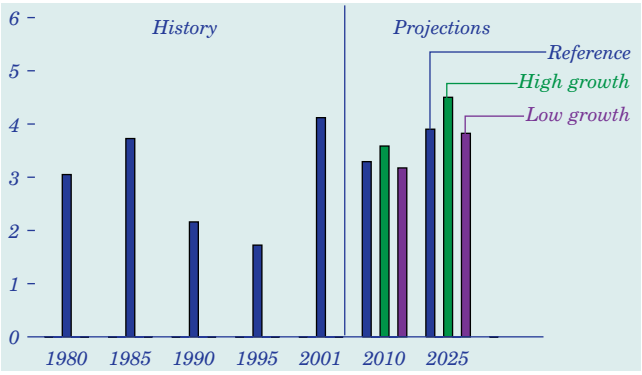
Natural Gas Prices Increase in All Economic Growth Cases

Figure 78. Projected lower 48 natural gas wellhead prices in three cases, 2010 and 2025 (2001 dollars per thousand cubic feet)



In the reference case, average wellhead natural gas prices are expected to increase to $3.90 per thousand cubic feet (2001 dollars) in 2025 (Figure 78). The 2025 wellhead price is projected to reach $3.83 per thousand cubic feet in the low growth case and $4.50 per thousand cubic feet in the high growth case. Technically recoverable natural gas resources (Table 9) are expected to be adequate to support the production increases projected in the three cases. As gas resources are depleted, however, wellhead prices are expected to increase, and a larger portion of U.S. natural gas consumption is projected to be met by foreign supplies and by production from Alaska.

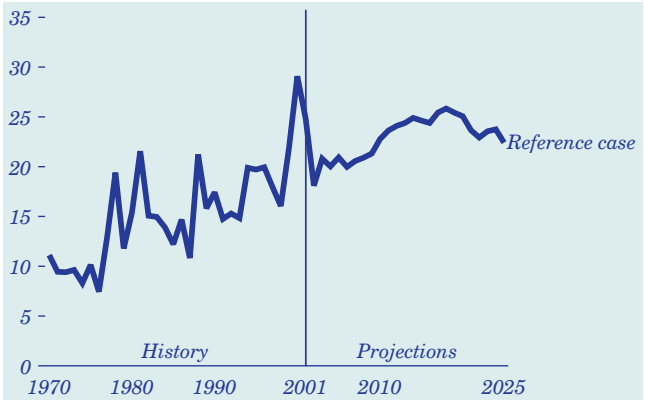
In the high growth case, higher levels of natural gas consumption are projected to stimulate the construction of the Alaskan North Slope and MacKenzie Delta pipelines and new liquefied natural gas (LNG) terminals earlier than in the reference case. Incremental supplies from those projects are projected to become available 2 years earlier than in the reference case. After the incremental volumes have been fully absorbed by growing gas consumption, prices are expected to escalate, beginning around 2020. In the low growth case, with lower price projections and lower demand for natural gas, supplies from the new projects do not come online until 2024.

Table 9. Technically recoverable U.S. natural gas resources as of January 1, 2002 (trillion cubic feet)

Proved	*183.5*
Unproved	*1,105.4*
Total	***1,288.9***

High Levels of Gas Reserve Additions Are Projected Through 2025

Figure 79. Lower 48 natural gas reserve additions, 1970-2025 (trillion cubic feet)



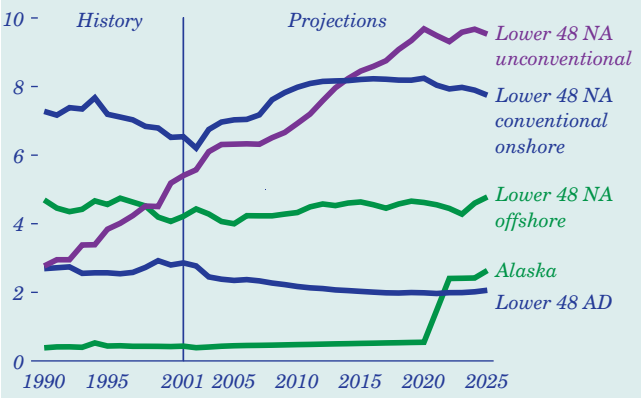
Projected lower 48 natural gas reserve additions reflect the expected increase in exploratory and developmental drilling that results from increasing natural gas prices and production revenues. Reserve additions also reflect projected productivity gains from technology improvements.

In the reference case, lower 48 reserve additions are expected to peak in 2018 at 25.8 trillion cubic feet and then slowly decline to 22.4 trillion cubic feet by 2025 (Figure 79). In the high growth case, reserve additions peak in 2017 at 25.9 trillion cubic feet and decline to 22.5 trillion cubic feet by 2025. In both cases, declining reserve additions at the end of the forecast reflect the rising cost of developing and producing the remaining domestic natural gas resource. Rising natural gas prices before 2020 are projected to stimulate lower 48 natural gas reserve additions, which generally exceed production in both the reference and high growth cases. After 2020, projected natural gas reserve additions are somewhat less than projected production.

In the low growth case, projected reserve additions remain relatively constant during the last 10 years of the forecast (2016-2025), averaging 24.3 trillion cubic feet per year. Because the Alaskan gas pipeline is not expected to be built and only one new LNG facility is expected to begin operation in 2024 in this case, natural gas prices remain roughly constant. As a result, reserve additions generally are expected to equal or exceed production through 2025 in the low growth case.

Growing Numbers of New Wells Increase Natural Gas Production

Figure 80. Natural gas production by source, 1990-2025 (trillion cubic feet)



As a result of technological improvements and rising natural gas prices, natural gas production from unconventional sources (tight sands, shale, and coalbed methane) is projected to increase more rapidly than conventional production. In the reference case, lower 48 unconventional gas production is projected to grow from 5.4 trillion cubic feet in 2001 to 9.5 trillion cubic feet in 2025 (Figure 80), increasing from 28 percent of total U.S. production in 2001 to 36 percent in 2025. Production of lower 48 nonassociated (NA) conventional natural gas is projected to grow from 10.8 trillion cubic feet in 2001 to 12.9 trillion cubic feet in 2020 and then decline to 12.5 trillion cubic feet in 2025.

