

## 2. Overview

### National Summary

The United States had the following proved reserves as of December 31, 2000:

- **Crude Oil** – 22,045 million barrels
- **Dry Natural Gas** – 177,427 billion cubic feet
- **Natural Gas Liquids** – 8,345 million barrels.

This Overview summarizes the 2000 proved reserves balances of crude oil, dry natural gas, and natural gas liquids on a National level and provides historical comparisons between 2000 and prior years.

**Table 1** lists the estimated annual reserve balances since 1990 for crude oil, dry natural gas, and natural gas liquids. A new column, *Net of Sales and Acquisitions (4)*, has been added to Table 1 for the 2000 report. It is the sum of two new reserves components, *Sales* and *Acquisitions*.

EIA expanded its 2000 EIA-23 survey to include two new reserves components; *Sales* -- the volume of proved reserves deducted from an operator's total when selling a field or properties, and *Acquisitions* -- the volume of proved reserves gained by the purchase of an existing field or properties. In prior years, these data would have been rolled into other categories such as Adjustments, Revision Increases, or Revision Decreases. Due to the large increase in acquisitions and divestitures in the petroleum industry in recent years, these data now warrant separation as components of proved reserves change.

Since operators have different engineering staffs and resources, or different development plans or schedules, the estimate of proved reserves for a field can change with a change in ownership. Because of this, *sales* and *acquisitions* are not equal volumes.

### Crude Oil

Proved reserves of crude oil increased by 280 million barrels in 2000. **Figure 1** shows the crude oil proved reserves levels by major region and **Figure 2** shows the components of reserves changes from 1990 through 2000.

As indicated in **Figure 1**, U.S. crude oil proved reserves increased in 2000 due to reserves additions in the Lower 48 States offshore.

The components of reserves changes for crude oil are shown in **Figure 2**. For report year 2000, EIA has defined 2 new components, *sales* and *acquisitions*, in addition to the previously established components; *adjustments*, *revision increases*, *revision decreases*, *extensions*, *new field discoveries*, *new reservoir discoveries in old fields*, and *estimated production*. The availability of *sales* and *acquisitions* volumes provides more insight into why proved reserves change. 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 1,291 million barrels in 2000, about 71 percent more than the prior 10-year average (753 million barrels) and 78 percent more than those in 1999 (725 million barrels).

Most crude oil *total discoveries* in 2000 were from *extensions* to existing fields, which accounted for 766 million barrels of crude oil reserves additions. This was almost triple the volume of 1999 extensions (259 million barrels).

*New field discoveries* of 276 million barrels were 14 percent lower than those of 1999 (321 million barrels) and 35 percent higher than the prior 10-year average (205 million barrels).

*New reservoir discoveries in old fields* were 249 million barrels, 72 percent more than in 1999 (145 million barrels) and 78 percent more than the prior 10-year average (140 million barrels).

Reserves additions are the sum of total discoveries, revisions and adjustments, and sales and acquisitions. The 2000 net of revisions and adjustments was 889 million barrels, about 41 percent of crude oil reserves additions.

The *sales* component of the crude oil reserves changes (5,328 million barrels) was larger than the *revision decreases* component, and *acquisitions* were larger than *revision increases*. While sales and acquisitions of crude oil proved reserves were both large, the net of sales and

**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 <sup>a</sup> and Adjustments (3)	Net of Sales and Acquisitions (4)	Extensions (5)	New Field Discoveries (6)	New Reservoir Discoveries in Old Fields (7)	Total <sup>b</sup> Discoveries (8)	Estimated Production (9)	Proved <sup>c</sup> Reserves 12/31 (10)	Change from Prior Year (11)
<b>Crude Oil</b> (million barrels of 42 U.S. gallons)											
1990	86	1,483	1,569	NA	456	98	135	689	2,505	26,254	-247
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
<b>Dry Natural Gas</b> (billion cubic feet, 14.73 psia, 60° Fahrenheit)											
1990	1,557	5,538	7,095	NA	7,952	2,004	2,412	12,368	17,233	169,346	+2,230
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
<b>Natural Gas Liquids</b> (million barrels of 42 U.S. gallons)											
1990	-83	221	138	NA	299	39	73	411	732	7,586	-183
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

<sup>a</sup>Revisions and adjustments = Col. 1 + Col. 2.

<sup>b</sup>Total discoveries = Col. 5 + Col. 6 + Col. 7.

<sup>c</sup>Proved 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 2000 contained in the *Petroleum Supply Annual 2000*, DOE/EIA-0340(00) and the *Natural Gas Annual 2000*, DOE/EIA-0131(00).

Sources: *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, 1990 through 2000 annual reports, DOE/EIA-0216.

