

World Oil Markets

IEO2005 projects that world crude oil prices in real 2003 dollars will decline from their current level by 2010, then rise gradually through 2025.

In the *International Energy Outlook 2005 (IEO2005)* reference case, world demand for crude oil grows from 78 million barrels per day in 2002 to 103 million barrels per day in 2015 and to just over 119 million barrels per day in 2025. Much of the growth in oil consumption is projected for the emerging Asian nations, where strong economic growth results in a robust increase in oil demand. Emerging Asia (including China and India) accounts for 45 percent of the total world increase in oil use over the forecast period in the *IEO2005* reference case.

The projected increase in world oil demand would require an increment to world production capability of more than 42 million barrels per day relative to the 2002 crude oil production capacity of 80.0 million barrels per day. Producers in the Organization of Petroleum Exporting Countries (OPEC) are expected to be the major source of production increases. In addition, non-OPEC supply is expected to remain highly competitive, with major increments to supply coming from offshore resources, especially in the Caspian Basin, Latin America, and deepwater West Africa. The estimates of incremental production are based on current proved reserves and a country-by-country assessment of ultimately recoverable petroleum. In the *IEO2005* oil price cases, the substantial investment capital required to produce the incremental volumes is assumed to exist, and the investors are expected to receive at least a 10-percent return on investment.

In 2004, crude oil prices averaged \$36 per barrel (see text box below), with prices turning upward throughout the year and well into 2005. Although OPEC production quotas (excluding Iraq) were raised from 23.5 million

barrels per day in April 2004 to 28.0 million barrels per day in July 2005, world oil prices generally continued to rise [1]. In June 2005, crude oil futures prices exceeded \$60 per barrel, a record high price in nominal dollars [2].

Several factors have worked to keep world crude oil prices high in the near term. First, world petroleum demand grew at a robust 3.4 percent (2.7 million barrels per day) in 2004, reflecting dramatic increases in China's demand for oil-generated power and oil-based transportation fuels, as well as a rebound in U.S. oil demand. Second, oil prices typically are sensitive to any incremental tightening of supply during periods of high economic growth. On the supply side, there was very little spare upstream capacity, and the spare downstream capacity was not always properly configured to produce the required slate of products. World oil inventories, in terms of "days of supply," were unusually low. Next, geopolitical tensions in major oil-producing countries—including the continuing the war in Iraq and uncertain prospects for a return to normalcy in Iraq's oil sector—and potential unrest in Nigeria and Venezuela contributed to the volatility in world oil markets.

Tempered by high world oil prices, growth in world petroleum demand in 2005 is expected to remain strong, while retreating somewhat from its 2004 pace. Any expectation of incremental supply tightness in non-OPEC supply or downstream refinery capacity could cause crude oil prices to increase even further. As a result, the refiner acquisition cost of imported crude oil in 2005 is expected to average more than \$47 per barrel. OPEC producers may find it more challenging to maintain high oil prices over the next few years, however, given the projected increase in non-OPEC supply.

Despite evidence that OPEC members have achieved some of their price goals in recent years by using a price-band strategy, production cutbacks have historically had only limited success. OPEC's market management strategies have often ended in failure, and its successes for the most part have been the result of tight market conditions and disciplined participation by OPEC members. Currently, spare production capacity worldwide—with the exception of two or three Persian Gulf members of OPEC—is negligible, making OPEC's consensus building easier. Non-OPEC production is expected to show significant increases over the next 5

World Oil Prices in *IEO2005*

World oil prices in *IEO2005* are defined on the basis of "average refiner acquisition cost" of imported oil to the United States (IRAC). The IRAC price tends to be a few dollars less than the widely cited West Texas Intermediate (WTI) spot price. WTI is a higher quality, lighter, low-sulfur crude than that represented by IRAC. In recent months, IRAC has been as much as 6 dollars a barrel lower than the WTI. In 2004, WTI averaged \$41.44 per barrel and IRAC averaged \$36.00 per barrel (in nominal dollars).

years, and a number of OPEC member countries have announced plans to expand production capacity in the short term. In an oil market environment with substantial spare production capacity, it will be more difficult for OPEC to achieve agreement among its members; however, obstacles to investment in new production capacity in some areas with abundant resources may keep the growth in supply below its expected potential.

Although OPEC's share of world oil supply is projected to increase significantly over the next two decades, competitive forces are expected to remain strong enough to forestall efforts to escalate real oil prices significantly. Competitive forces operate within OPEC, between OPEC and non-OPEC sources of supply, and between conventional oil and other sources of energy (particularly, nonconventional oil, natural gas, and coal).