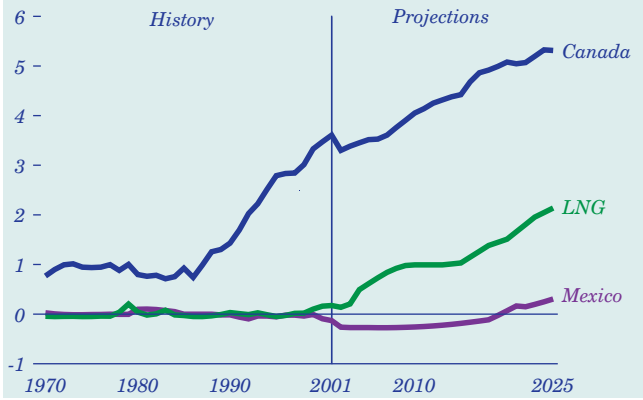
Production of associated-dissolved (AD) natural gas from lower 48 crude oil reserves declines by 1.3 percent per year in the reference case, consistent with a projected decline in crude oil production. Lower 48 AD natural gas is projected to account for 8 percent of U.S. natural gas production in 2025, compared with 15 percent in 2001.

Between 2001 and 2025, with increased drilling activity in deep waters, offshore natural gas production is projected to increase gradually from 5.3 trillion cubic feet in 2001 to 5.7 trillion cubic feet in 2025; however, the share of total U.S. production declines from 27 percent in 2001 to 21 percent by 2025.

The North Slope Alaskan gas pipeline is expected to begin transporting Alaskan natural gas production to the lower 48 States in 2021. In 2025, total Alaskan gas production is projected to be 2.6 trillion cubic feet in the reference case.

Net Imports of Natural Gas Grow in the Projections

Figure 81. Net U.S. imports of natural gas, 1970-2025 (trillion cubic feet)



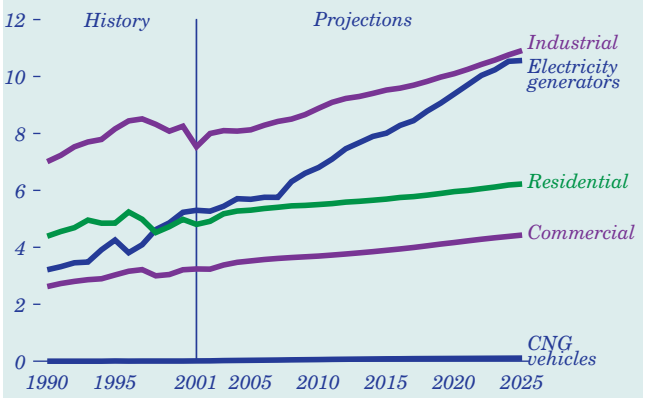
Net imports of natural gas make up the difference between U.S. production and consumption (Figure 81). Imports are expected to be priced competitively with domestic sources. Natural gas supplies from western Canada and the Scotian Shelf in the offshore Atlantic are expected to account for most of the increase in U.S. imports. In addition, the reference case projects that a new natural gas pipeline from the MacKenzie Delta will begin operation in 2016. Net imports from Canada are projected to provide 15 percent of total U.S. supply in 2025 in the reference case, about the same as in 2001.

LNG imports are expected to increase to 2.1 trillion cubic feet per year in 2025, equal to 6 percent of total U.S. gas supply. The projected 2025 LNG import level is based on expectations that all four existing LNG import facilities will be fully reopened and expanded—and that three new facilities will be constructed in the Gulf of Mexico and Florida areas—by 2025. The three new LNG facilities are expected to have a combined gas delivery rate of 2 billion cubic feet per day.

Although Mexico has a considerable natural gas resource base, trade with Mexico has until recently consisted primarily of exports from the United States. In the reference case, Mexico is projected to remain a net importer of U.S. natural gas through 2019. After 2019, Mexican natural gas imports are expected to come from an LNG import terminal built in Baja California, Mexico. By 2025, the United States is expected to import about 300 billion cubic feet of natural gas from Mexico per year.

Projected Increases in Natural Gas Use Are Led by Electricity Generators

Figure 82. Natural gas consumption by sector, 1990-2025 (trillion cubic feet)



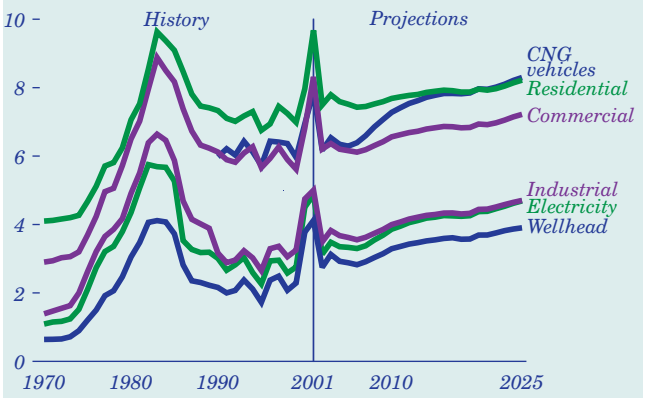
Total natural gas consumption is projected to increase between 2001 and 2025 in all the *AEO2003* cases. The projections for domestic natural gas consumption in 2025 range from 31.8 trillion cubic feet per year in the low economic growth case to 37.5 trillion cubic feet in the high economic growth case, as compared with 22.6 trillion cubic feet in 2001. In the reference case, natural gas consumption for electricity generation is projected to increase from 5.3 trillion cubic feet in 2001 to 10.6 trillion cubic feet in 2025, an average annual growth rate of 2.9 percent (Figure 82). Demand by electricity generators is expected to account for 33 percent of total end-use natural gas consumption in 2025.

Most new electricity generation capacity is expected to be fueled by natural gas, and natural gas consumption in the electricity generation sector is projected to grow rapidly throughout the forecast as electricity consumption increases. Although average coal prices to electricity generators are projected to fall throughout the forecast, natural-gas-fired generators are expected to have advantages over coal-fired generators, including lower capital costs, higher fuel efficiency, shorter construction lead times, and lower emissions.

Demand growth is also expected in the residential, commercial, industrial, and transportation sectors. Industrial consumption is expected to be the second largest source of demand growth. In the reference case, industrial consumption is projected to increase from 7.5 trillion cubic feet in 2001 to 10.9 trillion cubic feet in 2025, accounting for 34 percent of total end-use natural gas consumption in 2025.

