

DOE/EIA-0216(2003)
November 2004

U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2003 Annual Report



Energy Information Administration

eia.doe.gov



Energy Information Administration

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

2003 Annual Report

November 2004

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

This report was prepared by the Energy Information Administration, the independent statistical and analytical agency within the U.S. Department of Energy. The information contained herein should be attributed to the Energy Information Administration and should not be construed as advocating or reflecting any policy position of the Department of Energy or any other organization.

eia.doe.gov



Energy Information Administration

Preface

The *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2003 Annual Report* is the 27th 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, 2003, as well as production volumes for the United States and selected States and State subdivisions for the year 2003. 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 2003 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 2003; Table 1 converted to metric units; historical State data; a summary of survey operations; a discussion of statistical considerations; methods used to develop

the estimates provided in this report; maps of selected State subdivisions; and examples of the survey forms. A glossary of the terms used in this report and in survey Forms EIA-23 and EIA-64A is provided to assist readers in more fully understanding the data.

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

Authors were John H. Wood, Steven G. Grape, Rafi Zeinalpour, and Rhonda S. Green. Technical contributions were made by Jack Perrin, Dewayne Cravens, Paul Chapman, and Gwen Cox. Technical editing was provided by David F. Morehouse.

Address questions on specific sections of the publication to the following analyst/author:

- Executive Summary and Appendices F and G
John H. Wood
Phone: 214-720-6160
E-mail: jwood@eia.doe.gov
Fax: 214-720-6155
- Chapters 1, 2, 3, 4, 5
Steven G. Grape
Phone: 214-720-6174
E-mail: sgrape@eia.doe.gov
Fax: 214-720-6155
- Appendices A, B, C, D, E, H, and I
Rhonda S. Green
Phone: 214-720-6161
E-mail: rgreen@eia.doe.gov
Fax 214-720-6155
- Field-level Reserves Quality Assurance
Rafi M. Zeinalpour
Phone: 214-720-6191
E-mail: rzeinalp@eia.doe.gov
Fax 214-720-6155

Internet Site Services

Visit the Energy Information Administration web site: <http://www.eia.doe.gov>

The web site offers nearly all EIA publications. Users can view or download selected pages or entire reports, search for information, download EIA data and analysis applications, and find out about new EIA information products and services.

COVER PHOTO:

Gas drilling operations in the Newark East Field in the Barnett Shale, courtesy of Devon Energy Corporation. Devon Energy Corporation, headquartered in Oklahoma City, is the largest producer in the Newark East Field in the Barnett Shale. The Barnett has become the 6th largest gas field in the United States, located in the Fort Worth area.

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	11
Mergers and Acquisitions	11
Reserve-to-Production Ratios and Ultimate Recovery	15
R/P Ratios	15
Proved Ultimate Recovery	15
International Perspective	19
International Reserves	19
Petroleum Consumption	19
Dependence on Imports	20
List of Appendices.	20
3. Crude Oil Statistics	21
Proved Reserves	21
Discussion of Reserves Changes	24
Total Discoveries	24
Extensions	24
New Field Discoveries	24
New Reservoir Discoveries in Old Fields.	24
Revisions and Adjustments	25
Sales and Acquisitions	25
Production	25
Areas of Note: Large Discoveries and Reserve Additions	25
Gulf of Mexico Federal Offshore	25
Other Gain Areas.	26
Areas of Note: Large Reserve Declines.	26
Texas.	26
Alaska	26
California	26
Other Decline Areas	26
Reserves in Nonproducing Status	27
4. Natural Gas Statistics	29
Dry Natural Gas	29
Proved Reserves	29
Discussion of Reserves Changes	32
Total Discoveries	32
Revisions and Adjustments	32
Sales and Acquisitions	36
Production	36
Wet Natural Gas.	36
Nonassociated Natural Gas	36
Proved Reserves	36
Total Discoveries	36
Production	36

