508	R16.0
1994	603	500	103	R110	R493	R18.2
1995	630	496	134	R294	R336	R46.7
1996	753	621	132	R300	R456	R39.8
1997	906	785	121	349	557	38.5

^aIncludes Federal Offshore Alabama.

^bRevisions 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."

Summary of Data Collection Operations

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 1997 by crude oil or natural gas well operators who were active as of December 31, 1997. 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 1990 and 1997, and depicts the number of active operators, 1990 showing the largest in the series. The 1997 sampling frame consisted of 180 Category I, 461 Category II, 1,194 Category III Certainty, and 20,843 Category III Noncertainty operators, for a total of 22,678 active operators. The survey sample consisted of 1,835 operators selected with certainty that included all of the Category I and II Certainty operators, the 1,194 smaller operators that were selected with certainty because of their size in relation to the area or areas in which they operated, and 1,645 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 1997 survey is summarized in **Table E2**. EIA makes a considerable effort to gain responses from all operators. About 13 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 442 nonoperators, 43 had successor operators that had taken over the production of the nonoperator. These successor operators were subsequently sampled. The overall response rate for the 1997 survey was 99.8 percent. This compares with a 100 percent overall response rate for all operators in 1996.

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, 1990-1997

Operator Category	Number of Operators							
	1990	1991	1992	1993	1994	1995	1996	1997
Certainty								
Category I	144	144	157	160	161	161	176	180
Category II	468	484	480	500	482	476	486	461
Category III	2,316	2,074	1,896	1,723	1,694	1,596	3	1,194
Sampled	2,928	2,702	2,533	2,383	2,337	2,233	665	1,835
Percent Sampled	100	100	100	100	100	100	100	100
Noncertainty								
Sampled	1,431	1,760	1,724	1,691	1,737	1,632	0	1,645
Percent Sampled	6	8	8	8	8	8	0	8
Total								
Active Operators	27,556	24,846	24,173	23,656	24,222	22,766	23,410	22,678
Not Sampled	23,196	20,384	19,916	19,791	20,148	18,901	22,745	19,198
Sampled	4,360	4,462	4,257	4,074	4,074	3,865	665	3,480
Percent Sampled	16	18	18	17	17	17	3	15

R=Revised data.

Note: Active operators in 1997 include 10 operators added after December 29, 1997 and not included in Table E3.

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

Table E2. Form EIA-23 Survey Response Statistics, 1997

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	180	3	0	-14	169	169	100.0	0	0.0
Category II	461	5	-11	-37	418	418	100.0	0	0.0
Category III	1,194	21	11	-80	1,146	1,146	100.0	0	0.0
Subtotal	1,835	29	0	-131	1,733	1,733	100.0	0	0.0
Noncertainty	1,645	14	0	-311	1,348	1,342	99.6	6	0.4
Total	3,480	43	0	-442	3,081	3,075	99.8	6	0.2

^aSuccessor operators are those, not initially sampled, that have taken over the production of a sampled operator.

^bNet of recategorized operators in the sample (excluding nonoperators).

^cIncludes former operators reporting that they were not operators during the report year and operators that could not be located who are treated as nonoperators.

^dAdjusted 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" 1997.

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 1997*, in February of 1998, was the 16th annual report and reflected data collected through October 1997. 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 1997, Form EIA-23 National estimates of production were 2,312 million barrels for crude oil and lease condensate or 43 million barrels (1.8 percent) lower than that reported in the *Petroleum Supply Annual 1997* for crude oil and lease condensate. Form EIA-23 National estimates of production for dry natural gas were 19,211 billion cubic feet or 310 billion cubic feet (1.6 percent) higher than the *Natural Gas Annual 1997* for 1997 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, has been revised annually. In addition, outside sources, such as State publications and computer tapes, and commercial information data bases such as Dwight's Energydata and Petroleum Information, 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 1995 survey mailing. These changes resulted from all frame maintenance activities.

The Form EIA-23 operator frame contained a total of 65,420 entries as of December 29, 1997. Of these, 22,668 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 1997 Operator Frame Activity, Form EIA-23

Total 1996 Operator Frame.....	64,172
Operators.....	22,240
Nonoperators.....	41,932
Changes to 1996 Operator Status.....	1,183
From Nonoperator to Operator.....	177
From Operator to Nonoperator.....	986
No Changes to 1996 Operator Status...	63,009
Operators.....	21,254
Nonoperators.....	41,755
Additions to 1996 Operator Frame.....	1,248
Operator.....	1,237
Nonoperator.....	11
Total 1997 Operator Frame.....	65,420
Operators.....	22,668
Nonoperators.....	42,752

Note: Includes operator frame activity through December 29, 1997.
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.

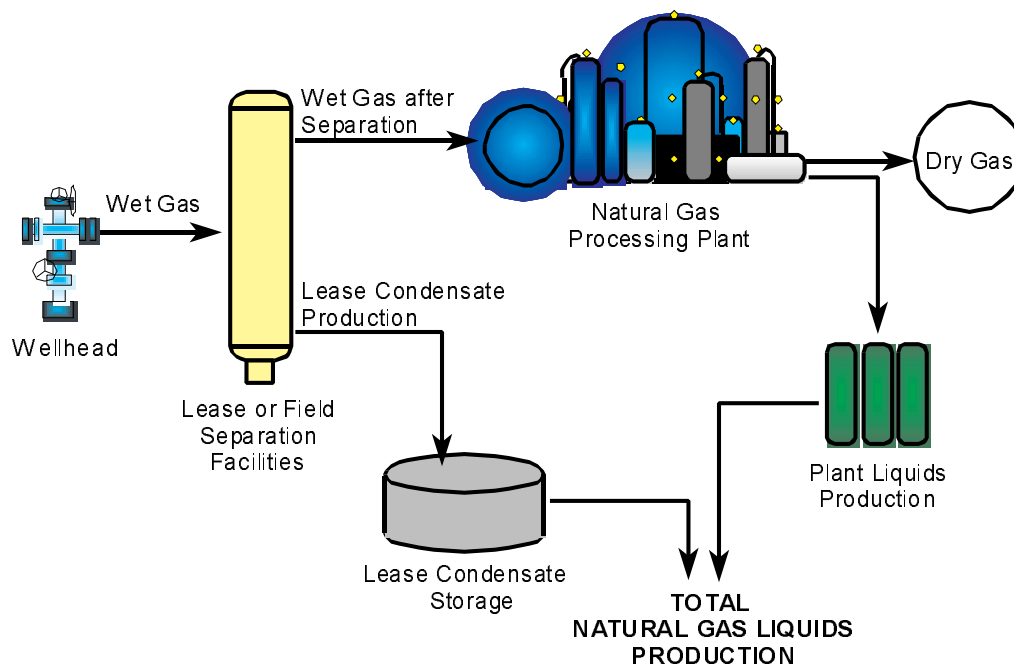
Form EIA-64A Response Statistics

EIA mailed EIA-64A forms to all known natural gas processing plant operators as of January 10, 1998. In addition, plant operators whose plants were shut down or dismantled during 1997 were required to complete forms for the portion of 1997 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 263 operators of 659 plants were sent forms. This number included 4 new plants, 2 reactivated plants, and 16 successor plants identified after the initial 1997 survey mailing. A total of 27 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.

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 Reporting Requirements

Form EIA-64A consisted of the reporting schedule shown in **Figure 16**, 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

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 1997, the Form EIA-64A National estimates were 4.1 percent (27 million barrels) higher than the *Petroleum Supply Annual* 1997 volume for natural gas plant liquids production.

Table E4. Natural Gas Processed and Liquids Extracted at Natural Gas Processing Plants, 1997

Plant Location	Volume of Natural Gas Delivered to Processing Plants			Total Liquids Extracted (thousand barrels)
	State Production	Out of State Production	Natural Gas Processed	
	(million cubic feet)			
Alaska	2,964,734	0	2,964,734	34,908
Lower 48 States.	13,500,713	371,664	13,872,377	656,091
Alabama	113,367	1,044	114,411	3,471
Arkansas	185,244	0	185,244	429
California	243,054	0	243,054	9,246
Colorado	374,570	158	374,728	20,659
Florida	5,700	2,664	8,364	1,596
Kansas.	582,479	166,944	749,423	29,027
Kentucky	41,119	2,233	43,352	1,745
Louisiana.	4,620,039	147,926	4,767,965	107,473
Michigan	86,564	0	86,564	4,484
Mississippi.	4,372	0	4,372	232
Montana.	8,851	8	8,859	324
NewMexico	851,305	0	851,305	74,970
North Dakota	51,657	0	51,657	3,897
Oklahoma	1,012,149	1,859	1,014,008	67,745
Texas.	4,139,591	32,376	4,171,967	275,315
Utah.	237,345	12,585	249,930	13,757
West Virginia	68,960	132	69,092	5,057
Wyoming	862,108	944	863,052	35,952
Miscellaneous ^a	12,239	2,791	15,030	712
Total	16,465,447	371,664	16,837,111	690,999

^aIncludes Illinois, Nebraska, Ohio, Pennsylvania, and Tennessee.

Source: Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production," 1997.

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 1997 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 29, 1997.

Table E5. Form EIA-64A 1997 Plant Frame Activity

Frame as of 1996 survey mailing	710
Additions	141
Deletions	-197
Frame as of 1997 survey mailing	654

Note: Includes operator frame activity through December 29, 1997.
Source: Energy Information Administration, Office of Oil and Gas.

