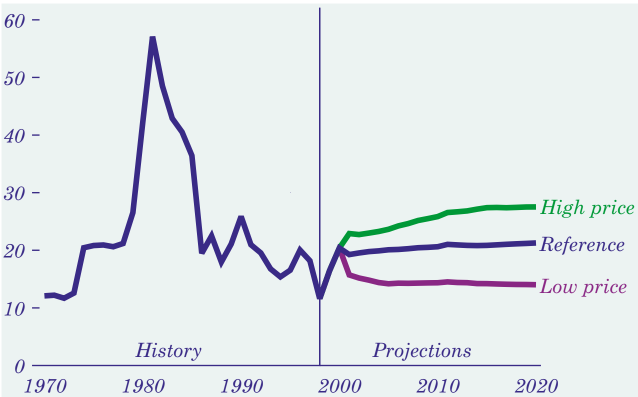
Oil Prices Are Expected To Remain Above Low 1998 Levels

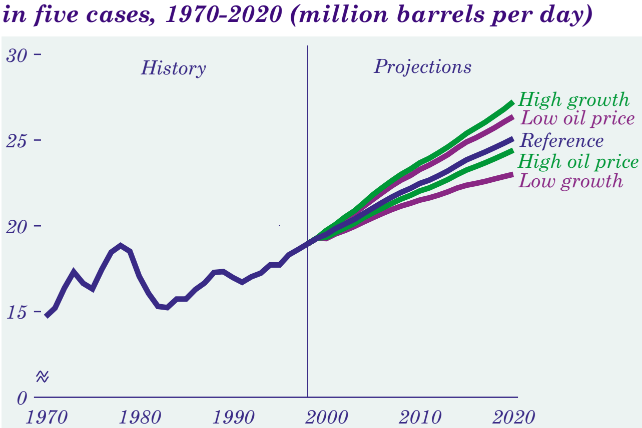
Figure 84. Lower 48 crude oil wellhead prices in three cases, 1970-2020 (1998 dollars per barrel)



Because domestic prices for crude oil are determined largely by the international market, the recovery from the 1998 decline in world oil prices causes a steep increase in wellhead prices for crude oil in the lower 48 States from 1998 through 2000 in all cases. After 2000, prices initially decline in the reference and low world oil price cases, then prices in all cases generally increase through the rest of the forecast. Prices remain above 1998 levels throughout the forecast in all cases, with wellhead prices projected to increase by 0.9, 2.8, and 4.0 percent a year from 1998 to 2020 in the low world oil price, reference, and high world oil price cases, respectively (Figure 84).

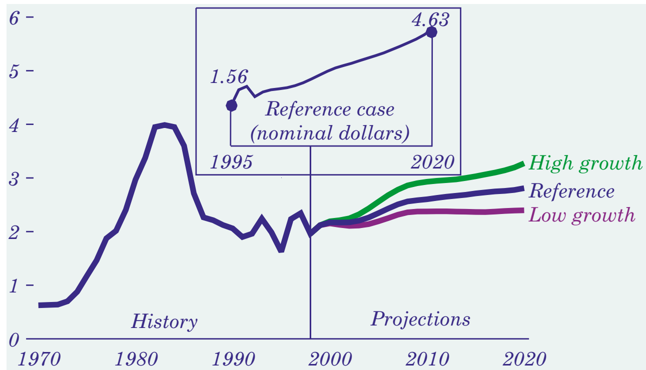
U.S. petroleum consumption continues to rise in all the *AEO2000* cases (Figure 85). Total petroleum product supplied ranges from 23.0 million barrels per day in the low economic growth case to 27.3 million in the high growth case, as compared with 18.9 million barrels per day in 1998.

Figure 85. 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 86. Lower 48 natural gas wellhead prices in three cases, 1970-2020 (1998 dollars per thousand cubic feet)



Wellhead prices for natural gas in the lower 48 States increase on average by 0.9, 1.7, and 2.4 percent a year in the low economic growth, reference, and high economic growth cases, respectively (Figure 86). The reference case price increases from $1.96 per thousand cubic feet in 1998 to $2.81 in 2020. The increases reflect rising demand for natural gas and its impact on the natural progression of the discovery process from larger and more profitable fields to smaller, less economical ones. Price increases also reflect more production from higher cost sources, such as unconventional gas recovery. Growth in lower 48 unconventional gas production ranges from 1.3 to 2.7 percent a year across cases, compared with a 2.1- to 2.2-percent range in annual growth for conventional sources across the cases. Despite the changes in sources of production, technically recoverable resources (Table 10) remain more than adequate overall to meet the production increases.

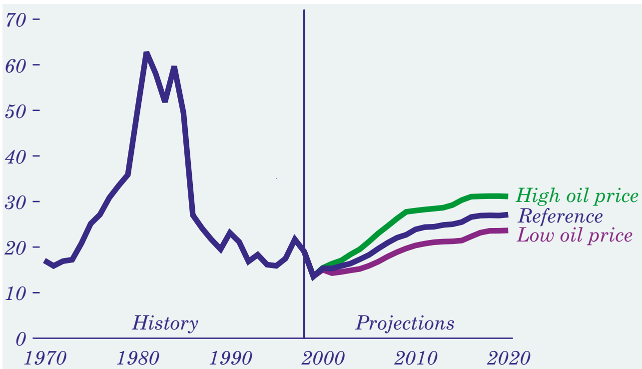
Although consumption, and thus production and price levels, for natural gas rise in all three cases, the price increases attributable to the rising demand are tempered by the beneficial impacts of technological progress on both the discovery process and production operations.

Table 10. Technically recoverable U.S. oil and gas resources as of January 1, 1998

Total U.S. resources	Crude oil (billion barrels)	Natural gas (trillion cubic feet)
Proved	24	167
Unproved	116	1,092
Total	**140**	**1,259**

Rising Gas Prices and Lower Drilling Costs Increase Well Completions

Figure 87. Successful new lower 48 natural gas and oil wells in three cases, 1970-2020 (thousand successful wells)



Both exploratory drilling and developmental drilling increase in the forecast. With rising prices and declining drilling costs, crude oil and natural gas well completions increase on average by 1.4 and 2.7 percent a year in the low and high oil price cases, respectively, compared with 2.1 percent in the reference case (Figure 87). Projected oil drilling varies more than gas drilling in the world oil price cases (Table 11), reflecting the relative sizes of the changes in prices for the two fuels.