Delivered Prices Increase More Slowly Than Wellhead Prices

Figure 83. Natural gas end-use prices by sector, 1970-2025 (2001 dollars per thousand cubic feet)

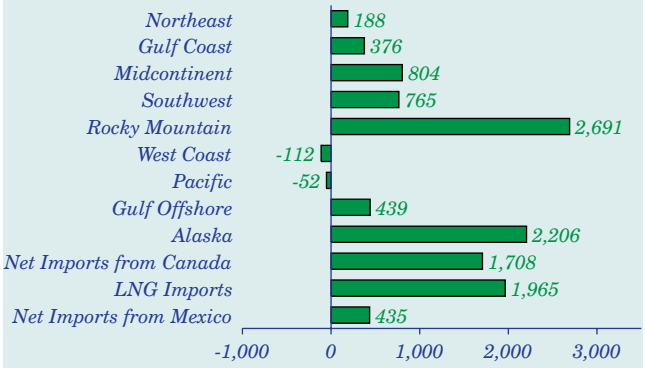


End-use natural gas prices are expected to decline in the early part of the forecast, from their relatively high levels in 2000 and 2001, followed by a gradual increase starting in about 2005 as a result of increasing wellhead prices (Figure 83). A portion of the increase in wellhead prices is expected to be offset by a projected decline in average transmission and distribution margins as a larger proportion of the natural gas delivery infrastructure becomes fully depreciated. The average end-use price is expected to increase by 89 cents per thousand cubic feet between 2005 and 2025 (in constant 2001 dollars), compared with an increase of $1.07 per thousand cubic feet in the average price of domestic and imported natural gas supplies over the same period.

The relative magnitude of the natural gas transmission and distribution margin reflects both the volume of gas delivered and the infrastructure requirements of the particular sector. For example, the margin associated with compressed natural gas vehicles is expected to increase, because the cost of the refueling infrastructure must be added to serve non-fleet vehicles. Conversely, the industrial and electricity generation sectors have the lowest end-use prices, in part because they receive most of their natural gas directly from interstate pipelines, avoiding local distribution charges. Summer-peaking electric generators reduce their transmission costs by using lower cost interruptible transportation rates during the summer when spare pipeline capacity is available; however, as electric generators take an increasing share of the natural gas market, they are expected to rely on higher cost firm transportation to a greater extent.

Natural Gas Supplies from the West Are Expected To Grow

Figure 84. Projected changes in U.S. natural gas supply by region and source, 2001-2025 (billion cubic feet)



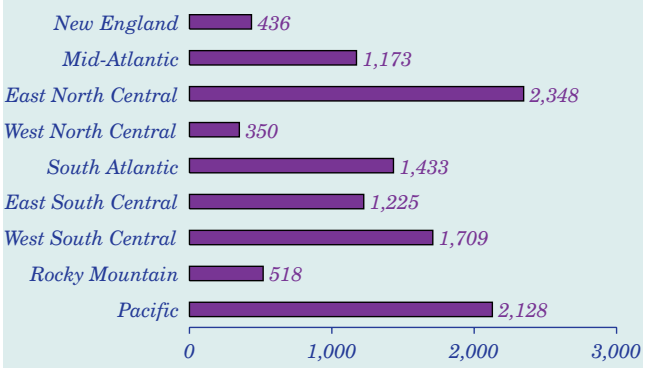
In the reference case, total foreign and domestic natural gas supplies are projected to grow by 11.4 trillion cubic feet between 2001 and 2025. Domestic natural gas production is expected to increase by 7.3 trillion cubic feet, accounting for 64 percent of the total growth in supply, and net imports are projected to increase by 4.1 trillion cubic feet, accounting for the remaining 36 percent.

The largest increase in domestic natural gas production from 2001 through 2025 is projected to come from the Rocky Mountain region, predominantly from unconventional sources. Rocky Mountain natural gas production is projected to increase by 2.7 trillion cubic feet between 2001 and 2025 (Figure 84). The next largest increase in domestic production is projected to come from Alaska, primarily as a result of the expected completion of a pipeline from the North Slope. Alaskan natural gas production in 2025 is expected to be 2.2 trillion cubic feet above its 2001 level. Other production regions, both onshore and offshore, collectively increase domestic natural gas production by a projected 2.4 trillion cubic feet between 2001 and 2025.

Net imports of Canadian natural gas and LNG are expected to increase by 1.7 trillion cubic feet and 2.0 trillion cubic feet, respectively, between 2001 and 2025. The growth in LNG imports is expected to occur primarily in the South Atlantic and Gulf Coast regions as a result of the reactivation and expansion of the four existing LNG import facilities in the United States and the construction and later expansion of three new LNG facilities.

Natural Gas Consumption Is Expected To Increase in All Regions

Figure 85. Projected changes in end-use natural gas consumption by region, 2001-2025 (billion cubic feet)

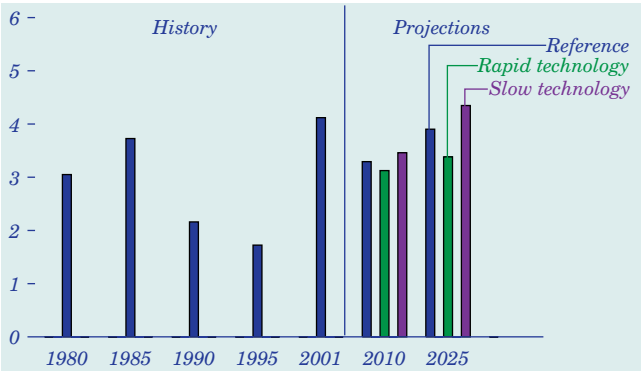


In the reference case, 58 percent of the growth in lower 48 end-use natural gas consumption between 2001 and 2025 is projected to occur east of the Mississippi River, with the remaining 42 percent occurring west of the Mississippi River (Figure 85). In the East, the largest increase in end-use consumption is expected in the East North Central region, which accounts for 2.3 trillion cubic feet of incremental consumption. The next largest consumption increase in the East occurs in the South Atlantic region at 1.4 trillion cubic feet. In the West, natural gas demand in the Pacific and West South Central regions is expected to increase by 2.1 trillion cubic feet and 1.7 trillion cubic feet, respectively. Together, these four regions are projected to account for 67 percent of the total increase in end-use natural gas consumption between 2001 and 2025 in the reference case. Differences in the projected growth rates for the various regions result from different prospects for population growth, economic activity, and electricity generation.

