

2. Overview

National Summary

The United States had the following proved reserves as of December 31, 2003:

- **Crude Oil — 21,891 million barrels**
- **Dry Natural Gas — 189,044 billion cubic feet**
- **Natural Gas Liquids — 7,459 million barrels.**

This Overview summarizes the 2003 proved reserves balances of crude oil, dry natural gas, and natural gas liquids on a National level and provides historical comparisons between 2003 and prior years. **Table 1** lists the estimated annual reserve balances since 1993 for crude oil, dry natural gas, and natural gas liquids.

Crude Oil

Proved reserves of crude oil decreased by 786 million barrels in 2003. **Figure 1** shows the crude oil proved reserves levels by major region and **Figure 2** shows the components of reserves changes from 1993 through 2003.

As indicated in **Figure 1**, U.S. crude oil proved reserves decreased in 2003 in the lower 48 States onshore and Alaska, but increased in the Federal Offshore.

The components of reserves changes for crude oil are shown in **Figure 2**. EIA tracks all components of reserves changes: adjustments, revision increases, revision decreases, sales, acquisitions, extensions, new field discoveries, new reservoir discoveries in old fields, and estimated production. These components are discussed below.

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 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, 702 million of which were in the Gulf of Mexico Federal Offshore. 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 and adjustments, and sales and acquisitions. In 2003 there were 1,091 million barrels of reserves additions, 48 percent less than the volume of reserves additions in 2002.

The smaller than average volume of net revisions and adjustments and a negative net of sales and acquisitions of crude oil proved reserves significantly reduced reserves additions in 2003. Crude oil net revisions and adjustments were 257 million barrels, 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.

Production of crude oil was an estimated 1,877 million barrels in 2003 (lease condensate not included, see Natural Gas Liquids section below for condensate volumes). This was up less than 1 percent from 2002's level (1,875 million barrels) and down 9 percent from the prior 10-year average (2,074 million barrels). Operators replaced only 58 percent of crude oil production with reserves additions in 2003.

Natural Gas

Dry natural gas proved reserves increased by 2,098 billion cubic feet in 2003. **Figure 3** shows the dry natural gas proved reserves levels by major region. It indicates that additions of gas reserves in the Lower 48 onshore are raising the National total despite declining offshore gas reserves. **Figure 4** shows the components of reserves changes from 1993 through 2003.

Table 1. Total U.S. Proved Reserves of Crude Oil, Dry Natural Gas, and Natural Gas Liquids, 1993-2003

Year	Adjustments (1)	Net Revisions (2)	Revisions ^a and Adjustments (3)	Net of Sales ^b and Acquisitions (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total ^c Discoveries (8)	Estimated Production (9)	Proved ^d Reserves 12/31 (10)	Change from Prior Year (11)
Crude Oil (million barrels of 42 U.S. gallons)											
1993	271	495	766	NA	356	319	110	785	2,339	22,957	-788
1994	189	1,007	1,196	NA	397	64	111	572	2,268	22,457	-500
1995	122	1,028	1,150	NA	500	114	343	957	2,213	22,351	-106
1996	175	737	912	NA	543	243	141	927	2,173	22,017	-334
1997	520	914	1,434	NA	477	637	119	1,233	2,138	22,546	+529
1998	-638	518	-120	NA	327	152	120	599	1,991	21,034	-1,512
1999	139	1,819	1,958	NA	259	321	145	725	1,952	21,765	+731
2000	143	746	889	-20	766	276	249	1,291	1,880	22,045	+280
2001	-4	-158	-162	-87	866	1,407	292	2,565	1,915	22,446	+401
2002	416	720	1,136	24	492	300	154	946	1,875	22,677	+231
2003	163	94	257	-398	426	705	101	1,232	1,877	21,891	-786
Dry Natural Gas (billion cubic feet, 14.73 psia, 60° Fahrenheit)											
1993	972	5,349	6,321	NA	6,103	899	1,866	8,868	17,789	162,415	-2,600
1994	1,945	5,484	7,429	NA	6,941	1,894	3,480	12,315	18,322	163,837	+1,422
1995	580	7,734	8,314	NA	6,843	1,666	2,452	10,961	17,966	165,146	+1,309
1996	3,785	4,086	7,871	NA	7,757	1,451	3,110	12,318	18,861	166,474	+1,328
1997	-590	4,902	4,312	NA	10,585	2,681	2,382	15,648	19,211	167,223	+749
1998	-1,635	5,740	4,105	NA	8,197	1,074	2,162	11,433	18,720	164,041	-3,182
1999	982	10,504	11,486	NA	7,043	1,568	2,196	10,807	18,928	167,406	+3,365
2000	-891	6,962	6,071	4,031	14,787	1,983	2,368	19,138	19,219	177,427	+10,021
2001	2,742	-2,318	424	2,630	16,380	3,578	2,800	22,758	19,779	183,460	+6,033
2002	3,727	937	4,664	380	14,769	1,332	1,694	17,795	19,353	186,946	+3,486
2003	2,841	-1,638	1,203	1,034	16,454	1,222	1,610	19,286	19,425	189,044	+2,098
Natural Gas Liquids (million barrels of 42 U.S. gallons)											
1993	102	124	226	NA	245	24	64	333	788	7,222	-229
1994	43	197	240	NA	314	54	131	499	791	7,170	-52
1995	192	277	469	NA	432	52	67	551	791	7,399	+229
1996	474	175	649	NA	451	65	109	625	850	7,823	+424
1997	-15	289	274	NA	535	114	90	739	864	7,973	+150
1998	-361	208	-153	NA	383	66	88	537	833	7,524	-449
1999	99	727	826	NA	313	51	88	452	896	7,906	+382
2000	-83	459	376	145	645	92	102	839	921	8,345	+439
2001	-429	-132	-561	102	717	138	142	997	890	7,993	-352
2002	62	31	93	54	612	48	78	738	884	7,994	+1
2003	-338	-161	-499	30	629	35	72	736	802	7,459	-535

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

^bNet of sales and acquisitions = acquisitions - sales.

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

^dProved reserves = Col. 10 from prior year + Col. 3 + Col. 4 + Col. 8 - Col. 9.

NA=Not available.

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 2003 contained in the *Petroleum Supply Annual 2003*, DOE/EIA-0340(03) and the *Natural Gas Annual 2003*, DOE/EIA-0131(03).

Sources: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, 1993 through 2002 annual reports, DOE/EIA-0216.