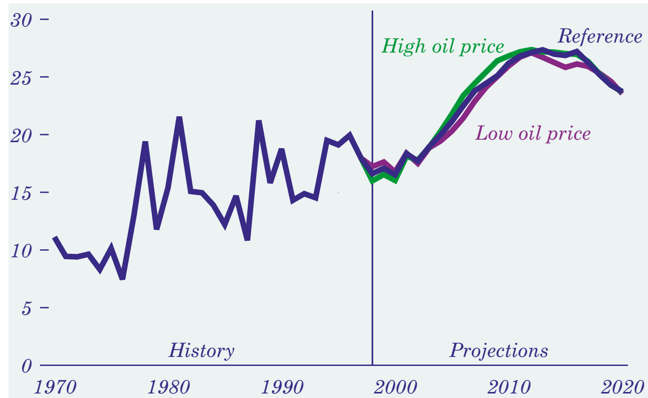
The productivity of natural gas drilling does not decline as much as that of oil drilling, in part because total recoverable gas resources are more abundant than oil resources. At the projected production levels, however, undiscovered recoverable resources of conventional natural gas decline rapidly in some areas, particularly in the onshore Gulf Coast and offshore Gulf of Mexico regions. In the final analysis, 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 [*66*].

Table 11. Natural gas and crude oil drilling in three cases, 1998-2020 (thousand successful wells)

	1998	2000	2010	2020
Natural gas				
Low oil price case		10.7	14.5	16.5
Reference case	12.1	11.0	15.9	16.9
High oil price case		11.0	17.3	16.7
Crude oil				
Low oil price case		4.3	5.8	7.2
Reference case	7.0	4.4	7.9	10.2
High oil price case		4.4	10.7	14.4

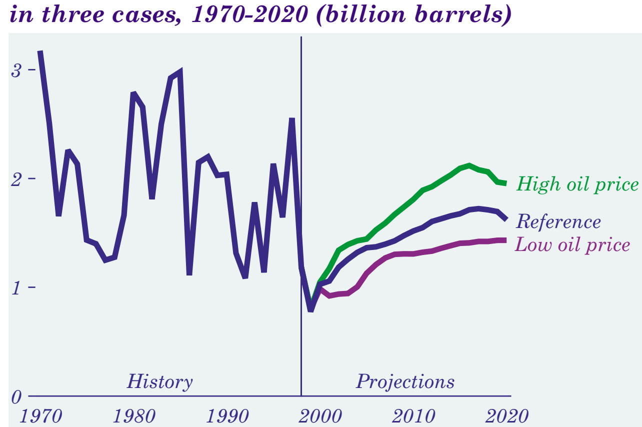
High Levels of Gas Reserve Additions Are Projected Through 2020

Figure 88. Lower 48 natural gas reserve additions in three cases, 1970-2020 (trillion cubic feet)



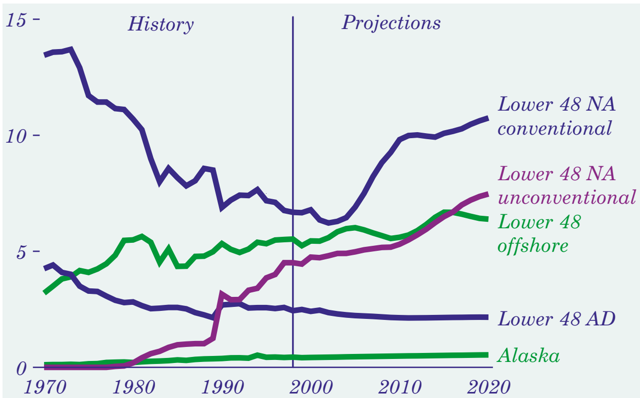
Although for most of the past two decades lower 48 production of both oil and natural gas has exceeded reserve additions, the pattern for natural gas reversed from 1994 through 1997. In 1998, falling prices caused production to exceed reserve additions again. After 2003, rising prices in the forecast cause natural gas reserve additions generally to exceed production until close to the end of the projection period (Figure 88), even with expected increases in demand. Relatively high levels of annual gas reserve additions through 2020 reflect increased exploratory and developmental drilling as a result of higher prices, as well as productivity gains from technology improvements comparable to those of recent years. In contrast, despite varying patterns of lower 48 oil reserve additions (Figure 89), total lower 48 crude oil production exceeds total reserve additions over the forecast period in all cases.

Figure 89. 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 90. Natural gas production by source, 1970-2020 (trillion cubic feet)



The continuing increase in domestic natural gas production in the forecast comes primarily from lower 48 onshore nonassociated (NA) sources (Figure 90). Conventional onshore production, which accounted for 35.4 percent of total U.S. domestic production in 1998, increases in share to 40.7 percent of the total in 2020. Unconventional sources also increase in share, and gas from offshore wells in the Gulf of Mexico contributes significantly to production. The innovative use of cost-saving technology and the expected mid-term continuation of recent huge finds, particularly in the deep waters of the Gulf of Mexico, support this projection.

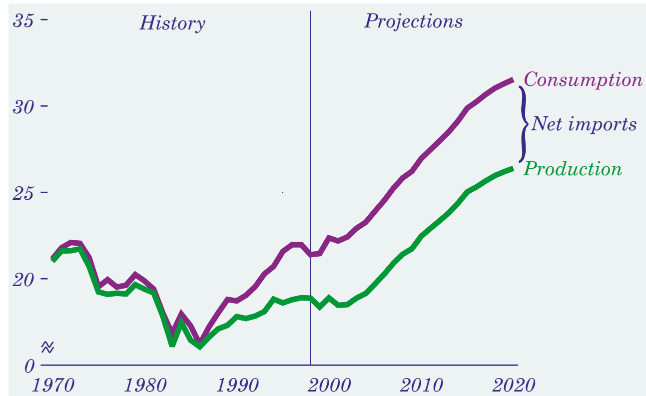
Production from conventional sources is projected to grow rapidly through 2010 in response to increasing demand. After 2010, slower growth of consumption and higher production from increasingly economical offshore and unconventional sources cause production from conventional sources to level off.