Between 2001 and 2025, the West—including Alaska, Western Canadian and most of the offshore Gulf of Mexico—is expected to provide about 80 percent of the incremental natural gas supply in the reference case. Because most of the growth in natural gas consumption is expected east of the Mississippi River, new natural gas pipelines are projected to be built from the West to the East, including a North Slope Alaska natural gas pipeline, whose terminus is expected to be near Chicago. An exception is the construction of new pipeline capacity originating in Canada and the Rocky Mountains, which will be needed to meet growth in natural gas consumption along the Pacific Coast.

Natural Gas Price Projections Change With Technology Assumptions

Figure 86. Projected lower 48 natural gas wellhead prices in three cases, 2010 and 2025 (2001 dollars per thousand cubic feet)



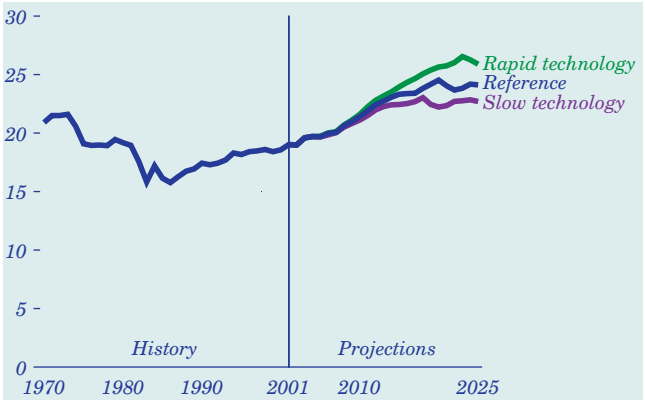
Continued improvements in technology are projected to result in lower production costs for natural gas from the Nation's resource base. Because wellhead gas prices reflect the underlying production cost structure, wellhead natural gas prices are relatively sensitive to variation in technological progress. The *AEO2003* reference case assumes that improvements in technology will continue at historical rates. The slow and rapid technology cases assume that the annual rate of technological improvement in production costs, finding rates, and success rates will decrease or increase by 15 percent relative to the historical rate.

An Alaskan natural gas pipeline and new LNG facilities are expected to come into operation by 2025 in both technology cases, but at different times. In the slow technology case, natural gas wellhead prices are projected to rise sooner and more rapidly (Figure 86), leading to earlier completion of the new facilities. In the rapid technology case, prices increase more slowly, delaying their completion until the end of the forecast period.

The slow technology case projects a wellhead price of $4.35 per thousand cubic feet in 2025, which is 12 percent higher than the reference case price of $3.90 per thousand cubic feet in 2025. In the rapid technology case, lower 48 natural gas wellhead prices are projected to reach $3.38 per thousand cubic feet in 2025, which is 13 percent lower than in the reference case.

Natural Gas Production Projections Reflect Technological Progress

Figure 87. Lower 48 natural gas production in three cases, 1970-2025 (trillion cubic feet)



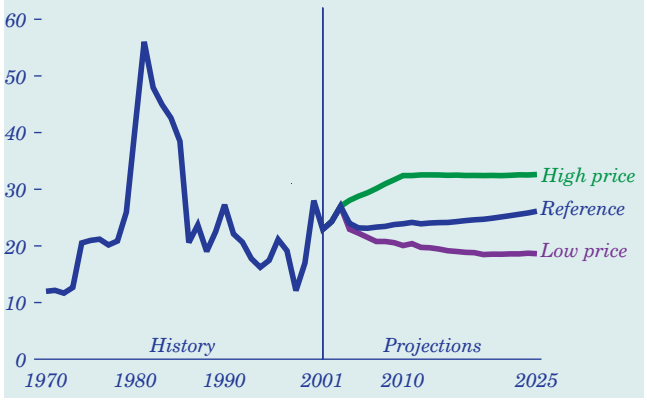
Generally, technological progress reduces the cost of natural gas production, leading to lower wellhead prices, higher levels of end-use consumption, and—in order to meet the increase in demand—more production. Therefore, a higher rate of technological progress is expected to result in a higher projection for domestic natural gas production.

Total U.S. natural gas production in 2025 is projected to be 6 percent higher in the rapid technology case and 6 percent lower in the slow technology case than in the reference case (Figure 87). The strongest impact of the rapid and slow technology assumptions is on projected production from unconventional natural gas sources, which in 2025 is 15 percent higher in the rapid technology case and 6 percent lower in the slow technology case than in the reference case.

Projected natural gas consumption in 2025 is 3 percent higher in the rapid technology case than in the reference case, but as a result of the increase in domestic production projected in the rapid technology case, net natural gas imports in 2025 are 7 percent lower than in the reference case. In the slow technology case, with consumption of natural gas projected to be 2 percent lower than in the reference case in 2025, net imports are projected to be 11 percent higher.

Oil Prices Are Expected To Remain Above Low 1998 Levels

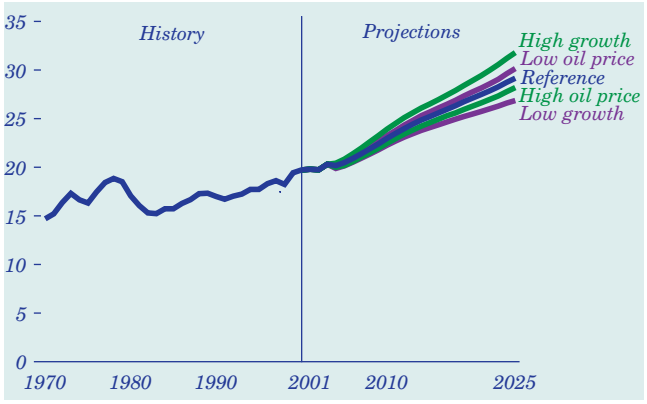
Figure 88. Lower 48 crude oil wellhead prices in three cases, 1970-2025 (2001 dollars per barrel)



Crude oil prices are determined largely by the international market and production in OPEC and non-OPEC nations. In the reference case, the average lower 48 crude oil price is projected to increase on average by 0.5 percent per year after 2001, to $26.12 per barrel in 2025. The high and low world oil price cases project different levels of OPEC production. In the high price case, the lower 48 crude oil price increases by 1.5 percent per year from 2001 to 2025, to $32.59 per barrel in 2025, or 25 percent higher than in the reference case (Figure 88). In the low price case, the lower 48 price generally declines through 2020 and reaches $18.62 per barrel in 2025.