Figure 1. U.S. Crude Oil Proved Reserves, 1993-2003

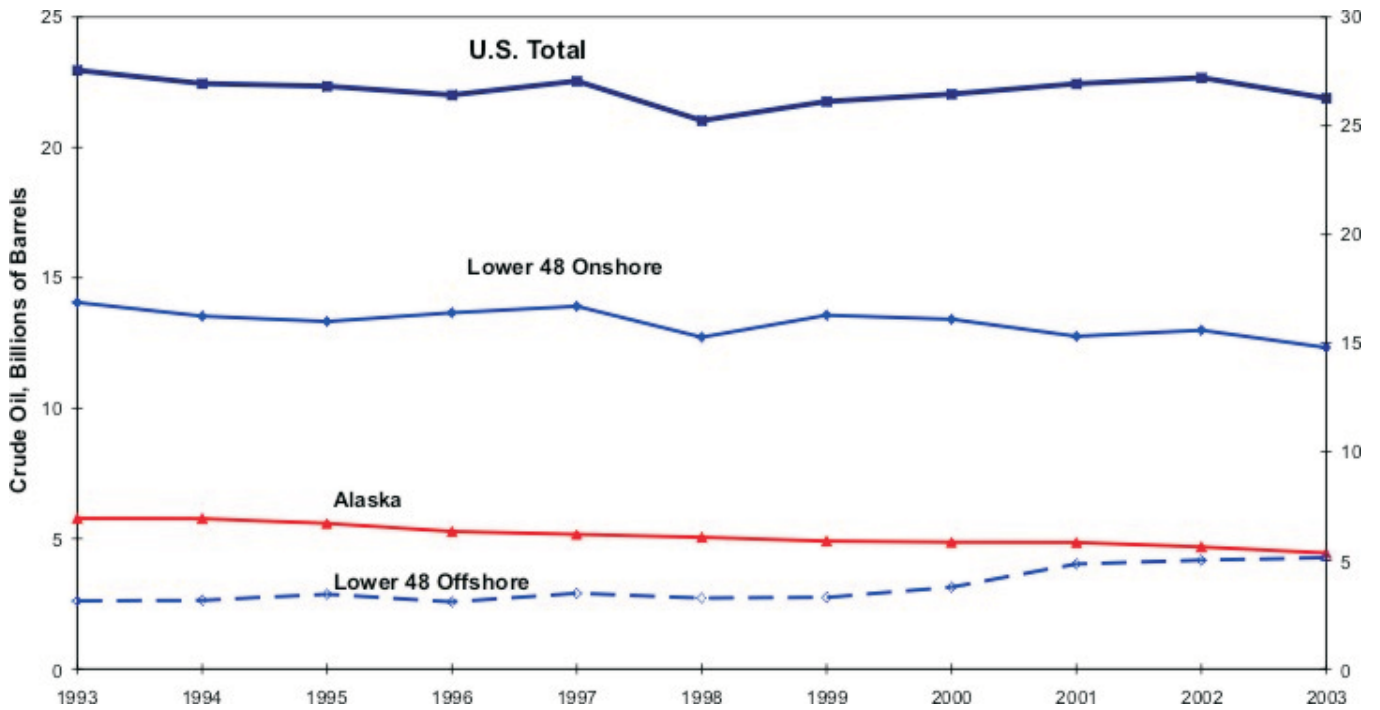
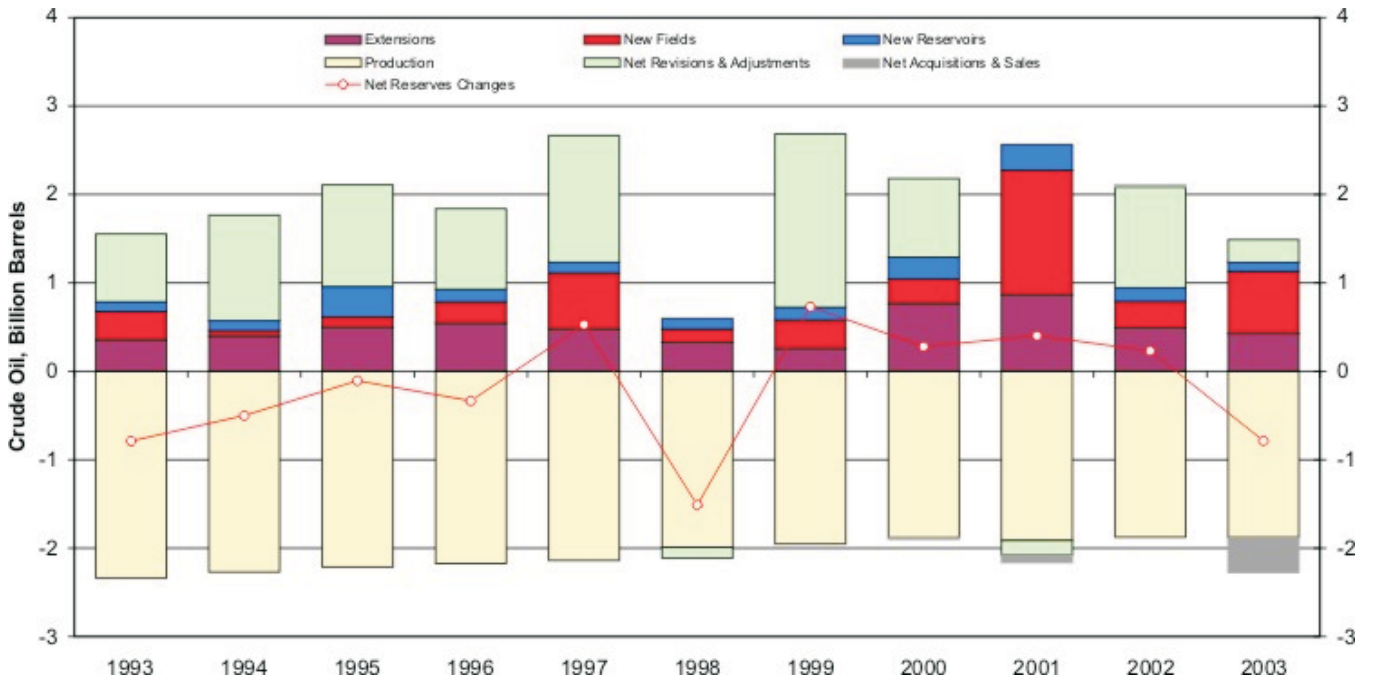


Figure 2. Components of Reserves Changes for Crude Oil, 1993-2003



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1993-2002 annual reports, DOE/EIA-0216.{17-26}

Figure 3. U.S. Dry Natural Gas Proved Reserves, 1993-2003

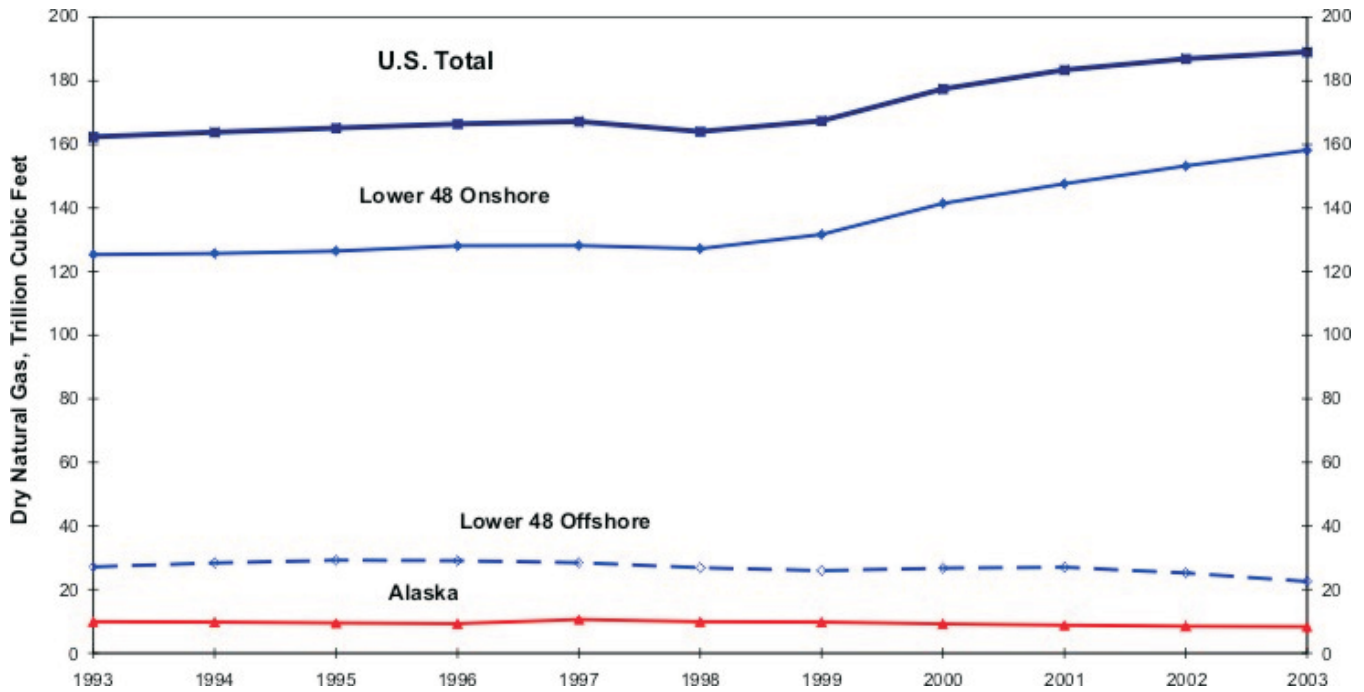
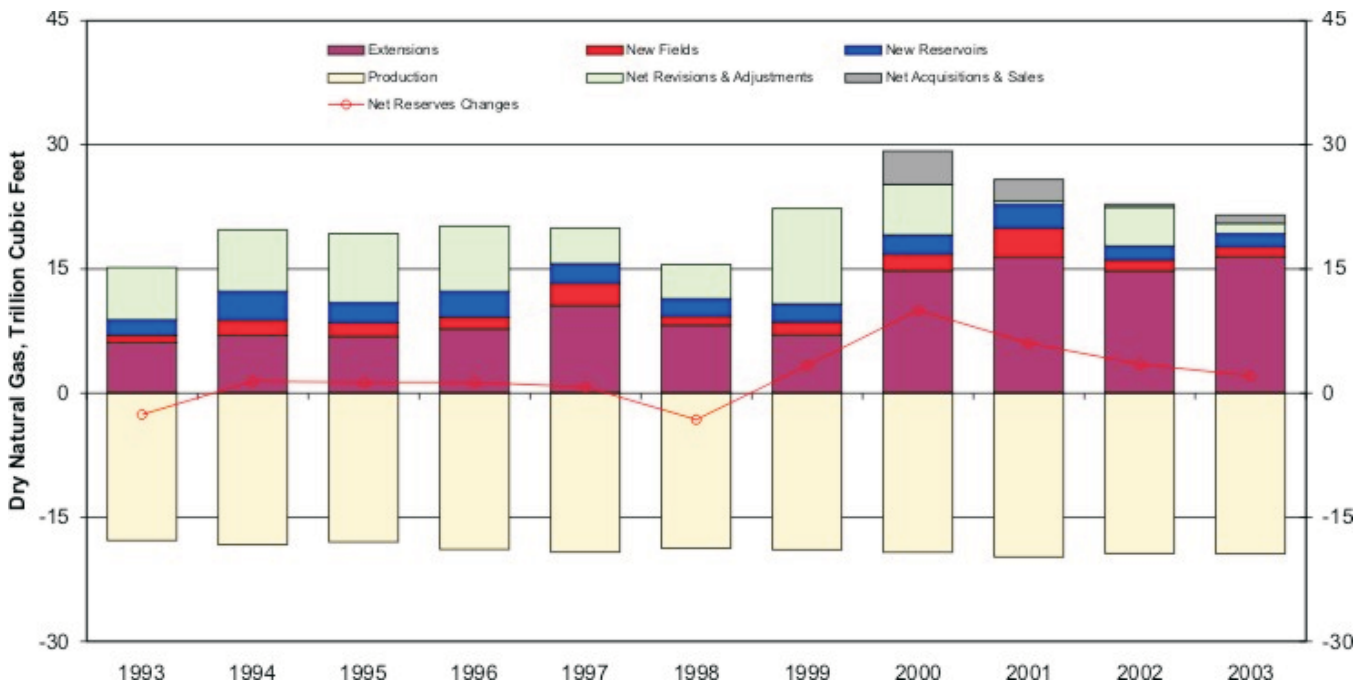


Figure 4. Components of Reserves Changes for Dry Natural Gas, 1993-2003



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1993-2002 annual reports, DOE/EIA-0216.{17-26}

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 less 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, 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.

