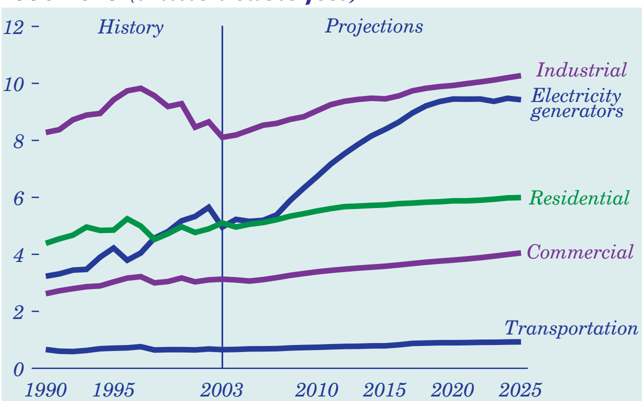
Projected Increases in Natural Gas Use Are Led by Electricity Generators

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

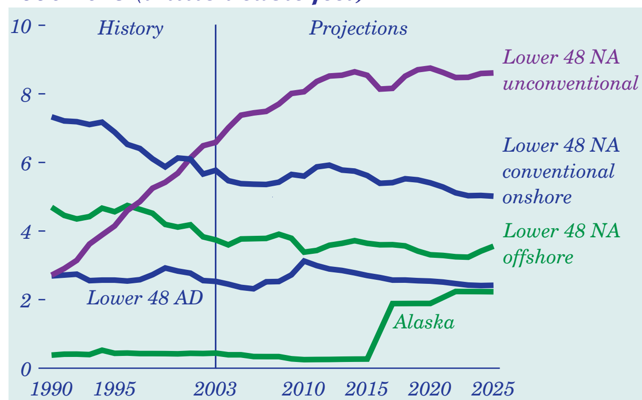


In the *AEO2005* reference case, total natural gas consumption increases from 22.0 trillion cubic feet in 2003 to 30.7 trillion cubic feet in 2025. In the electric power sector, natural gas consumption increases from 5.0 trillion cubic feet in 2003 to 9.4 trillion cubic feet in 2025 (Figure 82), accounting for 31 percent of total demand for natural gas in 2025 as compared with 23 percent in 2003. The increase in natural gas consumption for electricity generation results from both the construction of new gas-fired generating plants and higher capacity utilization at existing plants. Most new electricity generation capacity is expected to be fueled by natural gas, because natural-gas-fired generators are projected to have advantages over coal-fired generators that include lower capital costs, higher fuel efficiency, shorter construction lead times, and lower emissions. Toward the end of the forecast, however, when natural gas prices rise substantially, coal-fired power plants are expected to be competitive for new capacity additions.

Industrial consumption of natural gas, including lease and plant fuel, is projected to increase from 8.1 trillion cubic feet in 2003 to 10.3 trillion cubic feet in 2025. Although increases are projected for most industrial sectors, decreases are expected in the iron, steel, and aluminum industries. The industrial sectors with the largest projected increases in natural gas consumption growth from 2003 through 2025 include metal-based durables, petroleum refining, bulk chemicals, and food. Natural gas use is also projected to increase in the residential sector by 0.7 percent per year and in the commercial sector 1.2 percent per year on average from 2003 to 2025.

Unconventional Production Becomes the Largest Source of U.S. Gas Supply

Figure 83. 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 relatively abundant unconventional sources (tight sands, shale, and coalbed methane) is projected to increase more rapidly than conventional production. Lower 48 unconventional gas production grows from 6.6 trillion cubic feet in 2003 to 8.6 trillion cubic feet in 2025 (Figure 83) and from 35 percent of total lower 48 production in 2003 to 44 percent in 2025.

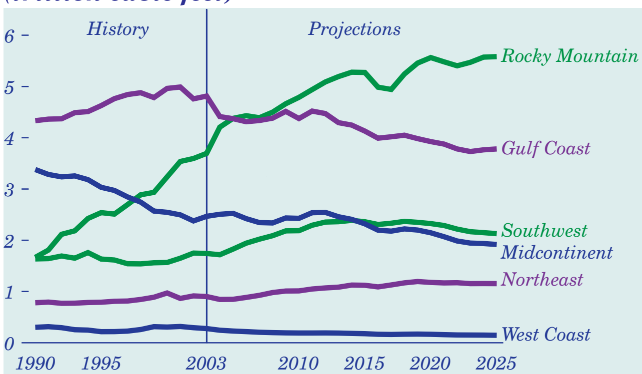
Production of lower 48 nonassociated (NA) conventional natural gas declines from 9.5 trillion cubic feet in 2003 to 8.6 trillion cubic feet in 2025, as resource depletion causes exploration and development costs to increase. Offshore NA natural gas production is projected to rise slowly to a peak of 3.9 trillion cubic feet in 2008, then decline to 3.6 trillion cubic feet in 2025.

Production of associated-dissolved (AD) natural gas from lower 48 crude oil reserves is projected to increase from 2.5 trillion cubic feet in 2003 to 3.1 trillion cubic feet in 2010 due to a projected increase in offshore AD gas production [*139*]. After 2010, both onshore and offshore AD gas production are projected to decline, and total lower 48 AD gas production falls to 2.4 trillion cubic feet in 2025.

The North Slope Alaska natural gas pipeline is projected to begin transporting Alaskan gas to the lower 48 States in 2016. In 2025, total Alaskan gas production is projected to be 2.2 trillion cubic feet in the reference case, compared with 0.4 trillion cubic feet in 2003.

