

2. Overview

National Summary

The United States had the following proved reserves as of December 31, 2001:

- **Crude Oil** — 22,446 million barrels
- **Dry Natural Gas** — 183,460 billion cubic feet
- **Natural Gas Liquids** — 7,993 million barrels.

This Overview summarizes the 2001 proved reserves balances of crude oil, dry natural gas, and natural gas liquids on a National level and provides historical comparisons between 2001 and prior years. **Table 1** lists the estimated annual reserve balances since 1991 for crude oil, dry natural gas, and natural gas liquids.

Crude Oil

Proved reserves of crude oil increased by 401 million barrels in 2001. **Figure 1** shows the crude oil proved reserves levels by major region and **Figure 2** shows the components of reserves changes from 1991 through 2001.

As indicated in **Figure 1**, U.S. crude oil proved reserves increased in 2001 due to reserves additions in the Lower 48 States offshore.

The components of reserves changes for crude oil are shown in **Figure 2**. EIA tracks the 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 2,565 million barrels in 2001, over three times the prior 10-year average (813 million barrels) and almost twice those in 2000 (1,291 million barrels).

Most crude oil *total discoveries* in 2001 were from *new field discoveries*, rather than *extensions* to existing fields. New fields accounted for 1,407 million barrels of crude oil reserves additions. This was over five times the volume of 2000 *new field discoveries* (276 million barrels).

Extensions of 866 million barrels were 13 percent higher than those of 2000 (766 million barrels) and almost twice the prior 10-year average (438 million barrels).

New reservoir discoveries in old fields were 292 million barrels, 17 percent more than in 2000 (249 million barrels) and 93 percent more than the prior 10-year average (152 million barrels).

Reserves additions are the sum of total discoveries, revisions and adjustments, and sales and acquisitions. In 2001, there were -4 million barrels of *adjustments*, 1,601 million barrels of *revision increases* and 1,759 million barrels of *revision decreases*. The 2001 net of *revisions* and *adjustments* was -162 million barrels.

The *sales* component of the crude oil reserves changes (529 million barrels) was smaller than the *revision decreases* component in 2001, and *acquisitions* (442 million barrels) were smaller than *revision increases*. The net of sales and acquisitions of crude oil proved reserves was -87 million barrels.

Production of crude oil was an estimated 1,915 million barrels in 2001 (lease condensate not included, see Natural Gas Liquids section below for condensate volumes). This was up 2 percent from 2000's level (1,880 million barrels) and down 13 percent from the prior 10-year average (2,191 million barrels). Operators replaced 121% of crude oil production with reserves additions in 2001.

Natural Gas

Dry natural gas proved reserves increased by 6,033 billion cubic feet in 2001. **Figure 3** shows the dry natural gas proved reserves levels by major region. **Figure 4** shows the components of reserves changes from 1991 through 2001.

U.S. *total discoveries* of dry gas reserves were 22,758 billion cubic feet in 2001. This was almost twice the prior 10-year average (11,608 billion cubic feet) and 19 percent more than in 2000 (19,138 billion cubic feet).

Field extensions were 16,380 billion cubic feet, 11 percent more than the extensions in 2000 and also more than twice the prior 10-year average of 7,802 billion cubic feet.

Table 1. Total U.S. Proved Reserves of Crude Oil, Dry Natural Gas, and Natural Gas Liquids, 1990-2000

Year	Adjustments (1)	Net Revisions (2)	Revisions ^a and Adjustments (3)	Net of Sales and Acquisitions (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total ^b Discoveries (8)	Estimated Production (9)	Proved ^c Reserves 12/31 (10)	Change from Prior Year (11)
Crude Oil (million barrels of 42 U.S. gallons)											
1991	163	223	386	NA	365	97	92	554	2,512	24,682	-1,572
1992	290	735	1,025	NA	391	8	85	484	2,446	23,745	-937
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
Dry Natural Gas (billion cubic feet, 14.73 psia, 60° Fahrenheit)											
1991	2,960	4,416	7,376	NA	5,090	848	1,604	7,542	17,202	167,062	-2,284
1992	2,235	6,093	8,328	NA	4,675	649	1,724	7,048	17,423	165,015	-2,047
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
Natural Gas Liquids (million barrels of 42 U.S. gallons)											
1991	233	130	363	NA	189	25	55	269	754	7,464	-122
1992	225	261	486	NA	190	20	64	274	773	7,451	-13
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

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

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

^cProved 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 2001 contained in the *Petroleum Supply Annual 2001*, DOE/EIA-0340(01) and the *Natural Gas Annual 2001*, DOE/EIA-0131(01).

Figure 1. U.S. Crude Oil Proved Reserves, 1991-2001

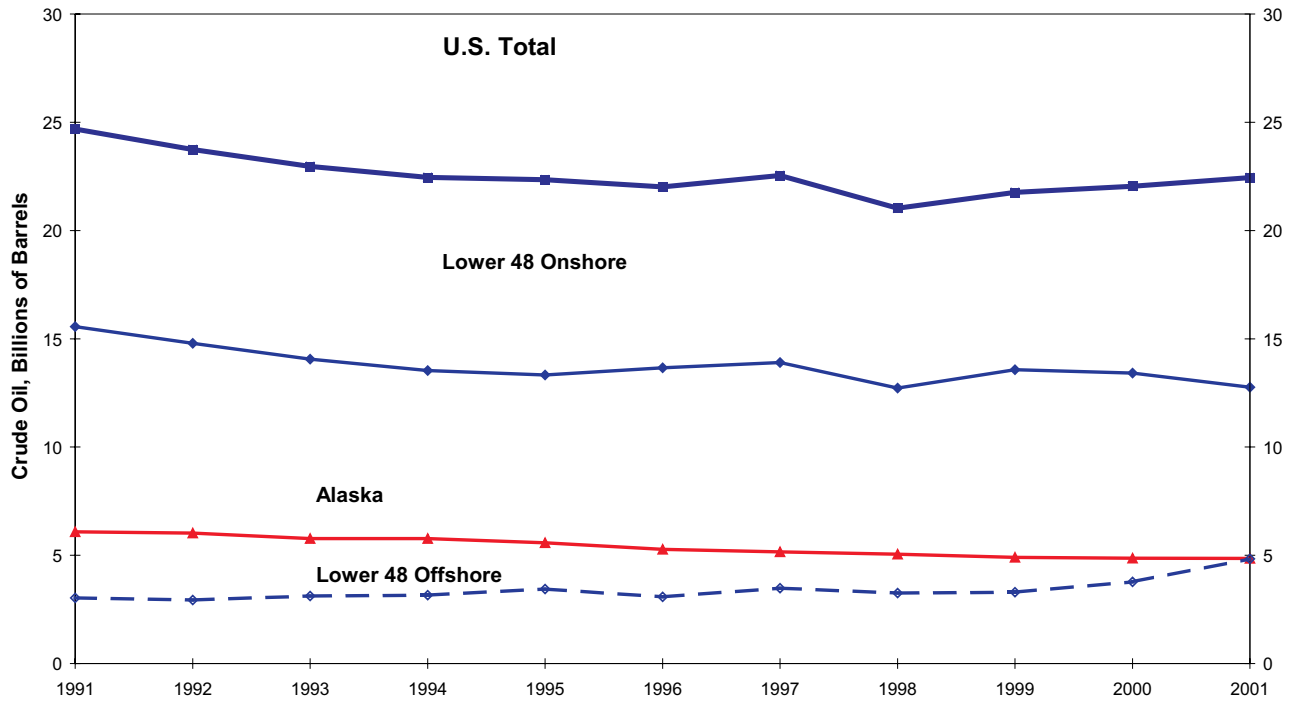
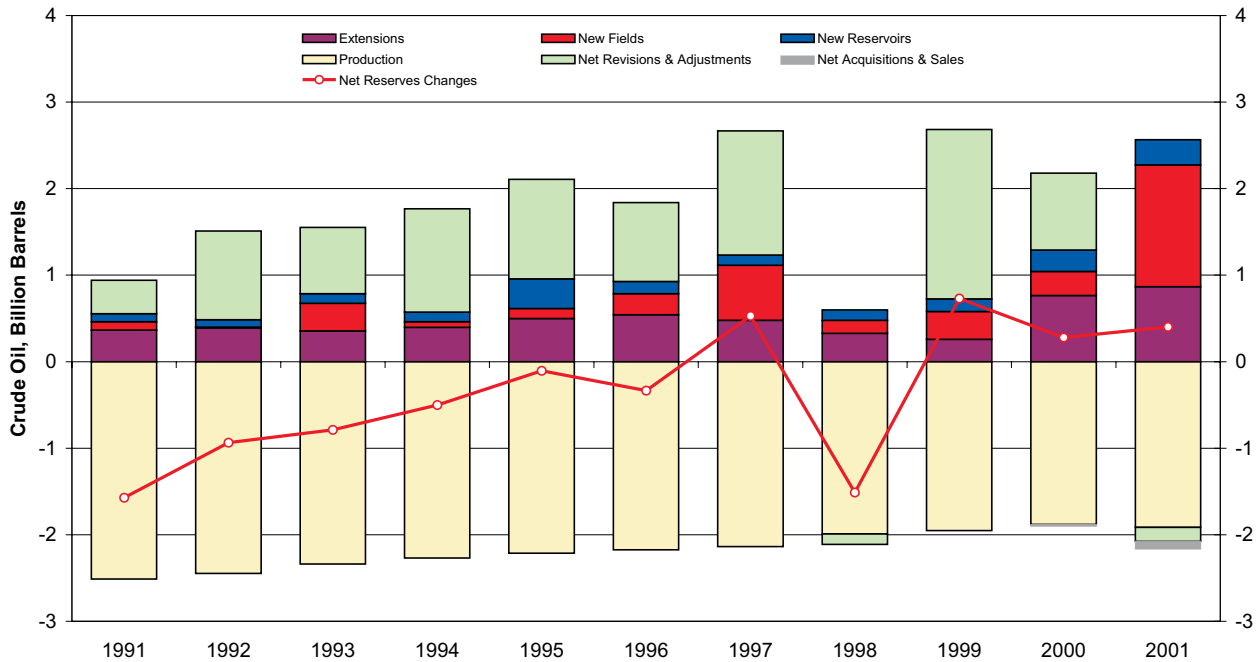