Figure 1. U.S. Crude Oil Proved Reserves, 1990-2000

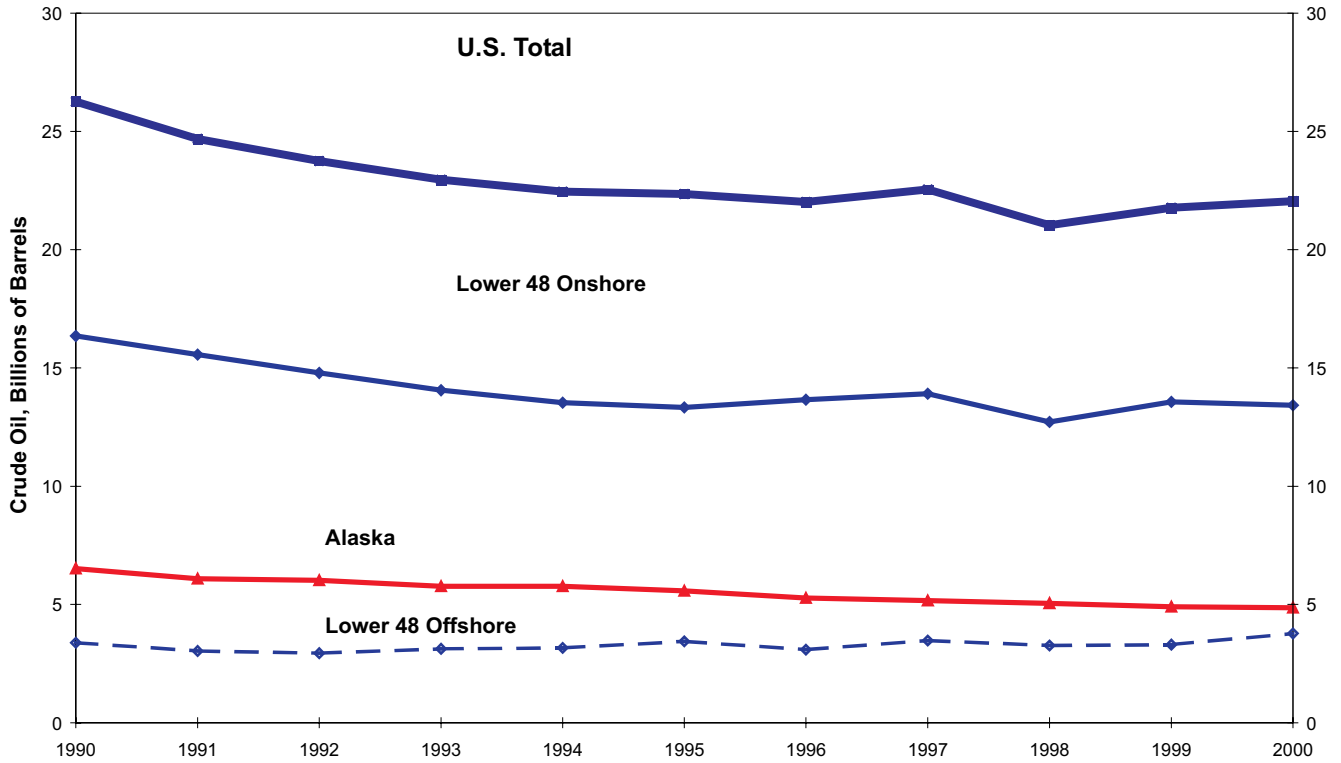
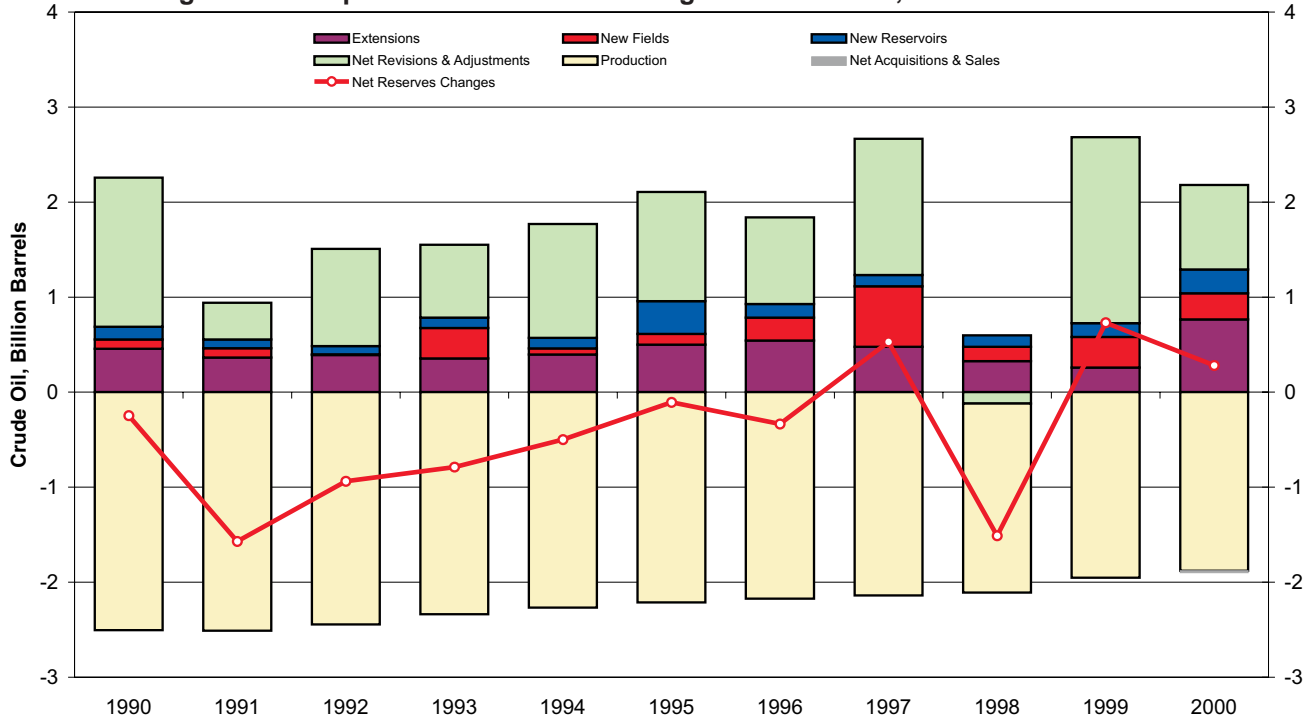
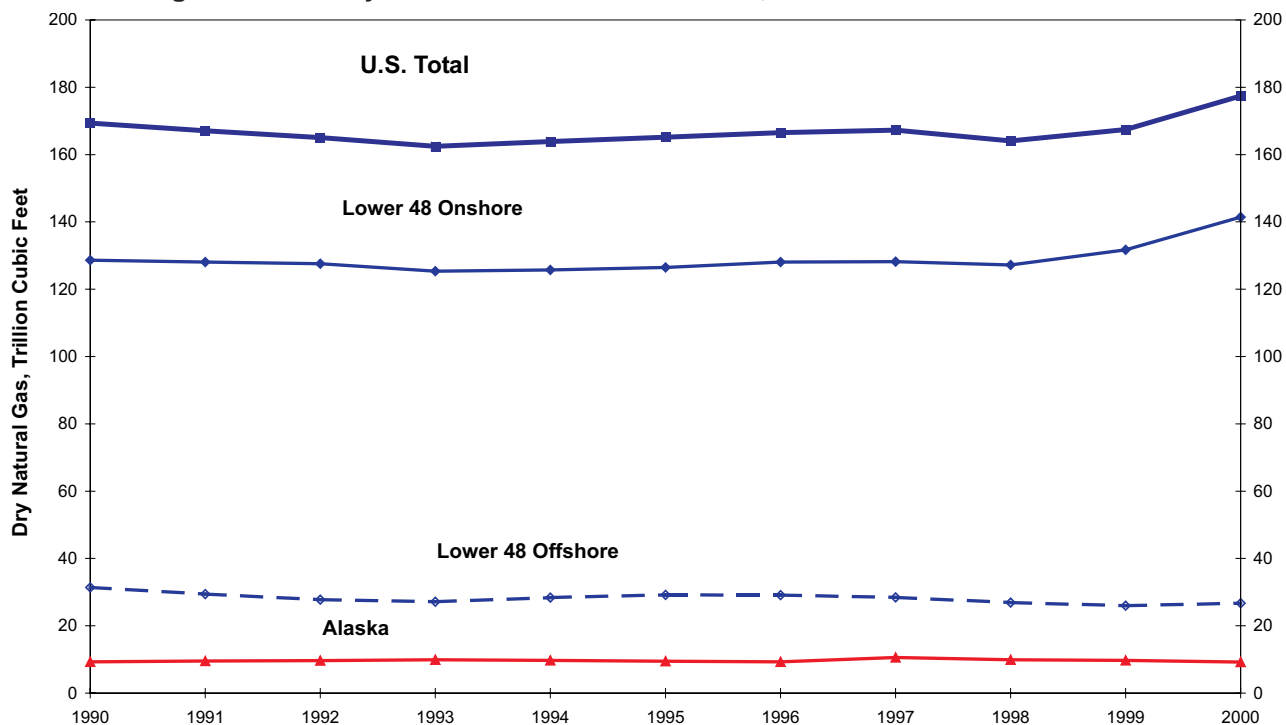