Production removed an estimated 19,425 billion cubic feet of proved reserves from the National total. Dry gas production increased by less than 1 percent compared to 2002. Operators replaced 111 percent of dry natural gas production with reserves additions.

Coalbed methane 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 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.

Natural Gas Liquids

Proved reserves of natural gas liquids 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 liquid content of gas production. **Figure 5** shows the natural gas liquids proved reserves levels by major region. It indicates that declining reserves in both the Lower 48 onshore and offshore combine to cause the decrease in the National total in 2003. **Figure 6** shows the components of natural gas liquids reserves changes from 1993 through 2003.

Operators replaced 33 percent of their 2003 natural gas liquids production with reserve additions. Total discoveries added 736 million barrels (primarily from extensions), net revisions and adjustments were -498 million barrels, and net sales and acquisitions added 30 million barrels in 2003.

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.

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 2003. The table has 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 2003 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 905 million barrels per year of new reserves
- had proved reserves additions of an average 2,093 million barrels per year from total discoveries, net revisions and adjustments, and net sales and acquisitions.
- ended each year with an average net reduction in U.S. proved reserves of 430 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 proved ultimate recovery appreciation in existing fields rather than the discovery of new oil fields. Only 12 percent of reserves additions since 1976 were booked as new field discoveries. Proved ultimate recovery appreciation is the sum of net revisions, adjustments, net sales and acquisitions, extensions, and new reservoir discoveries in old fields (see the Proved Ultimate Recovery section later in this chapter.) Since 1977, the 24,427 million barrels of total discoveries accounted for 43 percent of reserves additions.

Figure 5. U.S. Natural Gas Liquids Proved Reserves, 1993-2003

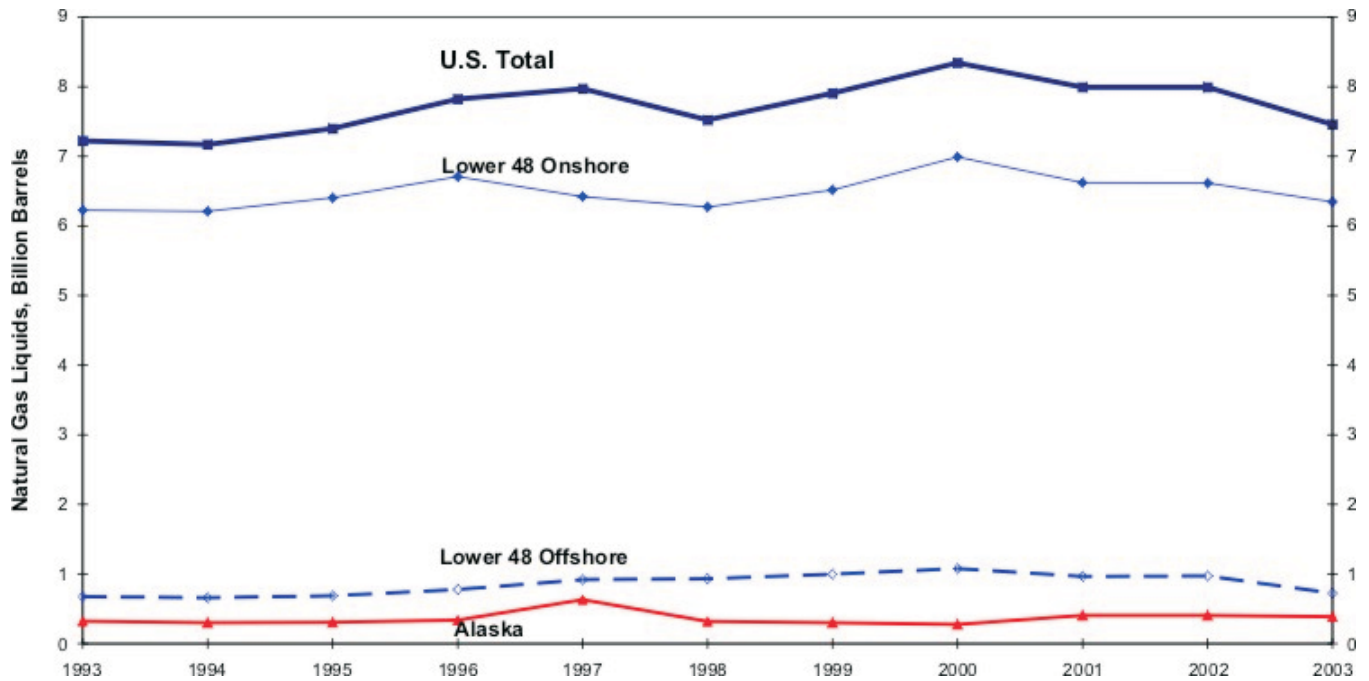
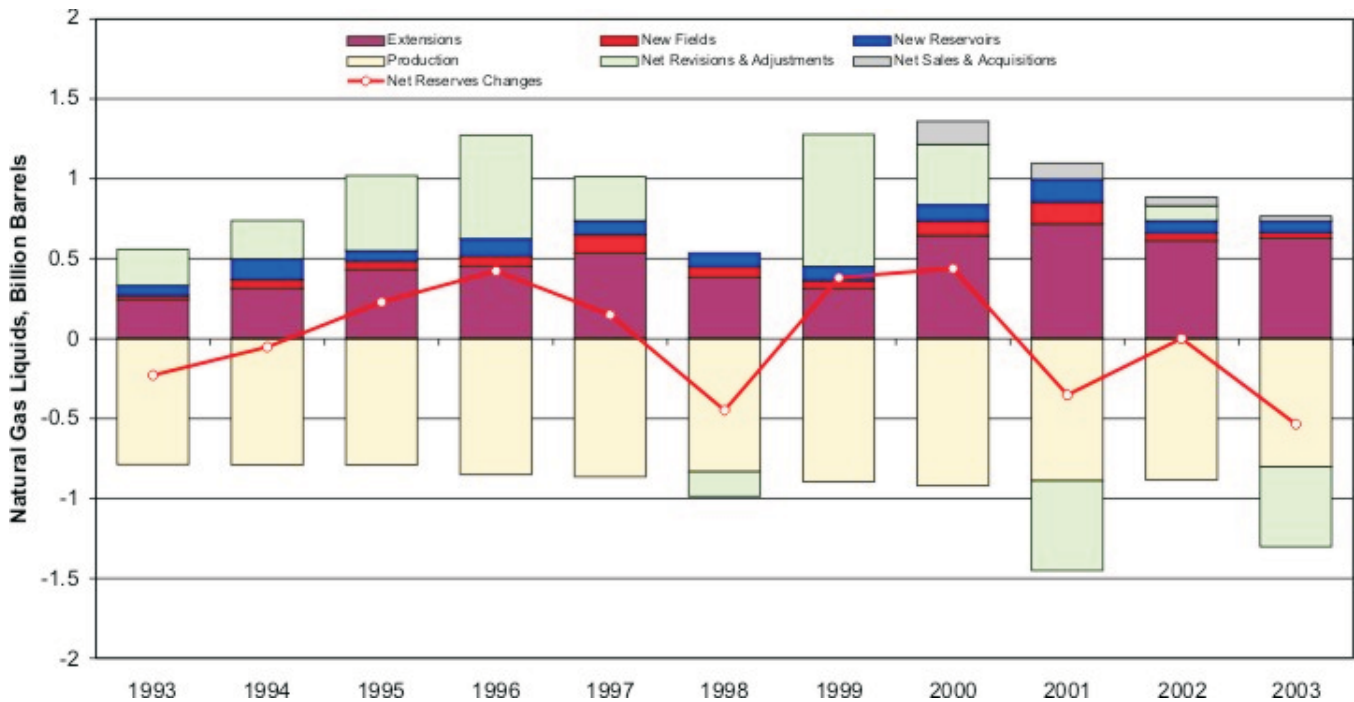


Figure 6. Components of Reserves Changes for Natural Gas Liquids, 1993-2003



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1993-2003 annual reports, DOE/EIA-0216.(17-26)

Table 2. Reserves Changes, 1977-2003

Components of Change	Lower 48 States			U.S. Total		
	Volume	Average per Year	Percent of Reserves Additions	Volume	Average per Year	Percent of Reserves Additions
Crude Oil (million barrels of 42 U.S. gallons)						
Proved Reserves as of 12/31/76	24,928	—	—	33,502	—	—
New Field Discoveries	5,692	211	12.3	6,643	246	11.8
New Reservoir Discoveries in Old Fields . .	3,840	142	8.3	3,970	147	7.0
Extensions	12,223	453	26.5	13,824	512	24.4
Total Discoveries	21,755	806	47.1	24,427	905	43.2
Revisions, Adjustments, Sales & Acquisitions ^a	24,416	904	52.9	32,097	1,189	56.8
Total Reserves Additions	46,171	1,710	100.0	56,524	2,093	100.0
Production	53,590	1,985	116.1	68,135	2,524	120.5
Net Reserves Change	-7,419	-275	-16.1	-11,611	-430	-20.5
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	52,170	1,932	11.0	52,412	1,941	11.4
New Reservoir Discoveries in Old Fields . .	66,919	2,478	14.1	67,333	2,494	14.6
Extensions	231,535	8,575	48.7	234,605	8,689	50.8
Total Discoveries	350,624	12,986	73.7	354,350	13,124	76.8
Revisions, Adjustments, Sales & Acquisitions ^a	125,060	4,632	26.3	107,037	3,964	23.2
Total Reserves Additions	475,684	17,618	100.0	461,387	17,088	100.0
Production	475,763	17,621	100.0	485,621	17,986	105.3
Net Reserves Change	-79	-3	0.0	-24,234	-898	-5.3

^a EIA did not separately collect data on sales and acquisitions of proved reserves until the year 2000.
Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1977-2003 annual reports, DOE/EIA-0216.(1-26)

Compared to the averages of reserves changes since 1977, 2003 was an up year for crude oil discoveries. Total discoveries of crude oil (1,232 million barrels) in 2003 were 36 percent greater than the post-1976 U.S. average (905 million barrels per year).