Figure 2. Components of Reserves Changes for Crude Oil, 1991-2001



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1991-2001 annual reports, DOE/EIA-0216.{14-24}

Figure 3. U.S. Dry Natural Gas Proved Reserves, 1991-2001

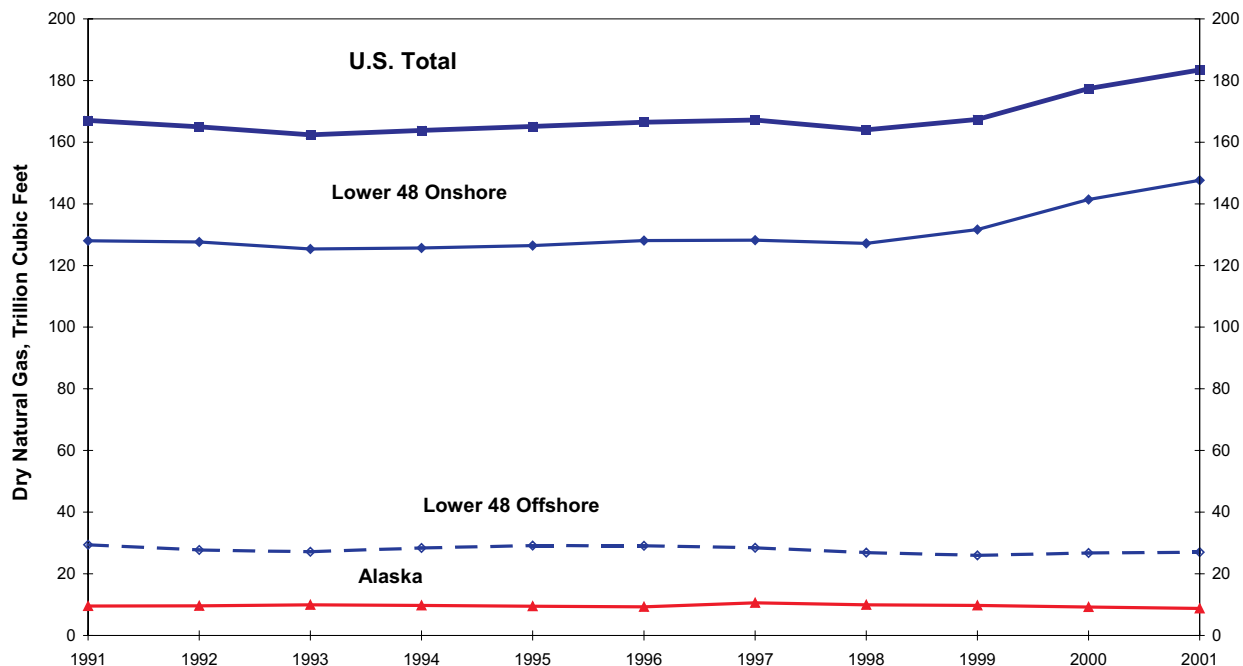
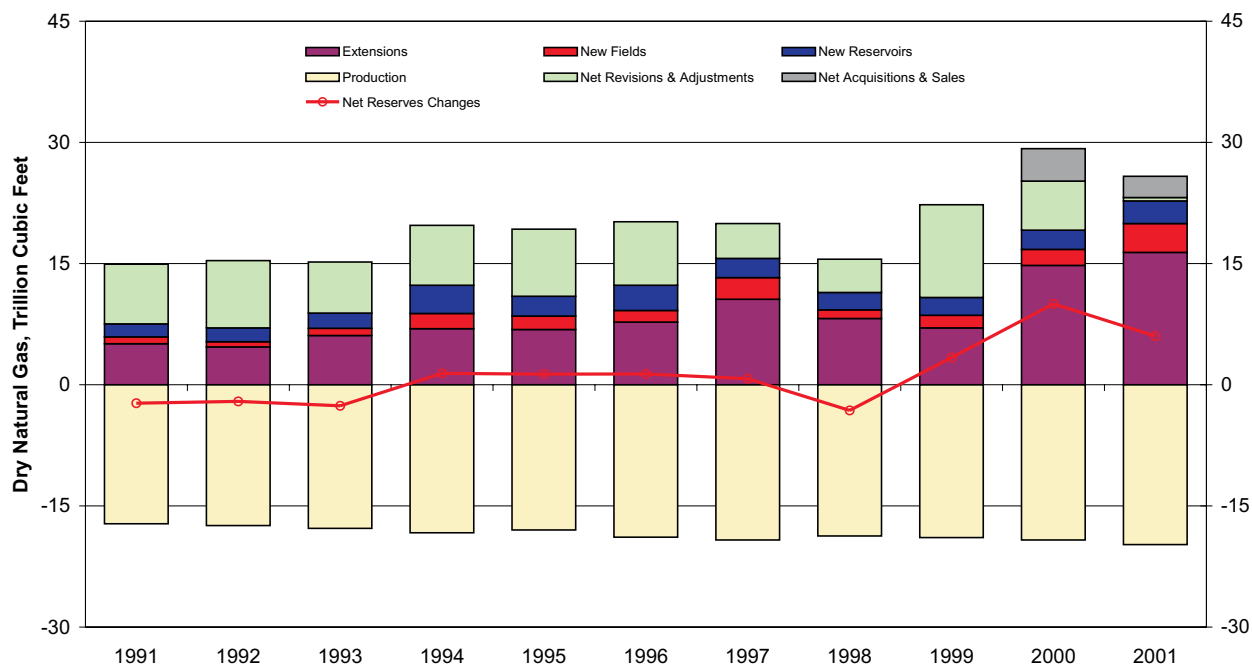


Figure 4. Components of Reserves Changes for Dry Natural Gas, 1991-2001



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1990-2000 annual reports, DOE/EIA-0216.{14-24}

New field discoveries were 3,578 billion cubic feet, 80 percent more than the volume discovered in 2000 (1,983 billion cubic feet) and more than twice the prior 10-year average (1,471 billion cubic feet).