Natural gas production from Alaska grows by 0.9 percent a year in the forecast. Alaskan gas is not expected to be transported to the lower 48 States, however, because the projected lower 48 prices are not high enough in the forecast period to support the required transport system [*67*].

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 accounts for 8.4 percent of total lower 48 production in 2020, compared with 14.1 percent in 1998.

Net Imports of Natural Gas Grow in the Projections

Figure 91. Natural gas production, consumption, and imports, 1970-2020 (trillion cubic feet)



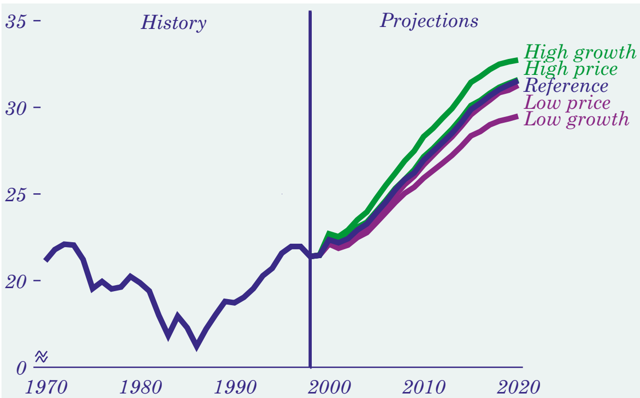
Net natural gas imports are expected to grow in the forecast (Figure 91) from 14.6 percent of total gas consumption in 1998 to 16.3 percent in 2020. Most of the increase is attributable to imports from Canada, which are projected to grow substantially. Although most of the additional imports come from western Canada, new pipeline capacity is also expected to provide access to eastern supplies. Natural gas from Sable Island, in the offshore Atlantic, is expected to begin flowing in late 1999.

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 the recent elimination of the 4-percent import tariff and an increase in cross-border pipeline capacity. U.S. exports to Mexico are projected to grow from 50 billion cubic feet in 1998 to 240 billion cubic feet in 2020.

Imports of liquefied natural gas (LNG) are projected to grow at a rate of 7.2 percent a year, resulting in part from a 50-percent expansion of capacity at the Everett, Massachusetts, terminal and the projected reactivation of the Elba Island terminal in 2002. In spite of this activity, given the projected low natural gas prices in the lower 48 markets, LNG is not expected to grow beyond a regionally significant source of U.S. supply. LNG imports are projected to reach a level of 0.39 trillion cubic feet in 2020, compared with 0.07 trillion cubic feet in 1998 [*68*].

Significant Increases in Natural Gas Use Are Seen in All Cases

Figure 92. Natural gas consumption in five cases, 1970-2020 (trillion cubic feet)

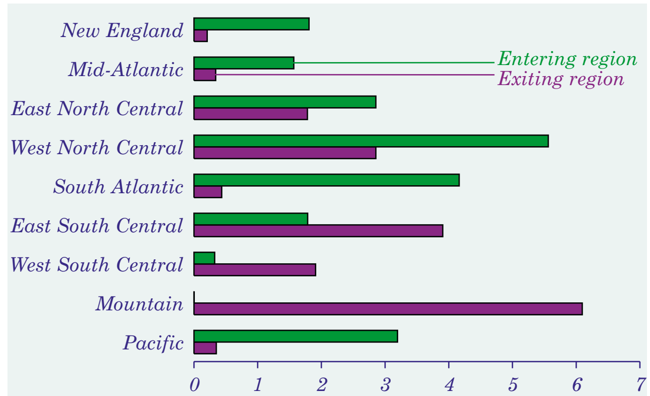


Natural gas consumption increases from 1998 to 2020 in all the *AEO2000* cases (Figure 92). Domestic consumption ranges from 29.5 trillion cubic feet per year in the low economic growth case to 32.7 trillion cubic feet in the high growth case in 2020, as compared with 21.4 trillion cubic feet in 1998. Growth is seen in all end-use sectors, and more than half the increase results from rising demand for electricity generation. Natural gas consumption in the electricity generation sector grows steadily throughout the forecast, as demand for electricity increases and retiring nuclear and older oil and gas steam plants are replaced by turbines and combined-cycle facilities.

In the reference case, natural gas consumption for electricity generation more than doubles, from 3.7 trillion cubic feet in 1998 to 9.3 trillion cubic feet in 2020. Although projected coal prices to the electricity generation sector fall throughout the forecast, the natural gas share of new capacity far outpaces the coal share. Lower capital costs, shorter construction lead times, higher efficiencies, and lower emissions give gas an advantage over coal for new generation in most regions of the United States. Natural-gas-fired facilities are less capital-intensive than coal, nuclear, or renewable electricity generation plants. Growth in natural gas use for electricity generation is also expected to be spurred by the environmental advantages of natural gas.

Gas Pipeline Capacity Expansion Is Needed To Serve New Markets

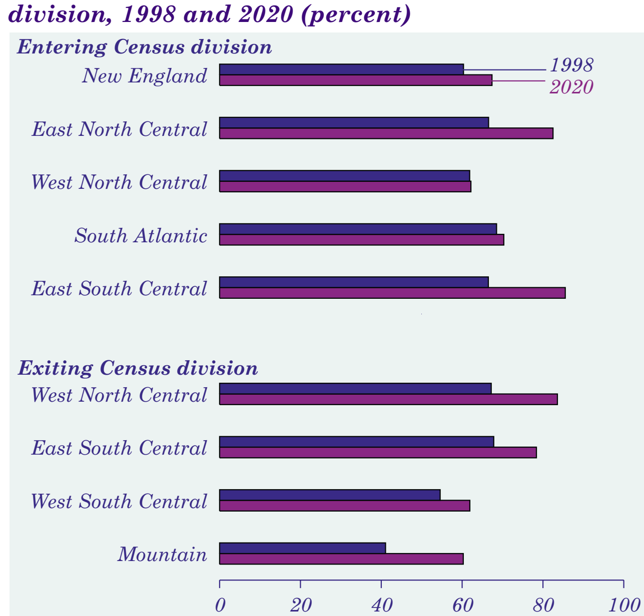
Figure 93. Pipeline capacity expansion by Census division, 1998-2020 (billion cubic feet per day)



Projected growth in natural gas consumption will require additional pipeline capacity. Expansion of interstate capacity (Figure 93) will be needed to provide access to new supplies and to serve expanding markets. Expansion is projected to proceed at an average rate of 0.8 percent a year in the forecast.

