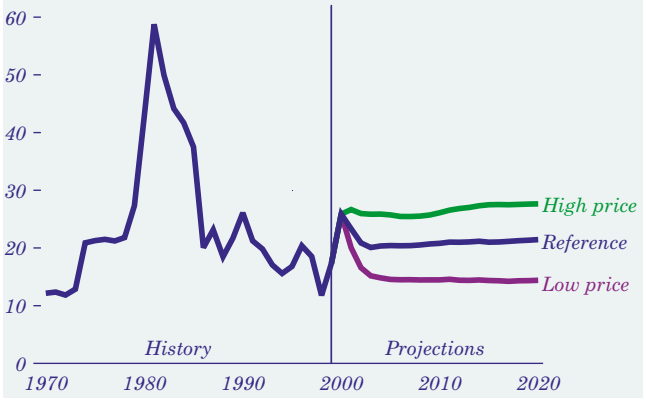
Oil Prices Are Expected To Remain Above Low 1998 Levels

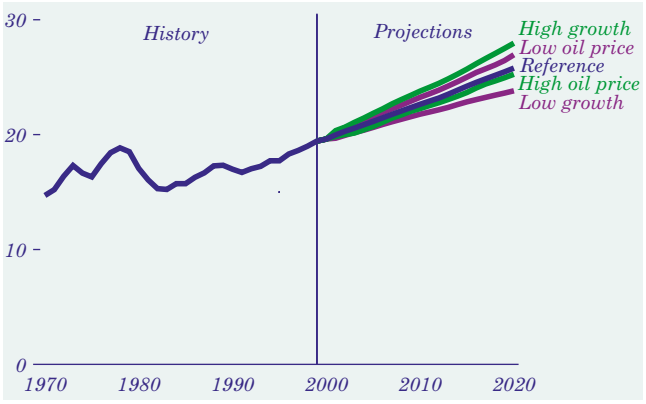
Figure 88. Lower 48 crude oil wellhead prices in three cases, 1970-2020 (1999 dollars per barrel)



Because domestic prices for crude oil are determined largely by the international market, recovery from the 1998 decline in world oil prices led to a steep increase in wellhead prices for crude oil in the lower 48 States in 1999 and 2000. After 2000, prices are projected to decline initially, then increase through the rest of the forecast. Prices are expected to remain above 1998 levels in all cases, with wellhead prices projected to decrease by 0.6 percent per year on average from 1999 to 2020 in the low world oil price case and to increase by 1.3 and 2.5 percent per year on average in the reference and high world oil price cases, respectively (Figure 88).

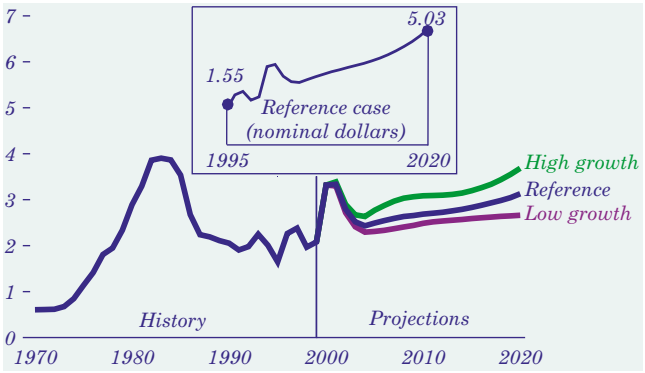
U.S. petroleum consumption is projected to rise in all the *AEO2001* cases (Figure 89). Total petroleum product supplied is projected to range from 23.8 million barrels per day in the low economic growth case to 28.0 million in the high growth case, as compared with 19.5 million barrels per day in 1999.

Figure 89. U.S. petroleum consumption in five cases, 1970-2020 (million barrels per day)



Rising Demand Increases Natural Gas Prices in All Economic Growth Cases

Figure 90. Lower 48 natural gas wellhead prices in three cases, 1970-2020 (1999 dollars per thousand cubic feet)



Wellhead prices for natural gas in the lower 48 States are projected to increase on average by 1.2, 2.0, and 2.8 percent per year in the low economic growth, reference, and high economic growth cases, respectively (Figure 90). In the reference case, gas prices are projected to increase from $2.08 per thousand cubic feet in 1999 to $3.13 in 2020. The increases reflect the rising demand projected for natural gas and its expected impact on the natural progression of the discovery process from larger and more profitable fields to smaller, less economical ones. The projected price increases also reflect more production expected from higher cost sources, such as unconventional gas recovery. Growth in lower 48 unconventional gas production is projected to range from 2.5 to 3.5 percent per year across cases, compared with a projected range of 2.3 to 2.7 percent per year for conventional sources. Technically recoverable resources (Table 14) are expected to remain more than adequate overall to meet the projected production increases.

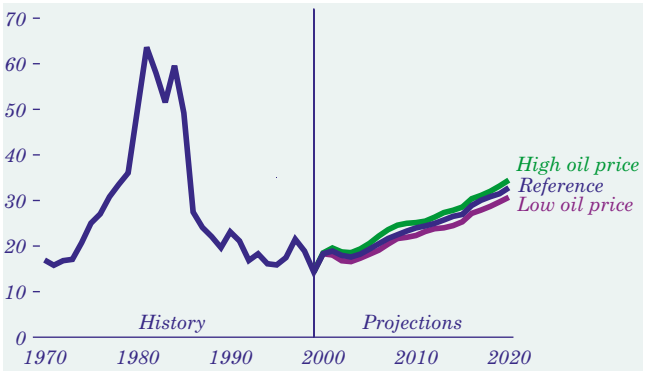
Although natural gas consumption (and thus production and prices) is projected to rise in all three cases, the price increases are expected to be tempered by the beneficial impacts of technological progress on both the discovery process and production operations.

Table 14. Technically recoverable U.S. oil and gas resources as of January 1, 1999

Total U.S. resources	Crude oil (billion barrels)	Natural gas (trillion cubic feet)
Proved	*22*	*164*
Unproved	*121*	*1,117*
Total	***144***	***1,281***

Rising Prices and Lower Drilling Costs Increase Well Completions

Figure 91. Successful new lower 48 natural gas and oil wells in three cases, 1970-2020 (thousand successful wells)



Both exploratory drilling and developmental drilling are projected to increase in the forecast (Table 15). With rising prices and declining drilling costs, crude oil and natural gas well completions are projected to increase on average by 3.7 and 4.3 percent per year in the low and high oil price cases, respectively, compared with 4.0 percent in the reference case (Figure 91). The high growth rates projected for oil and gas drilling reflect, in part, the low level of drilling activity in 1999.