New reservoir discoveries in old fields were 2,800 billion cubic feet, up 18 percent from 2000 (2,368 billion cubic feet) and 20 percent more than the prior 10-year average (2,334 billion cubic feet).

Natural gas net *revisions* and *adjustments* were 424 billion cubic feet. The net of *sales* and *acquisitions* of dry natural gas proved reserves was 2,630 billion cubic feet.

Production removed an estimated 19,779 billion cubic feet of proved reserves from the National total. Dry gas production increased by 3 percent compared to 2000. Operators replaced 131 percent of dry natural gas production with reserves additions.

Coalbed methane production and reserves are included in the 2001 totals. However, EIA tracks these reserves in order to record the development and performance of this gas source. Coalbed methane proved reserves increased in 2001 to a volume of 17,531 billion cubic feet. Coalbed methane accounted for 9.5 percent of 2001 U.S. dry natural gas reserves and 8 percent of 2001 U.S. dry gas production.

Natural Gas Liquids

Proved reserves of natural gas liquids decreased 352 million barrels to 7,993 million barrels during 2001—a 4 percent decrease from 2000 levels. **Figure 5** shows the natural gas liquids proved reserves levels by major region and **Figure 6** shows the components of reserves changes from 1991 through 2001.

Operators replaced 60 percent of their 2001 natural gas liquids production with reserve additions. *Total discoveries* added 997 million barrels (primarily from *extensions*), *net revisions and adjustments* subtracted 561 million barrels, and *net sales and acquisitions* added 102 million barrels.

Total proved reserves of liquid hydrocarbons (crude oil plus natural gas liquids) were 30,439 million barrels in 2001—a slight increase from the 2000 level. Natural gas liquids represented 26 percent of total liquid hydrocarbon proved reserves in 2001.

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 2001. **Table 2** 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 2001 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 890 million barrels per year of new reserves
- had proved reserves additions of an average 2,133 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 442 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 11 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 22,249 million barrels of *total discoveries* accounted for 42 percent of reserves additions.

Compared to the averages of reserves changes since 1977, 2001 was a major up year for crude oil discoveries. *Total discoveries* of crude oil (2,565 million barrels) in 2001 were almost three times greater than the post-1976 U.S. average (890 million barrels per year).

Looking at the components of *total discoveries* in 2001:

- 2001's *new field discoveries* greatly exceeded the post-1976 average. *New field discoveries* in 2001 accounted for 55 percent of reserves additions, and were 6 times larger than the historical average, and

Figure 5. U.S. Natural Gas Liquids Proved Reserves, 1991-2001

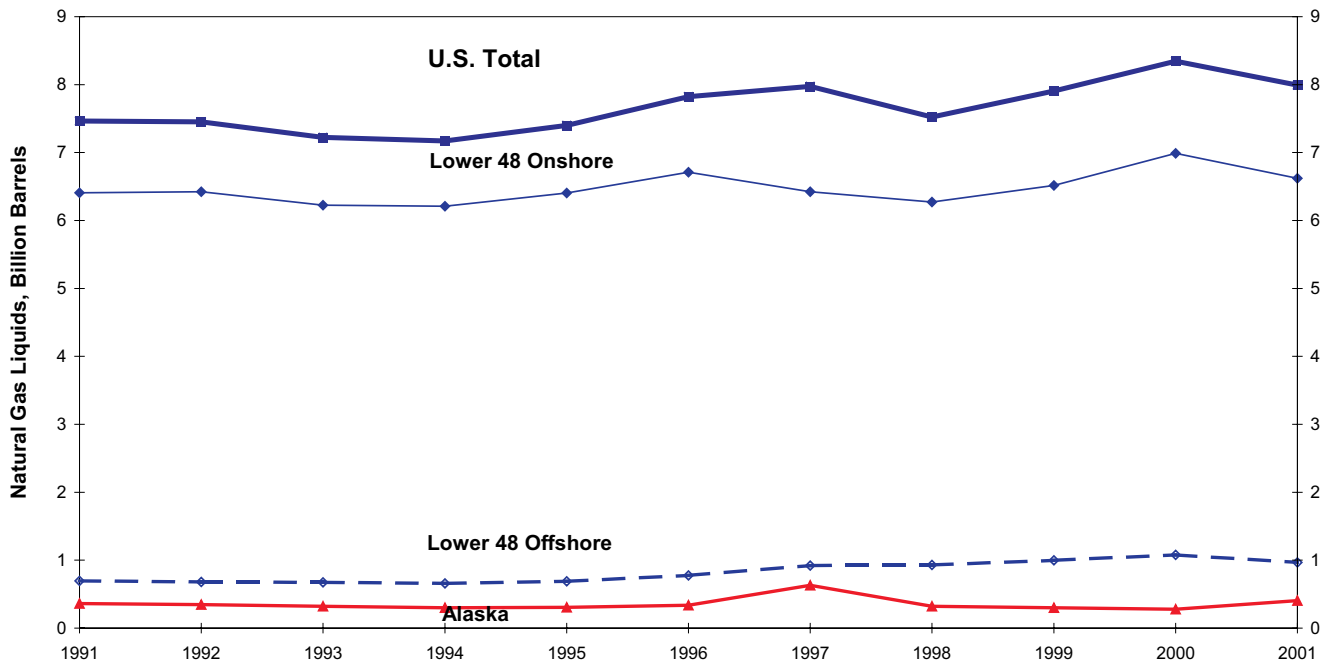
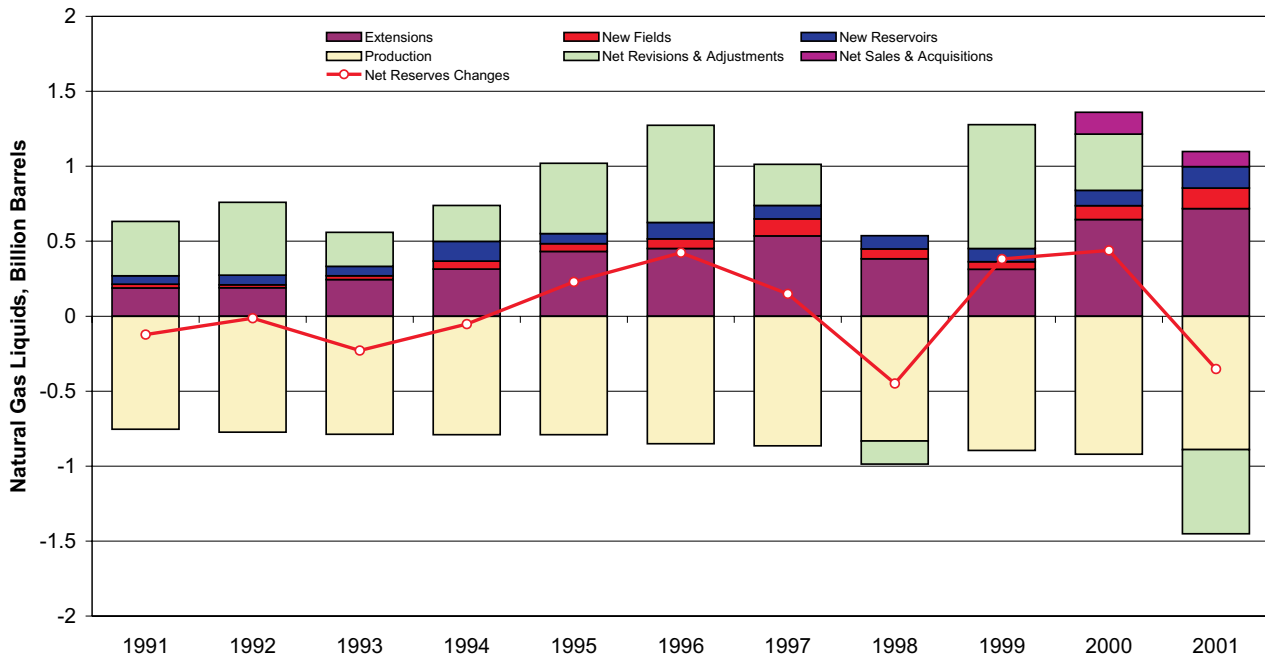