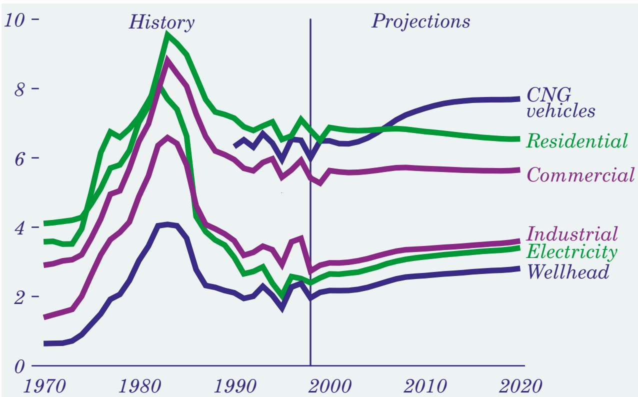
The greatest increases in capacity are expected along the corridors that provide access to Canadian, Gulf Coast, and Mountain region supplies and deliver them to the South Atlantic, Pacific, and Northeast regions. In all regions, growth in new pipeline construction is tempered by higher utilization of existing pipeline capacity (Figure 94).

Figure 94. Pipeline capacity utilization by Census division, 1998 and 2020 (percent)



Competitive Markets Keep Residential Gas Prices in Check

Figure 95. Natural gas end-use prices by sector, 1970-2020 (1998 dollars per thousand cubic feet)



While consumer prices to the industrial, electricity, and transportation sectors increase steadily throughout the forecast period, prices to the residential and commercial sectors remain within 5 percent of 1998 levels (Figure 95). The limited price fluctuations reflect declining distribution margins to these sectors due in part to anticipated efficiency improvements in an increasingly competitive market. Because industrial sector margins remain relatively constant, the growth in end-use prices results mainly from wellhead price increases. In the electricity generation sector, increases in pipeline margins and wellhead prices combine to yield an average 1.6-percent annual rise in end-use prices.

Compared with their rise and decline over the 1970 to 1998 period, transmission and distribution revenues in the natural gas industry are projected to grow steadily from 2002 forward, increasing overall at an average rate of 0.6 percent a year (Table 12). Declines in margins are balanced by higher volumes.

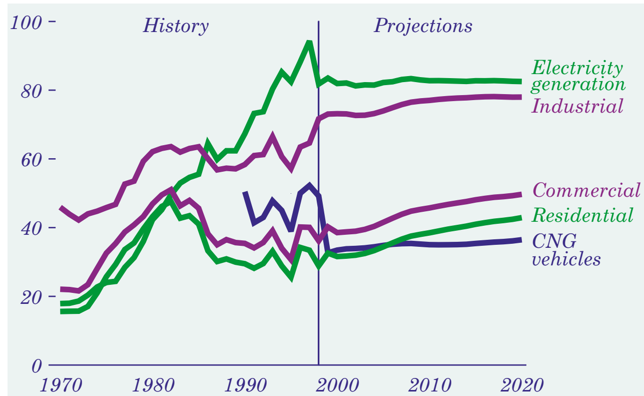
Table 12. Transmission and distribution revenues and margins, 1970-2020

	1970	1985	1998	2010	2015	2020
T&D revenues (billion 1998 dollars)	30.73	49.62	40.14	44.36	45.72	46.12
End-use consumption (trillion cubic feet)	19.21	15.97	19.42	24.68	27.39	28.90
Average margin* (1998 dollars per thousand cubic feet)	1.62	3.14	2.07	1.80	1.67	1.60

*Revenue divided by end-use consumption.

Distribution Costs Claim a Smaller Share of Residential Gas Prices

Figure 96. Wellhead share of natural gas end-use prices by sector, 1970-2020 (percent)



With distribution margins declining, the wellhead shares of end-use prices generally increase in the forecast (Figure 96). The greatest impact is in the residential and commercial markets, where most customers purchase gas through local distribution companies (LDCs). In the electricity generation sector, which has a relatively stable share, the majority of customers do not purchase from distributors.

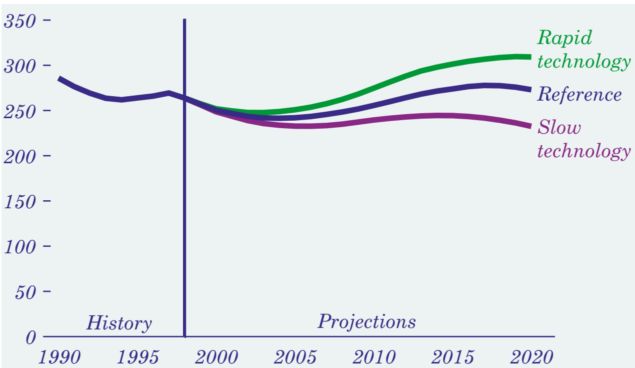
Changes have been seen historically in all components of end-use prices (Table 13). Pipeline margins decreased significantly between 1985 and 1998 with industry restructuring. Although the cost of interstate pipeline expansion causes margins to increase through 2000, modest decreases are projected to continue through the remainder of the forecast period. LDC margins in the residential sector are initially above 1985 levels, but efficiency improvements and other impacts of restructuring exert downward pressure on distribution costs, and reduced margins are projected for both the residential and commercial sectors.