Figure 2. Components of Reserves Changes for Crude Oil, 1990-2000

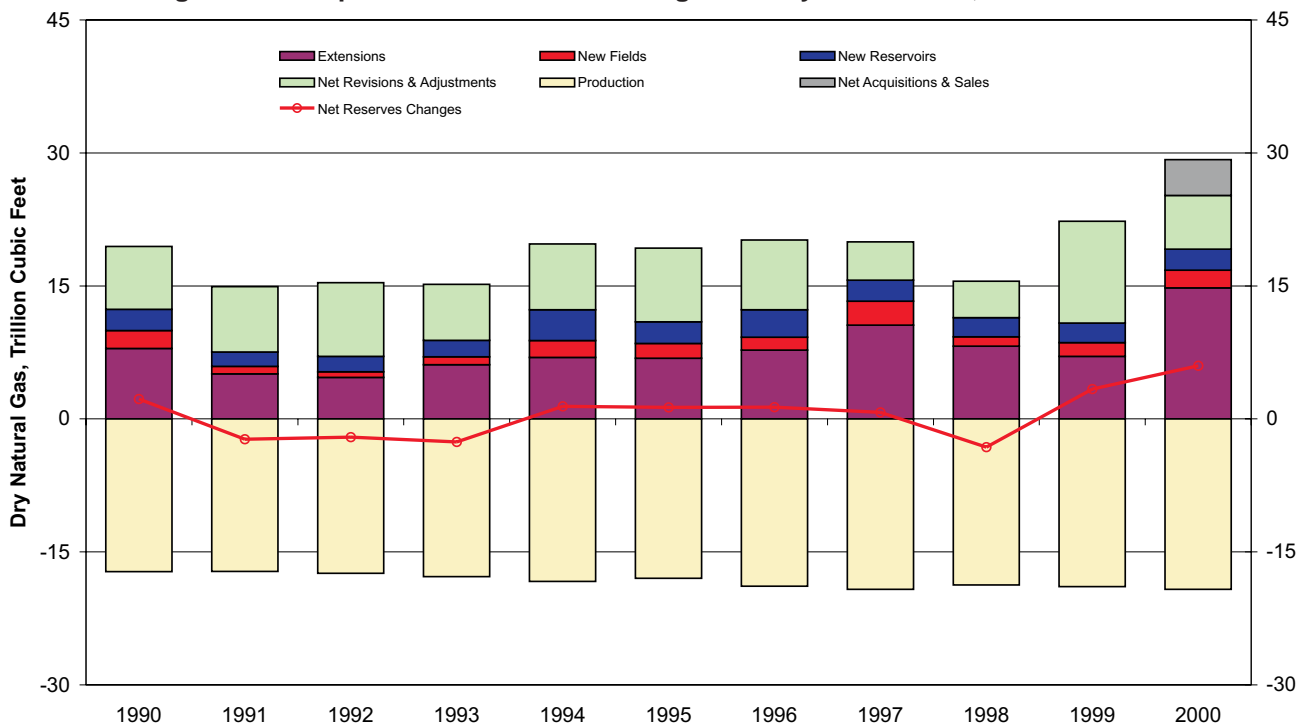


Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1990-2000 annual reports, DOE/EIA-0216.{13-23}

**Figure 3. U.S. Dry Natural Gas Proved Reserves, 1990-2000**



**Figure 4. Components of Reserves Changes for Dry Natural Gas, 1990-2000**



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1990-2000 annual reports, DOE/EIA-0216.{13-23}

acquisitions of crude oil proved reserves was only a negative 20 million barrels.

*Production* of crude oil was an estimated 1,880 million barrels in 2000 (lease condensate not included, see Natural Gas Liquids section below for condensate volumes). This was down 4 percent from 1999's level (1,952 million barrels) and down 17 percent from the prior 10-year average (2,254 million barrels). Operators replaced 115% of crude oil production with reserves additions in 2000.

## Natural Gas

Dry natural gas proved reserves increased by 10,021 billion cubic feet in 2000. **Figure 3** shows the dry natural gas proved reserves levels by major region. **Figure 4** shows the components of reserves changes from 1990 through 2000.

U.S. *total discoveries* of dry gas reserves were 19,138 billion cubic feet in 2000. This was 75 percent more than the prior 10-year average (10,931 billion cubic feet) and 77 percent more than in 1999 (10,807 billion cubic feet).

Field *extensions* were 14,787 billion cubic feet, more than twice the extensions in 1999 and also more than twice the prior 10-year average of 7,119 billion cubic feet.

*New field discoveries* were 1,983 billion cubic feet, 27 percent more than the volume discovered in 1999 (1,568 billion cubic feet) and 35 percent more than the prior 10-year average (1,473 billion cubic feet).

New reservoir discoveries in old fields were 2,368 billion cubic feet, up 8 percent from 1999 (2,196 billion cubic feet) and 1 percent more than the prior 10-year average.

Natural gas net revisions and adjustments were 6,071 billion cubic feet. The net of sales and acquisitions of dry natural gas proved reserves was 4,031 billion cubic feet.

*Production* removed an estimated 19,219 billion cubic feet of proved reserves from the National total. Dry gas production increased by 1.5 percent compared to 1999. Operators replaced 152 percent of dry natural gas production with reserves additions.

Coalbed methane production and reserves are included in the 2000 totals. However, EIA separately

tracks these reserves in order to record the development and performance of this gas source. Coalbed methane reserves increased in 2000 to a volume of 15,708 billion cubic feet. Coalbed methane accounted for 9 percent of 2000 U.S. dry natural gas reserves and 7 percent of 2000 U.S. dry gas production.

## Natural Gas Liquids

Proved reserves of natural gas liquids increased 439 million barrels to 8,345 million barrels during 2000— a 6 percent increase from 1999 levels. **Figure 5** shows the natural gas liquids proved reserves levels by major region and **Figure 6** shows the components of reserves changes from 1990 through 2000.

Operators replaced 148 percent of their 1999 natural gas liquids production with reserve additions. *Total discoveries* added 839 million barrels (primarily from *extensions*), *net revisions and adjustments* added 376 million barrels, and *net sales and acquisitions* added 145 million barrels.

Total proved reserves of liquid hydrocarbons (crude oil plus natural gas liquids) were 30,390 million barrels in 2000—a 2 percent increase from the 1999 level. Natural gas liquids represented 27 percent of total liquid hydrocarbon proved reserves in 2000.

## 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 2000. **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 2000 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 820 million barrels per year of new reserves
- had proved reserves additions of an average 2,125 million barrels per year from *total discoveries, net revisions and adjustments, and net sales and acquisitions*.

Figure 5. U.S. Natural Gas Liquids Proved Reserves, 1990-2000

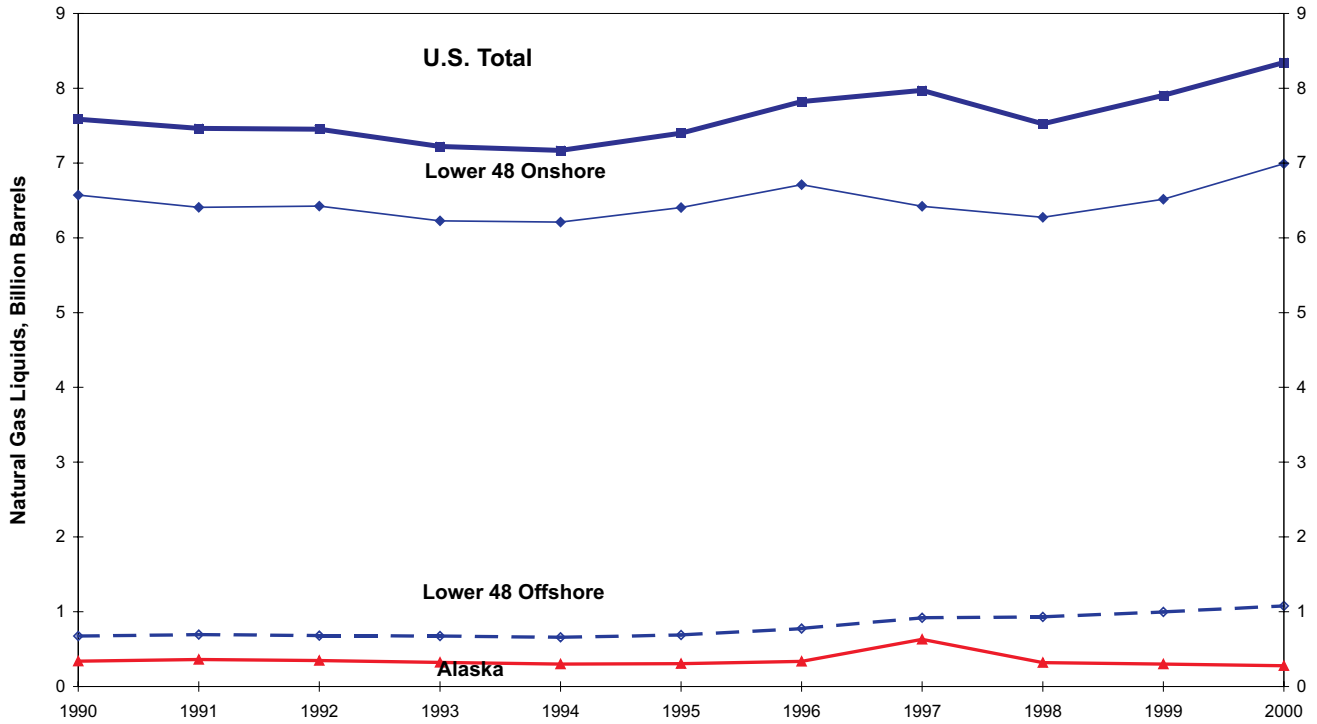
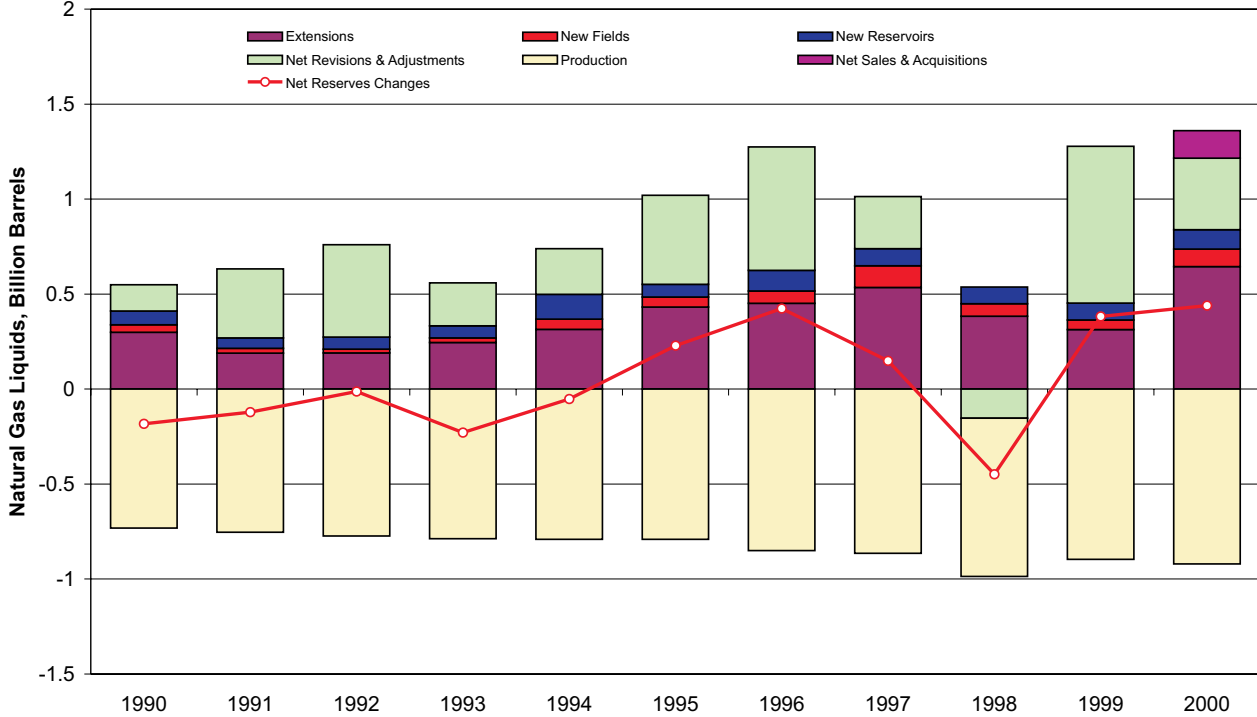