Non-OPEC producers have been somewhat slow in reacting to higher oil prices; however, there remains significant untapped production potential worldwide, especially in deepwater areas. Deepwater exploration and development initiatives generally are expected to be sustained worldwide, with the offshore Atlantic Basin emerging as a major future source of oil production in both Latin America and Africa.

Although the lag between higher prices and increases in drilling activity seems to have increased in the aftermath of the low price environment of 1998 and 1999, non-OPEC production has increased by more than 3 million barrels per day over the past 3 years and is expected to add an additional 0.7 million barrels per day in 2005. More than one-half of the worldwide increase in non-OPEC production over the next 2 years is expected to come from the former Soviet Union (FSU), and the remainder is expected to come mainly from the emerging economies of the Atlantic Basin (Latin America and West Africa). Technology and resource availability can sustain large increments in oil production capability at prices well below the current level.

Incorporating the recent price turbulence into the construction of an intermediate- and long-term oil market outlook is difficult and raises the following questions: Will OPEC maintain its cutback strategy in order to keep prices within a certain price band, or will the anticipated increase in non-OPEC production exert downward pressure on prices? Will China and other emerging economies of Asia be able to sustain the current robust economic growth and a corresponding increase in their demand for oil in the long term? Will technology guarantee that oil supply development will move forward even if a low world oil price environment returns?

The uncertainties associated with the *IEO2005* reference case projections are significant. The war in Iraq, the international war on terrorism, uncertain economic recovery in emerging Asia and Japan, the success of

China's economic reforms and its political situation, the potential for social unrest in Venezuela and Nigeria, Brazil's impact on other Latin American economies, and uncertain prospects for the pace of economic recovery in the FSU all increase the risk of near-term political and policy discontinuities that could lead to oil market behavior quite different from that portrayed in the projections.

World Oil Demand

World oil consumption rose by about 2.7 million barrels per day in 2004, with the mature market economies accounting for only about one-fourth of the increase. Demand in the emerging economies rose by almost 1.9 million barrels per day, with China accounting for more than one-half of that increase. Current growth in the emerging Asian economies is beginning to show signs of a return to the rapid economic expansion of the early and mid-1990s. Latin America's oil demand continues to grow at a modest rate. In the FSU, oil demand is expected to show a modest increase for 2004. In 2005, global oil demand is expected to grow by about 2.2 million barrels per day [3].

In the *IEO2005* reference case forecast, growth in world oil demand averages 1.9 percent per year over the forecast period. Most of the world's incremental oil demand is projected for use in the transportation sector, where there are currently no competitive alternatives to petroleum; however, several of the technologies associated with nonconventional liquids (gas to liquids, coal to liquids, and energy crops that can be used to produce ethanol and biodiesel) could reduce the pressure on conventional oil supply from the transportation sector. Of the projected increase in oil use in the reference case over the 2002 to 2025 period, 61 percent occurs in the transportation sector (Figure 28). The industrial sector also accounts for a fairly large share of the projected increase in world oil consumption: 28 percent of the increase is expected to be for industrial sector uses, mostly for chemical and petrochemical processes.

On a regional basis, two parts of the world account for most of the projected growth in world oil demand: emerging Asia and North America (Figure 29). Outside North America, oil consumption in the mature market economy regions grows much more slowly—by 0.3 percent per year—in both Western Europe and mature market Asia, reflecting expectations of slow growth or declines in population and economic growth over the next two decades.

In the emerging economies, strong expansion of oil use is projected, as robust economic growth fuels demand for oil to fuel burgeoning industrial sectors and rapidly expanding transportation use. The fastest growth in oil demand is projected for the emerging Asian economies, at an average rate of 3.5 percent per year over the

forecast period, and the other emerging economy regions also are expected to experience fast-paced increases in oil use. From 2002 to 2025, consumption of petroleum is projected to increase on average by 2.1 percent per year in the Middle East, 2.5 percent per year in Central and South America, and 2.7 percent per year in Africa.

Economic development in Asia will be crucial to long-term growth in oil markets. China, India, and the other nations of emerging Asia are expected to experience combined economic growth of 5.5 percent per year between 2002 and 2025, the highest rate of growth in the world. This robust expansion in gross domestic product (GDP) translates to a 3.5-percent annual increase in regional oil use. The projected evolution of Asian oil demand in the reference case could strengthen economic ties between the Middle East and Asia, as Asian nations rely more and more on Middle East oil supplies.