Growing Production Is Expected from the Rocky Mountain Region

Figure 84. Lower 48 onshore natural gas production by supply region, 1990-2025 (trillion cubic feet)



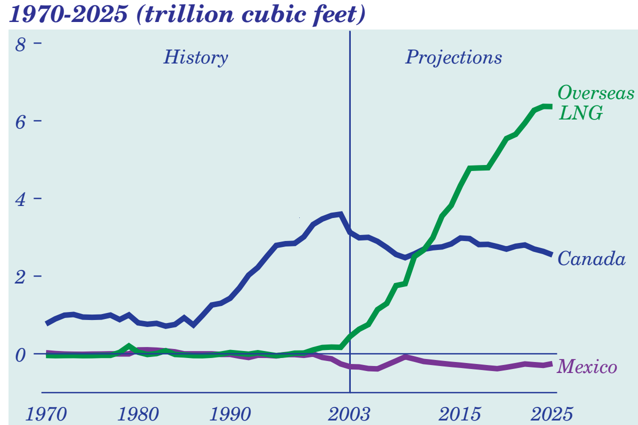
In the reference case, total natural gas supplies are projected to grow by 8.2 trillion cubic feet from 2003 to 2025. Domestic natural gas production is expected to account for 34 percent of the total growth in gas supply, and net imports are projected to account for the remaining 66 percent.

Over the forecast period, the largest increase in lower 48 onshore natural gas production is projected to come from the Rocky Mountain region, primarily from unconventional gas deposits [*140*]. Rocky Mountain natural gas production is projected to increase from 3.7 trillion cubic feet in 2003 to 5.6 trillion cubic feet in 2025 (Figure 84). In 2003, Rocky Mountain production was 27 percent of total lower 48 onshore production. The Rocky Mountain region's share of lower 48 onshore production is projected to increase to 38 percent in 2025. The only other increases in production are expected in the Northeast and Southwest regions. In the Northeast, production rises from 900 billion cubic feet in 2003 to 1.2 trillion cubic feet in 2019 and declines slightly thereafter. In the Southwest, production rises from 1.7 trillion cubic feet in 2003 to 2.4 trillion cubic feet in 2018 and declines to 2.1 trillion cubic feet in 2025.

Natural gas production in the onshore Gulf Coast and Midcontinent regions remains relatively constant through 2011, then declines to 3.8 and 1.9 trillion cubic feet, respectively, in 2025. West Coast production declines throughout the forecast. Regional declines in the projections reflect depletion of the natural gas resource base and increasing costs of gas exploration and development in those regions.

Net Imports of Natural Gas Grow in the Projections

Figure 85. Net U.S. imports of natural gas, 1970-2025 (trillion cubic feet)



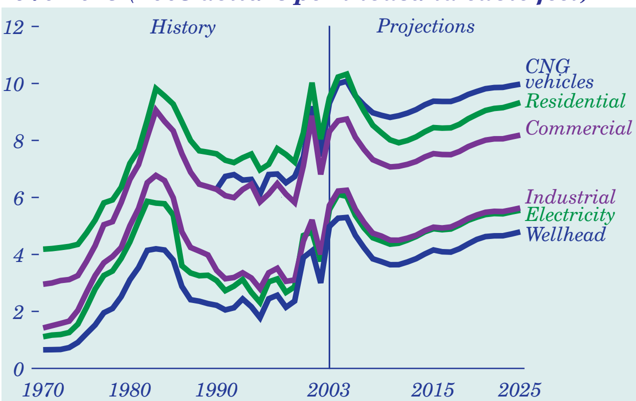
Net imports of natural gas make up the difference between U.S. production and consumption. Imports are expected to be priced competitively with domestic sources. Supplies of natural gas from overseas sources account for most of the projected increase in net imports in the reference case (Figure 85). New LNG terminals are projected to start coming into operation in 2006, and net LNG imports increase to 6.4 trillion cubic feet in 2025.

Net imports of natural gas from Canada are projected to decline from 3.0 trillion cubic feet in 2005 to 2.5 trillion cubic feet in 2009, rise again to 3.0 trillion cubic feet in 2015, and then decline to 2.5 trillion cubic feet in 2025. A steady decline of conventional production in the Western Sedimentary Basin is more than offset by increases in unconventional production in western Canada, conventional production in the MacKenzie Delta and Eastern Canada, and LNG imports. Although a MacKenzie Delta natural gas pipeline is expected to open in 2010, pipeline imports from Canada decline at the end of the forecast, because Canada's gas consumption increases more rapidly than its production.

Mexico has considerable natural gas resources, but the United States historically has been a net exporter of gas to Mexico, where industrial consumers along the border are closer to U.S. supplies than they are to domestic supplies. In the reference case, net U.S. exports to Mexico are projected to increase through 2006, when an LNG import terminal in Baja California, Mexico, begins exporting natural gas from western Mexico to the United States [*141*].

Delivered Prices Follow Projected Trends in Wellhead Prices

Figure 86. Natural gas prices by end-use sector, 1970-2025 (2003 dollars per thousand cubic feet)



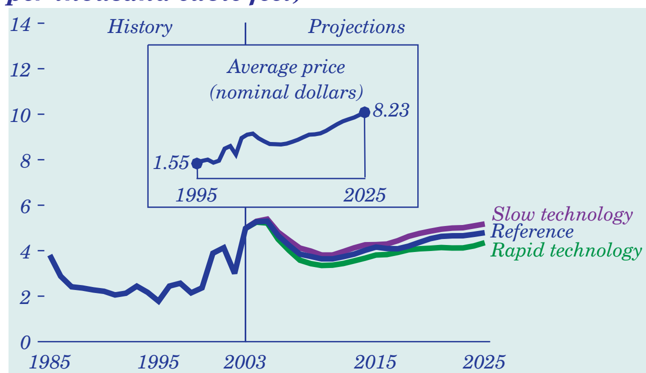
Trends in delivered natural gas prices largely reflect changes in wellhead prices. Wellhead natural gas prices are projected to decline in the early years of the *AEO2005* reference case forecast, as drilling levels increase, new production capacity comes on line, and LNG imports increase in response to current high prices. As a result, end-use delivered prices are projected to fall (Figure 86). After 2011, however, both wellhead and delivered natural gas prices are projected to increase in response to the higher exploration and development costs associated with smaller and deeper gas deposits in the remaining domestic gas resource base.