Table 13. Components of residential and commercial natural gas end-use prices, 1985-2020 (1998 dollars per thousand cubic feet)

Price Component	1985	1998	2000	2010	2020
Wellhead price	3.60	1.96	2.17	2.60	2.81
Citygate price	5.38	3.02	3.34	3.76	3.93
Pipeline margin	1.78	1.06	1.17	1.16	1.12
LDC margin					
Residential	3.40	3.77	3.54	3.00	2.62
Commercial	2.51	2.40	2.29	1.93	1.73
End-use price					
Residential	8.78	6.79	6.88	6.76	6.55
Commercial	7.89	5.42	5.63	5.69	5.66

Total Oil and Gas Reserves Change Little Throughout the Forecast

Figure 97. Lower 48 crude oil and natural gas end-of-year reserves in three cases, 1990-2020 (quadrillion Btu)



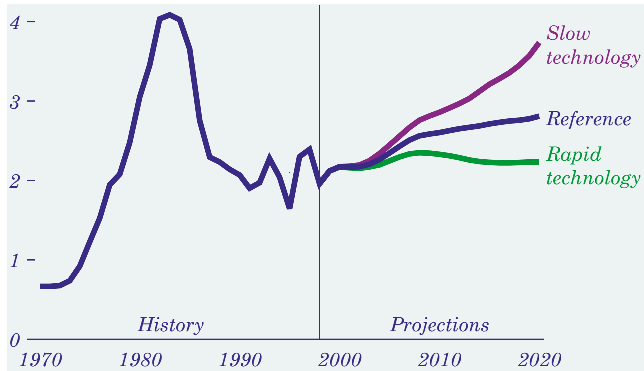
In the forecast, major advances in data acquisition, data processing, and the display and integration of seismic data with other geologic data—combined with lower cost computer power and experience gained with new techniques—continue to put downward pressure on costs while significantly improving finding 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 approximately one-third 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 make up a slightly larger share of the total in the reference case, total hydrocarbon reserve additions offset production, keeping total reserves essentially constant throughout the projection period (Figure 97). By 2020, reserves are 13.2 percent higher in the rapid technology case than in the reference case and 14.8 percent lower in the slow technology case.

Gas Price Projections Change With Technology Assumptions

Figure 98. Lower 48 natural gas wellhead prices in three cases, 1970-2020 (1998 dollars per thousand cubic feet)



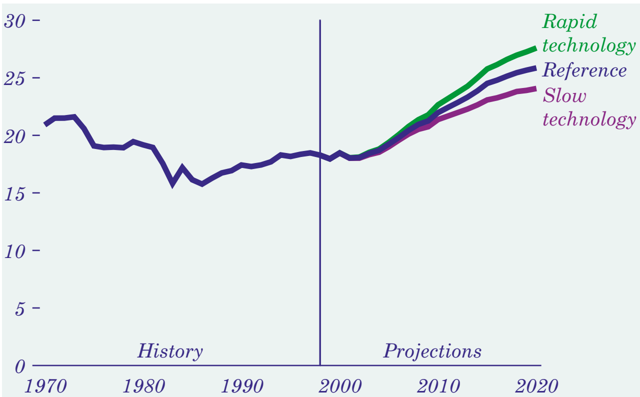
The natural gas price projections are highly sensitive to changes in assumptions about technological progress (Figure 98). Lower 48 wellhead prices increase at an average annual rate of 3.0 percent in the slow technology case, compared with only 1.7 percent in the reference case, over the projection period. In the rapid technology case, average natural gas wellhead prices are projected to remain below the 1997 average wellhead price of $2.39 per thousand cubic feet through 2020.

Through 2000, 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 33.1 percent higher (at $3.74 per thousand cubic feet) in the slow technology case and 20.6 percent lower (at $2.23 per thousand cubic feet) in the rapid technology case than the reference case level of $2.81 per thousand cubic feet.

Unlike natural gas, lower 48 average wellhead prices for crude oil do not vary significantly across the technology cases. In 2020, crude oil prices are 19 cents lower in the rapid technology case and 6 cents higher in the slow technology case than the reference case price of $21.27 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.

Advances in Recovery Technologies Promote Increased Gas Production

Figure 99. Lower 48 natural gas production in three cases, 1970-2020 (trillion cubic feet)



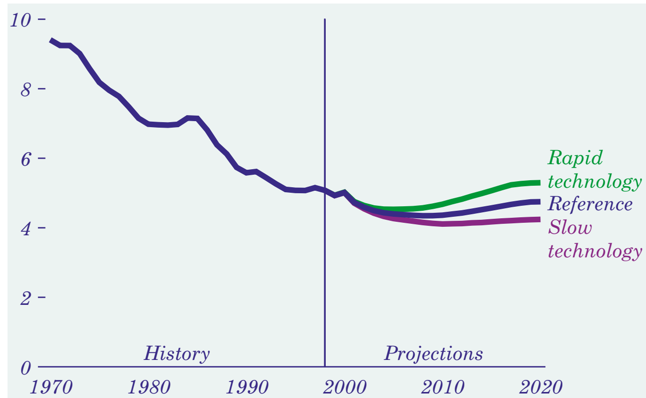
Changes in production in the alternative technology cases reflect the benefits of lower costs and higher finding rates for conventionally recoverable gas, as well as an array of technological enhancements for unconventional gas recovery. The changes in supply lead to price changes that affect new investment in all types of gas-fired technologies, especially in the more price-responsive industrial and electricity generation sectors. Rapid technology improvements yield benefits in the form of both lower prices and increased production to meet higher consumption requirements (Figure 99).

In the rapid technology case, the natural gas share of fossil fuel inputs to electricity generation facilities in 2020 is 31.9 percent, compared with 22.3 percent in the slow technology case. The higher level of gas consumption comes largely at the expense of coal. There is little additional displacement of petroleum products in the rapid technology case, because natural gas captures the bulk of the dual-fired boiler market in the reference case. In contrast, in the slow technology case, natural gas loses market share to both coal and petroleum products in the electricity generation sector.