Figure 6. Components of Reserves Changes for Natural Gas Liquids, 1991-2001



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1990-2000 annual reports, DOE/EIA-0216.{14-24}

Table 2. Reserves Changes, 1977-2001

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	4,687	187	10.8	5,638	226	10.6
New Reservoir Discoveries in Old Fields	3,593	144	8.3	3,715	149	7.0
Extensions	11,365	455	26.3	12,896	516	24.2
Total Discoveries	19,645	786	45.4	22,249	890	41.7
Revisions, Adjustments, Sales & Acquisitions	23,642	946	54.6	31,078	1,243	58.3
Total Reserves Additions	43,287	1,731	100.0	53,327	2,133	100.0
Production	50,556	2,022	116.8	64,383	2,575	120.7
Net Reserves Change	-7,269	-291	-16.8	-11,056	-442	-20.7
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	49,636	1,985	11.5	49,858	1,994	12.0
New Reservoir Discoveries in Old Fields	63,624	2,545	14.7	64,029	2,561	15.4
Extensions	200,455	8,018	46.4	203,382	8,135	48.8
Total Discoveries	313,715	12,549	72.7	317,269	12,691	76.1
Revisions, Adjustments, Sales & Acquisitions	118,030	4,721	27.3	99,756	3,990	23.9
Total Reserves Additions	431,745	17,270	100.0	417,025	16,681	100.0
Production	437,923	17,517	101.4	446,843	17,874	107.2
Net Reserves Change	-6,178	-247	-1.4	-29,818	-1,193	-7.2

Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1977-2001 annual reports, DOE/EIA-0216.(1-24)

- *extensions* and *new reservoir discoveries in old fields* exceeded the post-1976 averages for crude oil.

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

- discovered an average of 12,691 billion cubic feet per year of new reserves,
- had proved reserves additions of an average 16,681 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 1,193 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* account for 49 percent while *net revisions and adjustments* account for only 24 percent of all reserves additions since 1977. In 2001, *net revisions, adjustments, sales, and acquisitions* were 12 percent of all reserves additions. In 2001, *extensions* were 63 percent of all reserves additions.

Compared to the averages of reserves changes since 1977, 2001 was an up year for natural gas reserves additions from *total discoveries*. Operators reported 22,758 billion cubic feet of *total discoveries* of dry natural gas proved reserves, 79 percent more than the post-1976 average (12,691 billion cubic feet). Also, the net of *revisions, adjustments, sales, and acquisitions* was 23 percent lower in 2001 (3,054 billion cubic feet) compared to the post-1976 U.S. average (3,990 billion cubic feet per year).

Economics and Drilling

Economics: This section describes the price behavior in 2001 and the following section addresses drilling.

Table 3 lists the average annual domestic wellhead prices of crude oil and natural gas, as well as the average number of active rotary drilling rigs, from 1977 to 2001.

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, 1977-2001

Year	Crude Oil		Natural Gas		Number of Rigs
	Current	2001 Constant	Current	2001 Constant	
	(dollars per barrel)		(dollars per thousand cubic feet)		
1977	8.57	20.83	0.79	1.92	2,001
1978	9.00	20.42	0.91	2.06	2,259
1979	12.64	26.48	1.18	2.47	2,177
1980	21.59	41.41	1.59	3.05	2,909
1981	31.77	55.74	1.98	3.47	3,970
1982	28.52	47.10	2.46	4.06	3,105
1983	26.19	41.61	2.59	4.11	2,232
1984	25.88	39.64	2.66	4.07	2,428
1985	24.09	35.77	2.51	3.73	1,980
1986	12.51	18.17	1.94	2.82	964
1987	15.40	21.72	1.67	2.36	936
1988	12.58	17.16	1.69	2.31	936
1989	15.86	20.84	1.69	2.22	869
1990	20.03	25.33	1.71	2.16	1,010
1991	16.54	20.18	1.64	2.00	860
1992	15.99	19.05	1.74	2.07	721
1993	14.25	16.58	2.04	2.37	754
1994	13.19	15.03	1.85	2.11	775
1995	14.62	16.31	1.55	1.73	723
1996	18.46	20.20	2.17	2.37	779
1997	17.23	18.49	2.32	2.49	943
1998	10.87	11.52	1.96	2.08	827
1999	15.56	16.26	2.19	2.29	625
2000					
January	23.53	24.33	2.60	2.69	775
February	25.48	26.28	2.73	2.82	763
March	26.19	26.96	2.66	2.74	773
April	23.20	23.83	2.86	2.94	805
May	25.58	26.23	3.04	3.12	844
June	27.62	28.28	3.77	3.86	878
July	26.81	27.43	3.84	3.93	942
August	27.91	28.51	3.73	3.81	987
September	29.72	30.31	4.26	4.34	1,011
October	29.65	30.20	4.58	4.66	1,055
November	30.36	30.86	4.40	4.47	1,067
December	24.46	24.80	5.77	5.85	1,097
2000	26.72	27.35	3.69	3.78	918
2001					
January	24.58	24.82	8.06	8.14	1,118
February	25.27	25.44	5.84	5.88	1,136
March	23.02	23.12	5.15	5.17	1,166
April	23.41	23.48	5.21	5.22	1,206
May	24.06	24.08	4.56	4.56	1,234
June	23.43	23.41	3.88	3.88	1,270
July	22.94	22.85	3.39	3.38	1,278
August	23.08	22.97	3.23	3.21	1,252
September	22.37	22.26	2.55	2.54	1,193
October	18.73	18.67	2.40	2.39	1,111
November	16.49	16.44	2.74	2.73	1,000
December	15.54	15.48	3.93	3.92	901
2001	21.84	21.84	4.12	4.12	1,155

=Revised data.

Sources: Current dollars and number of rigs: *Monthly Energy Review October 2002*, DOE/EIA-0035(2001/10). 2001 constant dollars: U.S. Department of Commerce, Bureau of Economic Analysis, Gross Domestic Product Implicit Price Deflators, October 2002.

The U.S. crude oil first purchase price started at an average of \$24.46 per barrel in December 2000, rose to \$25.27 in February 2001, then declined to \$15.54 per barrel in December 2001. The average U.S. crude oil first purchase price decreased from \$26.72 in 2000 to \$21.84 per barrel in 2001.

Oil prices vary by region. In Texas the average 2001 crude oil first purchase price was \$23.41 per barrel, \$20.11 per barrel in California, \$24.82 per barrel in Colorado, \$22.55 per barrel in Ohio, and \$18.38 per barrel in the California Federal Offshore. The lowest average crude oil first purchase price in 2001 was \$18.18 per barrel for the Alaska North Slope oil. {25}

The average annual wellhead natural gas price increased from \$3.69 in 2000 to \$4.12 per thousand cubic feet in 2001. Natural gas prices started at \$8.06 per thousand cubic feet in January 2001 and declined to \$3.93 per thousand cubic feet by December 2001. The lowest average price of the year was \$2.40 per thousand cubic feet in October 2001. {26}

Drilling: From 2000 to 2001, the annual average active rig count increased from 918 to 1,155 (**Table 3**), a 26 percent increase in active rigs.

Looking first at exploratory wells, there were 2,715 exploratory wells drilled in 2001 (**Table 4**). Of these, 11 percent were completed as oil wells, 35 percent were completed as gas wells, and 54 percent were dry holes. The total (which includes dry holes) was 26 percent more than the revised 2000 total. Exploratory oil and gas completions in 2001 were 36 percent higher (**Figures 7 and 8**) than in 2000.

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 oil discoveries per exploratory well increased significantly in 2001. The 2001 average volume of gas discoveries per exploratory well decreased, as would be expected given the large increase in the number of wells drilled in search of gas.

The numbers of successful development wells increased 10 percent for oil and 34 percent for gas from their 2000 levels. Altogether there were an estimated 34,139 exploratory and development wells drilled in 2001. This is 23 percent more than in 2000 and 43 percent more than the average number of wells drilled annually in the prior 10 years (23,914).