Statistical Considerations

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 1997 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 1994 (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 1994 (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 1994 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 1994.
- **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 1994.
- **Category III - Small Operators:** Operators who produced less than the Category II operators in 1994, 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. 1997 EIA-23 Survey Initial Sample Criteria

State and Subdivision	Production Cutoffs		Certainty Operators	Noncertainty Sample Number of	
	Crude Oil (mbbls)	Gas (mmcf)		Single State Operators	Multi-State Operators
Alabama Onshore	107	1,000	68	2	1
Alaska	0	0	12	0	0
Arkansas	21	1,000	127	20	3
California Unspecified	17	88	12	37	0
California Coastal Region Onshore	200	1,000	24	1	0
California Los Angeles Basin Onshore	200	25	31	2	0
California San Joaquin Basin Onshore	200	1,000	46	3	0
Colorado	200	1,000	133	26	7
Florida Onshore	200	1,000	6	2	0
Illinois	200	27	31	37	3
Indiana	12	1	46	12	2
Kansas	85	1,000	241	174	12
Kentucky	37	1,000	33	21	0
Louisiana Unspecified	73	183	3	18	0
Louisiana North	13	633	293	40	7
Louisiana South Onshore	70	1,000	256	16	2
Michigan	200	1,000	42	12	2
Mississippi Onshore	200	1,000	120	11	3
Montana	200	1,000	83	11	5
Nebraska	13	2	54	6	0
New Mexico Unspecified	10	13	12	15	0
New Mexico East	200	1,000	141	3	1
New Mexico West	21	1,000	54	1	0
New York	3	1,000	32	48	0
North Dakota	200	1,000	91	3	8
Ohio	92	1,000	44	189	3
Oklahoma	143	1,000	341	268	18
Pennsylvania	4	1,000	80	31	0
Texas Unspecified	7	118	36	257	1
Texas-RRC District 1	23	800	196	44	8
Texas-RRC District 2 Onshore	200	1,000	174	8	9
Texas-RRC District 3 Onshore	200	1,000	252	34	12
Texas-RRC District 4 Onshore	91	1,000	175	9	8
Texas-RRC District 5	38	630	98	9	4
Texas-RRC District 6	200	1,000	184	21	9
Texas-RRC District 7B	34	82	223	72	11
Texas-RRC District 7C	200	1,000	161	9	4
Texas-RRC District 8	200	1,000	167	5	2
Texas-RRC District 8A	200	1,000	141	2	2
Texas-RRC District 9	52	1,000	114	12	1
Texas-RRC District 10	200	1,000	123	5	0
Utah	200	1,000	65	9	1
Virginia	200	1,000	12	2	0
West Virginia	5	1,000	62	35	2
Wyoming	200	1,000	152	17	6
Offshore Areas	0	0	286	0	0
Other States ^a	125	49	32	24	0
Total			b1,690	1,583	b72

^aIncludes 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.

^bNonduplicative 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:

$$\hat{V}_s = V_{sc} + \hat{V}_{sr}$$

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:

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

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 a difference estimator for many of the Noncertainty operators. This difference estimator took advantage of the stability of production reports from year-to-year in those State/subdivisions. The difference estimator was only applied to operators who had known production greater than 1 thousand barrels of oil and/or 1 million cubic feet of natural gas in the previous year. For those State/subdivisions and operators the above formula was modified with V_{srm} replaced by V'_{srm} :

$$V'_{srm} = V_{srm} + k(\bar{X}_{sr} - X_{srm})$$

where

k = 1 when estimating production volumes

k = regional R/P ratio (**Table F6**) when estimating reserve volumes

$\bar{X}_{sr}$ = average production volume reported in the State/subdivision for the preceding year by all qualifying Noncertainty operators

X_{srm} = production volume reported by the m -th Noncertainty sample operator in the State/subdivision for the preceding year.

In selecting the Noncertainty sample, the number of sample operators with production in a given State/subdivision is not controlled to the number

expected based on the sampling rate, but is subject to some variation. The weight used is the reciprocal of the actual sampling rate that resulted for the stratum from which the sample operator was selected, rather than the reciprocal of the expected sampling rate. The sample estimate with either set of weights is an unbiased estimator of the noncertainty stratum total. However, use of the actual sampling rates is expected to lead to smaller sampling errors for the estimates. 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 States/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 Certainty operators for the 1997 survey was 100 percent. Due to the 100 percent response rate, imputation for the nonresponding operators was not necessary.

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 actual data reported on an operated basis by Form EIA-23 respondents for the report year 1997 are summarized in **Tables F2, F3, F4, and F5**. The differences between these sums and the total estimates shown in **Tables 9, 10, 6 and 16** in the main text

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				Total
	I	II	Certainty III	Non-certainty III	
Field Level Reported and Imputed Data					
Proved Reserves as of 12/31/96.	146,168,261	12,586,503	1,573,141	—	160,327,905
(+) Revision Increases	18,994,658	1,586,968	107,048	—	20,688,674
(-) Revision Decreases	14,926,891	1,109,696	70,783	—	16,107,370
(+) Extensions	9,444,366	602,264	201,554	—	10,248,184
(+) New Field Discoveries	2,408,191	213,562	33,000	—	2,654,753
(+) New Reservoirs in Old Fields	2,118,852	167,369	28,831	—	2,315,052
(-) Production With Reserves in 1997	16,897,056	1,318,388	155,808	—	18,371,252
Proved Reserves Reported as of 12/31/97.	147,490,429	12,729,154	1,716,983	—	161,936,566
Production Without Proved Reserves.	0	574,585	74,224	—	648,809
Reserves Imputed for Production					
Without Proved Reserves.	0	4,378,268	541,666	—	4,919,934
Subtotal Production	16,897,056	1,892,973	230,032	—	19,020,061
Subtotal Proved Reserves 1997	147,490,429	17,107,422	2,258,649	—	166,856,500
State Level Reported and Imputed Data					
Production With Proved Reserves	63	47,819	141,080	12,410	201,372
Production Without Proved Reserves.	0	32,401	224,185	40,498	297,084
Subtotal Production.	63	80,220	365,265	52,908	498,456
Weighted Subtotal Production	63	80,220	365,265	678,980	1,124,528
Proved Reserves Reported.	397	376,683	1,335,723	93,647	1,806,450
Reserves Imputed for Production					
Without Proved Reserves.	0	227,663	1,685,552	311,987	2,225,202
Subtotal Proved Reserves	397	604,346	3,021,205	405,634	4,031,582
Weighted Subtotal Proved Reserves	397	604,346	3,021,205	5,244,768	8,870,716
Total Production in 1997	16,897,119	1,973,193	595,297	678,980	20,144,589
Total Proved Reserves as of 12/31/97.	147,490,826	17,711,768	5,279,854	5,244,768	175,727,216

— = 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," 1997.

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				Total
	I	II	Certainty III	Non-certainty III	
Field Level Detail Report					
Proved Reserves as of 12/31/96.	119,365,554	10,869,057	1,366,076	—	131,600,687
(+) Revision Increases	14,734,037	1,290,719	96,731	—	16,121,487
(–) Revision Decreases	12,169,811	888,206	61,996	—	13,120,013
(+) Extensions	8,589,214	553,532	122,047	—	9,264,793
(+) New Field Discoveries	1,052,849	209,565	33,000	—	1,295,414
(+) New Reservoirs in Old Fields	1,950,622	163,303	21,298	—	2,135,223
(–) Production With Reserves in 1997.	14,381,927	1,123,137	118,786	—	15,623,850
Proved Reserves Reported as of 12/31/97.	119,140,568	11,075,137	1,458,370	—	131,674,075
Production Without Proved Reserves.	0	493,355	62,391	—	555,746
Reserves Imputed for Production					
Without Proved Reserves.	0	3,781,517	463,530	—	4,245,047
Subtotal Production	14,381,927	1,616,492	181,177	—	16,179,596
Subtotal Proved Reserves 1997	119,140,568	14,856,654	1,921,900	—	135,919,122
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 Production					
Without Proved Reserves.	—	—	—	—	—
Subtotal Proved Reserves	—	—	—	—	—
Weighted Subtotal Proved Reserves	—	—	—	—	—
Total Production in 1997	14,381,927	1,616,492	181,177	—	16,179,596
Total Proved Reserves as of 12/31/97	119,140,568	14,856,654	1,921,900	—	135,919,122

— = Not applicable.

Notes: Table 10 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," 1997.