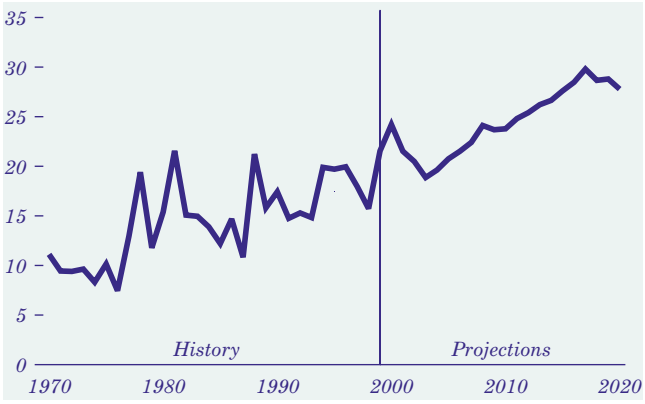
The productivity of natural gas drilling is not expected to decline as much as that of oil drilling, in part because total recoverable gas resources are more abundant than oil resources. At the projected production levels, however, undiscovered recoverable resources of conventional natural gas would decline rapidly in some areas, particularly in the onshore Gulf Coast and offshore Gulf of Mexico regions. The future overall productivity of both oil and gas drilling is necessarily uncertain, given the uncertainty associated with such factors as the extent of the Nation's oil and gas resources [*87*].

Table 15. Natural gas and crude oil drilling in three cases, 1999-2020 (thousand successful wells)

	1999	2000	2010	2020
Natural gas				
Low oil price case		*12.8*	*16.5*	*22.2*
Reference case	*10.3*	*12.8*	*17.5*	*23.4*
High oil price case		*13.0*	*18.1*	*24.3*
Crude oil				
Low oil price case		*5.5*	*5.8*	*8.5*
Reference case	*4.1*	*5.5*	*6.5*	*9.4*
High oil price case		*5.5*	*7.0*	*10.2*

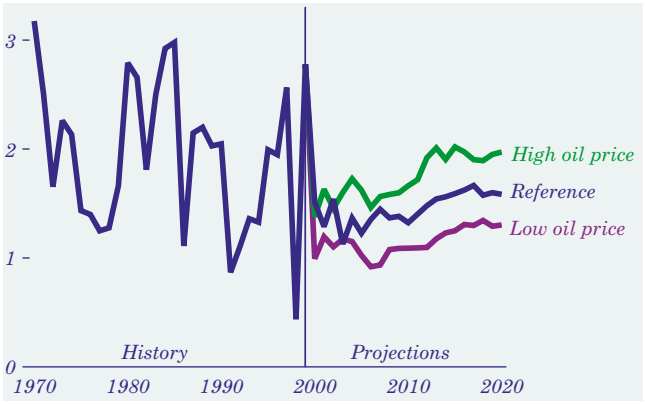
High Levels of Gas Reserve Additions Are Projected Through 2020

Figure 92. Lower 48 natural gas reserve additions in the reference case, 1970-2020 (trillion cubic feet)



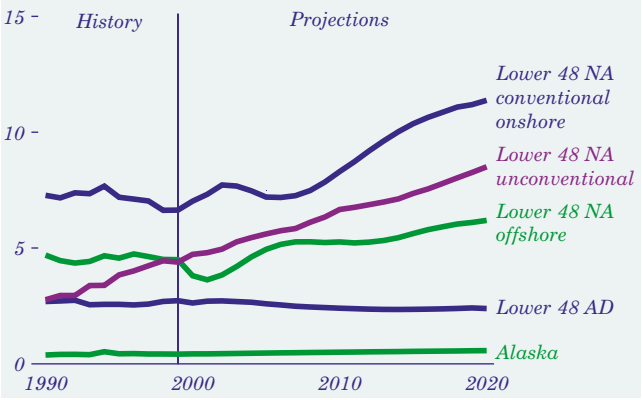
For most of the past two decades lower 48 production of both oil and natural gas has exceeded reserve additions, but the pattern for natural gas reversed from 1994 through 1997. Although reserve additions fell below production in 1998 with the decline in prices, they exceeded production again in 1999. After 2004, rising prices are projected to result in natural gas reserve additions that generally exceed production through 2020 (Figure 92), even with expected increases in demand. The relatively high projected levels of annual gas reserve additions through 2020 reflect an expected increase in exploratory and developmental drilling as a result of higher prices, as well as expected productivity gains from technology improvements comparable to those of recent years. For the most part, total lower 48 crude oil production is projected to continue to exceed total reserve additions (Figure 93), except in the later years in the high world oil price case.

Figure 93. Lower 48 crude oil reserve additions in three cases, 1970-2020 (billion barrels)



Significant New Finds Are Likely To Continue Increases in Gas Production

Figure 94. Natural gas production by source, 1990-2020 (trillion cubic feet)



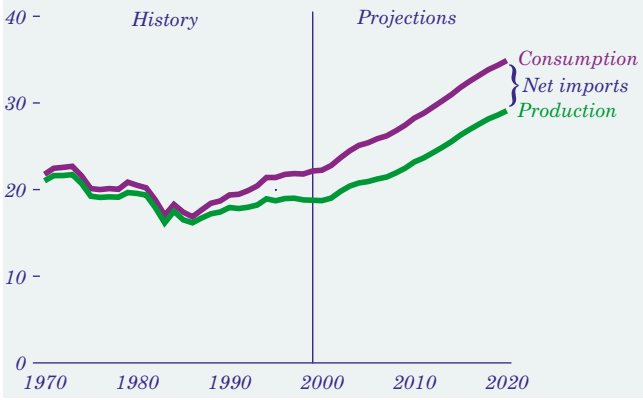
The continuing increase in domestic natural gas production in the forecast is expected to come primarily from lower 48 onshore nonassociated (NA) sources (Figure 94). Conventional onshore production is projected to grow rapidly from 2006 through 2020, increasing in share from 35.5 percent of total U.S. domestic production in 1999 to 39.2 percent of the total in 2020. Gas production from unconventional sources is projected to increase steadily over the forecast as a result of technology advances, playing a key role in meeting projected demand. Offshore production is projected to increase less rapidly but to remain a major source of domestic supply. Innovative use of cost-saving technology in recent years and the expected mid-term continuation of recent huge finds, particularly in the deep waters of the Gulf of Mexico, support the projections.