For the ninth 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 were announced in 2001, and are expected to have a major impact on the energy industry in the future:

On August 1, 2001, Kerr-McGee Corporation announced completion of its acquisition of HS Resources, Incorporated. Through this transaction Kerr-McGee will acquire proved reserves of 1.3 trillion cubic feet of natural gas equivalent, and gas gathering systems, undeveloped acreage and other assets valued at approximately \$300 million. The acquired reserves are predominately natural gas located in northeastern Colorado in the Denver-Julesburg Basin. {27}

On September 10, 2001, Dominion and Louis Dreyfus Natural Gas Corporation jointly announced that Dominion agreed to acquire Louis Dreyfus Natural Gas for \$2.3 billion in cash, stock and assumed debt. On November 1, 2001, the transaction was completed. {28}

On October 9, 2001, Chevron Corporation and Texaco Incorporated announced that their merger had been completed following stockholder approvals. The new company changed its name to ChevronTexaco Corporation. {29}

On November 18, 2001, Conoco Incorporated and Phillips Petroleum Company announced their intention to merge and filed a joint proxy statement/prospectus with the Securities and Exchange Commission. {30}

In December 2001, Unocal announced a 50-50 venture with Forest Oil Corporation for exploration and production operations in the Gulf of Mexico. {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

Table 4. U.S. Exploratory and Development Well Completions,^a 1970-2001

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	R 291	R 504	R 1,647	R 2,442	7,064	R 11,308	R 4,840	R 23,212
1999	R 154	R 530	R 1,195	R 1,879	4,136	R 10,877	R 3,364	R 18,377
2000	R 261	R 609	R 1,288	R 2,158	R 7,358	R 16,455	R 4,025	R 27,838
2001	310	961	1,444	2,715	8,060	22,083	3,996	34,139

^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 1973-2000: EIA *Monthly Energy Review* October 2002, DOE/EIA-0035(2002/10).

Figure 7. U.S. Exploratory Gas Well Completions, 1977-2001

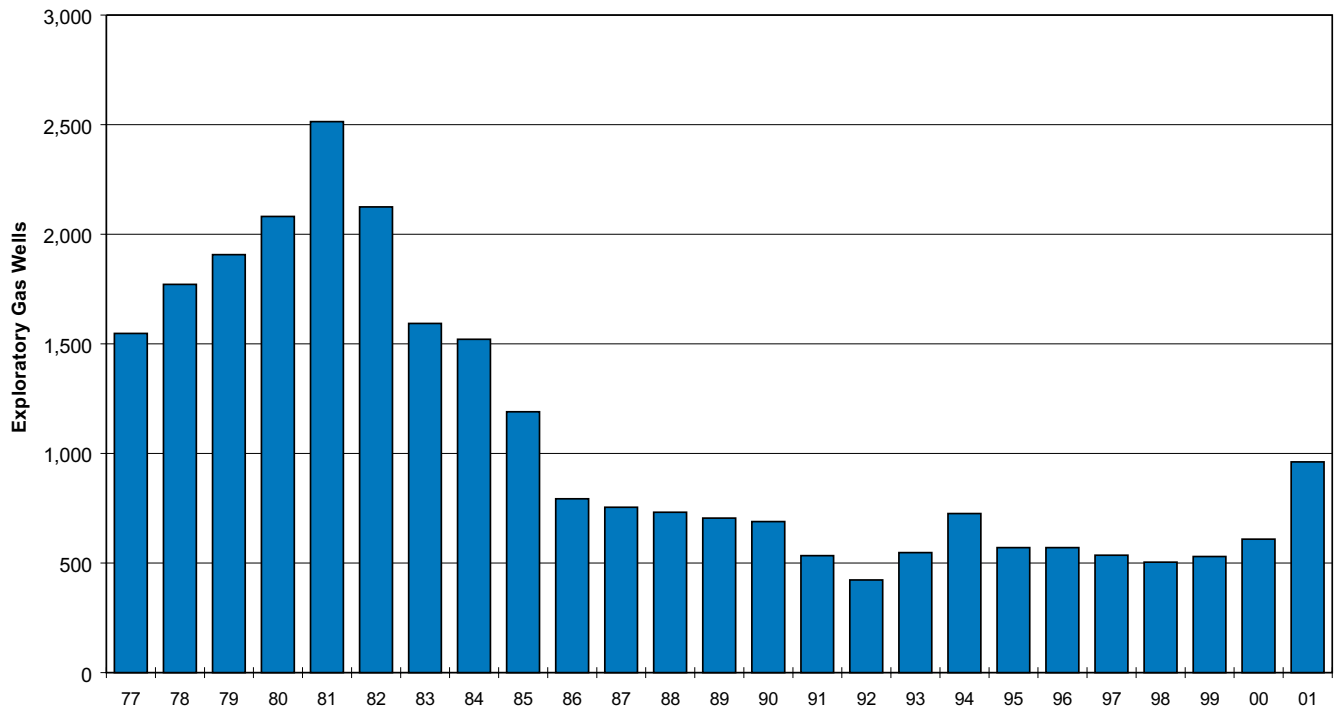
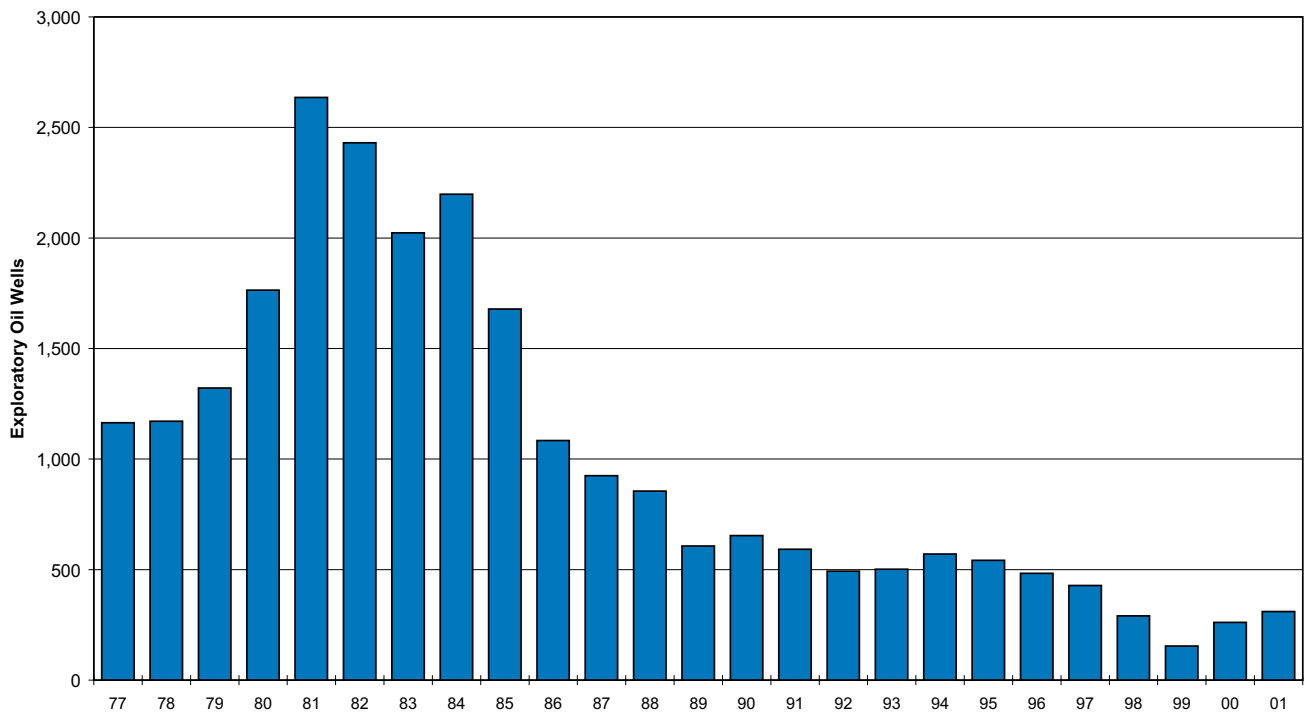


Figure 8. U.S. Exploratory Oil Well Completions, 1977-2001



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

Figure 9. U.S. Total Discoveries of Dry Natural Gas per Exploratory Gas Well Completion, 1977-2001