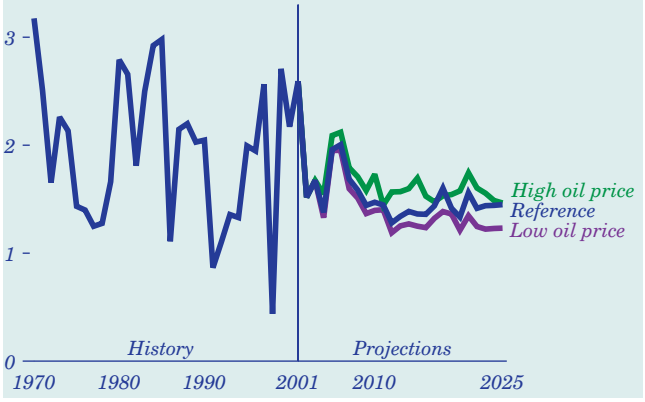
Projected U.S. petroleum consumption varies with the projected crude oil price, but the largest variation is seen for different assumptions about economic growth. Total consumption in 2025 ranges from 26.9 million to 31.8 million barrels per day in the low and high growth cases, respectively (Figure 89).

Figure 89. U.S. petroleum consumption in five cases, 1970-2025 (million barrels per day)



Projected Oil Reserve Additions Are Sensitive to Oil Price Assumptions

Figure 90. Lower 48 crude oil reserve additions in three cases, 1970-2025 (billion barrels)



Lower 48 crude oil reserve additions are sensitive to crude oil price projections (Figure 90). In the projections for 2025, lower 48 crude oil reserve additions range from a low of 1.2 billion barrels in the low world oil price case to 1.5 billion barrels in the high world oil price case.

The variation in crude oil prices in the world oil price cases primarily affects the development and production of offshore oil resources (Table 10), because smaller deepwater fields that are not profitable when price are low are expected to become profitable when oil prices rise.

Crude oil reserve additions reflect the number of oil wells completed during the forecast period, the size of the crude oil resource base (Table 11) and the pace of technological progress. In the reference case, technological progress is expected to continue at the historical rate.

Table 10. Onshore and offshore lower 48 crude oil production in three cases, 2025 (million barrels per day)

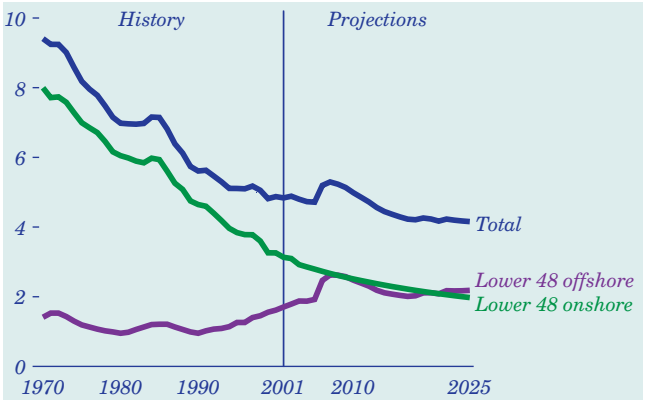
	Onshore	Offshore	Total
Low oil price	1.90	1.86	3.76
Reference	1.98	2.18	4.16
High oil price	2.02	2.50	4.52

Table 11. Technically recoverable U.S. oil resources as of January 1, 2002 (billion barrels)

Proved	24
Unproved	117
Total	***141***

Lower 48 Crude Oil Production Is Expected To Decline After 2007

Figure 91. Lower 48 crude oil production by source, 1970-2025 (million barrels per day)



In the reference case, total lower 48 crude oil production is projected to increase from 4.8 million barrels day in 2001 to 5.3 million barrels per day in 2007, then to decline to 4.2 million barrels per day in 2025. The low and high oil price cases also project production peaks in 2007, followed by declines to 3.8 and 4.5 million barrels per day, respectively, in 2025. The projected peak in 2007 is attributable primarily to offshore oil production (Figure 91). In the reference case, total offshore oil production (including the Gulf of Mexico and offshore California) rises to 2.6 million barrels per day in 2007 and then declines to 2.2 million barrels per day in 2025. The decline in offshore oil production is expected to occur on the shallow, outer continental shelf in the Gulf of Mexico (Table 12).

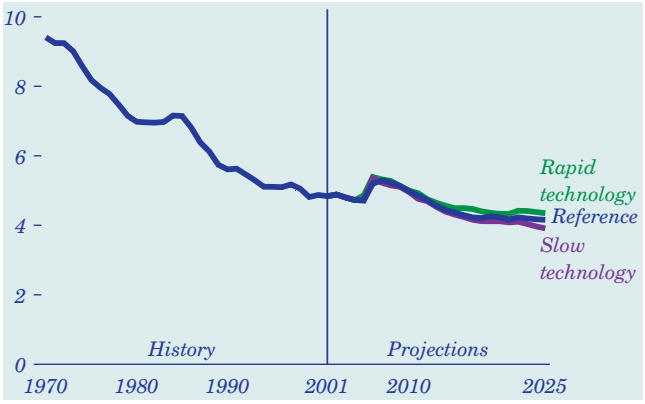
Offshore oil production is more sensitive to oil prices than onshore production. In the low and high oil prices cases, lower 48 offshore production is projected to be 1.9 and 2.5 million barrels per day, respectively, in 2025. Onshore lower 48 oil production is projected to decline in all cases, with 2025 values ranging from 1.9 million barrels per day in the low world oil price cases to 2.0 million in the high price case.

Table 12. Crude oil production from Gulf of Mexico offshore, 2001-2025 (million barrels per day)

	2001	2010	2020	2025
Shallow	0.7	0.8	0.3	0.2
Deep	0.9	1.6	1.8	1.9
Total	**1.6**	**2.4**	**2.1**	**2.1**

More Rapid Technology Advances Could Raise Oil Production Slightly

Figure 92. Lower 48 crude oil production in three cases, 1970-2025 (million barrels per day)



Lower 48 crude oil production is projected to reach 4.3 and 3.9 million barrels per day in 2025 in the rapid and slow technology cases, respectively, compared with 4.2 million barrels per day in the reference case (Figure 92). The technology cases assume the same world oil prices as in the reference case, but the rate of technological progress is assumed to be 15 percent higher (in the rapid technology case) or lower (in the slow technology case) than the historical rate. Because oil prices are determined by world markets and domestic consumption is not expected to change significantly in the technology cases, changes in production result in different levels of petroleum imports. In 2025, net petroleum imports are projected to range from 19.4 million barrels per day in the rapid technology case to 20.3 million barrels per day in the slow technology case.