Natural gas production from Alaska is projected to grow by 1.5 percent per year through 2020, not including gas from the North Slope. The future of North Slope gas is uncertain, however. Current options under consideration include transporting the gas through a pipeline, converting it to liquefied natural gas, and converting it to synthetic petroleum products [*88*].

Production of associated-dissolved (AD) natural gas from lower 48 crude oil reservoirs generally declines in the projections, following the expected pattern of domestic crude oil production. AD gas is projected to account for 8.2 percent of total production in 2020, compared with 14.6 percent in 1999.

Net Imports of Natural Gas Grow in the Projections

Figure 95. Natural gas production, consumption, and imports, 1970-2020 (trillion cubic feet)



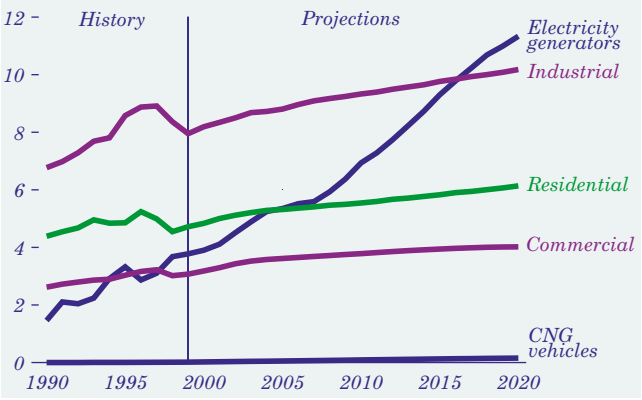
Net natural gas imports are expected to grow in the forecast (Figure 95) from 15.8 percent of total gas consumption in 1999 to 16.7 percent in 2020. Most of the increase is attributable to imports from Canada, which are projected to grow substantially. Most of the additional imports are expected to come from western Canada. In addition, new pipeline capacity is now providing access to eastern supplies. Natural gas from Sable Island, in the offshore Atlantic, began flowing on January 1, 2000.

Mexico has a considerable natural gas resource base, but its indigenous production is unlikely to increase sufficiently to satisfy rising demand. Since 1984, U.S. natural gas trade with Mexico has consisted primarily of exports. That trend is expected to continue throughout the forecast, especially in light of continuing additions to cross-border pipeline capacity. U.S. exports to Mexico are projected to grow from 60 billion cubic feet in 1999 to 520 billion cubic feet in 2020.

Imports of liquefied natural gas (LNG) are projected to increase by 8.0 percent per year on average, resulting in part from the expected reactivation of both the Elba Island terminal in Georgia and the Cove Point terminal in Maryland in 2003. LNG is not expected to grow beyond a regionally significant source of U.S. supply, however. LNG imports are projected to reach a level of 0.81 trillion cubic feet in 2020, compared with 0.16 trillion cubic feet in 1999.

Projected Increases in Natural Gas Use Are Led by Electricity Generators

Figure 96. Natural gas consumption by sector, 1990-2020 (trillion cubic feet)

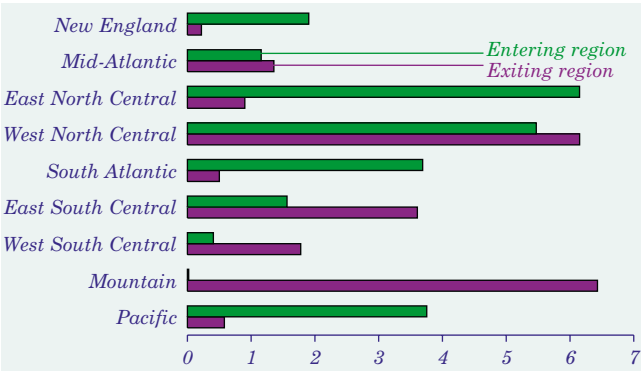


In all the *AEO2001* cases, total natural gas consumption is projected to increase from 1999 to 2020. The projections for domestic consumption in 2020 range from 32.2 trillion cubic feet per year in the low economic growth case to 36.1 trillion cubic feet in the high growth case, as compared with an estimated 21.4 trillion cubic feet in 1999. Although rising demand by electricity generators accounts for 57 percent of the increase in the reference case, growth is also expected in the residential, commercial, industrial, and transportation sectors (Figure 96). Natural gas consumption in the electricity generation sector is projected to grow steadily throughout the forecast as demand for electricity increases and retiring nuclear and older oil and gas steam plants are replaced by gas turbines and combined-cycle facilities.

In the reference case, natural gas consumption for electricity generation (excluding cogeneration) is projected to increase from 3.8 trillion cubic feet in 1999 to 11.3 trillion cubic feet in 2020. In 2017 electricity generation is projected to surpass the industrial sector as the largest consumer of natural gas. Although coal prices to the electricity generation sector are projected to fall throughout the forecast, lower capital costs, shorter construction lead times, higher efficiencies, and lower emissions are expected to give gas-fired generators an advantage over coal-fired plants for new capacity additions in most regions of the United States. Natural-gas-fired facilities are less capital-intensive than coal, nuclear, or renewable electricity generation plants. In addition, the environmental advantages of natural gas are expected to favor increased utilization of existing gas-fired power plants.

Gas Pipeline Capacity Expansion Is Needed To Serve New Markets

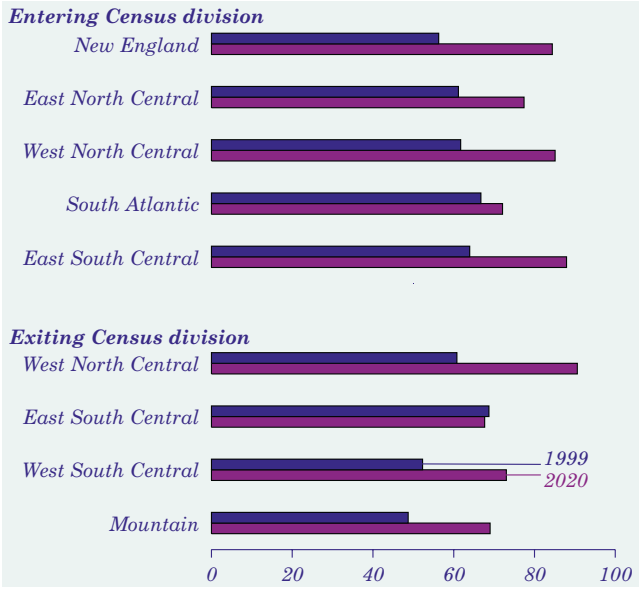
Figure 97. Projected pipeline capacity expansion by Census division, 1999-2020 (billion cubic feet per day)



Projected growth in natural gas consumption will require additional pipeline capacity. Expansion of interstate capacity (Figure 97) will be needed to provide access to new supplies and to serve expanding markets. Expansion is projected to proceed at an average rate of 1.0 percent per year in the forecast.