Looking at the components of total discoveries in 2003:

- 2003's new field discoveries (705 million barrels) were almost three times larger than the post-1976 average for crude oil,
- New reservoir discoveries in old fields (101 million barrels) were 31 percent less than the post-1976 average, and
- Extensions in 2003 (426 million barrels) were 17 percent less than the post-1976 average for crude oil.

In 2003, the Revisions, Adjustments, Sales & Acquisitions were -141 million barrels, a net loss. This loss was significantly smaller than the post-1976 average of 1,189 million barrels per year. Certain downward revisions and large reported sales of

reserves have negatively impacted the National total for 2003.

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

- discovered an average of 13,124 billion cubic feet per year of new reserves,
- had proved reserves additions of an average 17,088 billion cubic feet per year from total discoveries, net revisions and adjustments, and net sales and acquisitions, and
- had an average net reduction in U.S. reserves of 898 billion cubic feet per year.

Like crude oil reserves, natural gas reserves have been sustained primarily by proved ultimate recovery appreciation since 1977. Usually extensions rather than net revisions and adjustments are the largest component. Extensions accounted for 51 percent of all reserves additions since 1977 while net revisions and adjustments accounted for only 23 percent.

Table 3. U.S. Average Annual Domestic First Purchase Prices for Crude Oil, Wellhead Prices for Natural Gas, and the Average Number of Active Rotary Drilling Rigs, 1977-2003

Year	Crude Oil		Natural Gas		Number of Rigs	
	Current	2003 Constant	Current	2003 Constant		
	(dollars per barrel)		(dollars per thousand cubic feet)			
1977	8.57	21.41	0.79	1.97	2,001	
1978	9.00	20.89	0.91	2.12	2,259	
1979	12.64	27.21	1.18	2.54	2,177	
1980	21.59	42.55	1.59	3.13	2,909	
1981	31.77	57.28	1.98	3.57	3,970	
1982	28.52	48.40	2.46	4.17	3,105	
1983	26.19	42.76	2.59	4.23	2,232	
1984	25.88	40.74	2.66	4.19	2,428	
1985	24.09	36.76	2.51	3.83	1,980	
1986	12.51	18.68	1.94	2.90	964	
1987	15.40	22.32	1.67	2.42	936	
1988	12.58	17.63	1.69	2.37	936	
1989	15.86	21.42	1.69	2.28	869	
1990	20.03	26.03	1.71	2.22	1,010	
1991	16.54	20.74	1.64	2.06	860	
1992	15.99	19.58	1.74	2.13	721	
1993	14.25	17.04	2.04	2.44	754	
1994	13.19	15.45	1.85	2.17	775	
1995	14.62	16.76	1.55	1.78	723	
1996	18.46	20.76	2.17	2.44	779	
1997	17.23	19.00	2.32	2.56	943	
1998	10.87	11.84	1.96	2.14	827	
1999	15.56	16.71	2.19	2.35	625	
2000	26.72	28.11	3.68	3.87	918	
2001	21.84	22.44	4.00	4.11	1,156	
2002	January	15.89	16.24	2.50	2.56	867
	February	16.93	17.29	2.19	2.24	825
	March	20.28	20.68	2.40	2.45	763
	April	22.52	22.94	2.94	2.99	750
	May	23.51	23.92	2.94	2.99	826
	June	22.59	22.95	2.96	3.01	842
	July	23.51	23.86	2.92	2.96	851
	August	24.76	25.10	2.76	2.80	848
	September	26.08	26.40	2.97	3.01	860
	October	25.29	25.57	3.24	3.28	851
	November	23.38	23.60	3.59	3.62	834
	December	25.29	25.48	3.96	3.99	901
2002		22.51	22.87	2.95	3.00	830
2003	January	28.35	28.49	4.47	4.49	854
	February	31.85	31.96	5.45	5.47	907
	March	30.09	30.16	6.69	6.71	941
	April	25.46	25.51	4.71	4.72	983
	May	24.96	24.98	4.97	4.97	1,034
	June	26.83	26.82	5.35	5.35	1,067
	July	27.53	27.48	4.91	4.90	1,081
	August	27.94	27.85	4.72	4.71	1,090
	September	25.23	25.12	4.58	4.56	1,093
	October	26.52	26.37	4.43	4.40	1,102
	November	27.21	27.02	4.34	4.31	1,111
	December	28.54	28.31	5.08	5.04	1,114
2003		27.56	27.56	4.98	4.98	1,032

=Revised data.

Sources: Current dollars and number of rigs: *Monthly Energy Review September 2004*, DOE/EIA-0035(2004/9). 2003 constant dollars: U.S. Department of Commerce, Bureau of Economic Analysis, Gross Domestic Product Implicit Price Deflators, October 2004.

Compared to the averages of reserves changes since 1977, 2003 was an up year for dry natural gas total discoveries. Operators reported 19,286 billion cubic feet of total discoveries of dry natural gas proved reserves, 47 percent more than the post-1976 average (13,124 billion cubic feet).

The net of revisions, adjustments, sales, and acquisitions was 2,237 billion cubic feet in 2003, 44 percent lower than the post-1976 U.S. average (3,964 billion cubic feet per year).

Economics and Drilling

Economics: Table 3 lists the average annual domestic wellhead prices of crude oil and natural gas from 1977 to 2003.

The U.S. crude oil first purchase price started at an average of \$28.35 per barrel in January 2003, then fluctuated between a high of \$31.85 (February) and a low of \$24.96 (May). The average U.S. crude oil first purchase price increased from \$22.51 in 2002 to \$27.56 per barrel in 2003.

Oil prices vary by region. In Texas the average 2003 crude oil first purchase price was \$29.13 per barrel, \$26.43 per barrel in California, \$30.71 per barrel in Colorado, \$28.18 per barrel in Ohio, and \$24.25 per barrel in the California Federal Offshore. The lowest average crude oil first purchase price in 2003 was \$23.78 per barrel for the Alaska North Slope oil. {27}

The average annual wellhead natural gas price increased from \$3.00 in 2002 to \$4.98 per thousand cubic feet in 2003. Natural gas prices started at \$4.49 per thousand cubic feet in January 2003, rose to an annual average high on \$6.71 per thousand cubic feet in March, then fluctuated between \$4.31 and \$5.35 until the end of the year, ending with a price of \$5.04 per thousand cubic feet in December 2003. {28}

Drilling: Also listed in Table 3 are the average number of active rotary drilling rigs from 1977 to 2003. From 2002 to 2003, the annual average active rig count increased from 830 to 1,032, a 24 percent increase in active rigs.

Looking first at exploratory wells, there were 2,341 exploratory wells drilled in 2003 (Table 4). Of these, 11 percent were completed as oil wells, 33 percent were completed as gas wells, and 56 percent were dry holes. Exploratory oil and gas completions (excluding dry

holes) in 2003 were 17 percent more (Figures 7 and 8) than the revised 2002 total.

Figures 9 and 10 show the average volume of discoveries per exploratory well for dry natural gas and oil, respectively, since 1977. The 2003 average volume of oil discoveries per exploratory well increased 18 percent compared to 2002. The 2003 average volume of gas discoveries per exploratory well decreased 7 percent compared to 2002.

The number of successful development wells increased 4 percent for oil and 22 percent for gas from their 2002 levels. Including dry holes, there were an estimated 29,984 exploratory and development wells drilled in 2003. This is 16 percent more than in 2002 and 21 percent more than the average number of wells drilled annually in the prior 10 years (24,706).