Figure 6. Components of Reserves Changes for Natural Gas Liquids, 1990-2000



Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1990-2000 annual reports, DOE/EIA-0216.{13-23}

**Table 2. Reserves Changes, 1977-2000**

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
<b>Crude Oil</b> (million barrels of 42 U.S. gallons)						
<b>Proved Reserves as of 12/31/76</b> . . . . .	<b>24,928</b>	—	—	<b>33,502</b>	—	—
New Field Discoveries . . . . .	3,561	148	8.6	4,231	176	8.3
New Reservoir Discoveries in Old Fields . . . . .	3,301	138	8.0	3,423	143	6.7
Extensions . . . . .	10,649	444	25.8	12,030	501	23.6
<b>Total Discoveries</b> . . . . .	<b>17,511</b>	<b>730</b>	<b>42.4</b>	<b>19,684</b>	<b>820</b>	<b>38.6</b>
Revisions, Adjustments, Sales & Acquisitions	23,805	992	57.6	31,327	1,305	61.4
<b>Total Reserves Additions</b> . . . . .	<b>41,316</b>	<b>1,722</b>	<b>100.0</b>	<b>51,011</b>	<b>2,125</b>	<b>100.0</b>
<b>Production</b> . . . . .	<b>48,996</b>	<b>2,042</b>	<b>118.6</b>	<b>62,468</b>	<b>2,603</b>	<b>122.5</b>
<b>Net Reserves Change</b> . . . . .	<b>-7,680</b>	<b>-320</b>	<b>-18.6</b>	<b>-11,457</b>	<b>-477</b>	<b>-22.5</b>
<b>Dry Natural Gas</b> (billion cubic feet at 14.73 psia and 60° Fahrenheit)						
<b>Proved Reserves as of 12/31/76</b> . . . . .	<b>180,838</b>	—	—	<b>213,278</b>	—	—
New Field Discoveries . . . . .	46,132	1,922	11.4	46,280	1,928	11.8
New Reservoir Discoveries in Old Fields . . . . .	60,828	2,535	15.0	61,229	2,551	15.7
Extensions . . . . .	184,134	7,672	45.4	187,002	7,792	47.8
<b>Total Discoveries</b> . . . . .	<b>291,094</b>	<b>12,129</b>	<b>71.7</b>	<b>294,511</b>	<b>12,271</b>	<b>75.3</b>
Revisions, Adjustments, Sales & Acquisitions	114,863	4,786	28.3	96,702	4,029	24.7
<b>Total Reserves Additions</b> . . . . .	<b>405,957</b>	<b>16,915</b>	<b>100.0</b>	<b>391,213</b>	<b>16,301</b>	<b>100.0</b>
<b>Production</b> . . . . .	<b>418,605</b>	<b>17,442</b>	<b>103.1</b>	<b>427,064</b>	<b>17,794</b>	<b>109.2</b>
<b>Net Reserves Change</b> . . . . .	<b>-12,648</b>	<b>-527</b>	<b>-3.1</b>	<b>-35,851</b>	<b>-1,494</b>	<b>-9.2</b>

Source: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1977-2000 annual reports, DOE/EIA-0216.{1-23}

- ended each year with an average net reduction in U.S. proved reserves of 477 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 8 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 19,684 million barrels of *total discoveries* accounted for 39 percent of reserves additions.

Compared to the averages of reserves changes since 1977, 2000 was an up year for crude oil discoveries. *Total discoveries* of crude oil (1,291 million barrels) in 2000 were 57 percent more than the post-1976 U.S. average (820 million barrels per year).

Looking at the components of *total discoveries* in 2000:

- new field discoveries* and *new reservoir discoveries in old fields* exceeded the post-1976 averages for crude oil, and
- 2000's *extensions* greatly exceeded the post-1976 average. *Extensions* in 2000 accounted for 35 percent of reserves additions, a larger share than the historical 24 percent.

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

- discovered an average of 12,271 billion cubic feet per year of new reserves
- had proved reserves additions of an average 4,029 billion cubic feet per year from *total discoveries, net revisions and adjustments, and net sales and acquisitions*.
- had an average net reduction in U.S. reserves of 1,494 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.