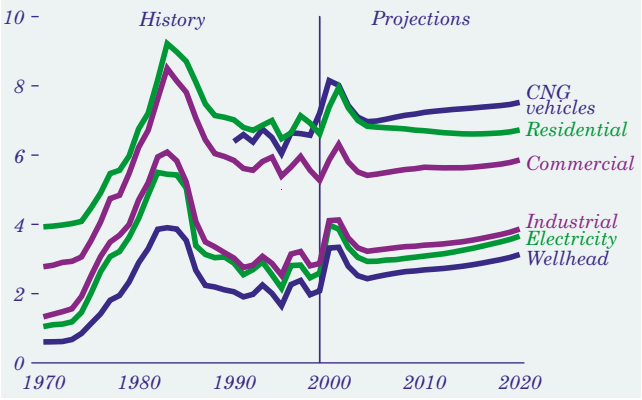
The greatest increases in capacity are expected along the corridors that provide access to Canadian, Gulf Coast, and Mountain region supplies and deliver them to the South Atlantic, Pacific, and Northeast regions. In all regions, growth in new pipeline construction is expected to be tempered by higher utilization of existing pipeline capacity (Figure 98).

Figure 98. Projected pipeline capacity utilization by Census division, 1999 and 2020 (percent)



Competitive Markets Keep Residential Gas Prices in Check

Figure 99. Natural gas end-use prices by sector, 1970-2020 (1999 dollars per thousand cubic feet)



Consumer prices for natural gas in all the end-use sectors are projected to be higher in 2020 that they were in 1999 (Figure 99), but prices in the residential and transportation sectors are expected to remain within 5 percent of 1999 levels. The limited price increases in the forecast reflect expectations for declining distribution margins, due in part to anticipated efficiency improvements in an increasingly competitive market. Margins in the industrial sector are projected to remain relatively constant, and growth in end-use prices is expected to result mainly from wellhead price increases. In the electricity generation sector, expected increases in both pipeline margins and wellhead prices combine to yield a projected 1.6-percent average annual increase in end-use prices.

Compared with their rise and decline over the 1970 to 1999 period, transmission and distribution revenues in the natural gas industry are projected to grow relatively steadily from 2000 forward, increasing overall at an average rate of 1.1 percent per year (Table 16). Declines in margins are expected to be balanced by higher volumes.

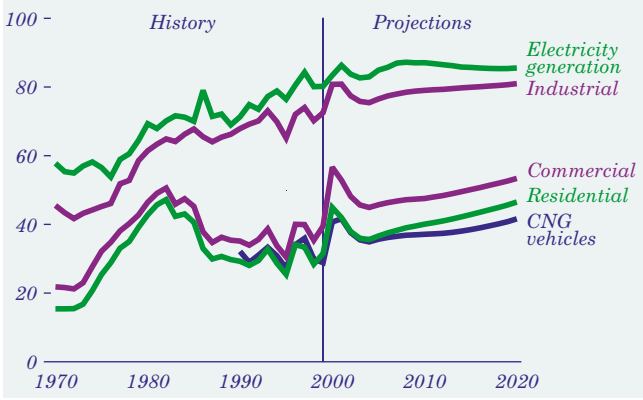
Table 16. Transmission and distribution revenues and margins, 1970-2020

	1970	1985	1999	2010	2015	2020
T&D revenues (billion 1999 dollars)	30.73	49.62	39.86	44.59	47.01	49.82
End-use consumption (trillion cubic feet)	19.21	15.97	21.41	28.05	31.61	34.73
Average margin* (1999 dollars per thousand cubic feet)	1.62	3.14	2.04	1.74	1.63	1.57

*Revenue divided by end-use consumption.

Distribution Costs Claim a Smaller Share of Residential Gas Prices

Figure 100. Wellhead share of natural gas end-use prices by sector, 1970-2020 (percent)



With distribution margins projected to decline, the wellhead shares of end-use prices generally increase in the forecast (Figure 100). The greatest impact is expected in the residential and commercial markets, where most customers purchase gas through local distribution companies (LDCs). In the electricity generation sector, the majority of customers do not purchase from distributors.

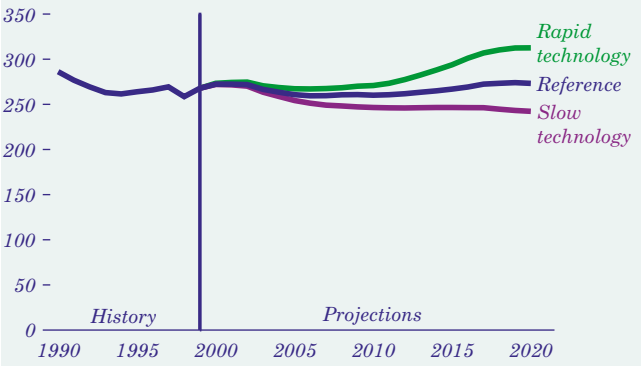
Changes have been seen historically in all components of end-use prices (Table 17). Pipeline margins dropped significantly between 1985 and 1999 with industry restructuring, and the decline is projected to continue through 2010. From 2010 to 2020, pipeline margins are projected to remain relatively flat. LDC margins in the residential and commercial sectors were above 1985 levels in 1999, but efficiency improvements and other impacts of restructuring are expected to exert downward pressure on distribution costs, and lower margins are projected for both the residential and commercial sectors in 2010 and 2020.

Table 17. Components of residential and commercial natural gas end-use prices, 1985-2020 (1999 dollars per thousand cubic feet)

Price Component	1985	1999	2010	2020
Wellhead price	3.38	2.08	2.69	3.13
Citygate price	5.05	3.10	3.60	4.04
Pipeline margin	1.67	1.02	0.91	0.91
LDC margin				
Residential	3.19	3.59	3.10	2.69
Commercial	2.36	2.39	2.05	1.82
End-use price				
Residential	8.24	6.69	6.70	6.73
Commercial	7.41	5.49	5.65	5.86

Technology Advances Could Improve Finding and Drilling Success Rates

Figure 101. Lower 48 crude oil and natural gas end-of-year reserves in three technology cases, 1990-2020 (quadrillion Btu)