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

Mergers and Acquisitions

The following large mergers and acquisitions were announced in 2003, and are expected to have a major impact on the energy industry in the future:

On February 14, 2003, the Federal Trade Commission voted unanimously 5- to-0 to approve Conoco Inc.'s merger with Phillips Petroleum Co., Dow Jones reported. The commission issued its final consent order following a public comment period. In November 2001, Oklahoma-based Phillips agreed to merge with Houston-based Conoco in a \$15.2 billion deal. The transaction forms ConocoPhillips, the world's sixth-largest oil and gas company in terms of proved reserves. The new company, which already is operating as ConocoPhillips, will be headquartered in Houston. {29}

In June 2003, Marathon signed a Dissolution and Distribution Agreement with Kinder Morgan Energy Partners, L.P. To dissolve MKM Partners L.P. Formed in January 2001, the MKM partnership had oil and gas production operations in the Permian Basin of Texas. Prior to the dissolution of the partnership, an agreement was signed exploring the sale of Marathon's interest in the Yates Field to Kinder Morgan. {30}

In October 2003, Shareholders of Carbon Energy Corporation of Denver, CO approved the proposed

Table 4. U.S. Exploratory and Development Well Completions,^a 1970-2003

Year	Exploratory				Total Exploratory and Development			
	Oil	Gas	Dry	Total	Oil	Gas	Dry	Total
1970	763	478	6,193	7,434	13,043	4,031	11,099	28,173
1971	664	472	5,995	7,131	11,903	3,983	10,382	26,268
1972	690	659	6,202	7,551	11,437	5,484	11,013	27,934
1973	642	1,067	5,952	7,661	10,167	6,933	10,320	27,420
1974	859	1,190	6,833	8,882	13,647	7,138	12,116	32,901
1975	982	1,248	7,129	9,359	16,948	8,127	13,646	38,721
1976	1,086	1,346	6,772	9,204	17,688	9,409	13,758	40,855
1977	1,164	1,548	7,283	9,995	18,745	12,122	14,985	45,852
1978	1,171	1,771	7,965	10,907	19,181	14,413	16,551	50,145
1979	1,321	1,907	7,437	10,665	20,851	15,254	16,099	52,204
1980	1,764	2,081	9,039	12,884	32,639	17,333	20,638	70,610
1981	2,636	2,514	12,349	17,499	43,598	20,166	27,789	91,553
1982	2,431	2,125	11,247	15,803	39,199	18,979	26,219	84,397
1983	2,023	1,593	10,148	13,764	37,120	14,564	24,153	75,837
1984	2,198	1,521	11,278	14,997	42,605	17,127	25,681	85,413
1985	1,679	1,190	8,924	11,793	35,118	14,168	21,056	70,342
1986	1,084	793	5,549	7,426	19,097	8,516	12,678	40,291
1987	925	754	5,049	6,728	16,164	8,055	11,112	35,331
1988	855	732	4,693	6,280	13,636	8,555	10,041	32,232
1989	607	705	3,924	5,236	10,204	9,539	8,188	27,931
1990	654	689	3,715	5,058	12,198	11,044	8,313	31,555
1991	592	534	3,314	4,440	11,770	9,526	7,596	28,892
1992	493	423	2,513	3,429	8,757	8,209	6,118	23,084
1993	502	548	2,469	3,519	8,407	10,017	6,328	24,752
1994	570	726	2,405	3,701	6,721	9,538	5,307	21,566
1995	542	570	2,198	3,310	7,627	8,354	5,075	21,056
1996	483	570	2,136	3,189	8,314	9,302	5,282	22,898
1997	428	536	2,110	3,074	10,436	11,327	5,702	27,465
1998	291	504	1,647	2,442	R 7,064	R 11,144	4,840	R 23,048
1999	R 157	539	1,195	R 1,891	4,176	10,877	R 3,412	R 18,465
2000	264	R 602	1,288	R 2,154	7,358	16,455	4,025	27,838
2001	R 322	988	R 1,669	R 2,979	8,060	22,083	R 4,084	R 34,227
2002	R 231	R 659	R 1,240	R 2,130	R 6,058	R 16,155	R 3,531	R 25,744
2003	254	766	1,321	2,341	6,284	19,722	3,978	29,984

^aExcludes service wells and stratigraphic and core testing.
R = Revised Data.

Notes: Estimates include only the original drilling of a hole intended to discover or further develop already discovered oil or gas resources. Other drilling activities, such as drilling an old well deeper, drilling of laterals from the original well, drilling of service and injection wells, and drilling for resources other than oil and gas are excluded.

Sources: Years 1970-1972: Energy Information Administration, Office of Oil and Gas. Years 1973-2003: EIA *Monthly Energy Review* September 2004, DOE/EIA-0035(2004/09). Web Page <http://www.eia.doe.gov/emeu/mer/resource.html>.

Figure 7. U.S. Exploratory Gas Well Completions, 1977-2003

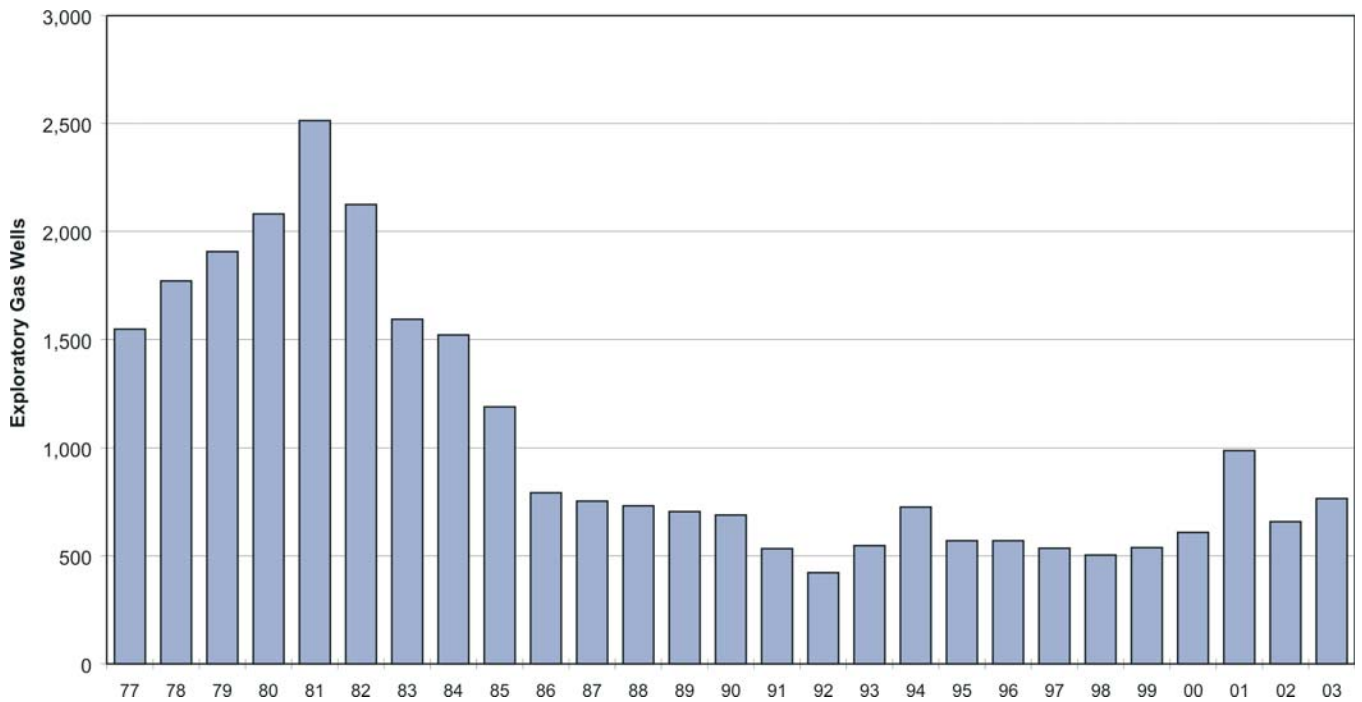
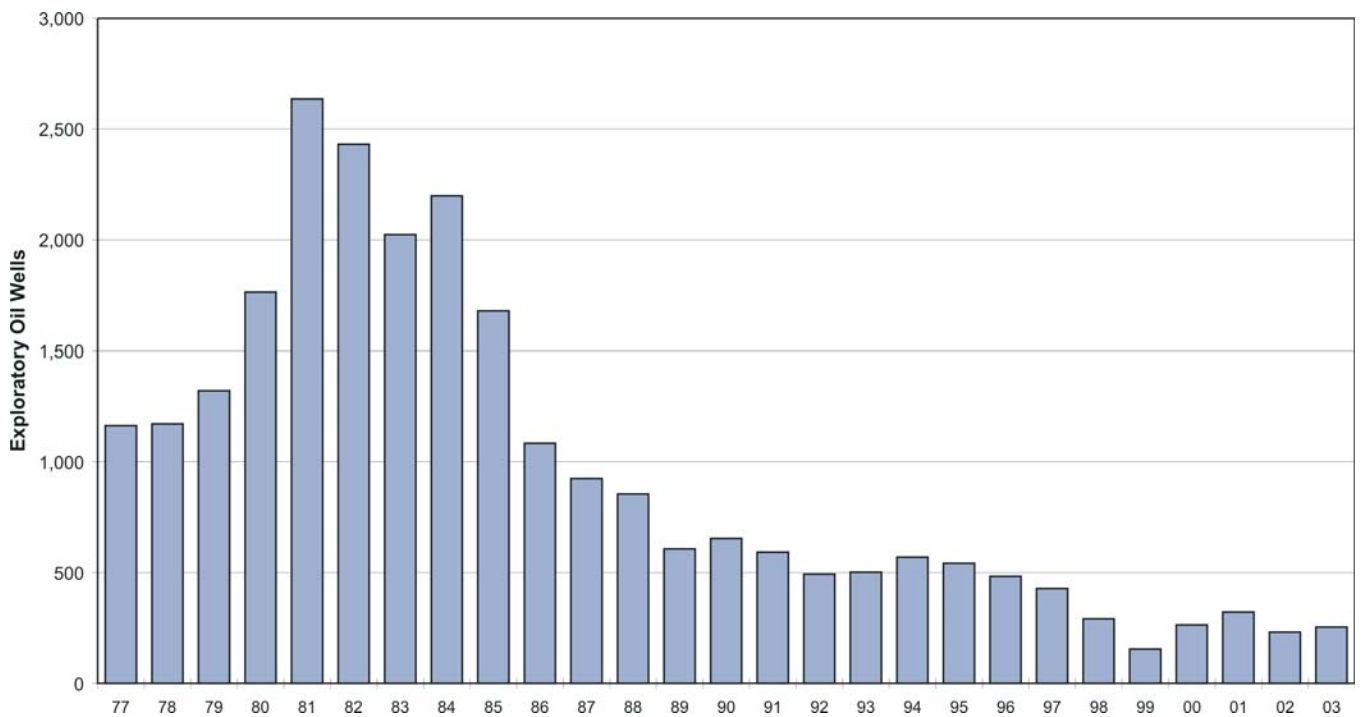