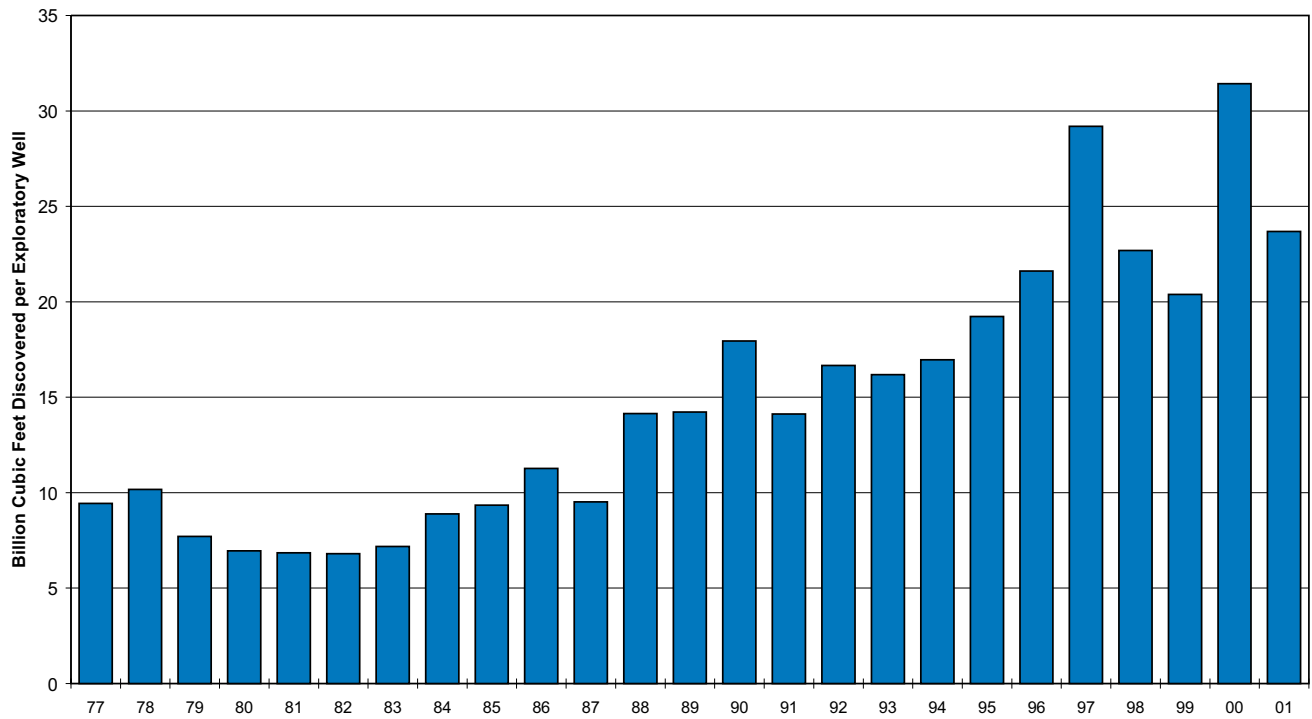
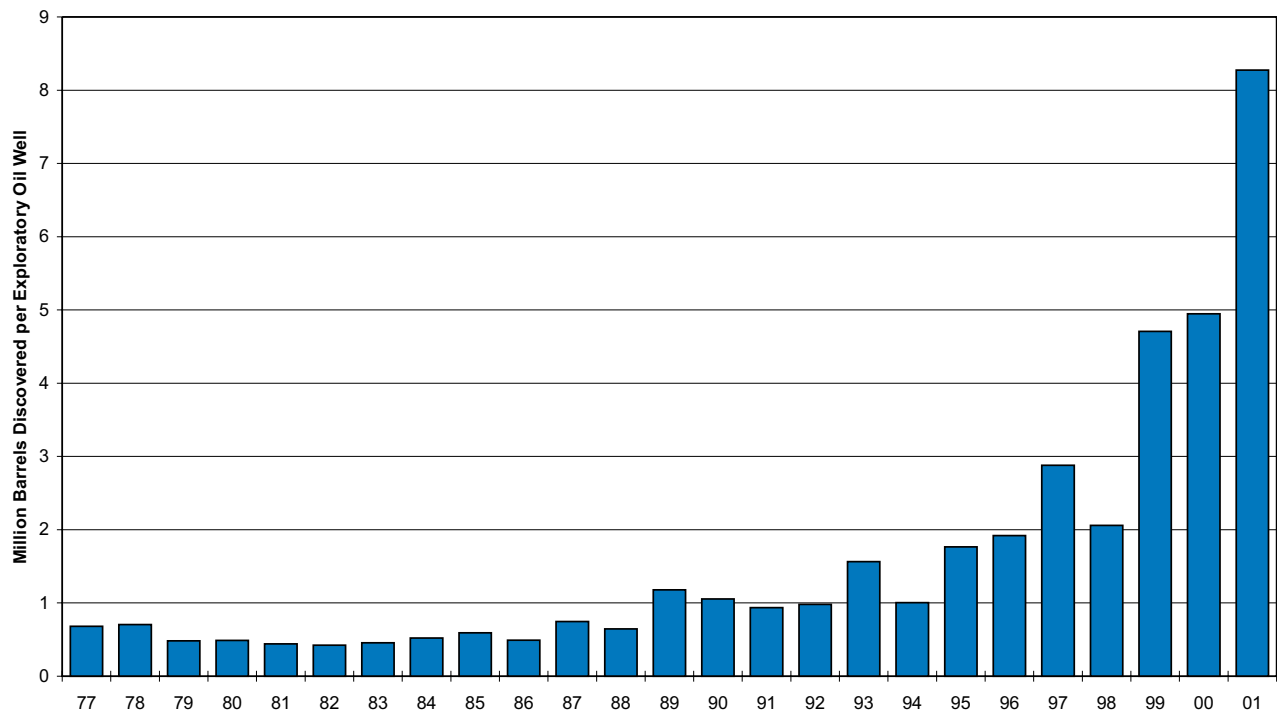


Figure 10. U.S. Total Discoveries of Crude Oil per Exploratory Oil Well Completion, 1977-2001



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

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 2001, U.S. crude oil proved reserves and oil production increased, resulting in no significant change to the National average R/P ratio of 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 2001 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 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 2000 to 2001 the U.S. average R/P ratio for natural gas remained unchanged from 9.2 since both proved reserves and production increased in 2001.

Different marketing, transportation, and production characteristics for gas are seen when looking at regional average R/P ratios, compared to the 2001 U.S. average R/P ratio of about 9.2-to-1. Areas with a higher range of R/P ratios than the National average were the Pacific offshore and the Rockies, and also include areas such as Alabama and Colorado where considerable booking of coalbed methane reserves has recently occurred. Several major gas producing areas have R/P ratios below the National average, particularly Texas, the Gulf of Mexico Federal Offshore, and Oklahoma.

Proved Ultimate Recovery

EIA has in past reports 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 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 2001. They illustrate the continued