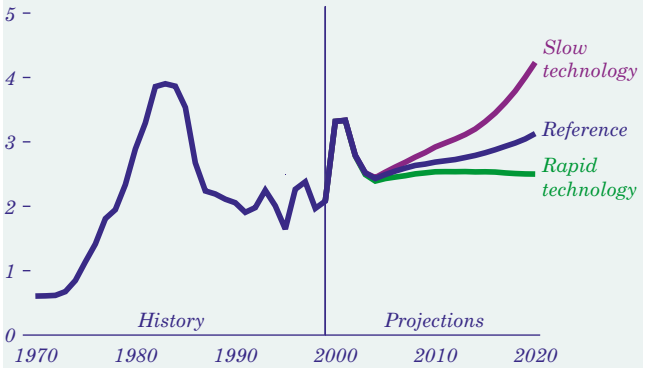
In the forecast, major advances in data acquisition, data processing, and the display and integration of seismic data with other geologic data—combined with lower cost computer power and experience gained with new techniques—are projected to continue putting downward pressure on costs while significantly improving finding and success rates. Effective use of improved exploration and production technologies to aid in the discovery and development of resources—particularly, unconventional gas and offshore deepwater fields—will be needed if new reserves are to replace those depleted by production.

Alternative cases assess the sensitivity of the projections to changes in success rates, exploration and development costs, and finding rates as a result of technological progress. The assumed technology improvement rates increase and decrease by 25 percent in the rapid and slow technology cases, which are analyzed as fully integrated model runs. All other parameters in the model are at their reference case values, including technology parameters in other energy markets, parameters affecting foreign oil supply, and assumptions about foreign natural gas trade, excluding Canada.

Although gas reserves are projected to make up a slightly larger share of the total in the reference case, total hydrocarbon reserve additions are expected to offset production, keeping total reserves essentially constant throughout the forecast (Figure 101). By 2020, reserves are projected to be 14.4 percent higher in the rapid technology case than in the reference case and 11.3 percent lower in the slow technology case.

Gas Price Projections Change With Technology Assumptions

Figure 102. Lower 48 natural gas wellhead prices in three technology cases, 1970-2020 (1999 dollars per thousand cubic feet)



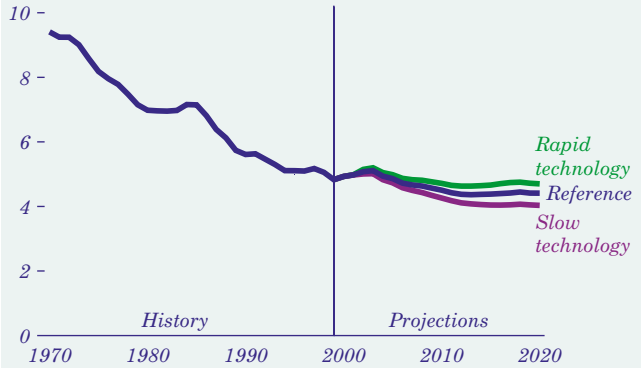
The natural gas price projections are highly sensitive to changes in assumptions about technological progress (Figure 102). Lower 48 wellhead prices are projected to increase at an average annual rate of 3.4 percent in the slow technology case, compared with only 2.0 percent in the reference case, over the projection period. In the rapid technology case, average natural gas wellhead prices are projected to remain relatively flat through 2020 at about $2.50 per thousand cubic feet.

Through 2003, the projections of both price and production levels for lower 48 oil and natural gas are almost identical in the reference case and the two technological progress cases. By 2020, however, natural gas prices are projected to be 35.1 percent higher (at $4.23 per thousand cubic feet) in the slow technology case and 20.1 percent lower (at $2.50 per thousand cubic feet) in the rapid technology case than the reference case level of $3.13 per thousand cubic feet.

Unlike the projections for natural gas prices, those for lower 48 average wellhead prices for crude oil do not vary significantly across the technology cases. In both the rapid and slow technology cases, the projections for crude oil prices vary from the reference case projections by at most $0.14 per barrel. Domestic oil prices are determined largely by the international market; changes in U.S. oil production do not constitute a significant volume relative to the global market.

More Rapid Technology Advances Could Raise Oil Production Slightly

Figure 103. Lower 48 crude oil production in three technology cases, 1970-2020 (million barrels per day)



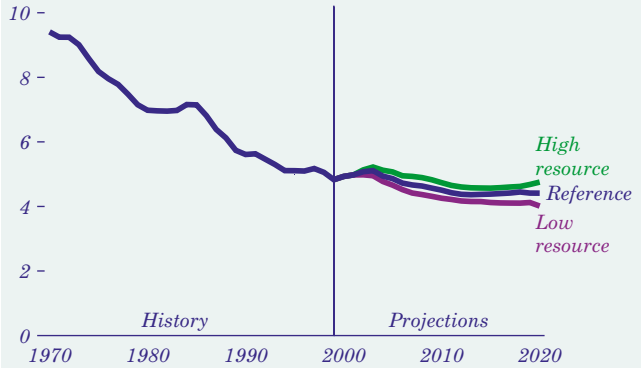
Projections for domestic oil production also are sensitive to changes in technological progress assumptions (Figure 103). In comparison with the projected lower 48 production level of 4.4 million barrels per day in 2020 in the reference case, oil production is projected to increase to 4.7 million barrels per day in the rapid technology case and to decrease to 4.0 million barrels per day in the slow technology case.

Given the assumption that changes in the levels of technology affect only U.S. oil producers, total oil supply adjusts to the variations in technological progress assumptions primarily through changes in imports of crude oil and other petroleum products. Net imports in 2020 are projected to range from a low of 16.1 million barrels per day in the rapid technology case to a high of 17.4 million barrels per day in the slow technology case.

Offshore oil production in the lower 48 States shows more sensitivity than onshore production to changes in technological progress assumptions, because large deepwater fields that are not economically feasible in the slow technology case are projected to become profitable in the rapid technology case. Cumulative offshore production from 1999 through 2020 is projected to be about 745 million barrels (4.9 percent) higher in the rapid technology case than in the reference case and 922 million barrels (6.0 percent) lower in the slow technology case than in the reference case. For onshore production, in contrast, the projected differences are only 3.5 percent and 3.6 percent. The projections for Alaskan oil production vary by about 3.9 percent from the reference case in both the rapid and slow technology cases.