**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, 1977-2000**

Year	Crude Oil		Natural Gas		Number of Rigs
	Current	2000 Constant	Current	2000 Constant	
	(dollars per barrel)		(dollars per thousand cubic feet)		
1977	8.57	20.38	0.79	1.88	2,001
1978	9.00	19.98	0.91	2.02	2,259
1979	12.64	25.90	1.18	2.42	2,177
1980	21.59	40.51	1.59	2.98	2,909
1981	31.77	54.53	1.98	3.40	3,970
1982	28.52	46.07	2.46	3.97	3,105
1983	26.19	40.70	2.59	4.03	2,232
1984	25.88	38.78	2.66	3.99	2,428
1985	24.09	34.99	2.51	3.65	1,980
1986	12.51	17.78	1.94	2.76	964
1987	15.40	21.25	1.67	2.30	936
1988	12.58	16.79	1.69	2.26	936
1989	15.86	20.39	1.69	2.17	869
1990	20.03	24.78	1.71	2.12	1,010
1991	16.54	19.75	1.64	1.96	860
1992	15.99	18.64	1.74	2.03	721
1993	14.25	16.22	2.04	2.32	754
1994	13.19	14.71	1.85	2.06	775
1995	14.62	15.95	1.55	1.69	723
1996	18.46	19.76	2.17	2.32	779
1997	17.23	18.09	2.32	2.44	943
1998	10.87	11.27	1.94	2.01	827
1999					
January	8.57	8.82	1.84	1.89	587
February	8.60	8.84	1.75	1.80	542
March	10.76	11.05	1.68	1.73	526
April	12.82	13.15	1.86	1.91	496
May	13.92	14.27	2.16	2.21	516
June	14.39	14.73	2.12	2.17	558
July	16.12	16.48	2.18	2.23	588
August	17.58	17.95	2.49	2.54	639
September	20.03	20.43	2.61	2.66	696
October	19.71	20.08	2.50	2.55	741
November	21.35	21.71	2.67	2.72	782
December	22.55	22.87	2.20	2.23	798
1999	<b>15.56</b>	<b>15.91</b>	<b>2.17</b>	<b>2.22</b>	<b>625</b>
2000					
January	23.53	23.76	2.12	2.14	775
February	25.48	25.67	2.30	2.32	763
March	26.19	26.32	2.36	2.37	773
April	23.20	23.29	2.55	2.56	805
May	25.58	25.63	2.90	2.91	844
June	27.62	27.63	3.73	3.73	878
July	26.81	26.78	3.70	3.70	942
August	27.91	27.84	3.67	3.66	987
September	29.72	29.60	4.26	4.24	1,011
October	29.65	29.50	4.61	4.59	1,055
November	30.36	30.15	4.62	4.59	1,067
December	24.46	24.24	6.35	6.29	1,097
2000	<b>26.72</b>	<b>26.72</b>	<b>3.60</b>	<b>3.60</b>	<b>918</b>

=Revised data.

Sources: Current dollars and number of rigs: *Monthly Energy Review October 2001*, DOE/EIA-0035(2001/10). 2000 constant dollars: U.S. Department of Commerce, Bureau of Economic Analysis, Gross Domestic Product Implicit Price Deflators, October 2001.



*Extensions* account for 48 percent while *net revisions and adjustments* account for only 25 percent of all reserves additions since 1977. In 2000, *net revisions, adjustments, sales, and acquisitions* were 35 percent of all reserves additions. In 2000, *extensions* were 51 percent of all reserves additions.

Compared to the averages of reserves changes since 1977, 2000 was an up year for natural gas reserves additions from *total discoveries*. Operators reported 19,138 billion cubic feet of *total discoveries* of dry natural gas proved reserves—56 percent more than the post-1976 average (12,271 billion cubic feet). Also, *net revisions, adjustments, sales, and acquisitions* were up in 2000 (10,102 billion cubic feet) compared to the post-1976 U.S. average (4,029 billion cubic feet per year). Before 2000, the net of sales and acquisitions were captured in the net of revisions and adjustments.

## Economics and Drilling

**Economics:** This section describes the price behavior in 2000 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 2000.

The U.S. crude oil first purchase price started at an average of \$22.55 per barrel in December 1999, then rose during the year, reaching \$30.36 per barrel in November 2000. The average U.S. crude oil first purchase price increased from an average \$15.56 in 1999 to \$26.72 per barrel in 2000.

Oil prices vary by region. In Texas the average 2000 crude oil first purchase price was \$28.60 per barrel, while in California it was \$24.82 per barrel, and only \$23.62 per barrel on the Alaskan North Slope. The lowest average crude oil first purchase price in 2000 was for Federal Offshore California oil—\$23.32 per barrel. {24}

The average annual wellhead natural gas price increased from \$2.17 in 1999 to \$3.60 per thousand cubic feet in 2000. Natural gas prices started at \$2.12 per thousand cubic feet in January 2000 and rose to \$6.35 per thousand cubic feet by December 2000 (the highest average price of the year). {25}

**Drilling:** From 1999 to 2000, the annual average active rig count increased from 625 to 918 (**Table 3**), a 47 percent increase in active rigs. Operators are now using

significantly improved drilling and seismic exploration technology to dramatically increase their drilling success rate.

Looking first at exploratory wells, there were 2,949 exploratory wells drilled in 2000 (**Table 4**). Of these, 7 percent were completed as oil wells, 25 percent were completed as gas wells, and 68 percent were dry holes. The total (which includes dry holes) was 39 percent more than in 1999. In 2000, there were 27 percent more completed exploratory oil and gas wells (**Figures 7 and 8**) than in 1999.

**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 discoveries per exploratory well increased significantly for both.

The number of successful development wells increased 14 percent for oil and increased 45 percent for gas from 1999. Altogether there were an estimated 25,140 exploratory and development wells drilled in 2000. This is 38 percent more than in 1999 and 3 percent more than the average number of wells drilled annually in the prior 10 years (24,358).

For the eighth 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 2000, and are expected to have a major impact on the energy industry in the future:

On April 14, 2000, BP Amoco received approval from the Federal Trade Commission for its \$28 billion merger with Atlantic Richfield Corporation (ARCO). As part of the approval, ARCO agreed to sell its crude oil production operations in Alaska to Phillips Petroleum. {26}

On April 26, 2000, Phillips Petroleum Company completed its acquisition of ARCO's Alaskan businesses. Phillips Alaska Inc. will include ARCO's Alaskan businesses, plus all of Phillips' current Alaska operations, including the Kenai liquefied natural gas plant. Net daily production from the assets in 2000 is now expected to be 340,000 barrels of oil equivalent, and Phillips will add a total of 2.2 billion barrels of oil equivalent to its reserve base. As previously

**Table 4. U.S. Exploratory and Development Well Completions,<sup>a</sup> 1970-2000**

Year	Exploratory <sup>b</sup>				Total Exploratory and Development <sup>b</sup>			
	Oil	Gas	Dry	Total	Oil	Gas	Dry	Total
1970	763	478	6,193	7,434	13,043	4,031	11,099	28,173
1971	664	472	5,995	7,131	11,903	3,983	10,382	26,268
1972	690	659	6,202	7,551	11,437	5,484	11,013	27,934
1973	642	1,067	5,952	7,661	10,167	6,933	10,320	27,420
1974	859	1,190	6,833	8,882	13,647	7,138	12,116	32,901
1975	982	1,248	7,129	9,359	16,948	8,127	13,646	38,721
1976	1,086	1,346	6,772	9,204	17,688	9,409	13,758	40,855
1977	1,164	1,548	7,283	9,995	18,745	12,122	14,985	45,852
1978	1,171	1,771	7,965	10,907	19,181	14,413	16,551	50,145
1979	1,321	1,907	7,437	10,665	20,851	15,254	16,099	52,204
1980	1,764	2,081	9,039	12,884	32,639	17,333	20,638	70,610
1981	2,636	2,514	12,349	17,499	43,598	20,166	27,789	91,553
1982	2,431	2,125	11,247	15,803	39,199	18,979	26,219	84,397
1983	2,023	1,593	10,148	13,764	37,120	14,564	24,153	75,837
1984	2,198	1,521	11,278	14,997	42,605	17,127	25,681	85,413
1985	1,679	1,190	8,924	11,793	35,118	14,168	21,056	70,342
1986	1,084	793	5,549	7,426	19,097	8,516	12,678	40,291
1987	925	754	5,049	6,728	16,164	8,055	11,112	35,331
1988	855	732	4,693	6,280	13,636	8,555	10,041	32,232
1989	607	705	3,924	5,236	10,204	9,539	8,188	27,931
1990	654	689	3,715	5,058	12,198	11,044	8,313	31,555
1991	592	534	3,314	4,440	11,770	9,526	7,596	28,892
1992	493	423	2,513	3,429	8,757	8,209	6,118	23,084
1993	502	548	2,469	3,519	8,407	10,017	6,328	24,752
1994	570	726	2,405	3,701	6,721	9,538	5,307	21,566
1995	542	570	2,198	3,310	7,627	8,354	5,075	21,056
1996	483	570	2,136	3,189	8,314	9,302	5,282	22,898
1997	428	536	2,110	3,074	10,436	11,327	5,702	27,465
1998	303	579	1,816	2,698	7,064	12,106	4,913	24,083
1999	151	583	1,389	2,123	4,136	10,513	3,580	18,229
2000	192	740	2,017	2,949	4,731	15,206	5,203	25,140

<sup>a</sup>Excludes service wells and stratigraphic and core testing.