Transmission and distribution margins in the end-use sectors reflect both the volumes of gas delivered and the infrastructure arrangements of the sectors. The industrial and electricity generation sectors have the lowest end-use prices, because they receive most of their natural gas directly from interstate pipelines, avoiding local distribution charges. In addition, summer-peaking electric generators reduce transmission costs by using interruptible transportation rates during the summer, when there is spare pipeline capacity. As power generators take a larger share of the natural gas market, however, they are expected to rely more on higher cost firm transportation service.

On average, transmission and distribution margins are projected to remain relatively constant in the forecast, because the cost of new facilities largely offset the reduced depreciation expenses of existing facilities. If public opposition prevented the building of new infrastructure, delivered prices could be higher than projected in the reference case.

Technology Advances Could Moderate Future Natural Gas Prices

Figure 87. Lower 48 natural gas wellhead prices in three cases, 1985-2025 (2003 dollars per thousand cubic feet)



In the reference case, average lower 48 wellhead natural gas prices are projected to decline from the 2004 level to $3.64 per thousand cubic feet (2003 dollars) in 2010 and then increase to $4.79 per thousand cubic feet in 2025 (Figure 87). Technically recoverable natural gas resources (Table 28) are expected to be adequate to support projected production increases. As lower 48 conventional natural gas resources are depleted and wellhead prices rise, an increasing proportion of U.S. natural gas supply is projected to come from Alaska, unconventional production, and LNG imports.

In the slow oil and gas technology case, advances in exploration and production technologies are assumed to be 50 percent slower than those assumed in the reference case, which are based on historical rates. As a result, natural gas development costs are higher, wellhead prices are higher ($5.18 per thousand cubic feet in 2025), natural gas consumption is reduced, and LNG imports increase.

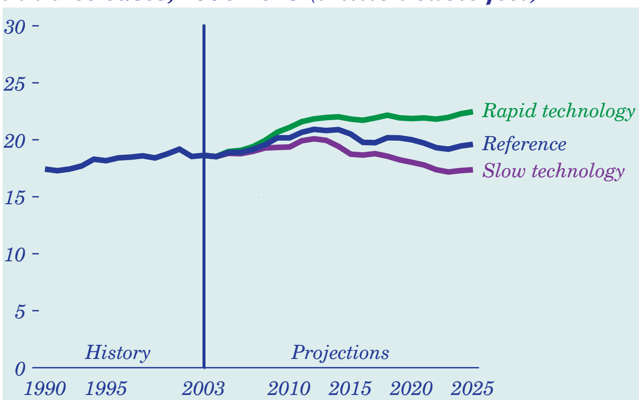
The rapid technology case assumes 50 percent faster technology progress than in the reference case, resulting in lower development costs, lower wellhead prices ($4.35 per thousand cubic feet in 2025), increased consumption of natural gas, and lower LNG imports than are projected in the reference case.

Table 28. Technically recoverable U.S. natural gas resources as of January 1, 2003 (trillion cubic feet)

Proved	Unproved	Total
186.9	1,150.5	1,337.5

Natural Gas Supply Projections Reflect Technological Progress Rates

Figure 88. Lower 48 natural gas production in three cases, 1990-2025 (trillion cubic feet)



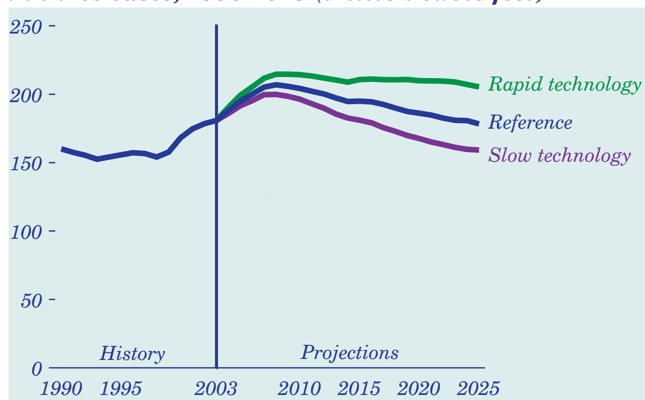
Because the impacts of technological progress are cumulative, the rapid and slow technology cases diverge increasingly from the reference case in the later years of the forecast (Figure 88). In the reference case, lower 48 natural gas production is projected to total 19.6 trillion cubic feet in 2025. The corresponding projections are 22.5 trillion cubic feet in the rapid oil and gas technology case and 17.4 trillion cubic feet in the slow technology case.

The cost-reducing effects of rapid technological progress primarily affect the economic recoverability of the unconventional resource base, because there are more opportunities for technological improvement in the exploration and recovery of unconventional gas than there are for conventional gas. In 2025, unconventional gas production is projected to be 11.0 trillion cubic feet in the rapid technology case and 7.1 trillion cubic feet in the slow technology case, compared with 8.6 trillion cubic feet in the reference case.

The rate of technological progress also affects the contributions of other natural gas supply sources. Because rapid progress is projected to increase the rate of production of lower 48 natural gas resources and reduce wellhead prices, both the Alaska gas pipeline and new LNG terminals are less viable economically in the rapid technology case than in the reference case, and their construction is delayed. In the slow technology case, more LNG terminal capacity is projected to be built, and the Alaska gas pipeline and some LNG terminals are projected to be built earlier. Projected LNG imports in 2025 total 5.7 trillion cubic feet in the rapid technology case and 6.8 trillion cubic feet in the slow technology case.