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				Total
	I	II	Certainty III	Non-certainty III	
Field Level Detail Report					
Proved Reserves as of 12/31/96.	19,347,430	1,071,988	156,225	—	20,575,643
(+) Revision Increases	1,567,972	168,843	10,543	—	1,747,358
(-) Revision Decreases	799,058	83,813	11,890	—	894,761
(+) Extensions	362,706	13,137	27,047	—	402,890
(+) New Field Discoveries	630,774	2,092	0	—	632,866
(+) New Reservoirs in Old Fields	110,474	3,453	979	—	114,906
(-) Production With Reserves in 1997	1,759,703	109,062	14,030	—	1,882,795
Proved Reserves Reported as of 12/31/97.	19,460,604	1,066,684	168,874	—	20,696,162
Production Without Proved Reserves.	0	36,491	10,243	—	46,734
Reserves Imputed for Production					
Without Proved Reserves	0	248,886	72,202	—	321,088
Subtotal Production	1,759,703	145,553	24,273	—	1,929,529
Subtotal Proved Reserves 1997	19,460,604	1,315,570	241,076	—	21,017,250
State Level Reported and Imputed Data					
Production With Proved Reserves	5	6,868	29,202	1,983	38,058
Production Without Proved Reserves.	0	4,332	46,865	7,583	58,780
Subtotal Production.	5	11,200	76,034	9,566	96,805
Weighted Subtotal Production	5	11,200	76,034	123,609	210,848
Proved Reserves Reported.	50	51,907	236,811	16,010	304,778
Reserves Imputed for Production					
Without Proved Reserves	0	30,430	321,373	53,326	405,129
Subtotal Proved Reserves	50	82,337	558,184	69,336	709,907
Weighted Subtotal Proved Reserves	50	82,337	564,529	893,522	1,540,438
Total Production in 1997	1,759,708	156,753	100,307	123,609	2,140,377
Total Proved Reserves as of 12/31/97.	19,460,654	1,397,907	805,605	893,522	22,557,688

— = Not applicable.

Notes: Table 6 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," 1997.

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				Total
	I	II	Certainty III	Non- certainty III	
Field Level Detail Report					
Proved Reserves as of 12/31/96.	1,141,581	90,203	8,454	—	1,240,238
(+) Revision Increases	195,410	19,558	1,075	—	216,043
(-) Revision Decreases	224,356	20,609	737	—	245,702
(+) Extensions	97,051	7,660	317	—	105,028
(+) New Field Discoveries	53,026	6,405	94	—	59,525
(+) New Reservoirs in Old Fields	35,245	692	1,104	—	37,041
(-) Production With Reserves in 1997	148,778	12,536	1,021	—	162,335
Proved Reserves Reported as of 12/31/97.	1,149,187	91,387	9,286	—	1,249,860
Production Without Proved Reserves	0	4,342	478	—	4,820
Reserves Imputed for Production Without Proved Reserves	0	30,408	3,380	—	
Subtotal Production	148,778	16,878	1,499	—	167,155
Subtotal Proved Reserves 1997	1,149,187	121,795	12,666	—	1,283,648
State Level Reported and Imputed Data					
Production With Proved Reserves	0	293	1,293	61	1,647
Production Without Proved Reserves	0	1,003	1,075	344	2,422
Subtotal Production.	0	1,296	2,368	405	4,069
Weighted Subtotal Production	0	1,296	2,368	5,435	9,099
Proved Reserves Reported.	1	2,747	7,758	273	10,779
Reserves Imputed for Production Without Proved Reserves	0	7,557	7,623	2,383	17,563
Subtotal Proved Reserves	1	10,304	15,381	2,656	28,342
Weighted Subtotal Proved Reserves	1	10,304	15,381	35,635	61,321
Total Production in 1997	148,778	18,174	3,867	5,435	176,254
Total Proved Reserves as of 12/31/97	1,149,188	132,099	28,047	35,635	1,344,969

— = Not applicable.

Notes: Table 16 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," 1997.

and imputation performed by EIA. The reported data in **Table F2** shows that those responding operators accounted for 97.5 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 94.5 percent of the nonassociated natural gas production and 92.5 percent of the reserves published in **Table 10**. The reported data shown in **Table F4** indicate that those responding operators accounted for 95.1 percent of published crude oil production and 94.1 percent of the reserves shown in **Table 6**. Additionally, **Table F5** indicates that those responding operators accounted for 99.4 percent of the published production and 99.3 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 reserves imputed were weighted to 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 in each case where an estimate was not provided by the respondent. Reserves were imputed from reported production data for all Noncertainty operators. 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

Table F6. Statistical Parameters of Reserve Estimation Equation by Region for 1997

Region Number	Region	Number of Nonzero R/P Pairs			Characteristic Multipliers		
		Oil	Gas	Lease Condensate	Oil	Gas	Lease Condensate
2	Pacific Coast States	16	24	1	^a 6.9	5.5	^a 7.1
3	Western Rocky Mountains	48	51	14	7.3	9.6	^a 7.1
4	Northern Rocky Mountains	61	53	5	7.9	8.1	^a 7.1
5	West Texas and East New Mexico	194	185	43	7.5	7.0	^a 7.1
6 + 6A	Western Gulf Basin and Gulf of Mexico	230	195	160	6.5	6.7	6.9
7	Mid-Continent	190	141	62	6.3	7.5	7.9
8 + 9	Michigan Basin and Eastern Interior	44	26	7	6.7	8.7	^a 7.1
10 + 11	Appalachians	22	27	1	7.3	11.5	^a 7.1
	United States	805	702	293	6.9	7.5	7.1

^aMultiplier 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, 1997".

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

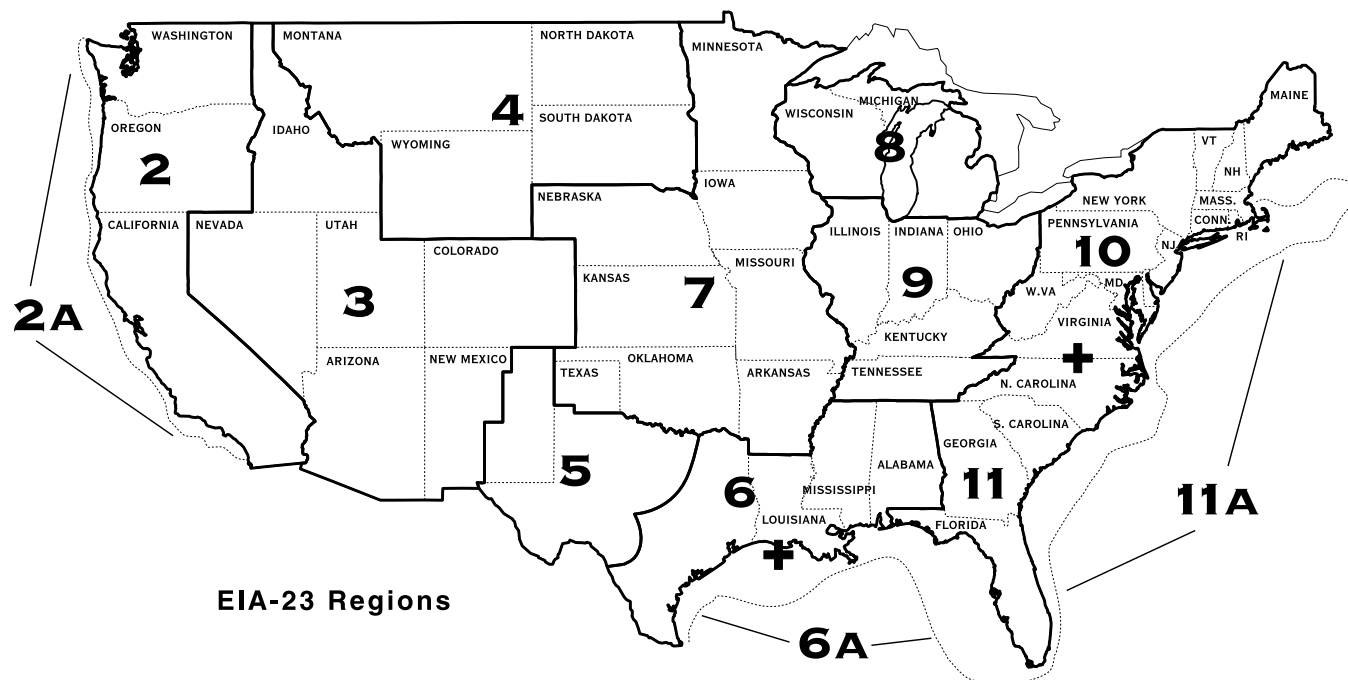
Category II and Category III operators that do not keep reserves data were not asked to provide estimates of beginning-of-year reserves or annual changes to proved reserves by component of change, i.e.,

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:

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

Figure F1. Form EIA-23 Regional Boundaries



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

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.

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 that very few of the same Noncertainty operators are sampled each year. Less than 8 percent of the Noncertainty stratum operators sampled in 1995 were sampled again in 1997, and 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 1997 than in 1996.
- One or more operators may have reported data incorrectly on Schedule A in 1996 or 1997, but not both, and the error was not detected by edit processing.
- Operation of properties was transferred during 1997 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 1997 to an operator with a different evaluation of the proved reserves associated with the properties than that of the 1996 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:

$$\hat{V}_s \pm k \text{ S.E. } (\hat{V}_s)$$

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:

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

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

The noncertainty estimate for a given State/subdivision had two separately weighted components based on reports of:

- **Type 1 Operators** shown in the frame as having had crude oil or natural gas production in the State/subdivision.

- **Type 2 Operators** shown in the frame as having had no crude oil or natural gas production in the State/subdivision.

Correspondingly, the sampling variance had two components associated with the estimated production from each component:

$$\text{Var}(\hat{V}_{sr}) = \text{Var}(\hat{V}_{sr1}) + \text{Var}(\hat{V}_{sr2})$$

The $\text{Var}(V_{sr})$ was estimated as the sum of the estimated variances of the two component estimates. The variance for any component, say component j , was estimated from the formula:

$$\text{Var}(\hat{V}_{srj}) = n_{srj} \left(\frac{W_{srj} - 1}{W_{srj}} \right) S_{srj}^2$$

In general, $\hat{V}_{srj}$ denotes the production estimate from component j for each of the two types of operator, and $\text{Var}(\hat{V}_{srj})$ denotes its variance where

n_{srj} = number of operators in sample in component j

w_{srj} = weight for operator reports in component j

S_{srj}^2 = variance between operator reports in component j .