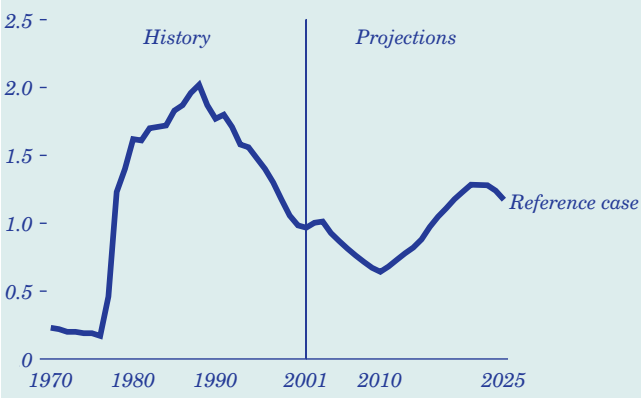
Offshore crude oil production in the lower 48 States is expected to be more sensitive to changes in technological progress than onshore production. Relative to the reference case, cumulative offshore production from 2001 through 2025 is projected to be 768 million barrels (3.9 percent) higher in the rapid technology case and 389 million barrels (2.0 percent) lower in the slow technology case.

Projected lower 48 onshore crude oil production shows less variation in cumulative volumes produced between 2001 and 2025 than does offshore production. Cumulative onshore production from 2001 through 2025 is projected to be 22.2 billion barrels in the reference case, and the cumulative production total is about 0.9 percent higher and lower, respectively, in the rapid and slow technology cases.

Alaskan Oil Production and Oil Imports

Crude Oil Production in Alaska Is Projected To Rebound

Figure 93. Alaskan crude oil production, 1970-2025 (million barrels per day)



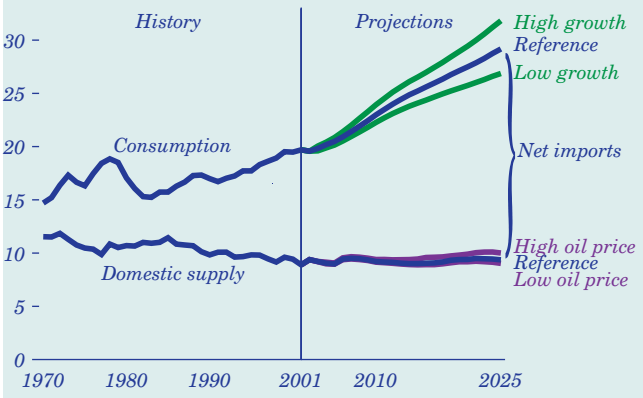
Alaskan crude oil production is expected mainly on the Alaskan North Slope, which includes the National Petroleum Reserve-Alaska (NPR-A) and the State lands surrounding Prudhoe Bay. NPR-A lease sales were held on May 5, 1999, and June 3, 2002. Because oil and gas producers are prohibited from building permanent roads in NPR-A, oil exploration and production is expected to be about 30 percent more expensive than is typical for the North Slope of Alaska. Because drilling is currently prohibited in the Arctic National Wildlife Refuge (ANWR), *AEO2003* does not project any production from ANWR.

In the reference case, crude oil production from Alaska is expected to decline to about 640 thousand barrels per day in 2010 (Figure 93). After 2010, the projected drop in oil production is expected to be offset by new oil production from NPR-A. This date is based on the expectation that a decade will be required to explore and develop new oil fields and to build the associated infrastructure. After 2010, total Alaskan crude oil production is projected to grow to a peak of 1.3 million barrels per day in 2021. NPR-A oil production begins to decline after 2021, and total Alaskan oil production is projected to be 1.2 million barrels per day in 2025.

Alaska's oil production is expected to show similar sensitivity to changes in assumed technological progress as lower 48 oil production. Relative to the reference case, cumulative Alaskan production from 2001 through 2025 is projected to be 172 million barrels (2.0 percent) higher in the rapid technology case and 164 million barrels (1.9 percent) lower in the slow technology case.

Imports Fill the Gap Between Domestic Supply and Demand

Figure 94. Petroleum supply, consumption, and imports, 1970-2025 (million barrels per day)



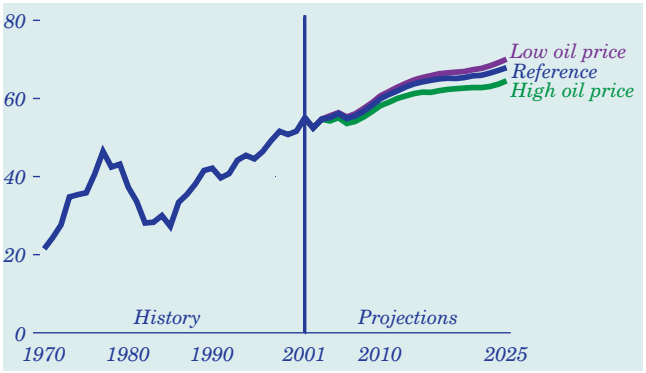
In the reference case, domestic petroleum supply is projected to increase from its 2001 level of 8.9 million barrels per day to 9.4 million barrels per day in 2025 (Figure 94). Although U.S. crude oil production falls off, refinery gain and production of natural gas plant liquids are projected to increase. Domestic supply in 2025 is projected to total 9.0 million barrels per day in the low oil price case and to rise to 10.0 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 12.1 million barrels per day over the 2001 level in the high growth case, compared with a projected increase of only 7.2 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 high growth case and the smallest in the low growth case. The projections for net petroleum imports in 2025 range from a high of 22.2 million barrels per day in the high growth case to a low of 17.8 million barrels per day in the low growth case, compared with 19.8 million barrels per day in the reference case, increasing from 10.9 million barrels per day in 2001. The expected value of petroleum imports in 2025 ranges from about $160 billion in the low world oil price case to nearly $250 billion in the high economic growth case. Total annual U.S. expenditures for petroleum imports, which reached a historical peak of $142.7 billion (in 2001 dollars) in 1980, were $102.9 billion in 2001 [*46*].