Figure 11. Reserves-to-Production Ratios for Crude Oil, 1945-2001

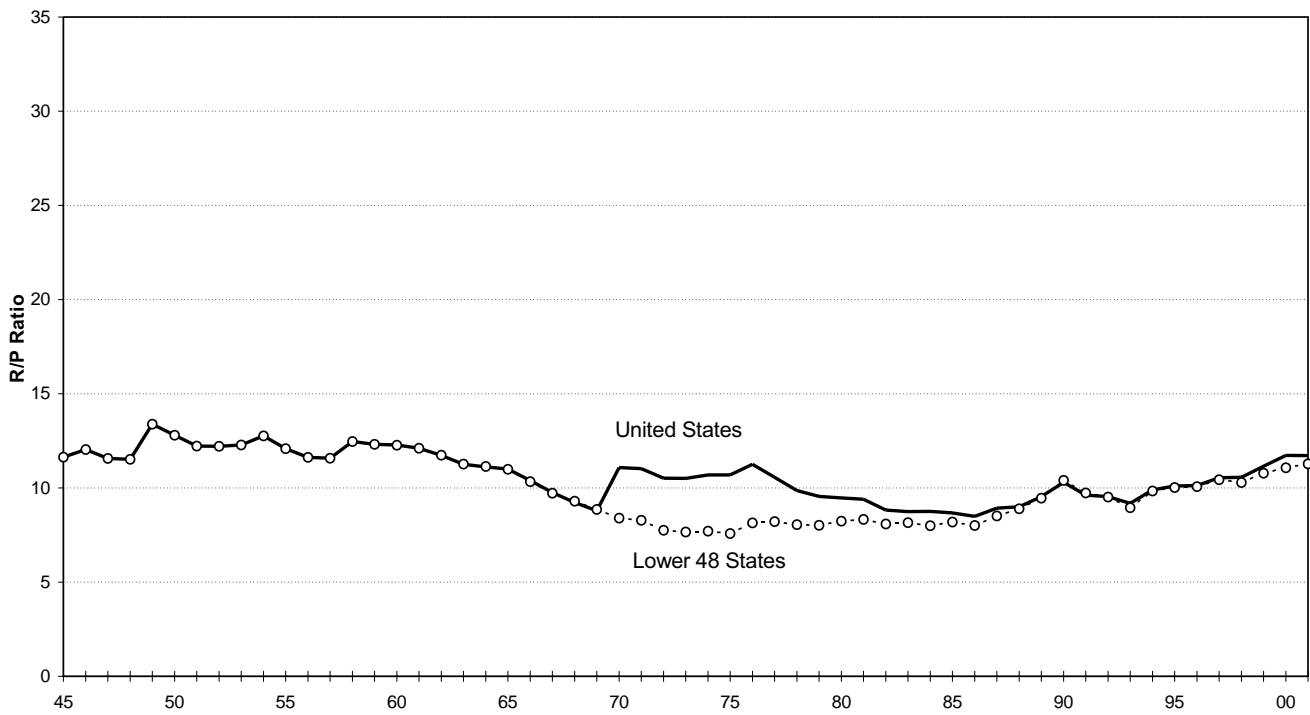
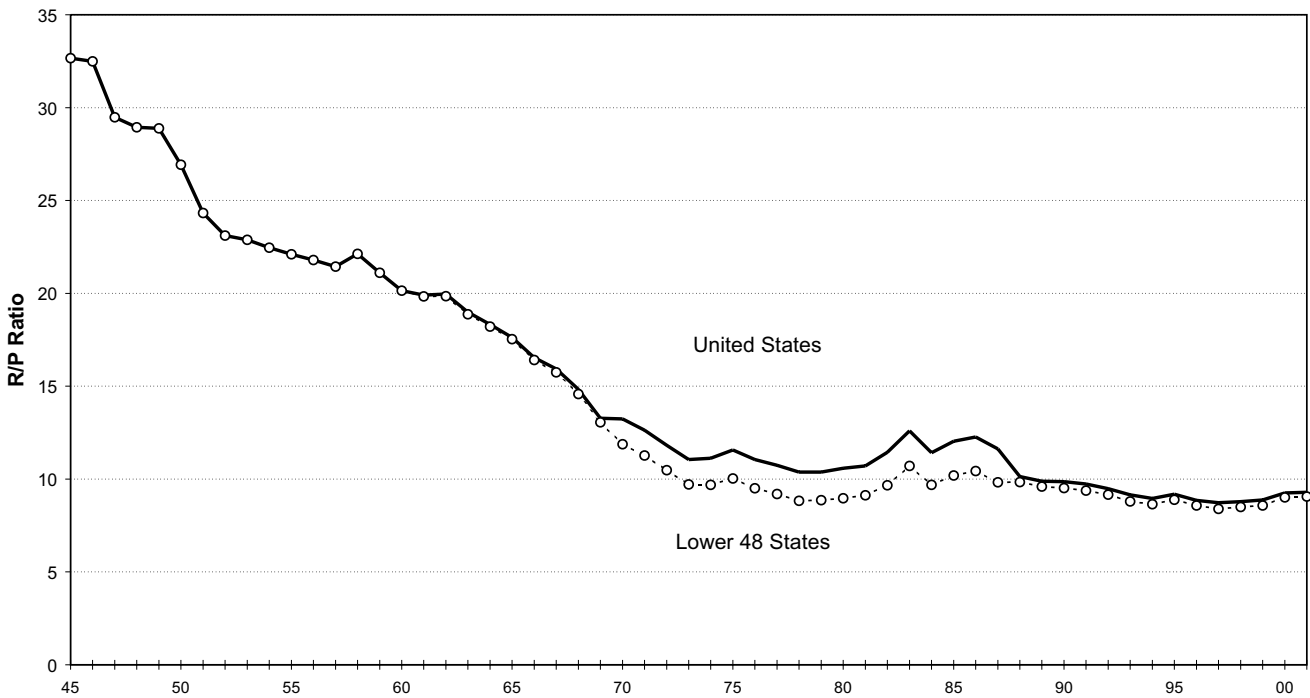


Figure 12. Reserves-to-Production Ratios for Wet Natural Gas, 1945-2001



Sources: Annual reserves and production - American Petroleum Institute and American Gas Association (1945–1976) {32} and Energy Information Administration, Office of Oil and Gas (1977–2000){1-24}. 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, 1977-2001