A slower rate of technology improvement is projected to have little effect on offshore production, whereas rapid technology improvement leads to an 18.9-percent increase in production relative to the reference case in 2020. The reverse is true for unconventional sources: rapid technology improvement has little impact, but slow improvement leads to a 14.2-percent decrease in production relative to the reference case in 2020.

Technology Advances Could Increase Offshore and Alaskan Oil Production

Figure 100. Lower 48 crude oil production in three cases, 1970-2020 (million barrels per day)



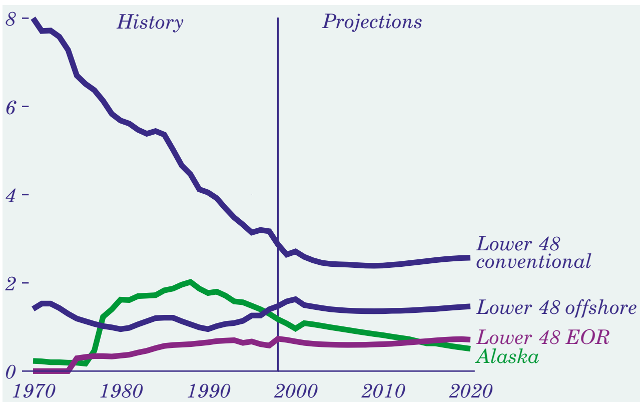
The projections for domestic oil production also are sensitive to changes in the technological progress assumptions (Figure 100). In comparison with the projected lower 48 production level of 4.8 million barrels per day in 2020 in the reference case, oil production increases to 5.3 million barrels per day in the rapid technology case and decreases to 4.2 million 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 range from a low of 11.0 million barrels per day in the rapid technology case to a high of 12.2 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 become profitable in the rapid technology case. In the rapid technology case, offshore production in 2020 is about 250,000 barrels per day (17 percent) higher than in the reference case, and in the slow technology case it is 190,000 barrels per day (13 percent) lower. For onshore production, in contrast, the differences are only 9 percent and 10 percent. The projections for Alaskan production are even more sensitive to the technology assumptions, varying by more than 17 percent from the reference case in both the rapid and slow technology cases.

Domestic Crude Oil Production Continues To Decline

Figure 101. Crude oil production by source, 1970-2020 (million barrels per day)



Projected domestic crude oil production continues its historic decline through 2005 (Figure 101). After 2005, technological improvements [*69*] and rising prices are projected to arrest the decline, leading to relatively stable lower 48 production in the remainder of the forecast. In 2020, the projected domestic production level of 5.3 million barrels per day is 1 million barrels per day less than the 1998 level. Conventional onshore production in the lower 48 States, which accounted for 45.9 percent of total U.S. crude oil production in 1998, is projected to increase to a 48.9-percent share in 2020.

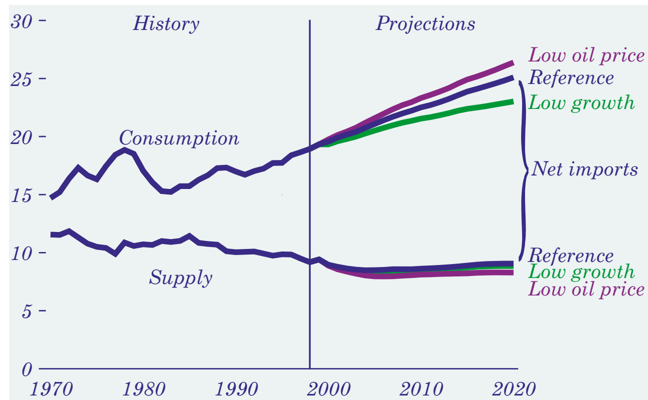
Crude oil production from Alaska is expected to decline at an average annual rate of 3.7 percent between 1998 and 2020. The overall decrease in Alaska's oil production results from a continuing decline in production from most of its oil fields and, in particular, from Prudhoe Bay, the largest producing field, which historically has accounted for more than 60 percent of total Alaskan production.

Offshore production ranges from 1.4 to 1.6 million barrels per day throughout the forecast. Technological advances and lower costs for deep exploration and production in the Gulf of Mexico help to offset a decline in production from shallow waters.

Production from enhanced oil recovery (EOR) [*70*], which becomes less profitable as oil prices fall, slows through 2006 and then increases along with world oil prices through the remainder of the forecast. The projected EOR production in 2020 is close to the 1998 level.

Imports Fill the Gap Between Domestic Supply and Demand

Figure 102. Petroleum supply, consumption, and imports, 1970-2020 (million barrels per day)



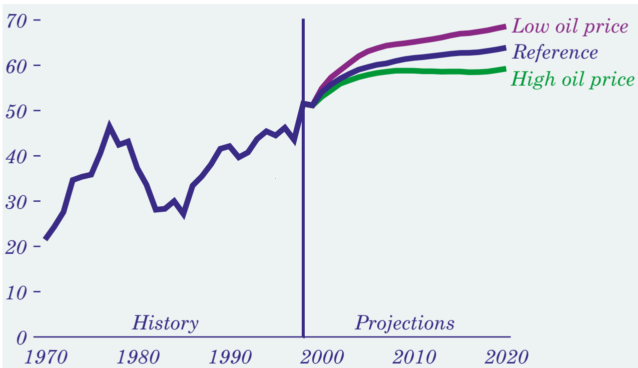
In the reference case, domestic petroleum supply declines slightly from its 1998 level of 9.2 million barrels per day to 9.1 million barrels per day in 2020 (Figure 102). As U.S. crude oil production falls off, refinery gain and production of natural gas plant liquids increase. In the low oil price case, domestic supply drops to 8.3 million barrels per day in 2020. In the high oil price case, domestic supply increases to 9.9 million barrels per day in 2020.

The greatest variation in petroleum consumption levels is seen across the economic growth cases, with an increase of 8.3 million barrels per day over the 1998 level in the high growth case, compared with an increase of only 4.1 million barrels per day in the low growth case.