Rapid Technology Assumptions Raise Natural Gas Reserve Projections

Figure 89. Lower 48 natural gas reserves in three cases, 1990-2025 (trillion cubic feet)



Natural gas wellhead productive capacity directly reflects reserve levels. The *AEO2005* projections for lower 48 natural gas reserves are based on expected levels of natural gas exploration and development drilling resulting from projected cash flows and profitability. In the reference case, lower 48 reserves grow to 207 trillion cubic feet in 2008, then decline slowly to 178 trillion cubic feet in 2025 (Figure 89).

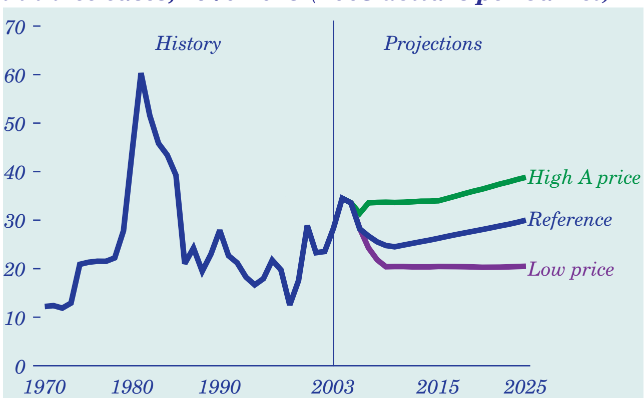
In the rapid technology case, the finding and success rates for gas well drilling are higher than in the reference case, and exploration and development costs are reduced, resulting in more drilling activity and reserve additions. In this case, lower 48 reserves are projected to peak at 215 trillion cubic feet in 2009, then decline to 205 trillion cubic feet in 2025.

In the slow technology case, finding and success rates are lower, exploration and development costs are higher, and drilling activity and reserve additions are lower than projected in the reference case. Lower 48 reserves are projected to peak at 200 trillion cubic feet in 2008, then decline to 159 trillion cubic feet in 2025.

In all three cases, the natural gas resource base is sufficient in the early years of the forecast to support the increases in drilling activity and reserve additions that are stimulated by higher projected prices. As a result, reserve additions early in the forecast generally exceed production. In later years, resource depletion reduces reserve additions per well, and rising costs of gas well development reduce drilling activity. As a result, production generally exceeds reserve additions, causing total reserves to decline toward the end of the forecast.

Oil Prices Are Expected To Decline from Recent Peaks, Then Rise

Figure 90. Lower 48 crude oil wellhead prices in three cases, 1970-2025 (2003 dollars per barrel)



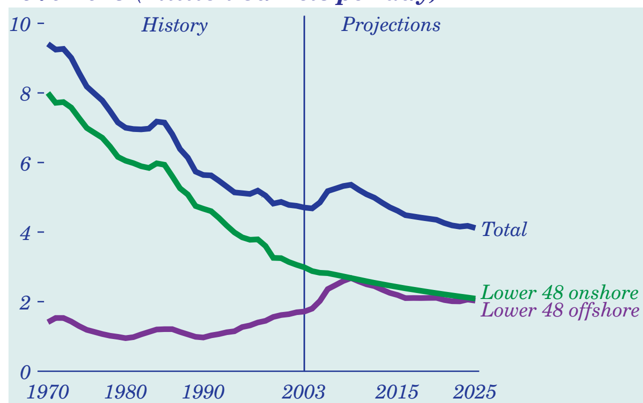
In the *AEO2005* reference case, the average lower 48 crude oil price (as distinct from the world oil price) is projected to decline from current levels to $24.50 per barrel (2003 dollars) in 2010, before increasing to $30.00 per barrel in 2025 (Figure 90). The U.S. price of oil, unlike natural gas, is set in the international marketplace. In the high A world oil price case, the lower 48 crude oil price is projected to be $33.65 per barrel in 2010 and $38.84 per barrel in 2025. In the low world oil price case, the lower 48 price declines to $20.44 per barrel in 2010, then remains relatively stable through 2025.

Between 2003 and 2010, crude oil prices are expected to decline as new deepwater oil fields are brought into production in the Gulf of Mexico and West Africa, new oil sands production is initiated in Canada, and OPEC and Russia expand production capacity. Near-term price expectations are highly uncertain, however, given the potential for political instability in many oil-exporting countries, which could significantly change the world's oil demand and supply picture.

Uncertainty about world oil prices in the longer term is reflected in the low and high A world oil price cases. Crude oil prices are determined largely by the balance between production and consumption and the mix of OPEC and non-OPEC production. In the reference case, oil production and consumption in 2025 are balanced at 120 million barrels per day, with OPEC accounting for 46 percent of total production. The low oil price case projects production of 128 million barrels per day in 2025, with the OPEC share at 51 percent. The high A case projects 114 million barrels per day, with the OPEC share at 37 percent.

Lower 48 Crude Oil Production Is Expected To Decline After 2009

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 4.7 million barrels per day in 2003 to 5.4 million barrels per day in 2009, then decline to 4.1 million barrels per day in 2025 (Figure 91). In the low oil price case, lower 48 oil production peaks in 2009 at 5.3 million barrels per day, then declines to 3.9 million barrels per day in 2025. In the high A oil price case, lower 48 production peaks in 2009 at 5.4 million barrels per day and declines to 4.5 million barrels per day in 2025. The projected peaks in oil production are attributable to offshore production, particularly in the Gulf of Mexico, where deepwater oil production is projected to total 2.3 million barrels per day in 2009 (Table 29).