If the subscripts sr are dropped, S_{srj}^2 can be expressed as:

$$S_{srj}^2 = \frac{\sum_i^{n_j} V'^2_{ji} - \left(\sum_i^{n_j} V'_{ji} \right)^2 / n_j}{n_j - 1}$$

where

V'_{ji} = weighted production or reserves volume for the i -th sample operator in the component j .

The variance of the estimated total volume for a State having subdivisions is the sum of corresponding Type 1 and Type 2 components where the classification of operators by type is with regard to the State as a whole; e.g., Type 2 operators at the State level are those that were not shown in the sample frame as having production anywhere in the State.

Table F7. Factors for Confidence Intervals (2S.E.) for Dry Natural Gas Proved Reserves and Production, 1997 (Billion Cubic Feet at 14.73 psia and 60 Degrees Fahrenheit)

State and Subdivision	1997 Reserves	1997 Production	State and Subdivision	1997 Reserves	1997 Production
United States.....	791	101	Oklahoma.....	311	40
Alabama.....	19	3	Pennsylvania.....	174	15
Alaska.....	0	0	Texas.....	435	65
Arkansas.....	32	4	RRC District 1.....	17	3
California.....	47	11	RRC District 2 Onshore.....	123	18
Coastal Region Onshore.....	0	0	RRC District 3 Onshore.....	86	13
Los Angeles Basin Onshore.....	3	0	RRC District 4 Onshore.....	178	26
San Joaquin Basin Onshore.....	95	20	RRC District 5.....	9	3
State Offshore.....	0	0	RRC District 6.....	137	20
Colorado.....	75	8	RRC District 7B.....	28	4
Florida.....	0	0	RRC District 7C.....	61	9
Kansas.....	138	18	RRC District 8.....	13	2
Kentucky.....	58	7	RRC District 8A.....	0	0
Louisiana.....	119	18	RRC District 9.....	12	2
North.....	43	6	RRC District 10.....	12	2
South Onshore.....	103	15	State Offshore.....	0	0
State Offshore.....	0	0	Utah.....	11	1
Michigan.....	96	11	Virginia.....	0	0
Mississippi.....	26	5	West Virginia.....	249	11
Montana.....	12	2	Wyoming.....	287	35
New Mexico.....	125	14	Federal Offshore ^a	0	0
East.....	12	3	Pacific (California).....	0	0
West.....	0	0	Gulf of Mexico (Louisiana) ^a	0	0
New York.....	72	7	Gulf of Mexico (Texas).....	0	0
North Dakota.....	10	1	Miscellaneous ^b	10	1
Ohio.....	141	15			

^aIncludes Federal offshore Alabama.

^bIncludes 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," 1997 and Form EIA-64A, "Annual Report of the Origin of Natural Gas Liquids Production," 1997.

Table F8. Factors for Confidence Intervals (2S.E.) for Natural Gas Proved Reserves and Production, Wet After Lease Separation, 1997 (Billion Cubic Feet at 14.73 psia and 60 Degrees Fahrenheit)

State and Subdivision	1997 Reserves	1997 Production	State and Subdivision	1997 Reserves	1997 Production
United States.....	836	107	Oklahoma.....	332	42
Alabama.....	20	3	Pennsylvania.....	175	15
Alaska.....	0	0	Texas.....	465	70
Arkansas.....	32	4	RRC District 1.....	18	3
California.....	50	12	RRC District 2 Onshore.....	131	19
Coastal Region Onshore.....	0	0	RRC District 3 Onshore.....	91	14
Los Angeles Basin Onshore.....	3	0	RRC District 4 Onshore.....	187	27
San Joaquin Basin Onshore.....	100	21	RRC District 5.....	9	3
State Offshore.....	0	0	RRC District 6.....	144	21
Colorado.....	84	9	RRC District 7B.....	32	5
Florida.....	0	0	RRC District 7C.....	69	10
Kansas.....	145	19	RRC District 8.....	15	2
Kentucky.....	60	8	RRC District 8A.....	0	0
Louisiana.....	124	19	RRC District 9.....	15	2
North.....	44	7	RRC District 10.....	13	2
South Onshore.....	108	16	State Offshore.....	0	0
State Offshore.....	0	0	Utah.....	13	1
Michigan.....	98	11	Virginia.....	0	0
Mississippi.....	26	5	West Virginia.....	257	12
Montana.....	12	2	Wyoming.....	303	37
New Mexico.....	138	15	Federal Offshore ^a	0	0
East.....	14	3	Pacific (California).....	0	0
West.....	0	0	Gulf of Mexico (Louisiana) ^a	0	0
New York.....	72	7	Gulf of Mexico (Texas).....	0	0
North Dakota.....	12	1	Miscellaneous ^b	10	1
Ohio.....	141	15			

^aIncludes Federal offshore Alabama.

^bIncludes 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," 1997.

Table F9. Factors for Confidence Intervals (2S.E.) for Crude Oil Proved Reserves and Production, 1997
(Million Barrels of 42 U.S. Gallons)

State and Subdivision	1997 Reserves	1997 Production	State and Subdivision	1997 Reserves	1997 Production
United States	108	13	North Dakota	10	1
Alabama	2	0	Ohio	11	1
Alaska	0	0	Oklahoma	38	5
Arkansas	3	1	Pennsylvania	1	0
California	27	3	Texas	70	9
Coastal Region Onshore	0	0	RRC District 1	5	1
Los Angeles Basin Onshore	2	0	RRC District 2 Onshore	5	1
San Joaquin Basin Onshore	24	0	RRC District 3 Onshore	14	2
State Offshore	0	0	RRC District 4 Onshore	5	1
Colorado	11	1	RRC District 5	3	0
Florida	0	0	RRC District 6	12	2
Illinois	12	2	RRC District 7B	10	1
Indiana	2	0	RRC District 7C	8	1
Kansas	18	3	RRC District 8	5	1
Kentucky	33	0	RRC District 8A	5	1
Louisiana	17	2	RRC District 9	4	0
North	2	0	RRC District 10	3	0
South Onshore	12	2	State Offshore	0	0
State Offshore	0	0	Utah	8	1
Michigan	9	1	West Virginia	1	0
Mississippi	6	1	Wyoming	29	4
Montana	10	1	Federal Offshore	0	0
Nebraska	6	0	Pacific (California)	0	0
New Mexico	10	1	Gulf of Mexico (Louisiana)	0	0
East	10	1	Gulf of Mexico (Texas)	0	0
West	0	0	Miscellaneous ^a	2	0

^aIncludes 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," 1997.

Table F10. Factors for Confidence Intervals (2S.E.) for Lease Condensate Proved Reserves and Production, 1997 (Million Barrels of 42 U.S. Gallons)

State and Subdivision	1997 Reserves	1997 Production	State and Subdivision	1997 Reserves	1997 Production
United States	36	5	North Dakota	0	0
Alabama	0	0	Oklahoma	0	0
Alaska	0	0	Texas	32	5
Arkansas	0	0	RRC District 1	0	0
California	1	0	RRC District 2 Onshore	0	0
Coastal Region Onshore	0	0	RRC District 3 Onshore	32	5
Los Angeles Basin Onshore	0	0	RRC District 4 Onshore	2	0
San Joaquin Basin Onshore	1	0	RRC District 5	0	0
State Offshore	0	0	RRC District 6	2	0
Colorado	0	0	RRC District 7B	0	0
Florida	0	0	RRC District 7C	0	0
Kansas	0	0	RRC District 8	0	0
Kentucky	0	0	RRC District 8A	0	0
Louisiana	19	3	RRC District 9	0	0
North	17	3	RRC District 10	0	0
South Onshore	0	0	State Offshore	0	0
State Offshore	0	0	Utah and Wyoming	1	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

^aIncludes Federal offshore Alabama.

^bIncludes Arizona, Illinois, Indiana, Maryland, Missouri, Nebraska, Nevada, New York, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, and Virginia.

Notes: Confidence intervals are associated with Table 16 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," 1997.

Since there are no operators in the frame who would be classified as Type 2 at the U.S. level, there would be no Type 2 components at the U.S. level. Therefore, at the U.S. level, there was only one sample variance component calculated for Type 1 operators.