Additional petroleum imports will be needed to fill the widening gap between supply and consumption. The greatest gap between supply and consumption is seen 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 18.1 million barrels per day in the low oil price case to a low of 14.2 million barrels per day in the low growth case, compared with the 1998 level of 9.8 million barrels per day. The value of petroleum imports in 2020 ranges from $108.3 billion in the low price case to $161.3 billion in the high economic growth case. Total annual U.S. expenditures for petroleum imports, which reached a historical peak of $133.7 billion (in 1998 dollars) in 1980 [*71*], were $46.6 billion in 1998.

Continued Dependence on Petroleum Imports Is Projected

Figure 103. Share of U.S. petroleum consumption supplied by net imports in three cases, 1970-2020 (percent)



In 1998, net imports of petroleum climbed to a record 52 percent of domestic petroleum consumption. Continued dependence on petroleum imports is projected, reaching 64 percent in 2020 in the reference case (Figure 103). The corresponding import shares of total consumption in 2020 are 59 percent in the high oil price case and 69 percent in the low price case.

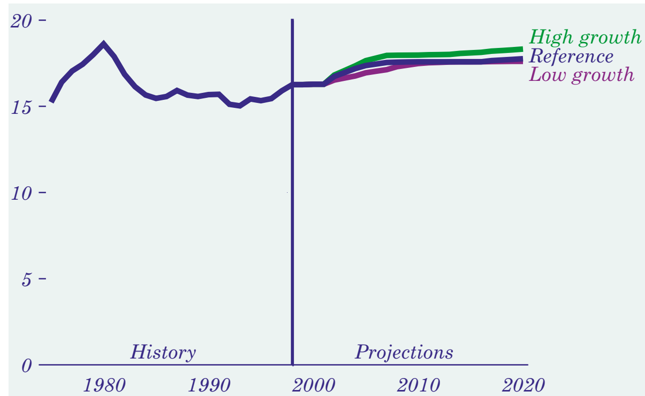
Although crude oil is expected to continue as the major component of petroleum imports, refined products represent a growing share. More imports will be needed as growth in demand for refined products exceeds the expansion of domestic refining capacity. Refined products make up 19 percent of net petroleum imports in 2020 in the low economic growth case and 34 percent in the high growth case, as compared with their 12-percent share in 1998 (Table 14).

Table 14. Petroleum consumption and net imports in five cases, 1998 and 2020 (million barrels per day)

Year and projection	Product supplied	Net imports	Net crude imports	Net product imports
1998	18.9	9.8	8.6	1.2
2020				
Reference	25.1	16.0	11.6	4.5
Low oil price	26.4	18.1	12.5	5.6
High oil price	24.4	14.5	10.9	3.6
Low growth	23.0	14.2	11.4	2.7
High growth	27.3	17.6	11.7	5.9

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

Figure 104. Domestic refining capacity in three cases, 1975-2020 (million barrels per day)



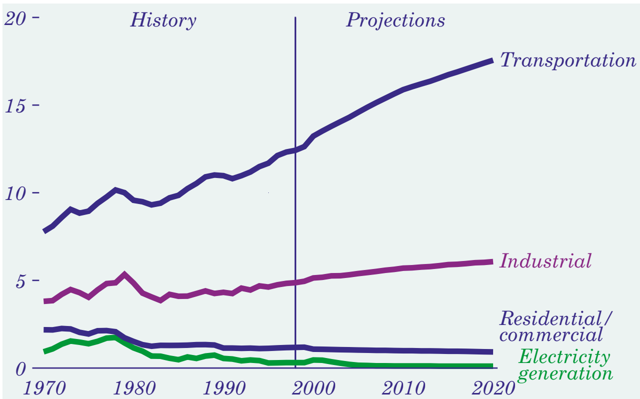
Falling demand for petroleum and the deregulation of the domestic refining industry in the 1980s led to 13 years of decline in U.S. refinery capacity. That trend was reversed in 1995, and 0.9 million barrels per day of distillation capacity had been added by 1999. Financial and legal considerations make 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 *AEO2000* cases (Figure 104).

Distillation capacity is projected to grow from the 1998 year-end level of 16.3 million barrels per day to 17.6 million in 2020 in the low economic growth case and 18.3 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 will continue to be utilized intensively throughout the forecast, in a range from 93 percent to 96 percent of design capacity. In comparison, the 1998 utilization rate was 96 percent, well above the rates of the 1980s and early 1990s.

Additional “downstream” processing units will 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 105. Petroleum consumption by sector, 1970-2020 (million barrels per day)



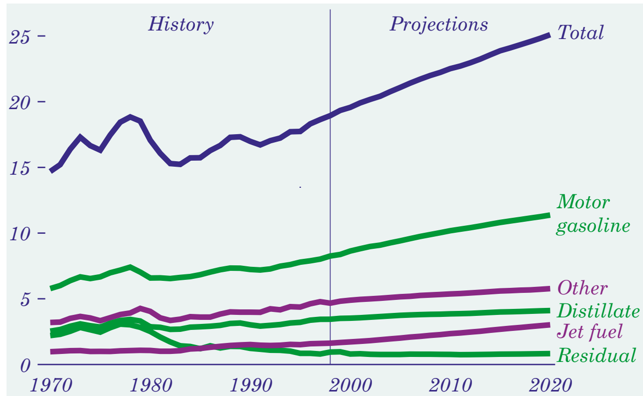
U.S. petroleum consumption is projected to increase by 6.2 million barrels per day between 1998 and 2020. Most of the increase in petroleum consumption occurs in the transportation sector, which accounted for two-thirds of U.S. petroleum use in 1998 (Figure 105). Petroleum use for transportation increases by 5.4 million barrels per day in the reference case, 4.0 million in the low economic growth case, and 6.7 million in the high economic growth case.

In the industrial sector, which accounts for more than a quarter of U.S. petroleum use, consumption in 2020 is higher than the 1998 level by 1.2 million barrels per day in the reference case, 0.6 million in the low economic growth case, and 1.9 million in the high economic growth case. More than half the growth is expected in the petrochemical, construction, and refining sectors.