Growing Dependence on Petroleum Imports Is Projected

Figure 95. Share of U.S. petroleum consumption supplied by net imports in three cases, 1970-2025 (percent)



In 2001, net imports of petroleum accounted for 55 percent of domestic petroleum consumption. Increasing dependence on petroleum imports is projected, reaching 68 percent in 2025 in the reference case (Figure 95). The corresponding import shares of total consumption in 2025 are expected to be 65 percent in the high oil price case and 70 percent in the low oil price case.

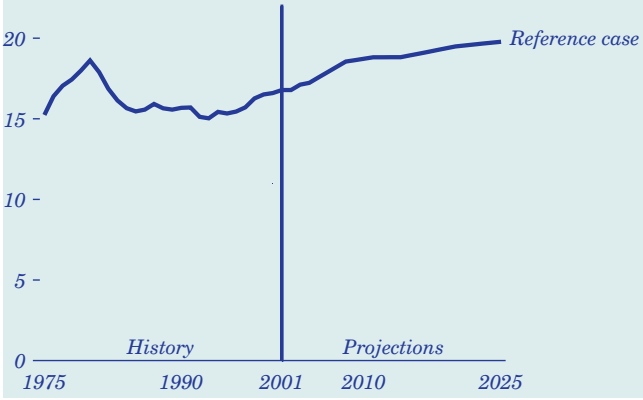
Although crude oil is expected to continue as the major component of petroleum imports, refined products are projected to represent a growing share. More imports would be needed as the projected growth in demand for refined products exceeds the expansion of domestic refining capacity. Refined products are projected to make up 27 percent of net petroleum imports in 2025 in the low economic growth case and 39 percent in the high growth case, compared with 34 percent in the reference case, increasing from a 15-percent share in 2001 (Table 13).

Table 13. Petroleum consumption and net imports in five cases, 2001 and 2025 (million barrels per day)

Year and projection	Product supplied	Net imports	Net crude imports	Net product imports
2001	19.8	10.9	9.3	1.6
2025				
Reference	29.2	19.8	13.1	6.7
Low oil price	30.1	21.1	14.1	7.1
High oil price	28.2	18.2	12.5	5.7
Low growth	26.9	17.8	13.1	4.8
High growth	31.8	22.2	13.5	8.6

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

Figure 96. Domestic refining capacity, 1975-2025 (million barrels per day)



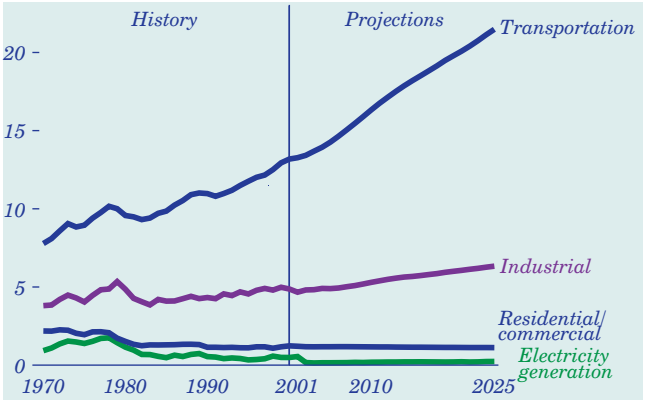
Falling demand for petroleum and deregulation of the domestic refining industry in the 1980s led to 13 years of decline in U.S. refinery capacity. That trend was reversed in 1995, and 1.4 million barrels per day of distillation capacity was added between 1995 and 2001. Financial and legal considerations 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 *AEO2003* cases (Figure 96).

Distillation capacity is projected to grow from the 2001 year-end level of 16.8 million barrels per day to 19.8 million barrels per day in 2025 in the reference case, 19.6 million barrels per day in the low economic growth case, and 20.4 million barrels per day 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 (91 to 95 percent of operable capacity) throughout the forecast. The 2001 utilization rate was 93 percent, well above the lows of 69 percent during the 1980s and 88 percent during the early 1990s but consistent with capacity utilization rates since the mid-1990s.

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

Petroleum Use Increases Mainly in the Transportation Sector

Figure 97. Petroleum consumption by sector, 1970-2025 (million barrels per day)

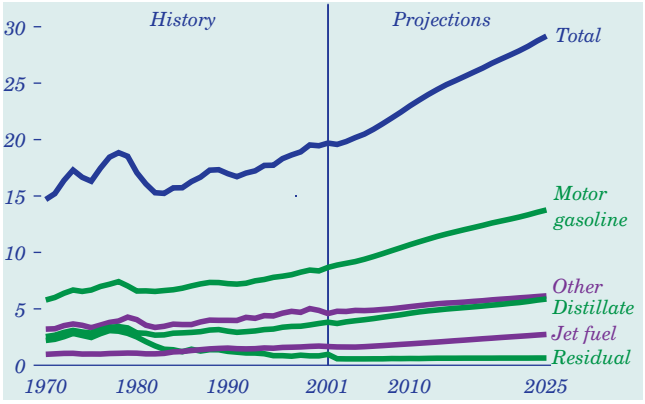


U.S. petroleum consumption is projected to increase by 9.5 million barrels per day between 2001 and 2025. Most of the increase is in the transportation sector (Figure 97), which accounted for two-thirds of U.S. petroleum use in 2001. Petroleum use for transportation increases by 8.2 million barrels per day in the reference case, as the number and usage of vehicles grow. In the industrial sector, which currently accounts for 23 percent of U.S. petroleum use, consumption in 2025 is projected to be higher than in 2001 by 1.7 million barrels per day in the reference case. About 89 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 and electricity for heating and to natural gas for electricity generation. Increased oil use for heating and electricity generation is projected, however, in the low oil price case. Natural gas use for home heating is projected to grow in the Northeast, the last stronghold of home heating oil, in the low oil price case. Compared with 2001, U.S. residential and commercial heating oil use is projected to be 94,000 barrels per day lower in 2025 in the high oil price case and 42,000 barrels per day higher in the low oil 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 combined heat and power) is projected to be 430,000 barrels per day lower in 2025 than in 2001 in the high price case and 64,000 barrels per day higher in the low price case.