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 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 1997 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 1997 Form EIA-64A survey, the national weighted average gas equivalents ratio was computed to be 1,392 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

Estimation of Reserves and Resources

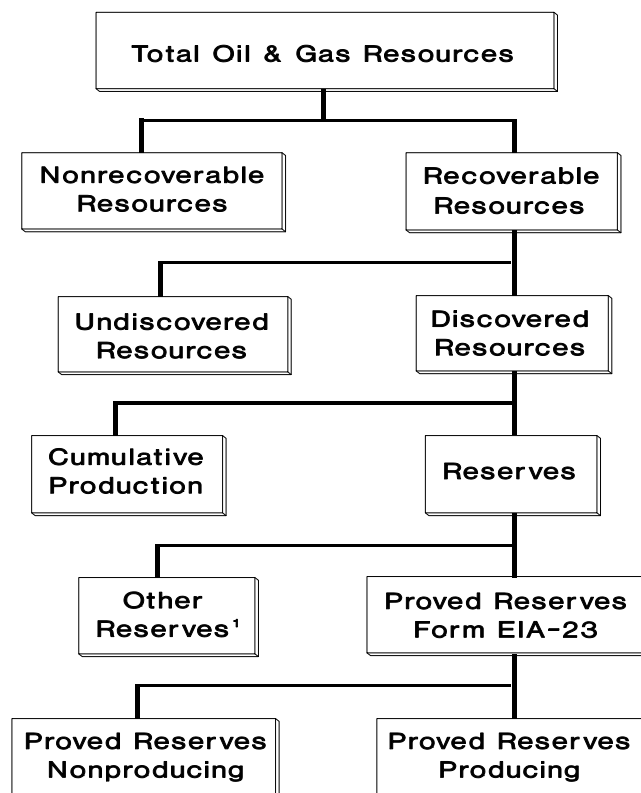
Oil and Gas Resource Base

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

Figure G1. Components of the Oil and Gas Resource Base



¹Of the numerous other reserve classifications, only “Indicated Additional” reserves are included in this report.

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

past) production, and reserves. Reserves are additionally subdivided into proved reserves and “other reserves”.

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 chinks, 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 unproved 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 unproved 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 unproved 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			
<u>Discovered</u>			
Proved Reserves (EIA, 1997)	17,385	^b 156,661	7,342
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
<u>Undiscovered, Technically Recoverable</u>			
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	113,442	1,174,186	NA
Alaska			
<u>Discovered</u>			
Proved Reserves (EIA, 1997)	5,161	10,673	631
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
<u>Undiscovered, Technically Recoverable</u>			
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	51,301	237,683	NA
Total Lower 48 States and Alaska	164,743	1,411,869	32,492
Deductions for Production and Proved Reserves Changes,			
1991-1997	-10,299	-80,880	-4,014
U.S. Total, 1997	154,444	1,330,989	28,478

^a Condensate is included with crude oil for MMS estimates in Federal Offshore regions.

^b Includes 11,462 billion cubic feet of coalbed methane (EIA, 1997).

^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.

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

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.

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.

Maps of Selected State Subdivisions

Maps of Selected State Subdivisions

Figure H1. Subdivisions of Alaska

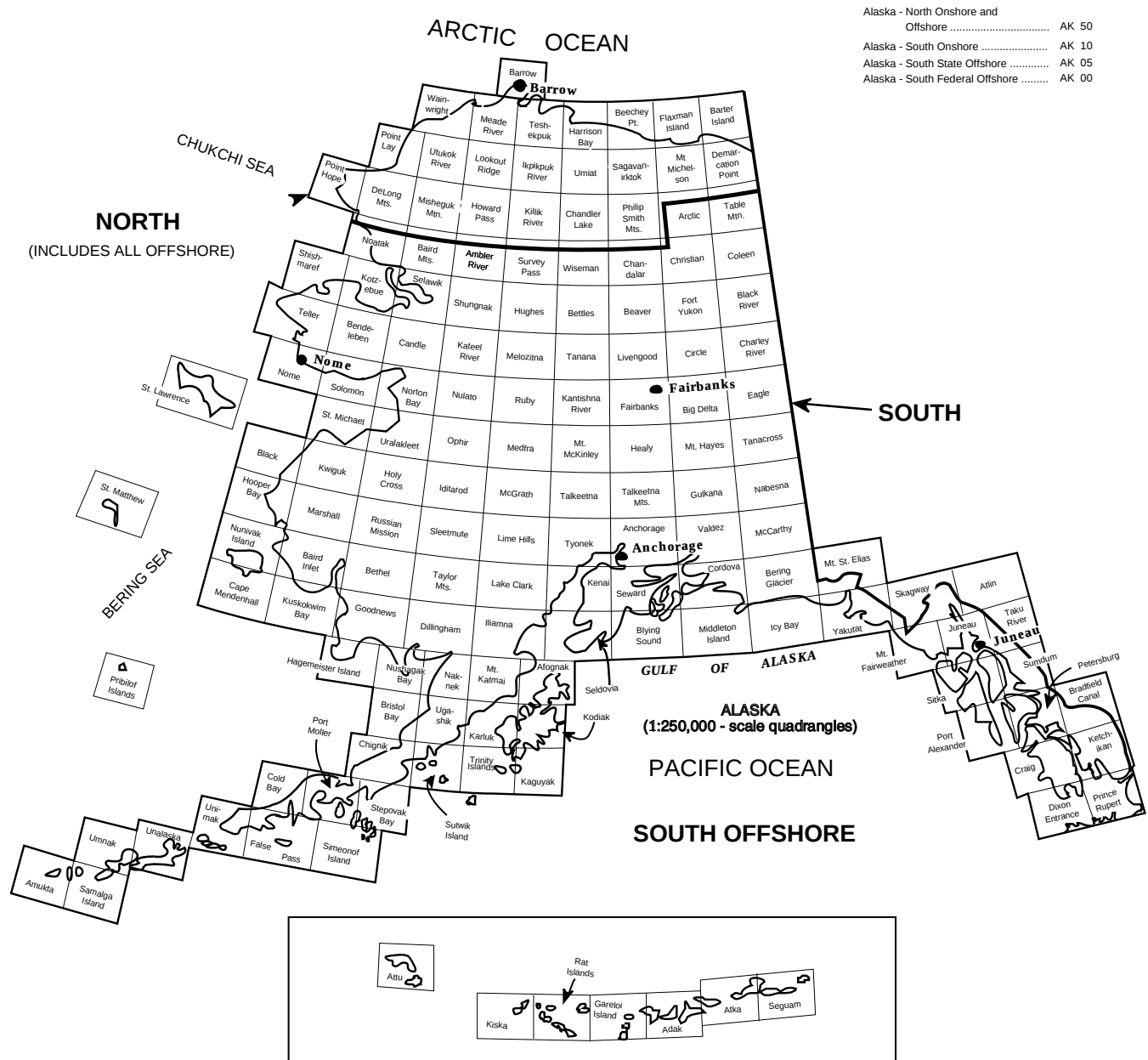
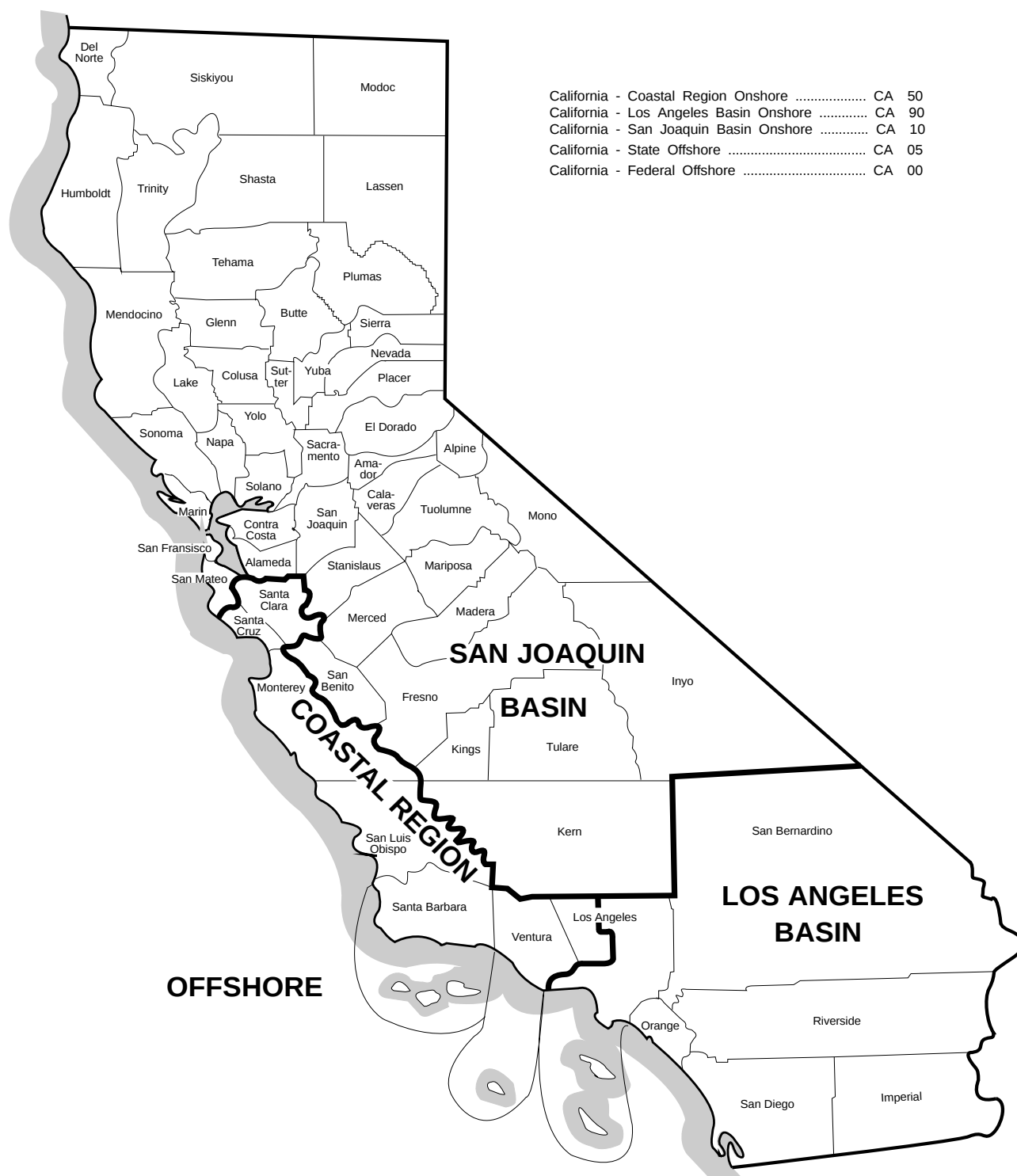
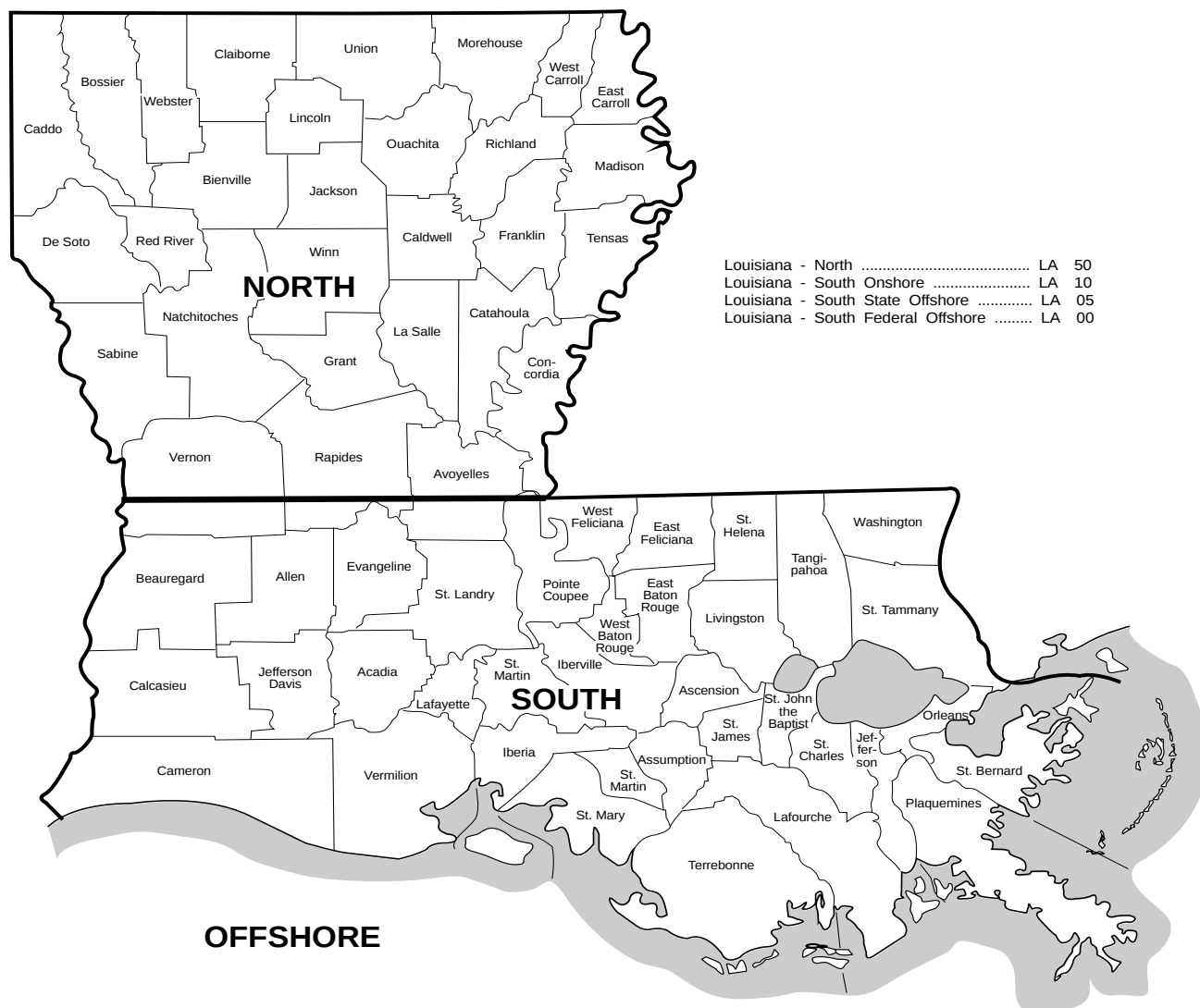