<sup>b</sup>All drilling counts for the years 1973-1999 have been revised.

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 2001, DOE/EIA-0035(2000/10).

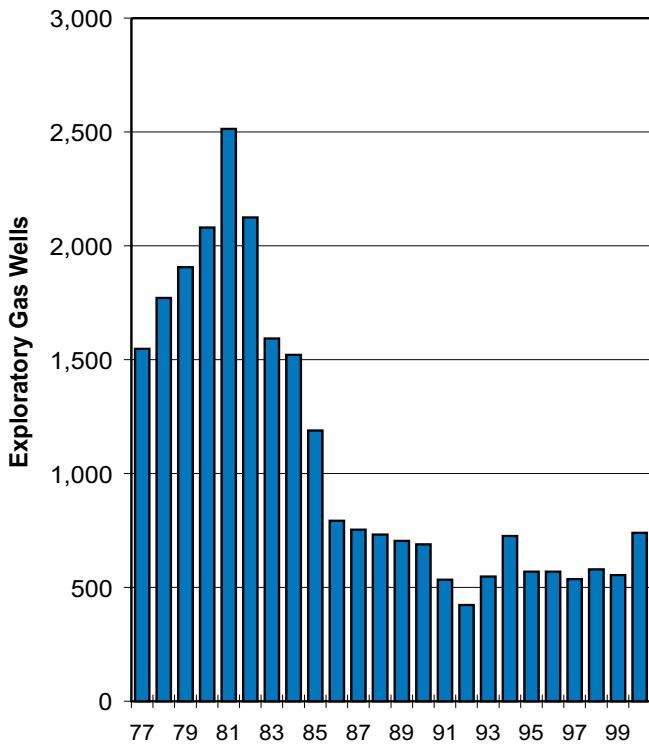
announced, Phillips will pay BP \$6.5 billion in cash and up to an additional \$500 million based on a formula tied to the price of crude oil. {27}

On July 14, 2000, Anadarko Petroleum Corporation closed the merger transaction involving Union Pacific Resources Group Inc. Shareholders of each company

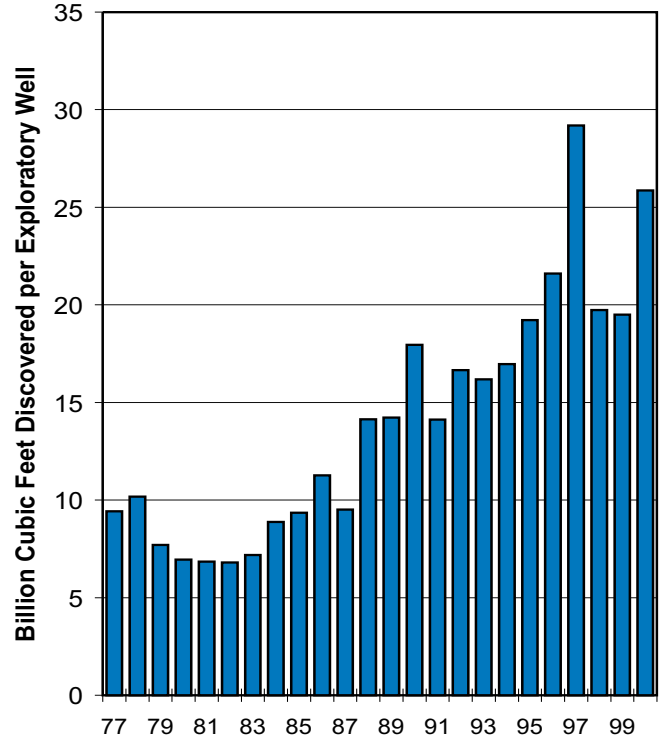
approved the merger on July 13, 2000, making UPR a wholly owned subsidiary of Anadarko. {28}

On October 16, 2000, Chevron Corporation and Texaco Incorporated announced their intention to merge, conditioned on shareholder approval for both companies, pooling accounting treatment for the merger and regulatory approvals of government

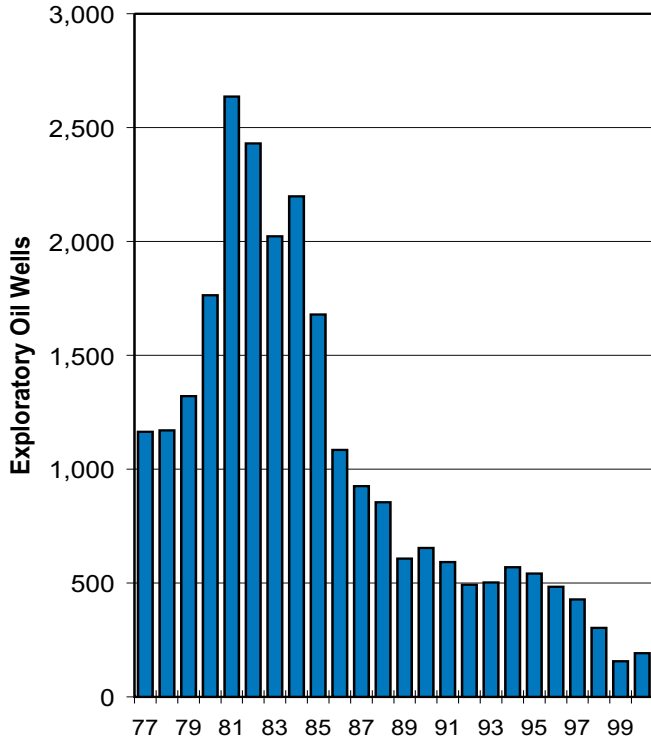
**Figure 7. U.S. Exploratory Gas Well Completions, 1977-2000**



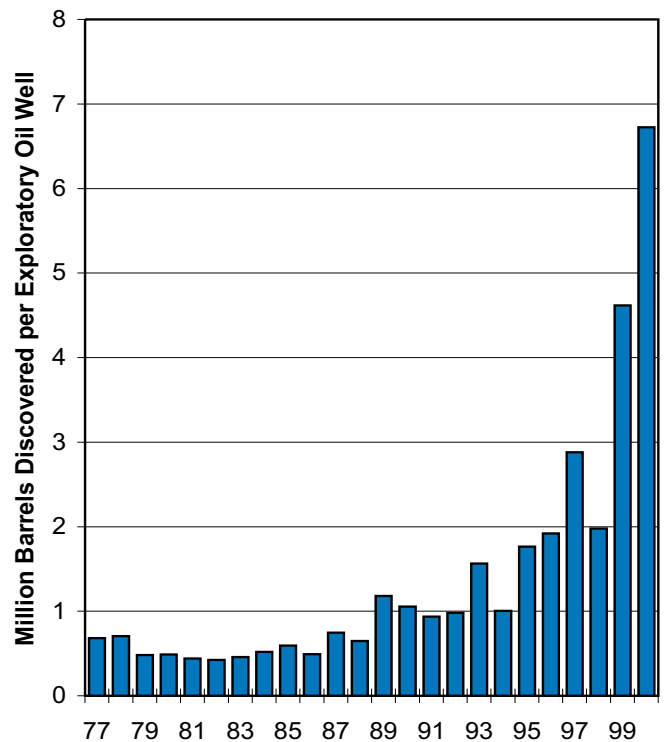
**Figure 9. U.S. Total Discoveries of Dry Natural Gas per Exploratory Gas Well Completion, 1977-2000**



**Figure 8. U.S. Exploratory Oil Well Completions, 1977-2000**



**Figure 10. U.S. Total Discoveries of Crude Oil per Exploratory Oil Well Completion, 1977-2000**



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

agencies such as the U.S. Federal Trade Commission. Upon completion of the merger, the new company would be named ChevronTexaco Corporation. {29}

On November 3, 2000, Russia's Lukoil announced it would purchase Getty Petroleum Marketing of the United States for \$71 million. Lukoil eventually intends to switch Getty's 1,300 retail outlets in the Northeastern and Middle Atlantic states to the Lukoil brand name. The purchase represents the first takeover of a publicly traded American company by a Russian firm. {30}

## 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 2000, U.S. crude oil proved reserves increased, while oil production decreased—resulting in an upward shift in the National average R/P ratio from 11.1 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 2000 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 (CO<sub>2</sub>) injection or steamflooding have improved recoverability of oil in old, mature fields. Areas that have the lowest R/P ratios, like the Mid-Continent region, usually have many older fields. There, new technologies such as horizontal drilling have helped add reserves equivalent to the annual production, keeping the regional reserves and R/P ratio for oil relatively stable.