Figure 8. U.S. Exploratory Oil Well Completions, 1977-2003



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

Figure 9. U.S. Total Discoveries of Dry Natural Gas per Exploratory Gas Well Completion, 1977-2003

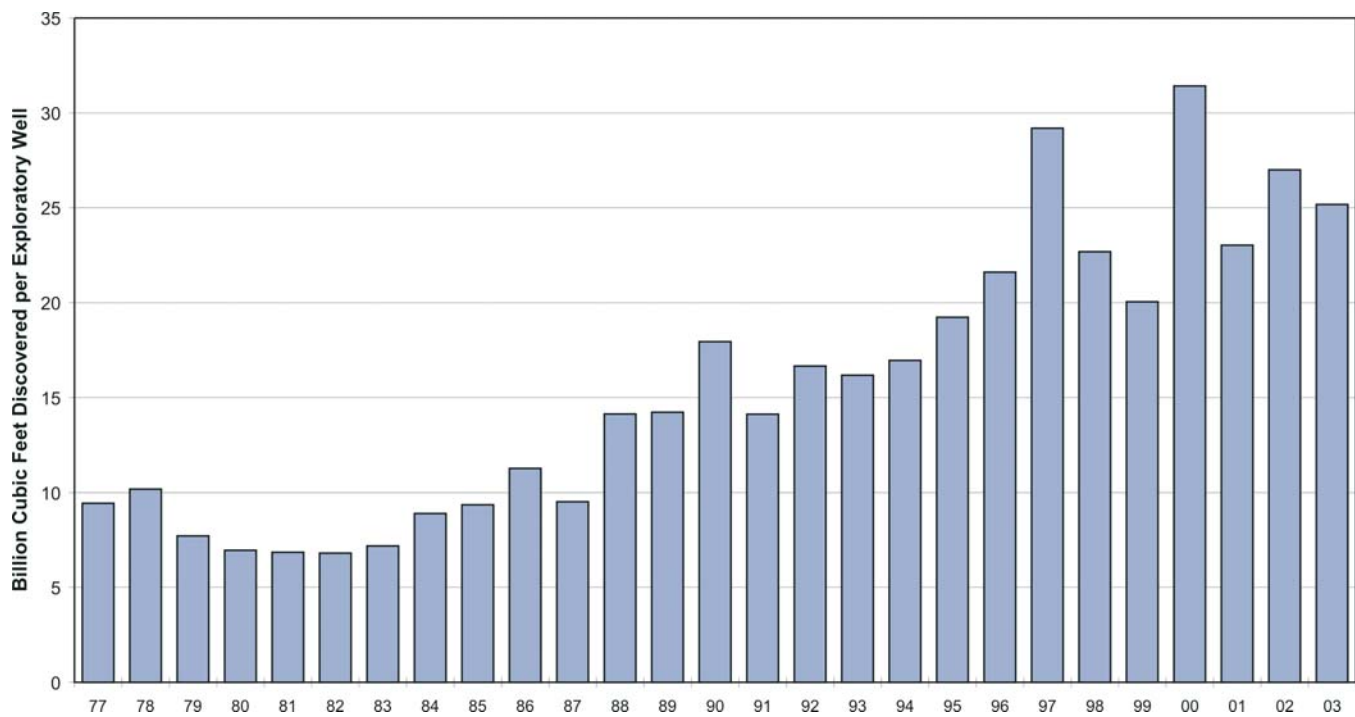
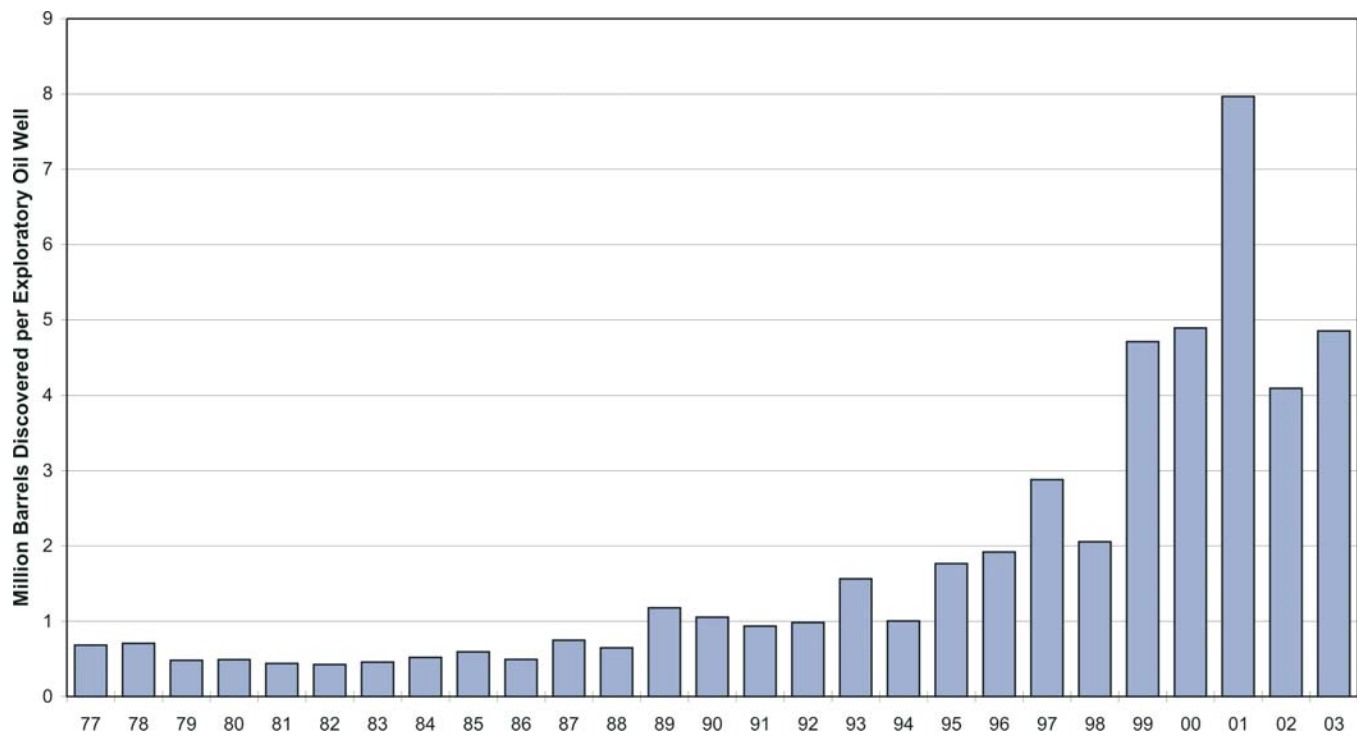


Figure 10. U.S. Total Discoveries of Crude Oil per Exploratory Oil Well Completion, 1977-2003



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

merger of Carbon with a subsidiary of Evergreen Resources, Inc. also based in Denver, in a deal worth about \$90 million. Carbon has oil and gas operations in the Piceance Basin of Colorado and in the Uintah Basin in Utah, as well as in central Alberta and southeast Saskatchewan in Canada. The acquired Carbon properties have about \$88 billion cubic feet equivalent of reserves, mostly in natural gas. {31}

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 2003, U.S. crude oil proved reserves decreased and oil production increased, decreasing the National average R/P ratio from 12.1 to 11.7.

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, because of differences in development history and reservoir conditions. The 2003 National average R/P ratio for crude oil was 11.7-to-1. 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 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 to 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 natural gas grew rapidly after World War II, lowering the R/P ratio. From 2002 to 2003 the U.S. average R/P ratio for natural gas increased from 9.66 to 9.74 since proved reserves increased and production decreased.

Different marketing, transportation, and production characteristics for gas are seen when looking at regional average R/P ratios, compared to the 2003 U.S. average R/P ratio of about 9.7-to-1. Areas with a higher range of R/P ratios than the National average were the Pacific offshore and the Rockies, as well as areas such as Alabama and Colorado where considerable booking of coalbed methane reserves has recently occurred. Several major gas producing areas have R/P ratios below the National average, particularly Texas, the Gulf of Mexico Federal Offshore, and Oklahoma.