Associated-Dissolved Natural Gas	36
Proved Reserves	36
Production	37
Coalbed Methane	38
Proved Reserves	38
Production	38
Areas of Note: Large Discoveries and Reserves Additions	38
Colorado	38
Texas	39
Wyoming	39
Areas of Note: Large Reserves Declines	40
Gulf of Mexico Federal Offshore	40
Utah	40
New Mexico	40
Reserves in Nonproducing Status.	40
5. Natural Gas Liquids Statistics	41
Natural Gas Liquids	41
Proved Reserves	41
Total Discoveries	41
Revisions and Adjustments	41
Sales and Acquisitions	41
Production	45
Natural Gas Plant Liquids	45
Proved Reserves	45
Production	45
Lease Condensate	45
Proved Reserves	45
Production	46
Reserves in Nonproducing Status.	46
References	47
Appendices	
A. Operator Data by Size Class	A-1
B. Top 100 Oil and Gas Fields for 2002	B-1
C. Conversion to the Metric System	C-1
D. Historical Reserves Statistics	D-1
E. Summary of Data Collection Operations	E-1
F. Statistical Considerations	F-1
G. Estimation of Reserves and Resources	G-1
H. Maps of Selected State Subdivisions	H-1
I. Annual Survey Forms for Domestic Oil and Gas Reserves	I-1
Glossary	
Tables	
1. U.S. Proved Reserves of Crude Oil, Dry Natural Gas, and Natural Gas Liquids, 1993-2003.	4
2. Reserves Changes, 1977-2003	9
3. U.S. Average Annual First Purchase Prices for Crude Oil, Domestic Wellhead Prices for Natural Gas, and the Average Number of Active Rotary Drilling Rigs, 1977-2003	10
4. U.S. Exploratory and Development Well Completions, 1970-2003	12
5. International Oil and Natural Gas Reserves as of December 31, 2003	18
6. Crude Oil Proved Reserves, Reserves Changes, and Production, 2003	22
7. Reported Reserves in Nonproducing Status for Crude Oil, 2003	27
8. Dry Natural Gas Proved Reserves, Reserves Changes, and Production, 2003	30

	Page
9. Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 2003	33
10. Nonassociated Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 2003	34
11. Associated-Dissolved Natural Gas Proved Reserves, Reserves Changes, and Production, Wet After Lease Separation, 2003	35
12. U.S. Coalbed Methane Proved Reserves and Production, 1989-2003	37
13. Natural Gas Liquids Proved Reserves, Reserves Changes, and Production, 2003	42
14. Natural Gas Plant Liquids Proved Reserves and Production, 2003.	43
15. Lease Condensate Proved Reserves and Production, 2003	44

Figures

1. U.S. Crude Oil Proved Reserves, 1993-2003	5
2. Components of Reserves Changes for Crude Oil, 1993-2003	5
3. U.S. Dry Natural Gas Proved Reserves, 1993-2003	6
4. Components of Reserves Changes for Dry Natural Gas, 1993-2003	6
5. U.S. Natural Gas Liquids Proved Reserves, 1993-2003	8
6. Components of Reserves Changes for Natural Gas Liquids, 1993-2003	8
7. U.S. Exploratory Gas Well Completions, 1977-2003	13
8. U.S. Exploratory Oil Well Completions, 1977-2003	13
9. U.S. Total Discoveries of Dry Natural Gas per Exploratory Gas Well Completion, 1977-2003	14
10. U.S. Total Discoveries of Crude Oil per Exploratory Oil Well Completion, 1977-2003	14
11. Reserves-to-Production Ratios for Crude Oil, 1945-2003.	16
12. Reserves-to-Production Ratios for Wet Natural Gas, 1945-2003	16
13. Components of Ultimate Recovery for Crude Oil and Lease Condensate, 1977-2003	17
14. Components of Ultimate Recovery for Wet Natural Gas, 1977-2003	17
15. Replacement of U.S. Crude Oil Production by Reserves Additions, 1994-2003	21
16. Crude Oil Proved Reserves by Area, 2003	23
17. Changes in Crude Oil Proved Reserves by Area, 2002 to 2003	23
18. Replacement of U.S. Dry Gas Production by Reserves Additions, 1994-2003	29
19. Dry Natural Gas Proved Reserves by Area, 2003.	31
20. Changes in Dry Natural Gas Proved Reserves by Area, 2002 to 2003	31
21. Coalbed Methane Proved Reserves, 1989-2003	38

eia.doe.gov



Energy Information Administration

Executive Summary: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2003 Annual Report

Proved reserves of natural gas increased for the fifth year in a row as U.S. natural gas reserves increased by 1 percent in 2003. The majority of natural gas total discoveries were from extensions of existing conventional and unconventional gas fields. Reserves additions replaced 111 percent of 2003 gas production. Natural gas proved reserves have increased in nine of the past ten years. U.S. gas production remained almost level in 2003 as declines in the Gulf of Mexico and New Mexico were offset by production increases in the Rocky Mountain States and Texas.

and coalbeds. Significant reserves were added in the Powder River basin (coalbed methane) and Green River basin (deep and tight sand) in Wyoming, and in the Wattenberg Field (tight sand) and San Juan basin (coalbed methane) in Colorado and New Mexico. Significant reserves were also added in Texas' Newark East Field (Barnett Shale) which is the Nation's sixth largest natural gas field.

Coalbed methane reserves increased 1 percent from 2002 and accounted for 10 percent of U.S. dry gas proved reserves. Coalbed methane production declined very slightly in 2003 (less than 1 percent) and accounted for 8 percent of U.S. dry gas production.

As of December 31, 2003 proved reserves were:

Crude Oil (million barrels)	
2002	22,677
2003	21,891
Decrease	-3.5%
Dry Natural Gas (billion cubic feet)	
2002	186,946
2003	189,044
Increase	+1.1%
Natural Gas Liquids (million barrels)	
2002	7,994
2003	7,459
Decrease	-6.7%

Proved reserves are the estimated quantities which 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 2003 U.S. proved reserves of crude oil, natural gas, and natural gas liquids is the 27th in an annual series prepared by the Energy Information Administration.