**Figure 12** shows the historical R/P ratio for wet natural gas since 1945. Prior to 1945, R/P ratios were very high since the interstate pipeline infrastructure was not well developed. The market for and production of natural gas grew rapidly after World War II, lowering the R/P ratio. The U.S. average R/P ratio for natural gas increased from 8.9 to 9.2 in 2000, as reserves increased 6 percent Nationally while production had a 1.5 percent increase.

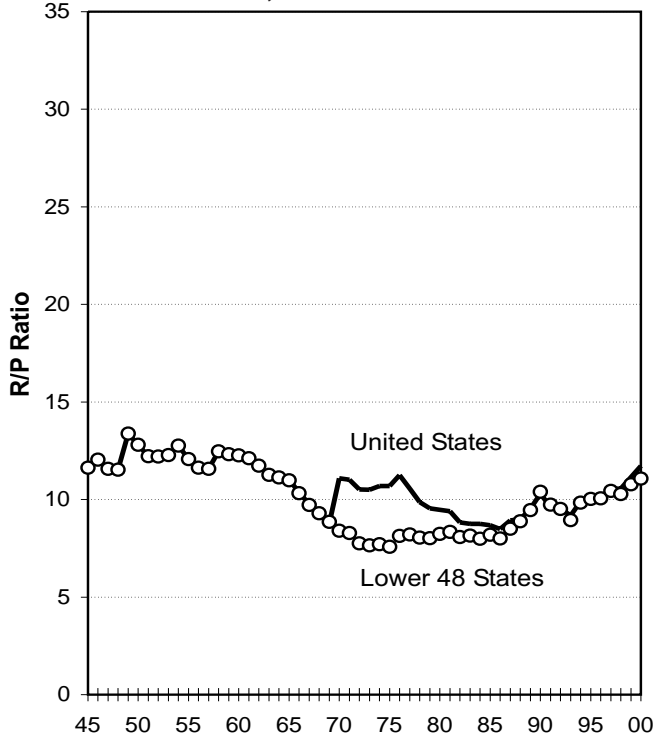
Different marketing, transportation, and production characteristics for gas are seen when looking at regional average R/P ratios, compared to the 2000 U.S. average R/P ratio of about 9.2-to-1. Areas with a higher range of R/P ratios than the National average were the Pacific offshore and the Rockies, 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

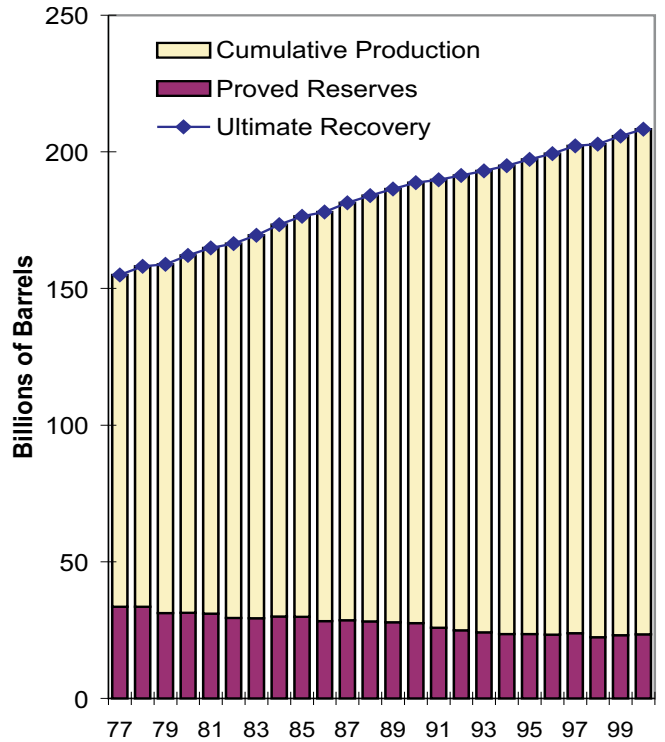
EIA has in past reports defined Ultimate Recovery as the sum of proved reserves and cumulative production. However, despite EIA's clear definition, the volume presented by EIA has often been misused or misinterpreted as the maximum recoverable volume of resources for an area. This neglects the addition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

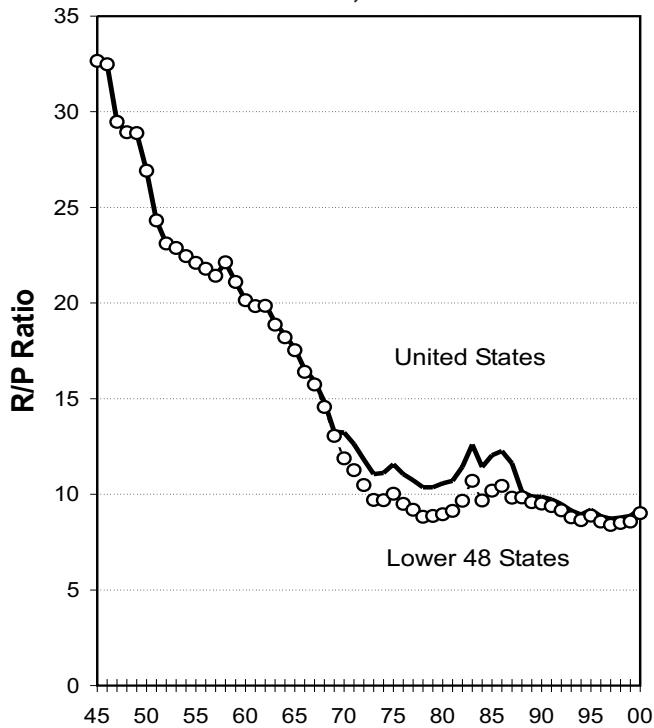
**Figure 11. Reserves-to-Production Ratios for Crude Oil, 1945-2000**



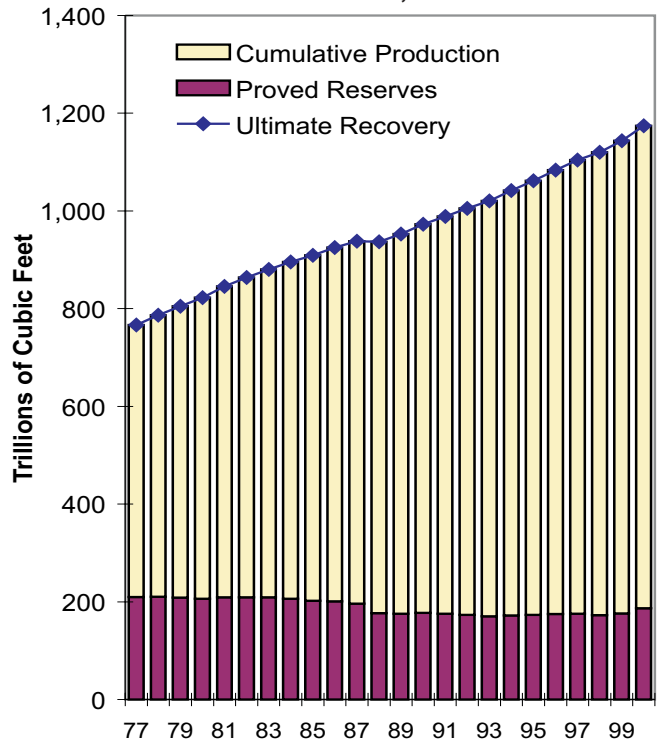
**Figure 13. Components of Proved Ultimate Recovery for Crude Oil and Lease Condensate, 1977-2000**