Figure H2. Subdivisions of California



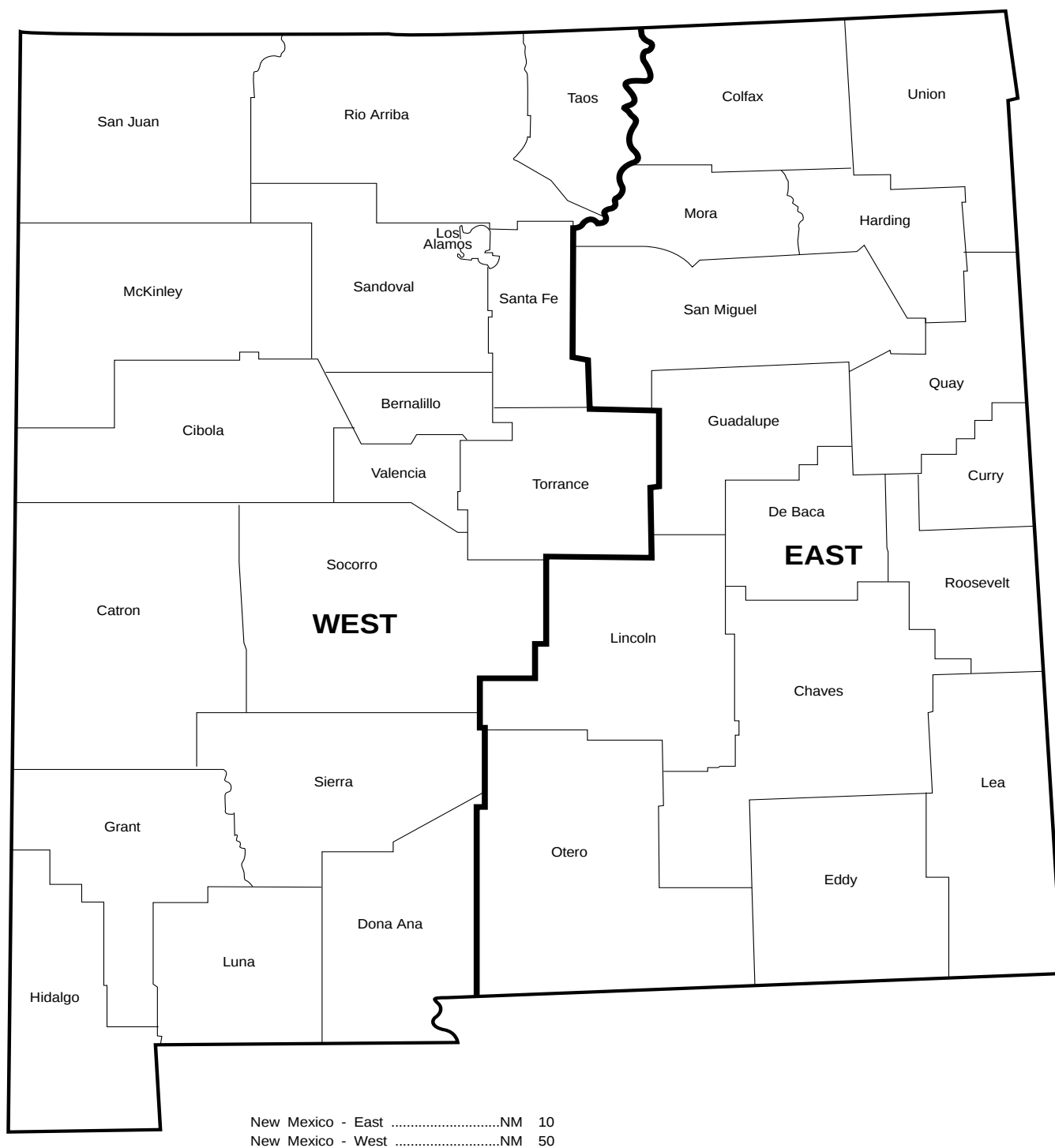
Source: Energy Information Administration, Office of Oil and Gas.