Proved Ultimate Recovery

EIA had defined Ultimate Recovery as the sum of proved reserves and cumulative production. However, despite EIA's definition, the volume presented by EIA has often been 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 therefore introduced the 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

Figure 11. Reserves-to-Production Ratios for Crude Oil, 1945-2003

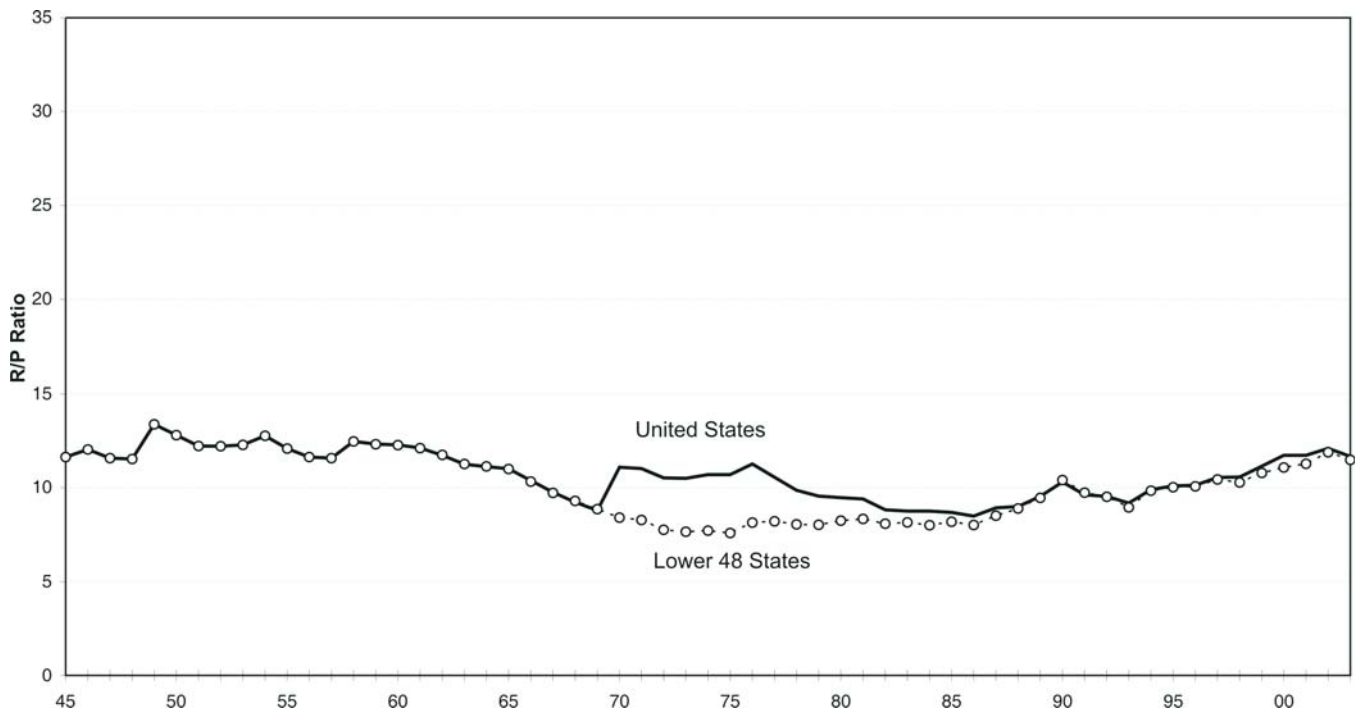
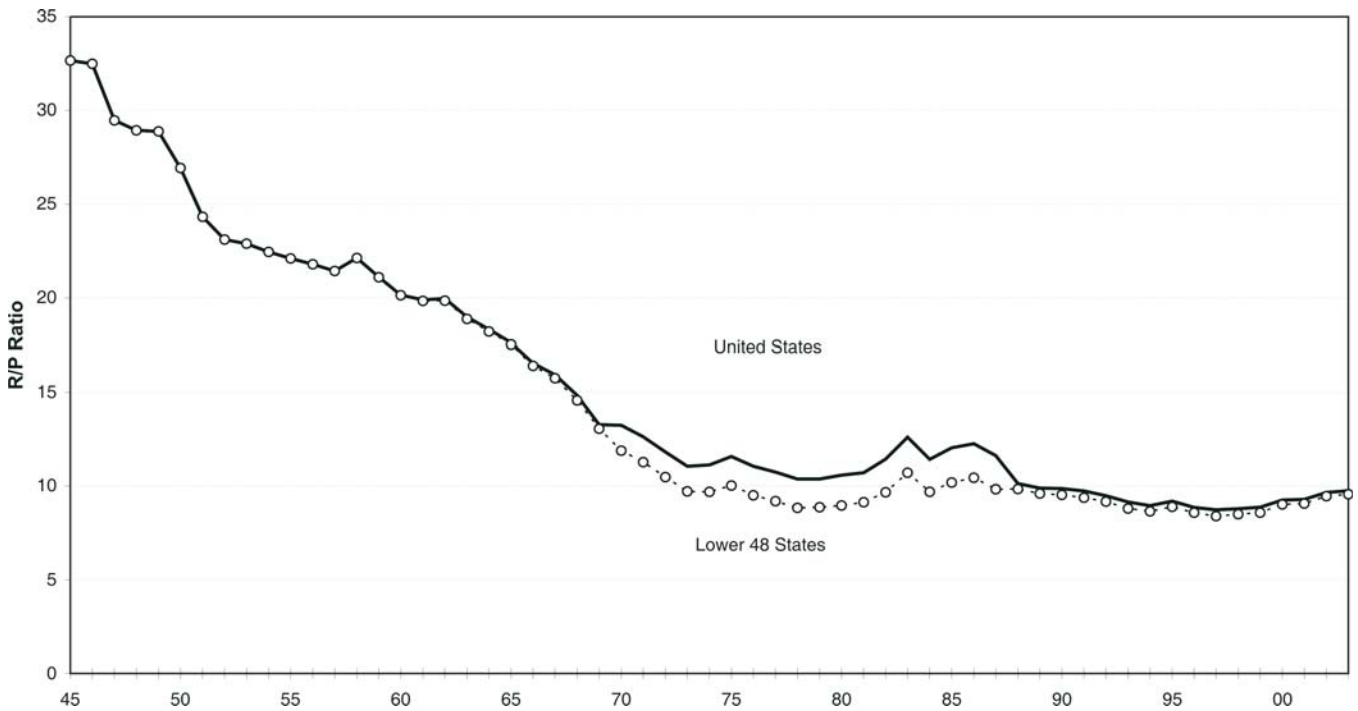


Figure 12. Reserves-to-Production Ratios for Wet Natural Gas, 1945-2003



Sources: Annual reserves and production - American Petroleum Institute and American Gas Association (1945–1976) {32} and Energy Information Administration, Office of Oil and Gas (1977–2002){1-26}. Cumulative production: *U.S. Oil and Gas Reserves by Year of Field Discovery* (1977-1988).{33}

Figure 13. Components of Proved Ultimate Recovery for Crude Oil and Lease Condensate, 1977-2003

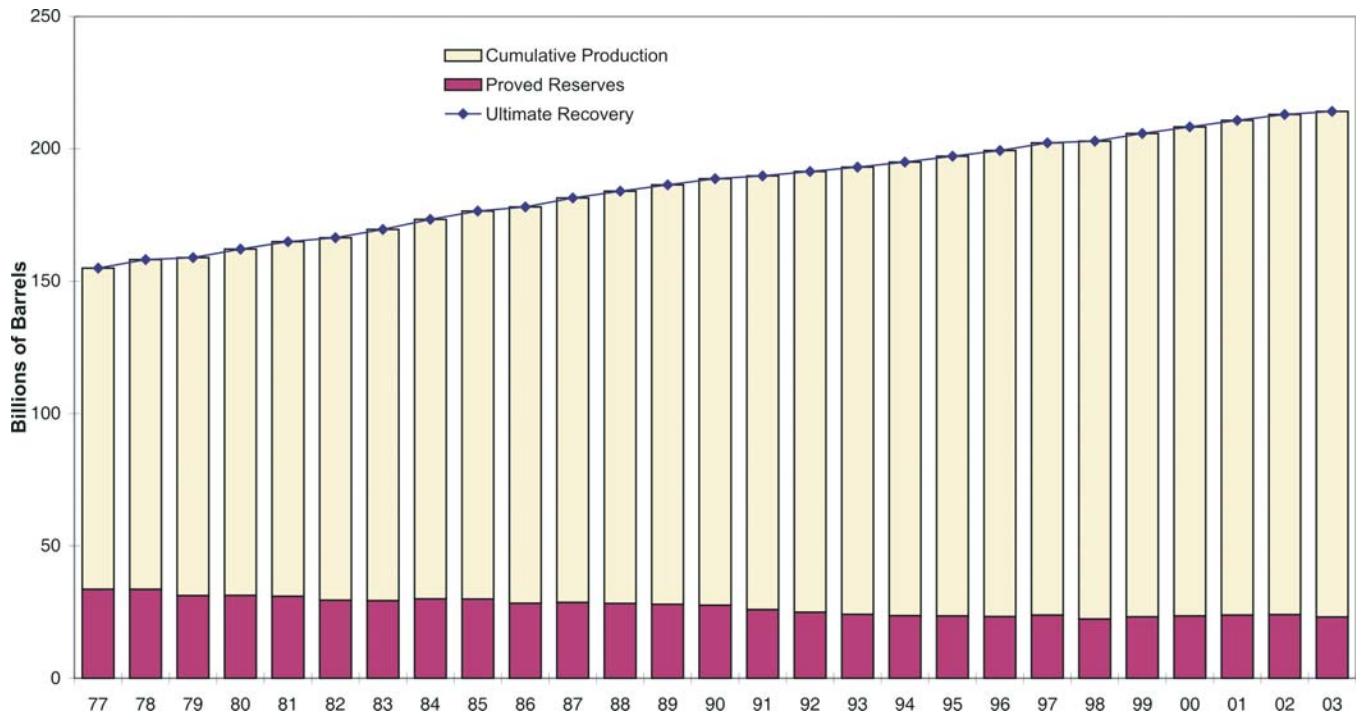
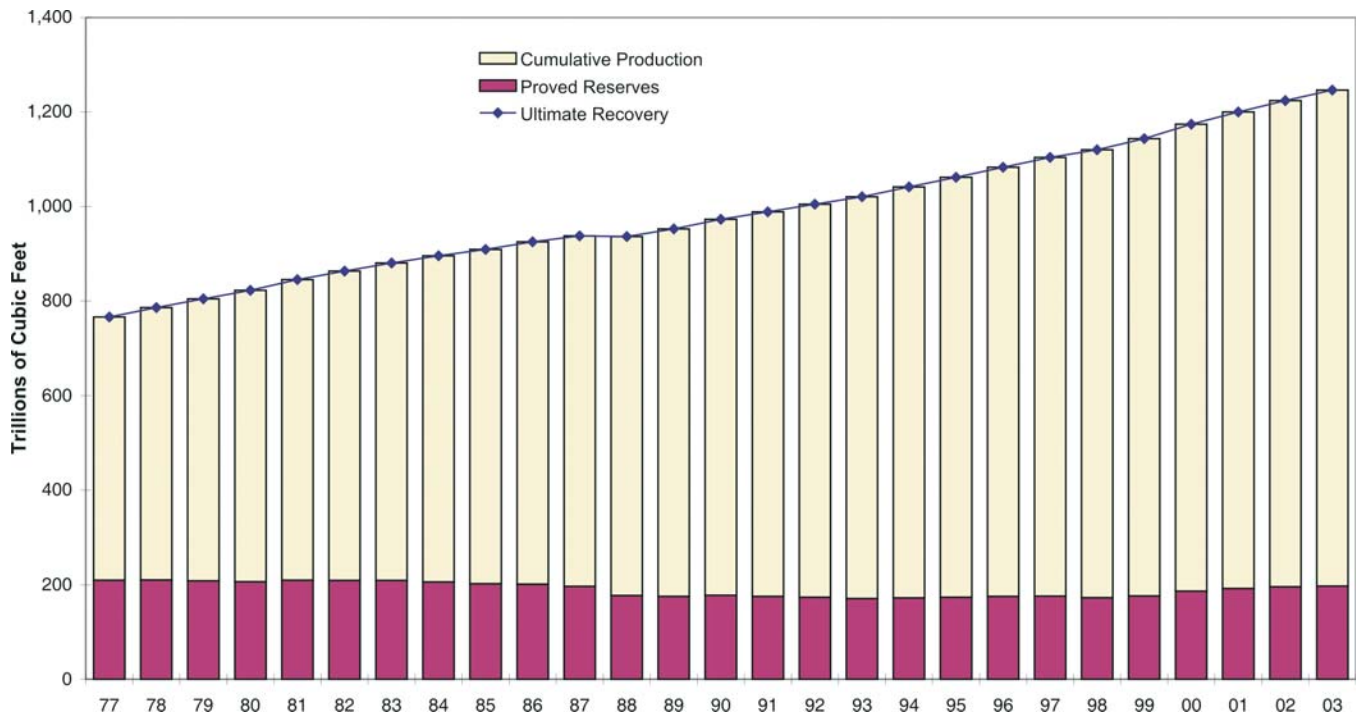