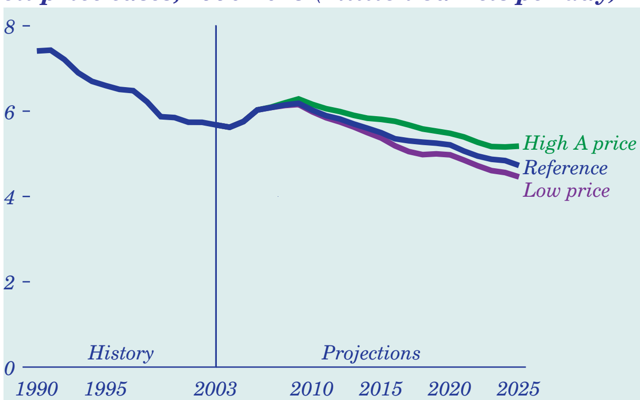
Offshore crude oil production is more sensitive than onshore production to oil prices, because a smaller portion of offshore oil resources has been depleted. In the reference case, total offshore production (including the Gulf of Mexico and offshore California) rises to 2.7 million barrels per day in 2009, then declines to 2.0 million barrels per day in 2025. In the low and high A price cases, the projections for lower 48 offshore production in 2025 are 1.9 million barrels per day and 2.3 million barrels per day, respectively. Onshore lower 48 oil production is projected to decline in all three cases, with 2025 values ranging from 2.0 million barrels per day in the low price case to 2.2 million barrels per day in the high A price case.

Table 29. Crude oil production from Gulf of Mexico offshore, 2003-2025 (million barrels per day)

	2003	2010	2015	2020	2025
Shallow	0.5	0.3	0.3	0.3	0.3
Deep	1.1	2.2	1.8	1.8	1.7
Total	**1.6**	**2.5**	**2.1**	**2.1**	**2.0**

U.S. Oil Production Is Marginally Sensitive to World Oil Prices

Figure 92. Total U.S. crude oil production in three oil price cases, 1990-2025 (million barrels per day)



The different paths projected for total U.S. crude oil production in the three world oil price cases reflect differences both in the numbers of new fields developed and in the volumes of oil recovered from existing fields. Total U.S. oil production is only marginally sensitive to crude oil price projections (Figure 92), both because future production is expected to come largely from developed fields, such as Prudhoe Bay, and because development of much of the remaining oil resource base (Table 30) would be uneconomical even with much higher oil prices. In the high A and low world oil price cases, total U.S. production in 2025 is projected at 5.2 and 4.5 million barrels per day, respectively.

The different price paths in the three cases primarily affect the development and production of lower 48 offshore resources (Table 31). Smaller deepwater fields that are not profitable when prices are low are expected to become profitable at higher price levels.

Table 30. Technically recoverable U.S. oil resources as of January 1, 2003 (billion barrels)

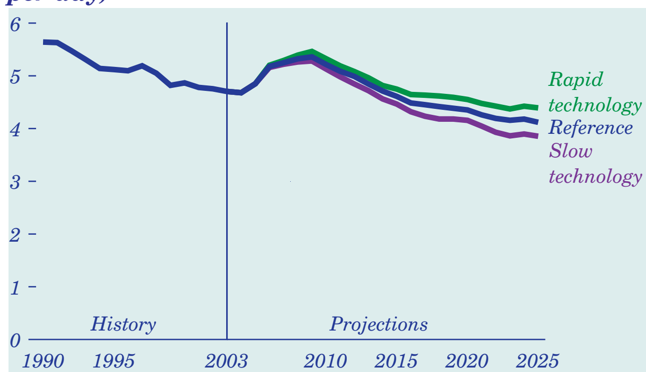
Proved	Unproved	Total
24.0	118.8	142.8

Table 31. Onshore and offshore lower 48 crude oil production in three cases, 2025 (million barrels per day)

	Onshore	Offshore	Total
Low oil price	2.03	1.88	3.91
Reference	2.09	2.03	4.12
High A oil price	2.16	2.30	4.47

More Rapid Technology Advances Could Raise Oil Production

Figure 93. Lower 48 crude oil production in three technology cases, 1990-2025 (million barrels per day)

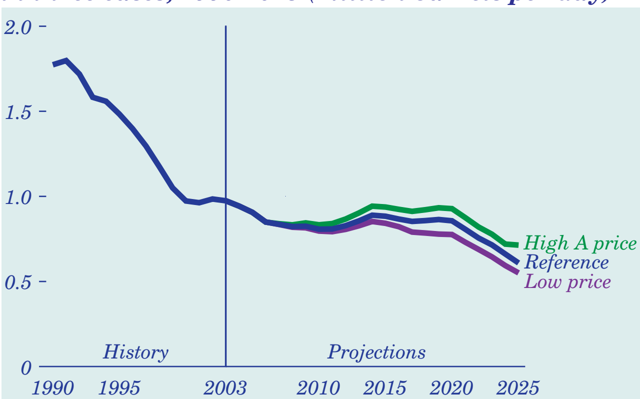


Lower 48 crude oil production is projected to reach 4.4 and 3.9 million barrels per day in 2025 in the rapid and slow technology cases, respectively, compared with 4.1 million barrels per day in the reference case (Figure 93). The technology cases assume the same world oil prices as in the reference case, but the rate of technological progress is assumed to be 50 percent higher (in the rapid technology case) or lower (in the slow technology case) than the historical rate. With domestic oil demand determined largely by oil prices and economic growth rates, consumption is not expected to change significantly in the technology cases. Thus, changes in production resulting from the different rates of technological progress lead to different projected levels of petroleum imports. In 2025, net petroleum imports are projected to range from 18.5 million barrels per day in the rapid technology case to 19.6 million barrels per day in the slow technology case, as compared with 19.1 million barrels per day in the reference case.