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

Figure 98. Consumption of petroleum products, 1970-2025 (million barrels per day)

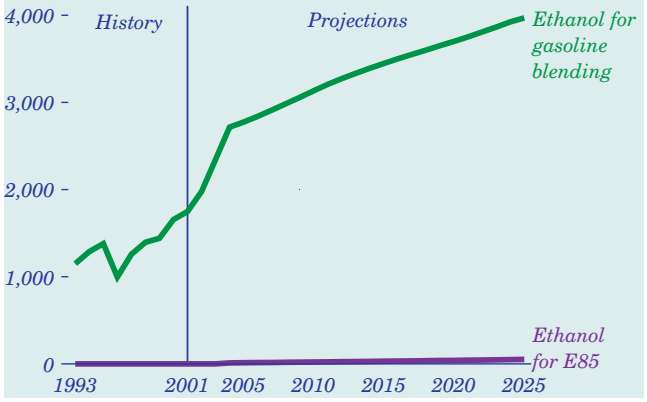


About 97 percent of the projected growth in petroleum consumption stems from increased consumption of "light products," including gasoline, diesel, heating oil, jet fuel, and liquefied petroleum gases, which are more difficult and costly to produce than heavy products (Figure 98). Although refinery investments and enhancements are expected to increase the ability of domestic refineries to produce light products, imports of light products are expected to more than quadruple by 2025.

In the forecast, gasoline continues to account for about 47 percent of all the petroleum used in the United States. Between 2001 and 2025, U.S. gasoline consumption is projected to rise from 8.7 million barrels per day to 13.8 million barrels per day. Consumption of distillate fuel is projected to be 2.1 million barrels per day higher in 2025 than it was in 2001. An even greater increase is projected for diesel fuel, as a larger portion of total distillate supply is used for diesel production and less is used in other sectors. With air travel also expected to increase, jet fuel consumption is projected to be 1.1 million barrels per day higher in 2025 than in 2001. Consumption of liquefied petroleum gas (LPG) is projected to increase by about 980,000 barrels per day between 2001 and 2025, largely for use as a feedstock in the industrial sector. Consumption of "other" petroleum products —including LPG, petrochemical feedstocks, still gas used to fuel refineries, asphalt and road oil, and other miscellaneous products—is projected to grow by 1.6 million barrels per day. Residual fuel use is projected to decline from 970,000 barrels per day in 2001 to 640,000 barrels per day in 2025. Most of the projected decline is in the electricity generation sector.

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

Figure 99. U.S. ethanol consumption, 1993-2025 (million gallons)



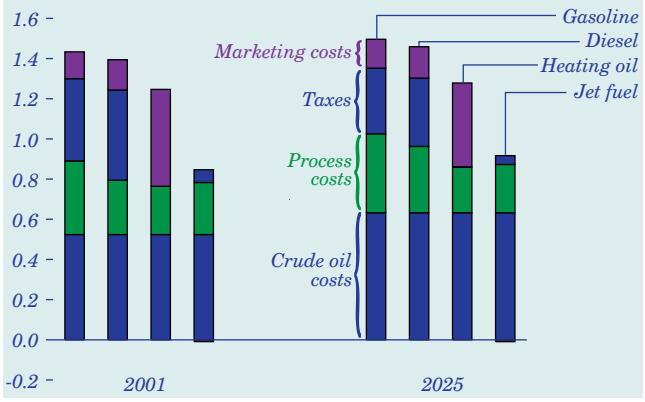
U.S. ethanol production, with corn as the primary feedstock, reached 1.7 billion gallons in 2001. Production is projected to increase to 4.0 billion gallons by 2025 (Figure 99), with about 25 percent of the growth from the conversion of cellulosic biomass. Ethanol is used primarily in the Midwest as a gasoline volume extender and octane enhancer and also serves as an oxygenate in areas that are required to use oxygenated fuels (minimum 2.7 percent oxygen content by volume) during the winter months to reduce carbon monoxide emissions. The high renewables case projects similar production, but all the projected growth is from cellulose, due to more rapid improvement in the technology. In the reference case, corn-based ethanol production drops from 96 percent of total ethanol output in 2015 to 85 percent in 2025.

Ethanol is expected to replace MTBE as the oxygenate for reformulated gasoline (RFG) in 17 States that have placed limits on MTBE use mainly because of concerns about groundwater contamination. It is assumed that the Federal requirement for 2 percent oxygen in RFG will continue in all States. Ethanol consumption in E85 vehicles is also projected to increase, from the national total of 8.7 million gallons in 2001 to 52 million gallons in 2025. E85 vehicles currently are used as government fleet vehicles, flexible-fuel passenger vehicles, and urban transit buses.

The Federal Highway Bill of 1998 extended the excise tax exemption for ethanol through 2007 with reductions from 54 cents per gallon to 53 cents in 2001, 52 cents in 2003, and 51 cents in 2005. It is assumed that the exemption will be extended at 51 cents per gallon (nominal dollars) through 2025.

Refining Costs for Most Petroleum Products Rise in the Forecast

Figure 100. Components of refined product costs, 2001 and 2025 (2001 dollars per gallon)



Refined product prices are determined by crude oil costs, refining process costs (including refiner profits), marketing costs, and taxes (Figure 100). In the *AEO2003* projection, crude oil costs are projected to continue to be the largest component of product prices, and marketing costs are projected to remain stable, but the contributions of processing costs and taxes are expected to change considerably.

Refining costs, including processing costs and profits for gasoline and diesel fuel, are expected to increase by 2 to 6 cents per gallon from 2001 to 2025. The increases result primarily from projected growth in demand for gasoline and diesel fuels and the investment needed to meet new Federal requirements for low-sulfur gasoline between 2004 and 2007 and ultra-low-sulfur diesel fuel between 2006 and 2010. Refining costs for heating oil and jet fuel fall by a projected 1 to 2 cents per gallon from 2001 to 2025.

Whereas processing costs tend to increase refined product prices in the forecast, the assumptions made about Federal taxes tend to slow the growth of motor fuel prices. In keeping with the *AEO2003* assumption of current laws and legislation, Federal motor fuel taxes are assumed to remain at nominal 2001 levels throughout the forecast. Although Federal motor fuel taxes have been raised occasionally in the past, the assumption of constant nominal Federal taxes is consistent with history. The net impact of the assumption is an expected decrease in Federal taxes in 2001 dollars between 2001 and 2025—8 cents per gallon for gasoline, 11 cents for diesel fuel, and 2 cents for jet fuel. State motor fuels taxes are assumed to keep up with inflation, as they have in the past.