Figure 14. Components of Proved Ultimate Recovery for Wet Natural Gas, 1977-2003



Sources: Annual reserves and production - American Petroleum Institute and American Gas Association (1945–1976) {32} and Energy Information Administration, Office of Oil and Gas (1977–2002){1-26}. Cumulative production: *U.S. Oil and Gas Reserves by Year of Field Discovery* (1977-1988).{33}

Table 5. International Oil and Natural Gas Reserves as of December 31, 2003

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	Saudia Arabia ^c	^d 261,900	^d 259,400	1	Russia	1,680,000	2,340,500
2	Iran ^c	125,800	105,000	2	Iran ^c	940,000	955,000
3	Iraq ^c	115,000	115,000	3	Qatar ^c	910,000	915,992
4	Kuwait ^c	^d 99,000	^d 99,375	4	Saudia Arabia ^c	^d 231,000	^d 238,500
5	Canada ^e	178,893	4,957	5	United Arab Emirates ^c	212,100	204,050
6	United Arab Emirates ^c	97,800	66,230	6	United States	186,946	186,946
7	Venezuela ^c	77,800	52,450	7	Nigeria ^c	159,000	178,500
8	Russia	60,000	65,393	8	Algeria ^c	160,000	171,500
9	Libya ^c	36,000	30,500	9	Venezuela ^c	148,000	149,210
10	Nigeria ^c	25,000	33,000	10	Iraq ^c	110,000	112,600
Top 10 Total		1,077,193	831,305	Top 10 Total		4,737,046	5,452,348
11	United States	22,677	22,677	11	Australia	90,000	142,900
12	Qatar ^c	15,207	27,352	12	Indonesia ^c	90,300	67,650
13	China	18,250	15,509	13	Norway	74,800	74,733
14	Mexico	15,674	14,597	14	Turkmenistan	71,000	-
15	Algeria ^c	11,314	14,000	15	Malaysia	75,000	57,608
16	Norway	10,447	9,395	16	Uzbekistan	66,200	-
17	Brazil	8,500	10,602	17	Kazakhstan	65,000	-
18	Kazakhstan	9,000	-	18	Egypt	58,500	71,250
19	Angola	5,412	8,800	19	Canada	59,069	59,069
20	Azerbaijan	7,000	-	20	Netherlands	62,000	55,100
21	Oman	5,506	5,700	21	Kuwait ^c	^d 55,500	^d 56,600
22	Indonesia ^c	4,700	5,500	22	China	53,325	47,911
23	Ecuador	4,630	4,950	23	Libya ^c	46,400	46,000
24	India	5,371	4,002	24	Ukraine	39,600	-
25	United Kingdom	4,665	4,300	25	Oman	29,280	31,000
Top 25 Total		1,225,546	978,689	Top 25 Total		5,673,020	6,162,169
OPEC Total		869,521	807,807	OPEC Total		3,062,400	3,095,602
World Total		1,265,812	1,051,477	World Total		6,076,494	6,803,282

^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.

^e*Oil and Gas Journal* Canadian oil reserves include heavy (low gravity) oil.

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 22, 2003, pp. 46-47. Gulf Publishing Company, *World Oil*, September, 2004, p 63.

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 both *crude oil plus lease condensate* and *wet natural gas*, over the period 1977 through 2003. They illustrate the continued appreciation (growth) of proved ultimate recovery over time.

In 1977, U.S. *crude oil plus lease condensate* proved reserves were 33,615 million barrels. Cumulative production of *crude oil plus lease condensate* for 1977 through 2003 was 69,732 million barrels. This substantially exceeds the 1977 proved reserves, but at the end of 2003 there were still 23,106 million barrels of *crude oil plus 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 12 percent of proved reserves additions of crude oil were booked as *new field discoveries* from 1976 through 2003. The rest came from the proved reserves categories related to the proved ultimate recovery appreciation process.

Similarly, the 1977 *wet natural gas* proved reserves were 209,490 billion cubic feet, but more than twice this amount of gas was produced from 1977 through 2003 and there were still 197,145 billion cubic feet of *wet natural gas* proved reserves in 2003. Only 11 percent of proved reserve additions of natural gas were booked as *new field discoveries* from 1976 through 2003.

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 1.16 trillion barrels of oil and 6.5 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 2003. A comparison of EIA's U.S. proved reserves estimates with worldwide estimates obtained from other sources shows that the United States had 2 percent of the world's total crude oil proved reserves and 3 percent of the world's total natural gas proved reserves at the end of 2003. There are sometimes substantial differences between the estimates from these sources. The *Oil & Gas Journal* reported oil reserves for Canada at about 179 billion barrels. This is much higher than the *World Oil* estimate of 5 billion. The *Oil and Gas Journal* estimate includes heavy oil from Canadian tar sands, the *World Oil* estimate does not. Another reason (among many) for these differences is that condensate is often included in foreign oil reserve estimates.

The *Oil & Gas Journal* {34} estimate for world oil reserves increased 4 percent in 2003 owing to its addition of former Soviet Union states. This addition was not shared by *World Oil* {35} where the estimate increased only 2 percent. For world gas reserves, the *Oil & Gas Journal* reported a 10 percent increase, while *World Oil* reported a 11 percent increase. *World Oil* estimated a 38 percent increase in Russian gas reserves in 2003, while *Oil and Gas Journal* attributed the reserves increases to Turkmenistan, Uzbekistan, and Kazakhstan.

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 and Canada have triple. (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*.{36} In 2003:

- The U.S. consumed 98,160,000,000,000 Btu of energy (98.2 quadrillion Btu). This was an increase of 0.13 quadrillion Btu from the 2002 level of consumption.
- 64 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 (25 percent).

- U.S. petroleum consumption was about 20 million barrels of oil and natural gas liquids and 60 billion cubic feet of dry gas per day.

Dependence on Imports

The United States remains dependent on imported oil and gas. In 2003, crude oil imports made up 63 percent of the U.S. crude oil supply.

Net gas imports decreased slightly from the revised 2002 total of 4.02 trillion cubic feet to 3.93 trillion cubic feet in 2003. The last decline in imports was in 1986. Imports satisfied approximately 17 percent of consumption. Almost all of this gas was pipelined from Canada. Some came from Mexico, though Mexico remains a net importer of natural gas from the U.S., and liquefied natural gas was imported from Trinidad and Tobago, Nigeria, and Algeria.

Saudi Arabia, Mexico, Canada, and Venezuela were the primary foreign suppliers of petroleum to the United States.^{37}

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. Two new tables have been added to this appendix for 2003, ranking the top 100 oil and natural gas fields by their 2003 production rather than their proved reserves. Table B5 in Appendix B lists the top U.S. operators by reported 2003 production.

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 1993-2003, due to expressed interest from the industry regarding this area. Table D9 contains the production and proved reserves for 1993-2003 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.