Petroleum use is expected to decline in the residential, commercial, and electricity generator sectors, where oil gives ground to natural gas. Increased oil use for heating and electricity generation is seen only 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 1998, heating oil use is 160,000 barrels a day lower in 2020 in the high price case and 30,000 barrels a 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 is 480,000 barrels a day lower in 2020 than in 1998 in the high price case and 360,000 barrels a day higher in the low price case.

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

Figure 106. Consumption of petroleum products, 1970-2020 (million barrels per day)



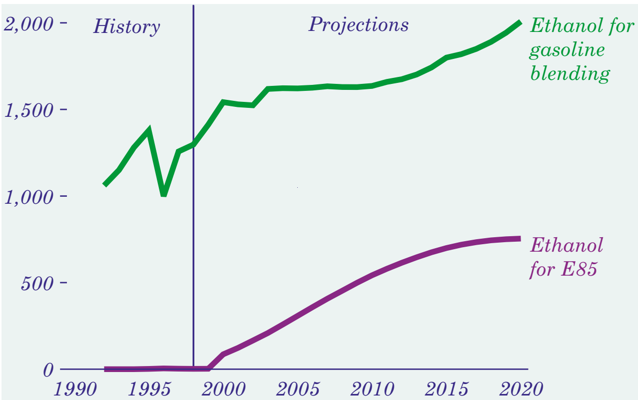
More than 90 percent of the projected growth in petroleum consumption stems from increased consumption of "light products," including gasoline, diesel, heating oil, jet fuel, and liquefied petroleum gases, which are more difficult and costly to produce than heavy products (Figure 106). Although refinery investments and enhancements are expected to increase the ability of domestic refineries to produce light products, they will compensate for less than half the additional demand; the remainder will be imported.

In the forecast, gasoline continues to account for about 45 percent of all the petroleum used in the United States. Between 1998 and 2020, U.S. gasoline consumption rises from 8.3 million barrels a day to 11.4 million barrels a day.

Increased air travel results in a near doubling of jet fuel consumption from 1.6 million barrels a day in 1998 to 3.0 million in 2020, accounting for 12 percent of total petroleum use in 2020 in the reference case, compared with 9 percent in 1998. Consumption of liquefied petroleum gases (LPGs)—primarily in the industrial sector—also increases, from 2.0 million barrels a day in 1998 to 2.5 million in 2020. Consumption of "other" petroleum products, mostly petrochemical feedstocks, still gas used to fuel refineries, and asphalt and road oil used in road construction, grows from 2.8 million to 3.3 million barrels a day. Diesel fuel consumption shows little change, whereas residual fuel use, mainly for electricity generation, declines by 250,000 barrels a day in the high oil price case but increases by 530,000 barrels a day in the low oil price case.

AEO2000 Projects an Expanded Role for Ethanol in Vehicle Fuels

Figure 107. U.S. ethanol consumption, 1992-2020 (million gallons)



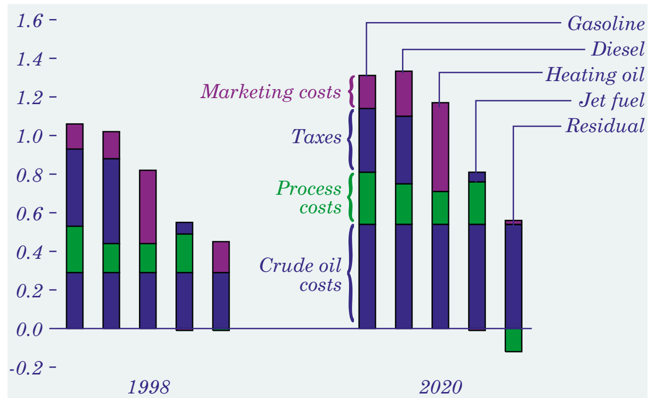
U.S. ethanol production, with corn as the primary feedstock, reached 1.4 billion gallons in 1998. Production is projected to increase to 2.7 billion gallons by 2020, with most of the growth coming from the conversion of cellulosic biomass to ethanol. Ethanol is used primarily in the Midwest as a gasoline 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.

AEO2000 projects an expanded role for ethanol, replacing MTBE as the oxygenate for reformulated gasoline (RFG) in California, where concerns about water quality in 1999 led to a State-wide ban on MTBE in gasoline by the end of 2002. To date, the U.S. Environmental Protection Agency (EPA) has not granted a waiver for the oxygen requirement in California RFG. In addition, ethanol consumption in E85 vehicles is projected to increase from the national total of 2.0 million gallons in 1998 to 754 million gallons in 2020 (Figure 107). 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 tax credit for ethanol through 2007 but stipulated reductions from 54 cents a gallon to 53 cents in 2001, 52 cents in 2003, and 51 cents in 2005. *AEO2000* assumes that the credit will be extended at 51 cents per gallon through 2020.

Processing Costs for Gasoline and Jet Fuel Rise in the Forecast

Figure 108. Components of refined product costs, 1998 and 2020 (1998 dollars per gallon)



Refined product prices are determined by crude oil costs, refining process costs (including refiner profits), marketing costs, and taxes (Figure 108). In the *AEO2000* projections, crude oil costs continue to make the greatest contribution to product prices, and marketing costs remain stable, but the contributions of processing costs and taxes change considerably.

The processing costs for gasoline and jet fuel increase by 5 cents and 4 cents a gallon, respectively, between 1998 and 2020. The increases are attributed primarily to growth in demand for those products and also in part to investments related to compliance with refinery emissions, health, and safety regulations, which add 1 to 3 cents a gallon to the processing costs of light products (gasoline, distillate, jet fuel, kerosene, and LPGs).

Whereas processing costs tend to increase refined product prices, assumptions about Federal taxes tend to slow the growth of motor fuels prices. In keeping with the *AEO2000* assumption of current laws and legislation, Federal motor fuels taxes are assumed to remain at nominal 1998 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 a decrease in Federal taxes between 1998 and 2020—7 cents per gallon for gasoline, 9 cents for diesel fuel, and 1 cent for jet fuel.