Oil Production Forecasts Vary, Depending on Resource Estimates

Figure 104. Lower 48 crude oil production in three oil and gas resource cases, 1970-2020 (million barrels per day)



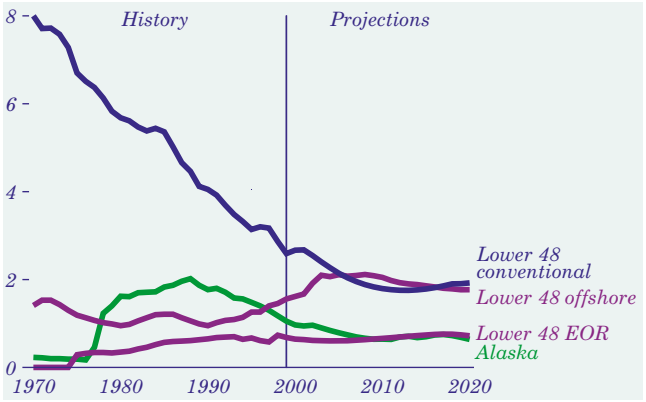
Another important assumption for the projections of domestic oil and gas resources is the size of the domestic resource base. Two alternative cases were used to evaluate the impacts of uncertainty in the resource estimates. In the high and low resource sensitivity cases, the estimates for both undiscovered technically recoverable resources and inferred reserves for conventional onshore and offshore production were increased and decreased, respectively, by 20 percent. As in the other *AEO2001* cases, resources in areas currently restricted from exploration and development were excluded from the resource assumption.

In the high resource case, both oil production levels and industry profits are projected to increase over those projected in the reference case. Lower 48 crude oil production is projected to reach 4.8 million barrels per day in 2020, as compared with 4.4 million barrels per day projected in the reference case (Figure 104). The corresponding projection in the low resource case is 4.0 million barrels per day.

The variations in oil production projections in the two resource sensitivity cases lead to similar variations in the projections of oil import dependence. In the high resource case, with higher projected production levels, net petroleum imports are projected to make up 62 percent of domestic supply in 2020, compared with 64 percent in the reference case. In the low resource case, with lower projected domestic production, imports are projected to make up 68 percent of domestic supply.

Domestic Crude Oil Production Continues To Decline

Figure 105. Crude oil production by source, 1970-2020 (million barrels per day)

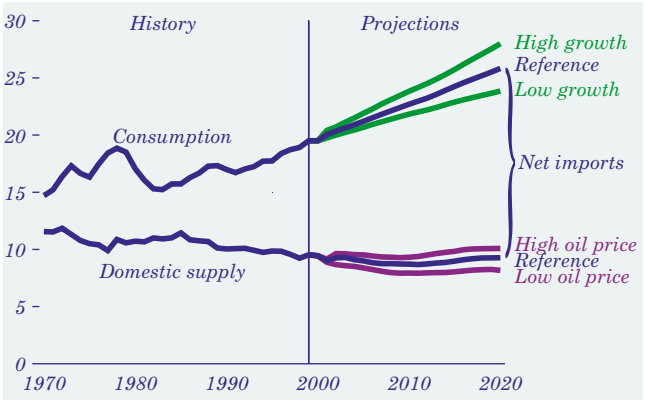


Domestic crude oil production is projected to remain relatively stable from 1999 through 2003 as a result of a favorable price environment and increased success of offshore drilling (Figure 105). A decline in production is projected from 2004 through 2010, followed by another period of projected stable production levels through 2020 as a result of rising prices and continuing improvements in technology [*89*]. In 2020, the projected domestic production level of 5.1 million barrels per day is 0.8 million barrels per day less than the 1999 level.

Conventional onshore production in the lower 48 States, accounting for 44 percent of total U.S. crude oil production in 1999, is projected to decrease to 38 percent in 2020, with production from mature areas expected to decline. Offshore production is projected to range from 1.6 to 2.1 million barrels per day throughout the forecast, surpassing the projected level of lower 48 conventional onshore production from 2006 to 2016. Crude oil production from Alaska is expected to decline at an average annual rate of 2.4 percent between 1999 and 2020. Projected drops in production from most of Alaska's oil fields—particularly Prudhoe Bay, the State's largest producing field—are expected to be offset by production from the National Petroleum Reserve–Alaska (NPRA), which is projected to commence in 2010. Production from the Alaska National Wildlife Refuge (ANWR) is not included, because drilling in the area is currently prohibited. Production from enhanced oil recovery (EOR) [*90*] is expected to slow as it becomes less profitable when oil prices fall in the forecast through 2003, and then to increase along with the world oil price projections until close to the end of the forecast.

Imports Fill the Gap Between Domestic Supply and Demand

Figure 106. Petroleum supply, consumption, and imports, 1970-2020 (million barrels per day)



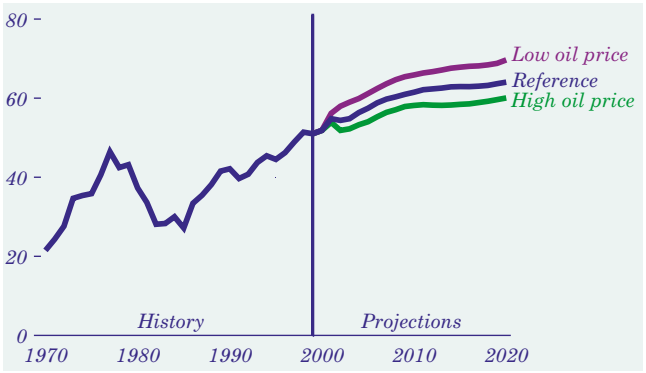
In the reference case, domestic petroleum supply is projected to decline slightly from its 1999 level of 9.5 million barrels per day to 9.3 million barrels per day in 2020 (Figure 106). As U.S. crude oil production falls off, refinery gain and production of natural gas plant liquids are projected to increase. Domestic supply in 2020 is projected to drop to 8.2 million barrels per day in the low oil price case and to rise to 10.1 million barrels per day in the high oil price case.

The greatest variation in petroleum consumption levels is seen across the economic growth cases, with a projected increase of 8.5 million barrels per day over the 1999 level in the high growth case, compared with a projected increase of only 4.4 million barrels per day in the low growth case.

Additional petroleum imports would be needed to fill the projected widening gap between supply and consumption. The greatest gap between supply and consumption is projected in the low world oil price case and the smallest in the low economic growth case. The projections for net petroleum imports in 2020 range from a high of 18.8 million barrels per day in the low oil price case to a low of 15.0 million barrels per day in the low growth case, compared with the 1999 level of 10.0 million barrels per day. The expected value of petroleum imports in 2020 ranges from $115.8 billion in the low price case to $170.8 billion in the high economic growth case. Total annual U.S. expenditures for petroleum imports, which reached a historical peak of $138.9 billion (in 1999 dollars) in 1980 [*91*], were $60.2 billion in 1999.