In the lower 48 States, offshore crude oil production is more sensitive than onshore production to changes in technology, because there are more opportunities for technological improvement in the less mature areas offshore, particularly in the deepwater Gulf of Mexico. Cumulative offshore production from 2004 through 2025 is projected to be 0.7 billion barrels (4.0 percent) higher in the rapid technology case and 0.8 billion barrels (4.7 percent) lower in the slow technology case than in the reference case. Cumulative onshore production is about 0.4 billion barrels (2.0 percent) higher in the rapid oil and gas technology case and 0.4 billion barrels (1.8 percent) lower in the slow technology case than in the reference case.

Crude Oil Production in Alaska Depends on Oil Prices

Figure 94. Alaskan crude oil production in three cases, 1990-2025 (million barrels per day)



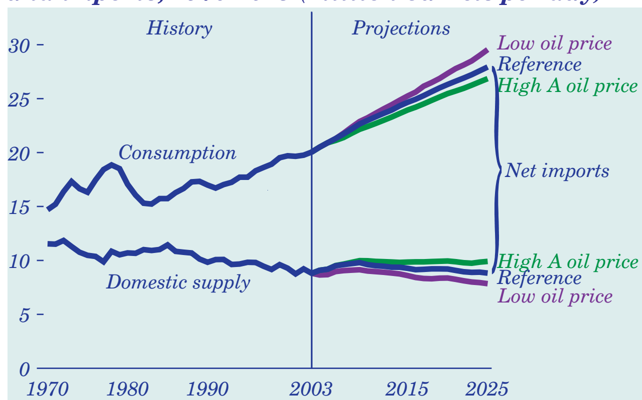
Alaskan crude oil production originates mainly from the North Slope, which includes the National Petroleum Reserve-Alaska (NPR-A) and the State lands surrounding Prudhoe Bay. Because oil and gas producers are prohibited from building permanent roads in NPR-A, exploration and production are expected to 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), *AEO2005* does not project any production from ANWR; however, an EIA analysis [*142*] projects that if drilling were allowed, production would start 10 years later and reach 900,000 barrels per day in 2025 if the area contains the mean level of resources (10.4 billion barrels) estimated by the U.S. Geological Survey.

In the reference case, crude oil production from Alaska is expected to decline to about 810,000 barrels per day in 2010 (Figure 94). After 2010, increased production from NPR-A raises Alaska's total production to about 890,000 barrels per day in 2014. Depletion of the oil resource base in the North Slope, NPR-A, and southern Alaska oil fields is expected to lead to a decline in the State's total production to about 610,000 barrels per day in 2025.

As in the lower 48 States, oil production in Alaska is marginally sensitive to projected changes in oil prices. Higher prices make more of the reservoir oil in-place profitable. In 2025, Alaska's production is projected to be about 100,000 barrels per day above the reference case level in the high A oil price case and 60,000 barrels per day below the reference case level in the low oil price case.

Imports Fill the Gap Between Domestic Supply and Demand

Figure 95. Petroleum supply, consumption, and imports, 1970-2025 (million barrels per day)



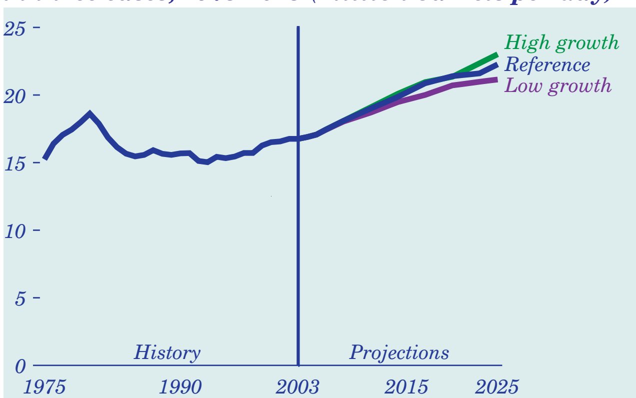
In 2003, net imports of crude oil and refined products accounted for 56 percent of domestic petroleum consumption. Dependence on petroleum imports is projected to reach 68 percent in 2025 in the reference case (Figure 95). The corresponding import shares of total consumption in 2025 are expected to be 63 percent in the high A oil price case and 72 percent in the low oil price case.

The portion of domestic petroleum demand that is supplied by imports depends on the world crude oil price. Because imported products are the most expensive source of petroleum supply, the first effect of assuming crude oil prices above those projected in the reference case is reduced consumption of imported petroleum products. Higher prices also stimulate the production of relatively high-cost domestic crude oil, resulting in lower projected levels of imported crude. Prices below those in the reference case have the opposite effect: U.S. consumption and product imports increase, production of domestic crude oil falls, and the portion of petroleum consumption met by imports rises.

Although crude oil is expected to continue as the major component of petroleum imports, refined products are projected to represent a growing share. More petroleum product 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 21 percent of net petroleum imports in 2025 in the low oil price case and 12 percent in the high A oil price case, compared with 16 percent in the reference case, increasing from a 14-percent share in 2003.

Expansion at Existing Refineries Increases U.S. Refining Capacity

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



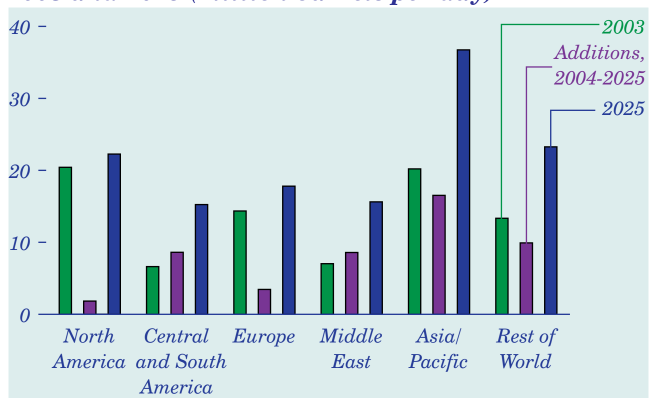
Falling demand for petroleum and deregulation of the domestic refining industry in the 1980s led to 13 years of decline in U.S. refinery capacity. That trend was reversed in 1996, and 1.4 million barrels per day of distillation capacity was added between 1996 and 2003. Financial and legal considerations 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 *AEO2005* cases (Figure 96).