**Figure 12. Reserves-to-Production Ratios for Wet Natural Gas, 1945-2000**



**Figure 14. Components of Proved Ultimate Recovery for Wet Natural Gas, 1977-2000**



Sources: Annual reserves and production - American Petroleum Institute and American Gas Association (1945-1976) {31} and Energy Information Administration, Office of Oil and Gas (1977-2000){1-23}. Cumulative production: *U.S. Oil and Gas Reserves by Year of Field Discovery* (1977-1988){32}

**Table 5. International Oil and Natural Gas Reserves as of December 31, 2000**

Oil (million barrels)				Natural Gas (billion cubic feet)			
Rank <sup>a</sup>	Country	Oil & Gas Journal	World Oil	Rank <sup>b</sup>	Country	Oil & Gas Journal	World Oil
1	Saudi Arabia <sup>c</sup>	<sup>d</sup> 261,700	<sup>d</sup> 265,325	1	Former U.S.S.R.	1,977,530	1,929,404
2	Iraq <sup>c</sup>	112,500	115,000	2	Iran <sup>c</sup>	812,300	929,130
3	Kuwait <sup>c</sup>	<sup>d</sup> 96,500	<sup>d</sup> 98,825	3	United Arab Emirates <sup>c</sup>	605,930	604,050
4	Iran <sup>c</sup>	89,700	96,400	4	Saudi Arabia <sup>c</sup>	<sup>d</sup> 213,800	<sup>d</sup> 214,000
5	United Arab Emirates <sup>c</sup>	110,957	68,395	<b>5</b>	<b>United States</b>	<b><sup>e</sup>167,406</b>	<b>170,755</b>
6	Venezuela <sup>c</sup>	76,862	47,620	6	Algeria <sup>c</sup>	159,700	155,586
7	Former U.S.S.R.	57,009	64,496	7	Venezuela <sup>c</sup>	146,800	147,583
8	Libya <sup>c</sup>	29,500	30,000	8	Nigeria <sup>c</sup>	124,000	125,000
9	Mexico	28,260	26,940	9	Iraq <sup>c</sup>	109,800	112,600
10	China	24,000	30,600	10	Indonesia <sup>c</sup>	72,268	146,882
<b>Top 10 Total</b>		<b>886,988</b>	<b>843,601</b>	<b>Top 10 Total</b>		<b>4,389,534</b>	<b>4,534,990</b>
11	Nigeria <sup>c</sup>	22,500	24,075	11	Malaysia	81,700	81,730
<b>12</b>	<b>United States</b>	<b><sup>e</sup>21,765</b>	<b>21,330</b>	12	Canada	61,010	62,200
13	Algeria <sup>c</sup>	9,200	12,680	13	Netherlands	62,542	58,420
14	Norway	9,447	10,125	14	Kuwait <sup>c</sup>	<sup>d</sup> 52,700	<sup>d</sup> 56,600
15	Brazil	8,100	8,465	15	Libya <sup>c</sup>	46,400	46,400
16	Indonesia <sup>c</sup>	4,980	9,665	16	China	48,300	42,039
17	Angola	5,412	9,000	17	Australia	44,638	44,000
18	Oman	5,506	5,848	18	Norway	44,037	41,783
19	Canada	4,706	5,622	19	Egypt	35,180	50,600
20	United Kingdom	5,003	4,740	20	Mexico	30,394	41,383
21	Malaysia	3,900	5,050	21	Oman	28,280	30,320
22	India	4,728	3,339	22	Argentina	26,420	27,387
23	Egypt	2,948	3,622	23	United Kingdom	26,839	25,956
24	Yemen	4,000	2,100	24	Pakistan	21,600	25,078
25	Argentina	3,071	2,963	25	Trinidad and Tobago	21,351	23,450
<b>Top 25 Total</b>		<b>1,002,254</b>	<b>972,225</b>	<b>Top 25 Total</b>		<b>5,020,925</b>	<b>5,192,336</b>
<b>OPEC Total</b>		<b>814,399</b>	<b>767,985</b>	<b>OPEC Total</b>		<b>2,343,698</b>	<b>2,537,831</b>
<b>World Total</b>		<b>1,028,276</b>	<b>1,003,412</b>	<b>World Total</b>		<b>5,277,483</b>	<b>5,443,535</b>

<sup>a</sup>Rank is based on an average of oil reserves reported by *Oil & Gas Journal* and *World Oil*.

<sup>b</sup>Rank is based on an average of natural gas reserves reported by *Oil & Gas Journal* and *World Oil*.

<sup>c</sup>Member of the Organization of Petroleum Exporting Countries (OPEC).

<sup>d</sup>Includes one-half of the reserves in the Neutral Zone.

<sup>e</sup>Energy Information Administration proved reserves as of December 31, 1999 were published by the *Oil & Gas Journal* as its estimates as of December 31, 2000.

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, 2000. Gulf Publishing Company, *World Oil*, August, 2001.

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

**Figures 13 and 14** show successive estimates of proved ultimate recovery and its components, proved reserves and cumulative production, for crude oil plus lease condensate, and wet natural gas, from 1977 through 2000. They illustrate the continued appreciation (growth) of proved ultimate recovery over time.

In 1977, U.S. crude oil and lease condensate proved reserves were 33,615 million barrels. Cumulative production of crude oil and lease condensate for 1977 through 2000 was 62,468 million barrels. This substantially exceeds the 1977 proved reserves, but at the end of 2000 there were still 23,513 million barrels of crude oil and lease condensate proved reserves. Therefore, the Nation's estimated proved ultimate recovery of crude oil was fundamentally increased during this period owing to the *proved ultimate recovery appreciation* process (continued development of old fields). In fact, only 8 percent of proved reserves additions of crude oil were booked as *new field discoveries* from 1976 through 2000. The rest was from 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 2000 and there were still 186,510 billion cubic feet of wet natural gas proved reserves in 2000. Only 12 percent of proved reserve additions of natural gas were booked as *new field discoveries* from 1976 through 2000.

## 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 5.3 quadrillion cubic feet of gas.

The United States ranked 12th in the world for proved reserves of crude oil and 5th for natural gas in 2000. A comparison of EIA's U.S. proved reserves estimates with worldwide estimates obtained from other sources shows that the United States had about 2 percent of the world's total crude oil proved reserves and over 3 percent of the world's total natural gas proved reserves at the end of 2000. 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 111 billion barrels. This is about 63 percent higher than the *World Oil* estimate of 68 billion. One reason (among many) for these differences is that condensate is often included in foreign oil reserve estimates.

The *Oil & Gas Journal*{33} estimate for world oil reserves increased 1 percent in 2000, while the *World Oil*{34} estimate increased 2 percent. For world gas reserves, the *Oil & Gas Journal* reported a 3 percent increase, while *World Oil* reported a 5 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 25 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*.{35} In 2000:

- The U.S. consumed 98,498,000,000,000 Btu of energy (98.5 quadrillion Btu).
- 62 percent of U.S. energy consumption was provided by petroleum and natural gas—crude

oil and natural gas liquids combined (38 percent), and natural gas (24 percent).

- U.S. petroleum consumption was about 19.5 million barrels of oil and natural gas liquids and 62.2 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 2000, crude oil imports made up 60 percent of the U.S. crude oil supply.

Net gas imports increased slightly in 2000 to 3.73 trillion cubic feet, which is approximately 16 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.<sup>{36}</sup>

## 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 2000 production and indicates pending mergers announced in 2000 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 1992-2000, due to expressed interest from the industry regarding this area. Table D9 contains the production and proved reserves for 1992-2000 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.