Growing Dependence on Petroleum Imports Is Projected

Figure 107. Share of U.S. petroleum consumption supplied by net imports in three oil price cases, 1970-2020 (percent)



In 1999, net imports of petroleum accounted for 51 percent of domestic petroleum consumption. Continued dependence on petroleum imports is projected, reaching 64 percent in 2020 in the reference case (Figure 107). The corresponding import shares of total consumption in 2020 are projected to be 60 percent in the high oil price case and 70 percent in the low price case.

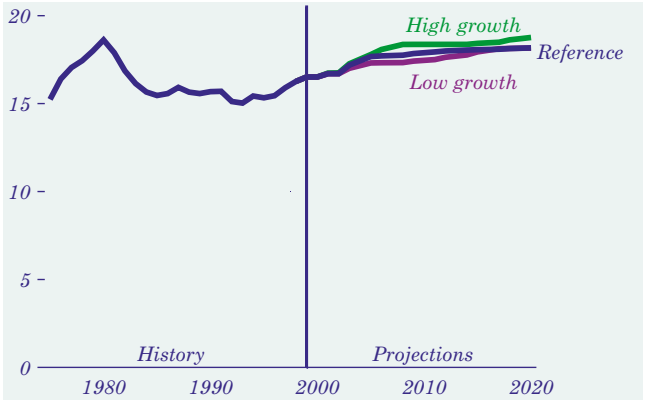
Although crude oil is expected to continue as the major component of petroleum imports, refined products are projected to represent a growing share. More imports would be needed as the projected growth in demand for refined products exceeds the expansion of domestic refining capacity. Refined products are projected to make up 19 percent of net petroleum imports in 2020 in the low economic growth case and 32 percent in the high growth case, as compared with their 13-percent share in 1999 (Table 18).

Table 18. Petroleum consumption and net imports in five cases, 1999 and 2020 (million barrels per day)

Year and projection	Product supplied	Net imports	Net crude imports	Net product imports
1999	19.5	9.9	8.6	1.3
2020				
Reference	25.8	16.5	12.1	4.4
Low oil price	27.0	18.8	13.3	5.5
High oil price	25.3	15.2	11.5	3.7
Low growth	23.9	15.0	12.1	2.9
High growth	28.0	18.2	12.5	5.8

New U.S. Oil Refining Capacity Is Likely To Be at Existing Refineries

Figure 108. Domestic refining capacity in three cases, 1975-2020 (million barrels per day)



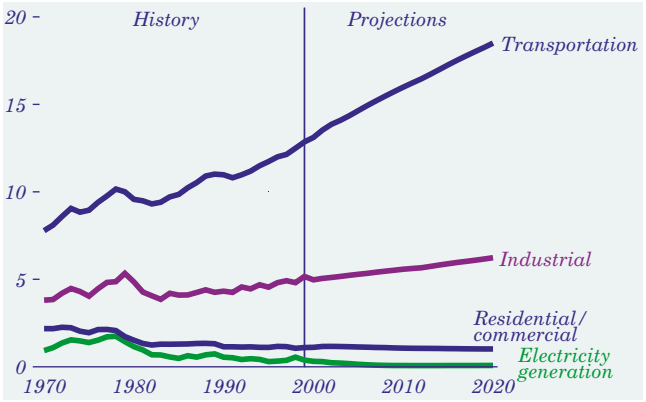
Falling demand for petroleum and the deregulation of the domestic refining industry in the 1980s led to 13 years of decline in U.S. refinery capacity. That trend was reversed in 1995, and 1.2 million barrels per day of distillation capacity had been added by 2000. Financial and legal considerations make it unlikely that new refineries will be built in the United States, but additions at existing refineries are expected to increase total U.S. refining capacity in all the *AEO2001* cases (Figure 108).

Distillation capacity is projected to grow from the 1999 year-end level of 16.5 million barrels per day to 18.2 million in 2020 in the low economic growth case and 18.8 million in the high growth case, compared with the 1981 peak of 18.6 million barrels per day. Almost all the capacity additions are projected to occur on the Gulf Coast. Existing refineries are expected to continue to be utilized intensively throughout the forecast, in a range from 91 percent to 95 percent of design capacity. In comparison, the 1999 utilization rate was 93 percent, well above the rates of the 1980s and early 1990s.

Additional "downstream" processing units are expected to allow domestic refineries to produce less residual fuel, which has a shrinking market, and more higher value "light product" such as gasoline, distillate, jet fuel, and liquefied petroleum gases.

Petroleum Use Increases Mainly in the Transportation Sector

Figure 109. Petroleum consumption by sector, 1970-2020 (million barrels per day)



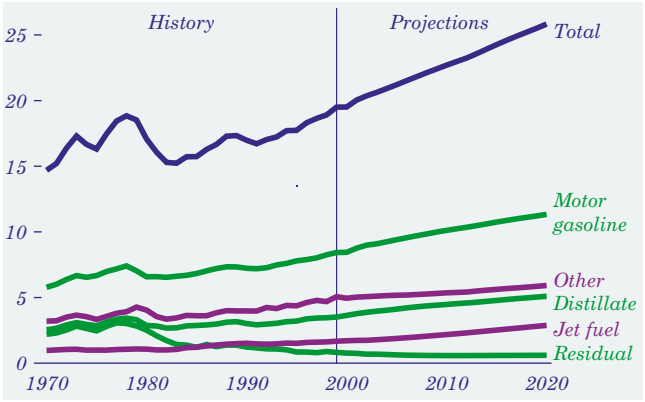
U.S. petroleum consumption is projected to increase by 6.3 million barrels per day between 1999 and 2020. Most of the increase is expected in the transportation sector, which accounted for two-thirds of U.S. petroleum use in 1999 (Figure 109). Petroleum use for transportation is projected to increase by 5.6 million barrels per day in the reference case, 4.3 million in the low economic growth case, and 7.0 million in the high economic growth case.

In the industrial sector, which currently accounts for 26 percent of U.S. petroleum use, consumption in 2020 is projected to be higher than the 1999 level by 1.1 million barrels per day in the reference case, by 0.4 million in the low economic growth case, and by 1.9 million in the high economic growth case. About 84 percent of the growth is expected in the petrochemical, construction, and refining sectors.

In the reference case, petroleum use for heating and for electricity generation is expected to decline as oil loses market share to natural gas. Increased oil use for heating and electricity generation is projected, however, in the low oil price case. Natural gas use for home heating is growing in New England, the last stronghold of heating oil. Compared with 1999, heating oil use is projected to be 150,000 barrels per day lower in 2020 in the high price case and 90,000 barrels per day higher in the low price case. For electricity generation, oil-fired steam plants are being retired in favor of natural gas combined-cycle units. Oil use for electricity generation (excluding cogeneration) is projected to be 320,000 barrels per day lower in 2020 than in 1999 in the high price case and 110,000 barrels per day higher in the low price case.