Distillation capacity is projected to grow from the 2003 year-end level of 16.8 million barrels per day to 22.3 million barrels per day in 2025 in the reference case, 21.4 million in the high A oil price case, and 22.5 million in the low price case, as compared with the 1981 peak of 18.6 million barrels per day. Almost all new capacity additions are projected to occur on the Gulf Coast. Existing refineries are expected to continue to be utilized intensively (92 to 95 percent of operable capacity) throughout the forecast. The 2003 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.

Distillation is only the first step in the refining process. Improved processing of the intermediate streams obtained from crude distillation is expected to reduce yields of residual fuel, which has a shrinking market, and improve yields of the higher value “light products,” such as gasoline, distillate, jet fuel, and liquefied petroleum gas. Further process improvements will be required to reduce the sulfur content of gasoline and some types of distillate fuel.

Asia/Pacific Region Is Expected To Surpass U.S. Refining Capacity

Figure 97. Worldwide refining capacity by region, 2003 and 2025 (million barrels per day)



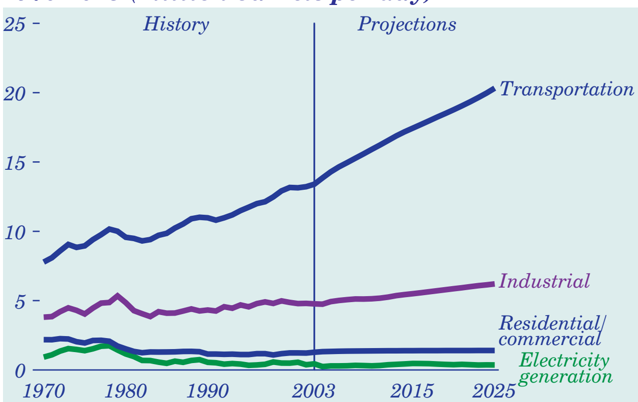
Worldwide crude oil distillation capacity was 82.0 million barrels per day at the end of 2003. To meet the growth in international oil demand in the reference case, worldwide refining capacity is expected to increase by about 60 percent—to more than 131 million barrels per day—by 2025. Substantial growth in distillation capacity is expected in the Middle East, Central and South America, and the Asia/Pacific region (Figure 97).

The Asia/Pacific region has been the fastest growing refining center over the past decade. In the mid-1990s, it surpassed Western Europe as the world’s second largest refining center (after North America) in terms of distillation capacity; and in 2003, capacity in the Asia/Pacific region capacity was only 220,000 barrels per day lower than that in North America. While not adding significantly to their distillation capacity, refiners in the United States and Europe have tended to improve product quality and enhance the usefulness of heavier oils through investment in downstream capacity.

Future investments in the refinery operations of developing countries must include configurations that are more advanced than those currently in operation. Their refineries will be called upon to meet increased worldwide demand for lighter products, to upgrade residual fuel, to supply transportation fuels with reduced lead, and to supply both distillate and residual fuels with lower sulfur levels. An additional burden on new refineries will be the need to supply lighter products from crude oils whose quality is expected to deteriorate over the forecast period.

Petroleum Use Increases Mainly in the Transportation Sector

Figure 98. Petroleum consumption by sector, 1970-2025 (million barrels per day)



The transportation sector accounted for two-thirds of U.S. petroleum use in 2003 (Figure 98). In the forecast, population growth and economic growth cause miles traveled to increase across all modes of transit. Although improvements in vehicle technology yield reductions in fuel use per mile traveled, the increases in mileage outweigh increases in efficiency, leading to increases in consumption of gasoline, diesel, and jet fuel.

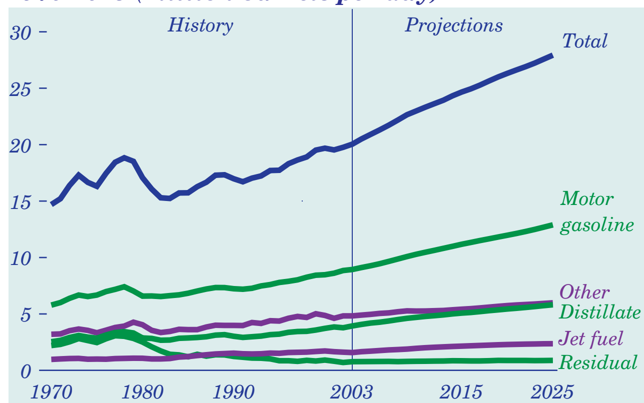
The industrial sector currently accounts for 24 percent of U.S. petroleum demand. In the reference case, industrial consumption is projected to be 1.2 million barrels per day higher in 2025 than it was in 2003, and industrial consumption of liquefied petroleum gas (LPG), largely as a chemical feedstock, increases by about 490,000 barrels per day.

In the residential sector, distillate use is displaced by LPG, natural gas, and electricity for home heating toward the end of the forecast, in systems that require less maintenance than oil furnaces. As a result, residential oil use drops by 88,000 barrels per day from 2003 to 2025. Commercial use of heating oil grows from 246,000 barrels per day in 2003 to 362,000 barrels per day in 2025. The delivered price of distillate to commercial customers is projected to be lower than the price of natural gas throughout the forecast.

Only 3 percent of U.S. electricity is currently generated from refined petroleum, but the electricity sector nearly matches residential petroleum use by the end of the forecast. Consumption of residual and distillate fuel in the electric power sector increase modestly.