Crude oil proved reserves declined 3 percent in 2003, the first decline in five years. Operators only replaced 58 percent of oil production with reserves additions. Total discoveries, that included significant new field discoveries in the Gulf of Mexico Federal Offshore, were larger than average. However, proved reserves in several fields were lowered substantially because of poor well performance accompanied by engineering reassessments. The net of revisions, adjustments, sales, and acquisitions was a negative 141 million barrels in 2003 compared to a more typical positive 1,160 million barrels in 2002.

Crude Oil

Total discoveries are those reserves attributable to field extensions, new field discoveries, and new reservoir discoveries in old fields. They result from the drilling of exploratory wells. Total discoveries of crude oil were 1,232 million barrels in 2003, 16 percent more than the prior 10-year average and 30 percent more than 2002's discoveries of 946 million barrels.

The Rocky Mountain States and Texas saw large gas reserves additions in 2003. These were driven by continuing development of unconventional gas fields, i.e., fields developed in tight sands, shales,

The majority of crude oil total discoveries in 2003 were new field discoveries in the Gulf of Mexico Federal Offshore. The north slope of Alaska (normally a major contributor to total discoveries) had no significant impact on the Nation's total discoveries in 2003.

New field discoveries accounted for 705 million barrels of crude oil reserves additions. Almost all were in the Gulf of Mexico Federal Offshore (702 of 705 million). This was more than double the new

field discoveries of 2002 and 84 percent more than the prior 10-year average.

Operators discovered 426 million barrels in extensions in 2003, 13 percent less than in 2002 and 14 percent less than the prior 10-year average.

New reservoir discoveries in old fields were 101 million barrels, 34 percent less than in 2002 and 43 percent less than the prior 10-year average.

Reserves additions are the sum of total discoveries, revisions, adjustments, sales, and acquisitions. In 2003, reserve additions were 1,091 million barrels which is 48 percent less than the volume of reserves additions in 2002.

Crude oil net revisions and adjustments were 257 million barrels, which is 77 percent less than the net revisions and adjustments of 2002. The net of sales and acquisitions of crude oil proved reserves was -398 million barrels.

Other 2003 crude oil events of note:

- The annual average domestic first purchase price for crude oil increased 22 percent from the 2002 level to \$27.56 per barrel.
- Exploratory and developmental oil completions were up 4 percent from 2002.

Natural Gas

Total discoveries of dry gas reserves were 19,286 billion cubic feet in 2003. This was 36 percent more than the prior 10-year average and 8 percent more than in 2002. The majority of natural gas total discoveries in 2003 were from extensions of existing conventional and unconventional gas fields.

Field extensions were 16,454 billion cubic feet, 11 percent more than extensions in 2002 and 66 percent more than the prior 10-year average of 9,941 billion cubic feet.

New field discoveries were 1,222 billion cubic feet, 8 percent less than the volume discovered in 2002 and 33 percent less than the prior 10-year average.

New reservoir discoveries in old fields were 1,610 billion cubic feet, down 5 percent from 2002 and 34 percent less than the prior 10-year average.

Natural gas net revisions and adjustments were 1,203 billion cubic feet, which is 74 percent less than the net revisions and adjustments of 2002. The net of sales and acquisitions of dry natural gas proved reserves was 1,034 billion cubic feet.

Coalbed methane proved reserves grew in 2003, while production declined slightly. Coalbed methane proved reserves were 18,743 billion cubic feet, an increase of 1 percent from 2002 and accounted for 10 percent of U.S. dry gas proved reserves. Coalbed methane production was 1,600 billion cubic feet, a decrease of less than 1 percent from 2002 and accounted for 8 percent of U.S. dry gas production.

Other 2003 natural gas events of note:

- Natural gas prices were up 69 percent in 2003 to an average of \$4.98 per thousand cubic feet at the wellhead, as compared to \$2.95 per thousand cubic feet in 2002.
- Exploratory and developmental gas completions were up 22 percent from 2002.
- U.S. gas production increased slightly (less than 1 percent) in 2003.

Natural Gas Liquids

U.S. natural gas liquids proved reserves declined 7 percent in 2003 to 7,459 million barrels. This resulted from changes in the relative economics of natural gas and natural gas liquids, and in the liquids content of the gas production. 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 29,350 million barrels in 2003, a 4 percent decrease from the 2002 level. Natural gas liquids represented 25 percent of total liquid hydrocarbon proved reserves in 2003.

Data

These estimates are based upon analysis of data from Form EIA-23, Annual Survey of Domestic Oil and Gas Reserves, filed by 1,554 operators of oil and gas wells, and Form EIA-64A, Annual Report of the Origin of Natural Gas Liquids Production, filed by operators of 507 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.