Figure H3. Subdivisions of Louisiana



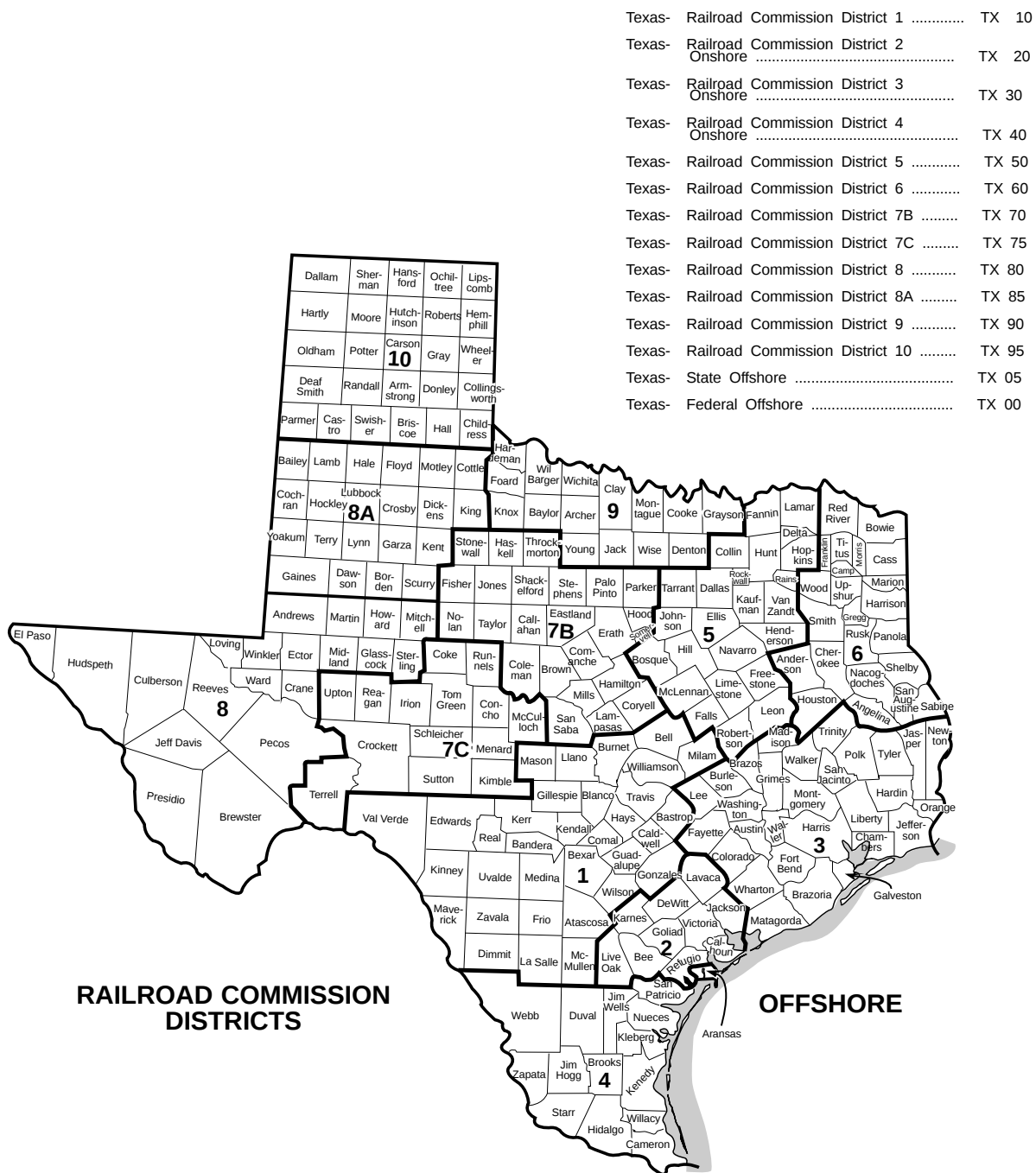
Source: Energy Information Administration, Office of Oil and Gas.