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

Figure 99. Consumption of petroleum products, 1970-2025 (million barrels per day)



U.S. petroleum consumption is projected to increase by 7.9 million barrels per day from 2003 to 2025 (Figure 99). About 92 percent of the projected growth in petroleum consumption consists of "light products" (including gasoline, diesel, heating oil, jet fuel, kerosene, LPG, and petrochemical feedstocks), which are more difficult and costly to produce than heavy products.

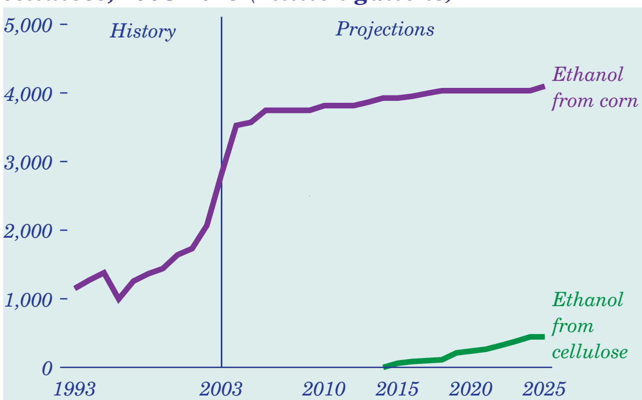
Gasoline continues to make up nearly one-half of all petroleum used in the United States, increasing from 8.9 million barrels per day in 2003 to 12.9 million in 2025, mostly for transportation. Consumption of distillate fuel is also projected to increase, by 1.9 million barrels per day, from 2003 to 2025. Gasoline is used only in spark-ignition engines; distillate is used in furnaces, boilers, diesel engines, and some turbines. Jet fuel consumption is projected to increase by 789,000 barrels per day from 2003 to 2025.

Consumption of "other" petroleum products is projected to increase from 4.8 million barrels per day in 2003 to 6.0 million barrels per day in 2025. LPG used for heating and chemical production is included in the "other" category, along with other chemical feedstocks, still gas used for refinery fuel, and asphalt.

Residual fuel use, constrained by air quality regulations, increases by only 110,000 barrels per day from 2003 to 2025, including an increase of 79,000 barrels per day in residual fuel use for baseload electricity generation. More intensive refinery processing to maximize light product yield and minimize heavy product yield is expected to limit the availability of residual fuel. LPG use also remains about constant.

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

Figure 100. U.S. ethanol production from corn and cellulose, 1993-2025 (million gallons)



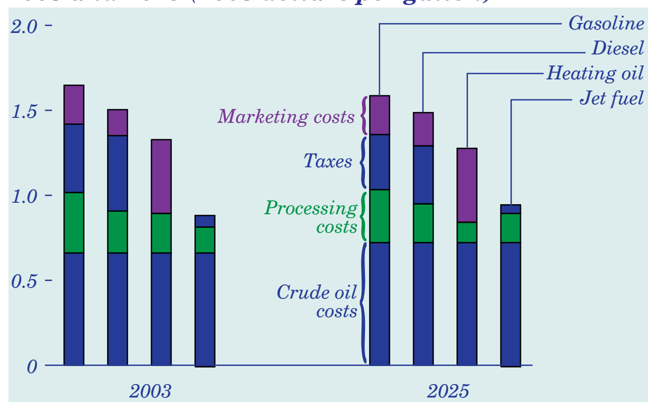
U.S. ethanol production, with corn as the primary feedstock, totaled 2,821 million gallons in 2003 and is projected to increase to 4,544 million gallons in 2025 (Figure 100). About 26 percent of the increase consists of ethanol distilled from cellulosic biomass such as wood and agricultural residues. The high renewables case projects a similar increase in ethanol production, but all the growth is in ethanol from cellulose, based on more rapid improvement in the technology.

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 weight) during the winter months to reduce carbon monoxide emissions. It is also expected to replace MTBE as the oxygenate for RFG in 20 States that have placed limits on MTBE use because of concerns about groundwater contamination. It is assumed that the Federal requirement for 2 percent oxygen in RFG will continue in all States. Some ethanol is also used in E85 fuel, a blend of 70 to 85 percent ethanol and gasoline. E85 consumption is projected to increase from a national total of 11 million gallons in 2003 to 47 million gallons in 2025.

The American Jobs Creation Act of 2004 extended the excise tax exemption for ethanol through 2010, at 51 cents per gallon. It is assumed that the exemption will continue to be extended at that level (in nominal dollars) through the end of the forecast.

Refining Costs for Most Petroleum Products Remain Stable or Decline

Figure 101. Components of refined product costs, 2003 and 2025 (2003 dollars per gallon)



Refined product prices are determined by crude oil costs, refining costs (including profits), marketing costs, and taxes (Figure 101). In the *AEO2005* projection, crude oil continues as the largest part of product prices. Marketing costs remain stable, but the contribution of taxes is projected to change considerably. Refining costs for gasoline and diesel fuel are expected to remain about the same in the forecast, despite rising demand and new Federal requirements for low-sulfur gasoline (2004 to 2007) and ultra-low-sulfur diesel fuel (2006 to 2010). Refining costs for jet fuel are projected to increase as demand increases, by 2 cents per gallon from 2003 to 2025, while refining costs for heating oil are projected to fall by 11 cents per gallon. Most diesel fuel must have no more than 15 parts per million sulfur by 2012, whereas heating oil, which is otherwise very similar to diesel fuel, has no sulfur limit.

Whereas crude oil costs tend to increase refined product prices in the forecast, the assumption that Federal motor fuel taxes remain at nominal 2003 levels tends to reduce prices. 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 2003 dollars) from 2003 to 2025—8 cents per gallon for gasoline, 10 cents for diesel fuel, and 2 cents for jet fuel. State motor fuels taxes are assumed to keep up with inflation, as they have generally in the past.