Light Products Account for Most of the Increase in Demand for Petroleum

Figure 110. Consumption of petroleum products, 1970-2020 (million barrels per day)

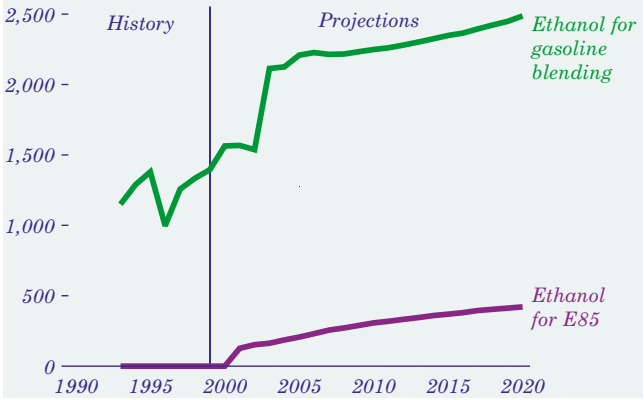


About 96 percent of the projected growth in petroleum consumption stems from increased consumption of "light products," including gasoline, diesel, heating oil, jet fuel, and liquefied petroleum gases, which are more difficult and costly to produce than heavy products (Figure 110). Although refinery investments and enhancements are expected to increase the ability of domestic refineries to produce light products, imports of light products are expected to more than triple by 2020.

In the forecast, gasoline continues to account for almost 45 percent of all the petroleum used in the United States. Between 1999 and 2020, U.S. gasoline consumption is projected to rise from 8.4 million barrels per day to 11.3 million barrels per day. Consumption of distillate fuel is projected to be 1.6 million barrels per day higher in 2020 than it was in 1999, with diesel fuel accounting for 92 percent of the projected increase as demand for freight transportation grows. With air travel also expected to increase, jet fuel consumption is projected to be 1.2 million barrels per day higher in 2020 than in 1999. Consumption of liquefied petroleum gas (LPG), included in "other" petroleum, is projected to increase by about 360,000 barrels per day between 1999 and 2020. Consumption of "other" petroleum products—including petrochemical feedstocks, still gas used to fuel refineries, asphalt and road oil, and other miscellaneous products—is projected to grow by 490,000 barrels per day. Residual fuel use, mainly for electricity generation, is projected to decline from 820,000 barrels per day in 1999 to 600,000 barrels per day in 2020.

State Bans on MTBE Are Expected To Result in Increased Use of Ethanol

Figure 111. U.S. ethanol consumption, 1993-2020 (million gallons)



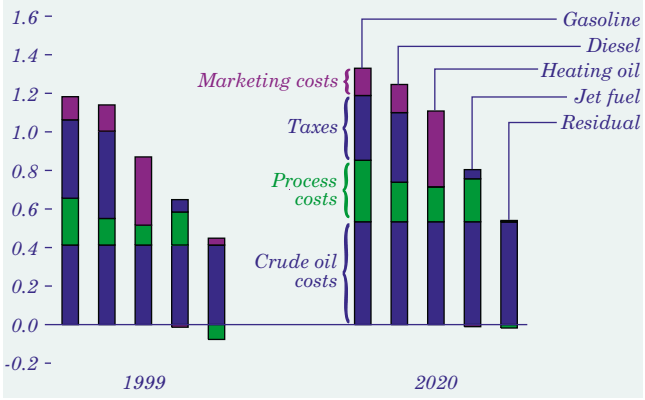
U.S. ethanol production, with corn as the primary feedstock, reached 1.5 billion gallons in 1999. Production is projected to increase to 2.9 billion gallons by 2020, with most of the growth coming from the conversion of cellulosic biomass to ethanol. Ethanol is used primarily in the Midwest as a gasoline volume extender and octane enhancer in a blend of 10 percent ethanol and 90 percent gasoline. It also serves as an oxygenate in areas that are required to use oxygenated fuels (with a minimum 2.7 percent oxygen content by volume) during the winter months to reduce carbon monoxide emissions.

AEO2001 projects an expanded role for ethanol, replacing MTBE as the oxygenate for reformulated gasoline (RFG) in the eight States that have passed legislation limiting the use of MTBE because of concerns about groundwater contamination. The reference case assumes that the Federal requirement for a 2-percent oxygen content in RFG will continue in all States. Ethanol consumption in E85 vehicles is also projected to increase, from the national total of 2.0 million gallons in 1999 to 421 million gallons in 2020 (Figure 111). E85 vehicles are currently in use as government fleet vehicles, flexible-fuel passenger vehicles (which run on either E85 or gasoline), and urban transit buses.

The Federal Highway Bill of 1998 extended the current excise tax exemption for ethanol through 2007 but stipulated reductions from 54 cents per gallon to 53 cents in 2001, 52 cents in 2003, and 51 cents in 2005. *AEO2001* assumes that the exemption will be extended at 51 cents per gallon (nominal) through 2020.

Processing Costs for Most Petroleum Products Rise in the Forecast

Figure 112. Components of refined product costs, 1999 and 2020 (1999 dollars per gallon)



Refined product prices are determined by crude oil costs, refining process costs (including refiner profits), marketing costs, and taxes (Figure 112). In the *AEO2001* projections, crude oil costs are projected to continue making the greatest contribution to product prices and marketing costs are projected to remain stable, but the contributions of processing costs and taxes are expected to change considerably.

The processing costs for light products, including gasoline, diesel fuel, heating oil, and jet fuel, are projected to increase by 6 to 7 cents per gallon between 1999 and 2020. The expected increases are attributed primarily to the projected growth in demand for those products, investment needed to meet new Federal requirements for low-sulfur gasoline between 2004 and 2007, and investments related to compliance with refinery emissions, health, and safety regulations.

Whereas processing costs tend to increase refined product prices in the forecast, assumptions about Federal taxes tend to slow the growth of motor fuels prices. In keeping with the *AEO2001* assumption of current laws and legislation, Federal motor fuels taxes are assumed to remain at nominal 1999 levels throughout the forecast, although Federal taxes have actually been raised sporadically in the past. State motor fuels taxes are assumed to keep up with inflation, as they have in the past. The net impact of the assumptions is an expected decrease in Federal taxes (in 1999 dollars) between 1999 and 2020—7 cents per gallon for gasoline, 9 cents for diesel fuel, and 1 cent for jet fuel.