Figure H4. Subdivisions of New Mexico



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

Figure H5. Subdivisions of Texas



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

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

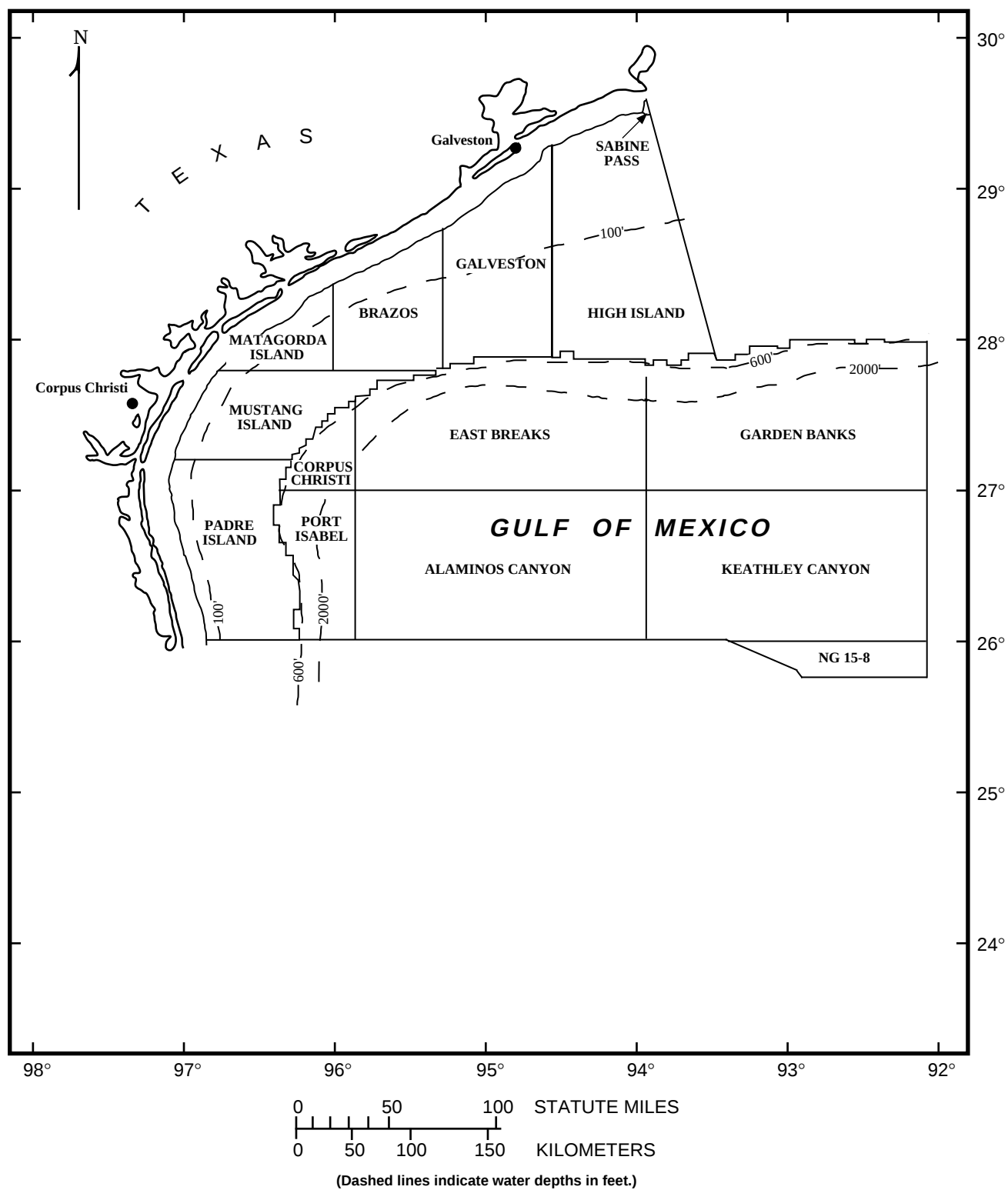


Figure H7. Central Planning Area, Gulf of Mexico Outer Continental Shelf Region

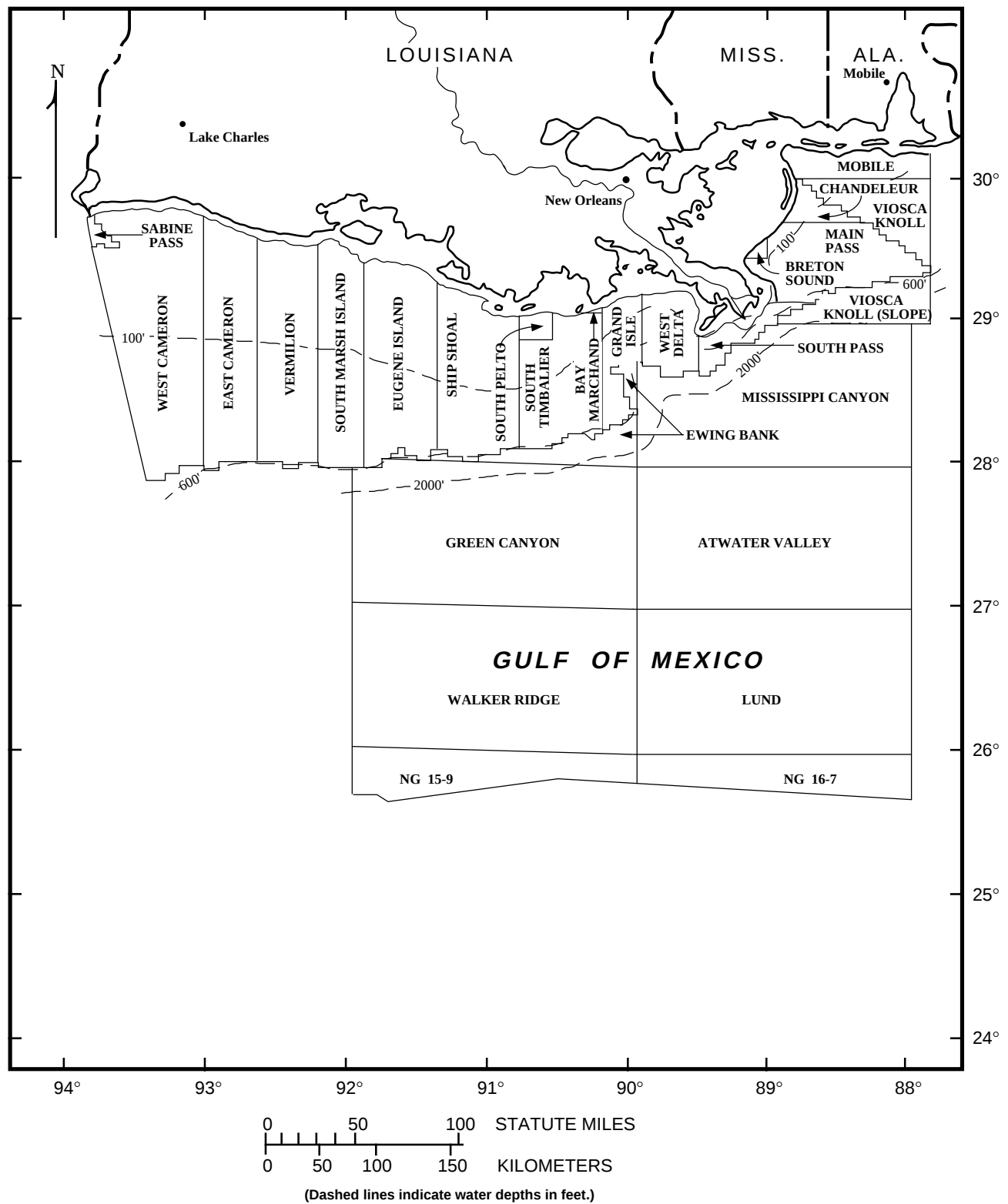
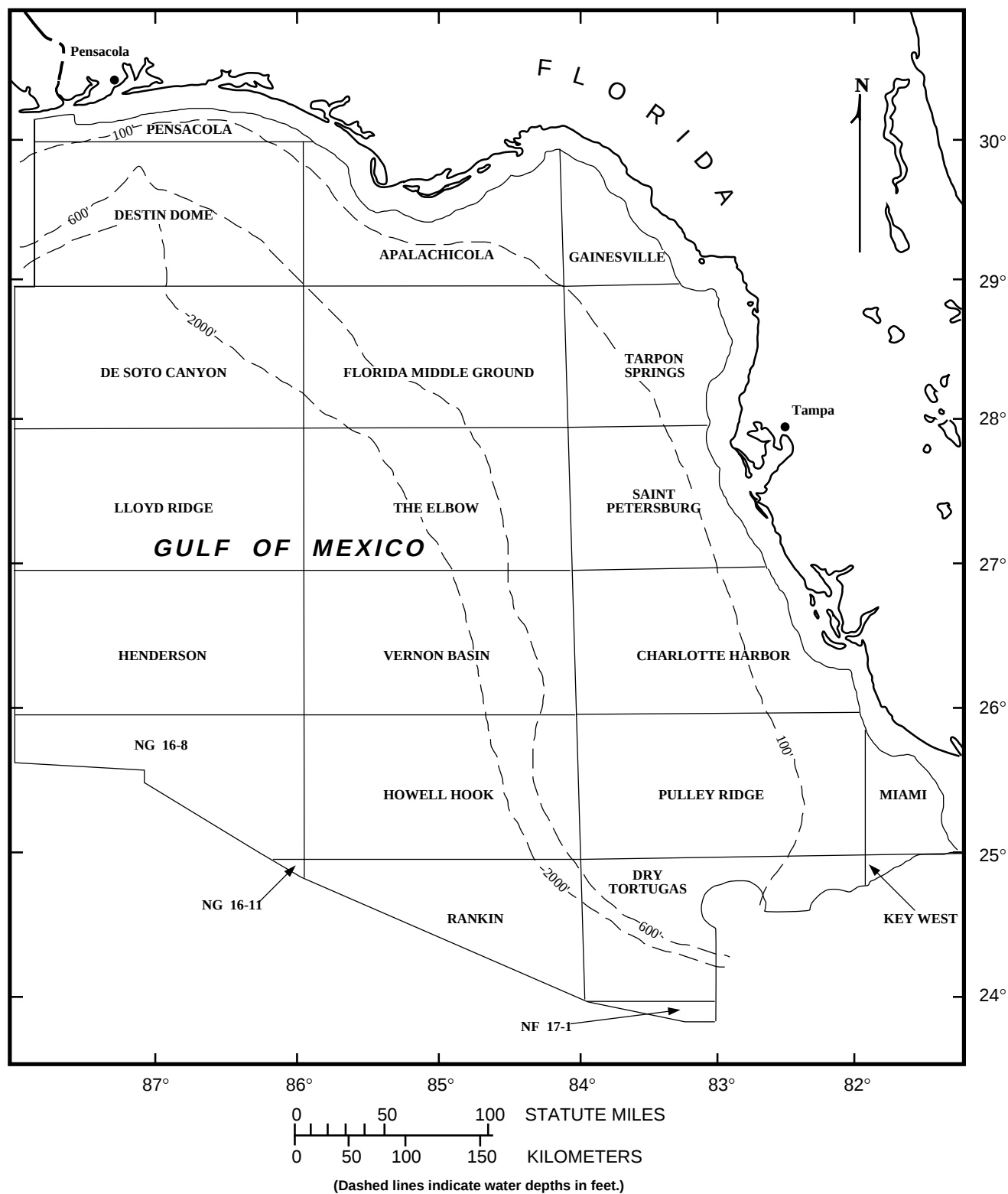


Figure H8. Eastern Planning Area, Gulf of Mexico Outer Continental Shelf Region



Appendix I

Annual Survey Forms for Domestic Oil and Gas Reserves

1997

ANNUAL SURVEY OF DOMESTIC OIL AND GAS RESERVES

U.S. DEPARTMENT OF ENERGY

CALENDAR YEAR 1997

Form Approved
OMB No. 1905-0057
Expires 12/98

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 from 62 to 333 hours per response, 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, Office of Statistical Standards EI-73, Washington, DC 20585; and to the Office of Information and Regulatory Affairs, Office 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, 1997?**
- (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.)

I hereby swear or affirm that I have read the report and am familiar with its contents, and that to the best of my knowledge, information, and belief, the information provided and 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 Department of the United States any false, fictitious or fraudulent statements as to any matter within its jurisdiction

FOR ASSISTANCE CALL 1-800-879-1470

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

ANNUAL SU OF DO ST C O L AND GAS S S														
OFFICIAL USE ONLY Form Approved OMB No. 1005-0057 Expires 12/96														
(Report All Volumes of Crude Oil and Lease Condensate in Thousands of Barrels [Mbbbl]; 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 97								
2.0 PRODUCTION AND RESERVES DATA														
STAT O G O G A C SUBD S O N		C U D O L			N A T U R A L G A S			L A S C O N D N S A T						
		S S	ODUCT ON	S S	ODUCT ON	S S	ODUCT ON	Proved Reserves Dec. 31, 1997 (Mbbbl)	Proved Reserves Dec. 31, 1997 (MMcf)	From properties for which reserves were Not Estimated (Mbbbl)	From properties for which reserves were Not Estimated (MMcf)	From properties for which reserves were Not Estimated (Mbbbl)	From properties for which reserves were Not Estimated (MMcf)	
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(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	CA80													
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 ONSHORE	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													

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

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

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

ANNUAL SU OF DO ST C O L AND GAS S S

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

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

OFFICIAL USE ONLY

. O A T O AND T D N T F C A T O N 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 97											
2.0 FIELD DATA (OPERATED BASIS)															
1. STATE ABBR.		2. SUBDIV. CODE		3. COUNTY CODE		4. FIELD CODE		5. OCSBLOCK NUMBER		6. FIELD NAME		7. Calendar Year PRODUCTION From Properties For which RESERVES Were NOT ESTIMATED		8. FOOTNOTE	
												CRUDE OIL (Mbbbl) (a)		LEASE CON- (d) DENISATE (Mbbbl)	
												ASSOC-DISSOLVED (b) GAS (MMcf)		NON-ASSOCIATED (c) GAS (MMcf)	
9. WATER DEPTH								10. FIELD DISCOVERY YEAR				11. INDICATED ADDITIONAL RESERVES OF CRUDE OIL (Mbbbl)			
								RESERVES (a) DECEMBER 31, 1996				NEW FIELD (e) DISCOVERIES		RESERVES (f) IN OLD FIELDS	
												REVISION (c) DECREASES		CALENDAR YEAR (g) PRODUCTION	
12. CRUDE OIL (Mbbbl)															
13. ASSOCIATED-DISSOLVED GAS (MMcf)															
14. NONASSOCIATED GAS (MMcf)															
15. LEASE CONDENSATE (Mbbbl)															
2.1															
2.2															
2.3															
2.4															

Figure I6. Form EIA-64A

A 4A e ised OFFICIAL USE ONLY	Energy Information Administration U.S. DEPARTMENT OF ENERGY Calendar Year 1997 ANNUAL REPORT OF THE NATIONAL GAS LIQUIDS PRODUCTION FORM EIA-64A	Form Approved OMB No. 1905-0057 Expires 12/98	
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, Office of Statistical Standards, 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		DOMESTIC OIL AND GAS RESERVES PROGRAM PO BOX 1470 ROCKVILLE, MD 20849-1470	
LAND AND PRODUCTION OF NATURAL GAS LIQUIDS			
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.)			
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 (Mbbbl) (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		
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.			
FO ASS STANC CALL 8 8 4			

Source: Energy Information Administration, Office 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 1995.

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.