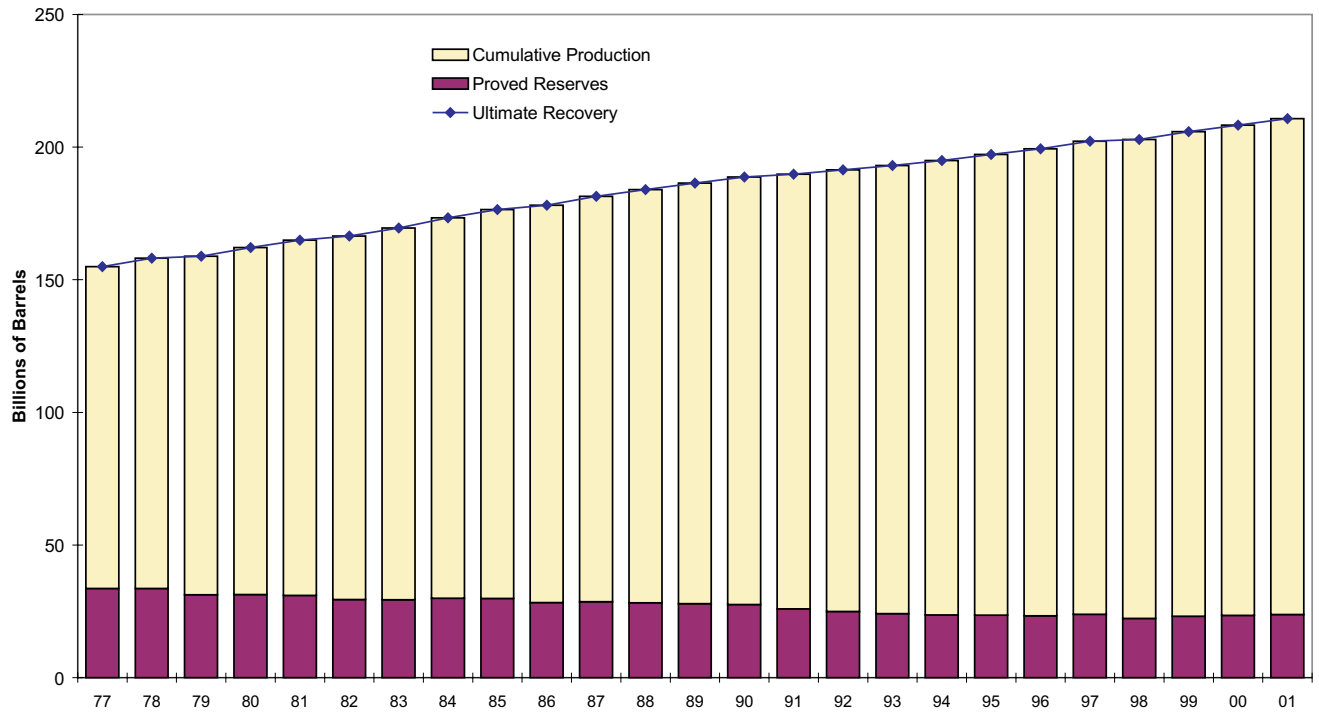
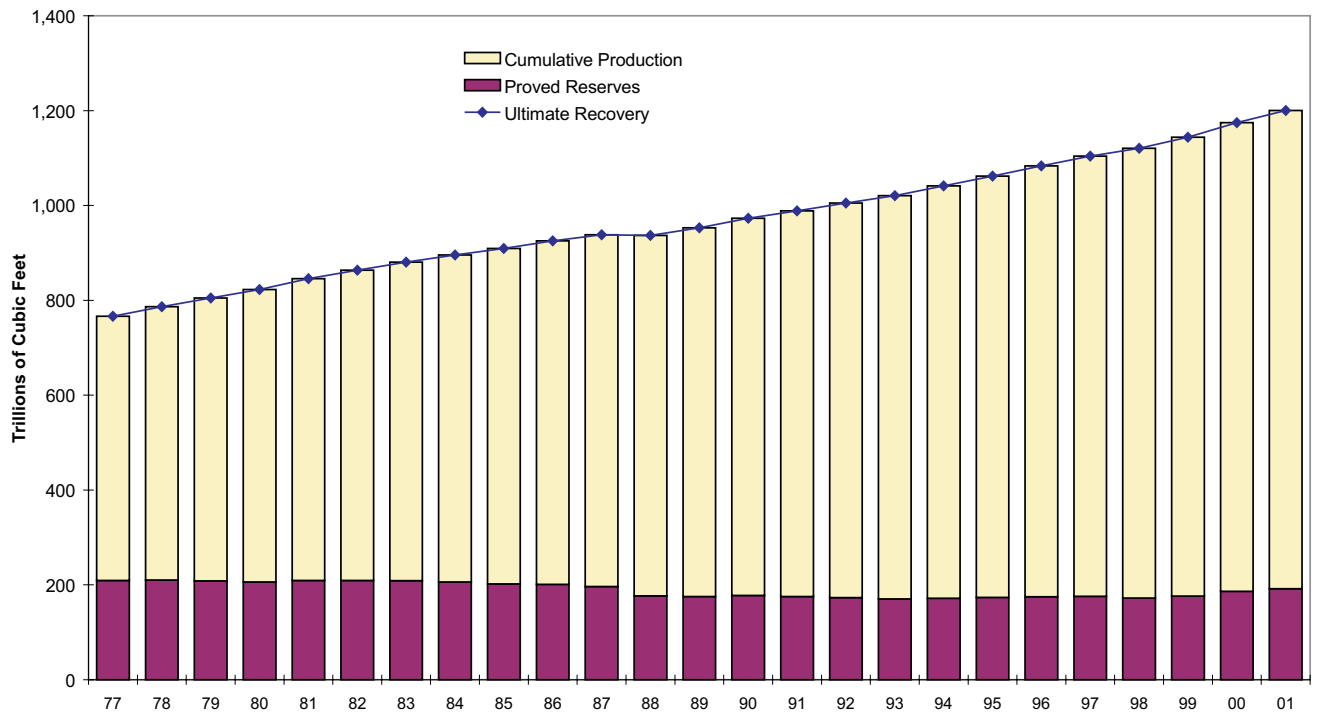


Figure 14. Components of Proved Ultimate Recovery for Wet Natural Gas, 1977-2001



Sources: Annual reserves and production - American Petroleum Institute and American Gas Association (1945–1976) {32} and Energy Information Administration, Office of Oil and Gas (1977–2000){1-24}. 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, 2001

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 261,750	^d 261,650	1	Former U.S.S.R.	1,959,231	1,935,243
2	Iraq ^c	112,500	115,000	2	Iran ^c	812,300	939,371
3	Kuwait ^c	^d 96,500	^d 98,850	3	Qatar ^c	508,540	757,700
4	Iran ^c	89,700	99,083	4	Saudi Arabia ^c	^d 219,500	^d 228,200
5	United Arab Emirates ^c	97,800	62,815	5	United Arab Emirates ^c	212,100	204,050
6	Venezuela ^c	76,862	47,620	6	United States	^e177,427	172,635
7	Former U.S.S.R.	57,086	65,364	7	Algeria ^c	159,700	175,000
8	Libya ^c	29,500	30,000	8	Venezuela ^c	147,585	149,207
9	Nigeria ^c	24,000	30,000	9	Nigeria ^c	124,000	159,000
10	China	24,000	29,500	10	Iraq ^c	109,800	112,600
Top 10 Total		870,521	842,482	Top 10 Total		4,430,183	4,833,006
11	Mexico	26,941	23,114	11	Indonesia ^c	92,500	87,500
12	United States	^e22,045	21,500	12	Australia	90,000	80,000
13	Qatar	15,207	13,817	13	Malaysia	75,000	82,519
14	Algeria ^c	9,200	17,000	14	Norway	44,037	77,194
15	Norway	9,447	10,271	15	Netherlands	62,542	57,045
16	Brazil	8,465	8,550	16	Canada	59,733	59,700
17	Indonesia ^c	5,000	9,165	17	Kuwait ^c	^d 52,700	^d 56,600
18	Oman	5,506	5,900	18	Libya ^c	46,400	46,900
19	Angola	5,412	5,970	19	China	48,300	42,796
20	Canada	4,858	5,365	20	Egypt	35,180	54,126
21	United Kingdom	4,930	4,551	21	Mexico	29,505	38,950
22	India	4,840	3,819	22	Oman	29,280	30,500
23	Malaysia	3,000	4,457	23	Argentina	27,460	26,780
24	Australia	3,500	3,828	24	Bolivia	24,000	27,361
25	Egypt	2,948	3,668	25	United Kingdom	25,956	24,534
Top 25 Total		1,001,820	983,457	Top 25 Total		5,172,776	5,625,511
OPEC Total		818,842	787,600	OPEC Total		2,485,125	2,916,128
World Total		1,031,553	1,017,763	World Total		5,451,065	5,919,369

^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, 2000 were published by the *Oil & Gas Journal* as its estimates as of December 31, 2001.

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 24, 2001, pp. 126-127. Gulf Publishing Company, *World Oil*, August, 2002, pp. 31-35.

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 2001 was 65,582 million barrels. This substantially exceeds the 1977 proved reserves, but at the end of 2001 there were still 23,846 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 10.6 percent of proved reserves additions of crude oil were booked as *new field discoveries* from 1976 through 2001. 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 2001 and there were still 191,743 billion cubic feet of *wet natural gas* proved reserves in 2001. Only 12 percent of proved reserve additions of natural gas were booked as *new field discoveries* from 1976 through 2001.

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 5.7 quadrillion cubic feet of gas.

The United States ranked 12th in the world for proved reserves of crude oil and 6th for natural gas in 2001. 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 2001. There are sometimes substantial differences between the estimates from these sources. The *Oil & Gas Journal* reported oil reserves for the United Arab Emirates at about 98 billion barrels. This is about 56 percent higher than the *World Oil* estimate of 63 billion. One 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 0.3 percent in 2001, while the *World Oil*{35} estimate increased 1.4 percent. For world gas reserves, the *Oil & Gas Journal* reported a 3.3 percent increase, while *World Oil* reported a 8.7 percent increase.

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 triple and Mexico has around 15 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*.{36} In 2001:

- The U.S. consumed 96,950,000,000,000 Btu of energy (96.9 quadrillion Btu). This was a decrease of 1.5 quadrillion Btu from the 2000 level of consumption.
- 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 19.6 million barrels of oil and natural gas liquids and 62.0 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 2001, crude oil imports made up 61 percent of the U.S. crude oil supply.

Net gas imports increased slightly from the revised 2000 total of 3.54 trillion cubic feet to 3.65 trillion cubic feet in 2001. Imports were used for 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 Algeria and Australia.

Canada, Saudi Arabia, Venezuela, and Mexico 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. Table B3 in Appendix B lists the top U.S. operators by reported 2001 production and indicates pending mergers announced in 2001 with linked arrows.

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 1992-2001, due to expressed interest from the industry regarding this area. Table D9 contains the production and proved reserves for 1992-2001 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.