In the transitional economies of Eastern Europe and the FSU (EE/FSU), oil consumption increases on average by 1.4 percent per year in the reference case forecast, from 5.5 million barrels per day in 2002 to 7.6 million barrels per day in 2025. Oil use in the EE/FSU region dropped precipitously after the collapse of the Soviet regime in the early 1990s, from 10.0 million barrels per day in 1990 to 5.3 million barrels per day in 1997, as the region's GDP contracted by almost one-third. Growth in oil demand in the EE/FSU region has begun to recover in recent years and by 2002 had reached 5.5 million barrels per day.

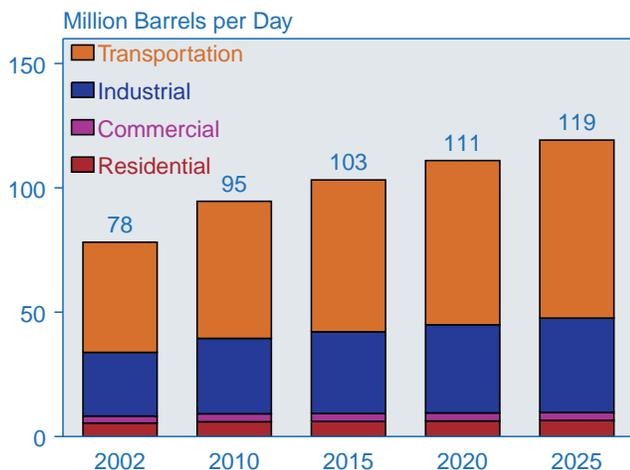
Positive economic growth returned to the FSU in 1999, when high world oil prices and a devalued ruble helped Russia, the region's largest economy and a major world oil exporter, post strong economic gains by boosting performance in its industrial sectors and increasing consumer demand for domestically produced goods. Even with the robust economic growth (an average of 4.4 percent per year) projected for the region, oil demand in the EE/FSU is not expected to be as strong in 2025 as it was in 1990.

World Oil Prices

The world oil price in the *International Energy Outlook 2005 (IEO2005)* is defined as the annual average U.S. refiner acquisition cost of imported crude oil. Three distinct world oil price scenarios are represented in *IEO2005*, reaching \$21, \$35, and \$48 per barrel in 2025, respectively, in the low world oil price, reference, and high world oil price cases in 2003 dollars. Although the *IEO* typically uses the same reference case as the *Annual Energy Outlook*, *IEO2005* has adopted the October futures case from the *Annual Energy Outlook 2005 (AEO2005)* as its reference case for the United States. The October futures case, which has an assumption of higher world oil prices than in the *AEO2005* reference case, now appears to be a more likely projection.²

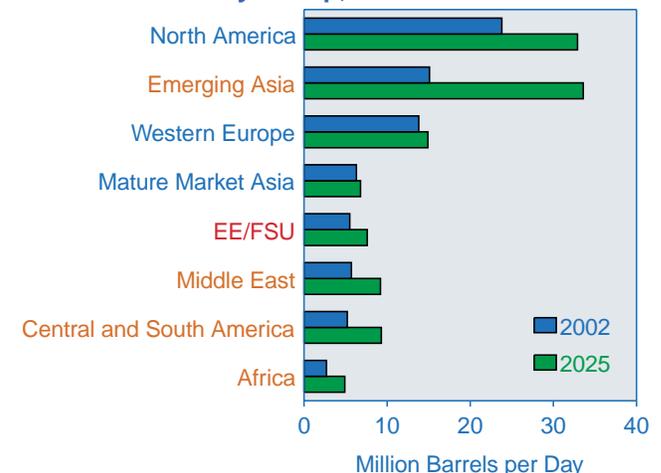
In October 2004, the New York Mercantile Exchange (NYMEX) oil futures prices implied that the annual average oil price in 2005 will exceed its 2004 level before

Figure 28. World Oil Consumption by End-Use Sector, 2002-2025



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2002*, DOE/EIA-0219(2002) (Washington, DC, March 2004), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2005).

Figure 29. World Oil Consumption by Region and Country Group, 2002 and 2025



Sources: **2002:** Energy Information Administration (EIA), *International Energy Annual 2002*, DOE/EIA-0219(2002) (Washington, DC, March 2004), web site www.eia.doe.gov/iea/. **2025:** EIA, System for the Analysis of Global Energy Markets (2005).

²For detailed descriptions and comparisons of the *AEO2005* reference, October oil futures, and other world oil price cases, see Energy Information Administration, *Annual Energy Outlook 2005*, DOE/EIA-0383(2005) (Washington, DC, February 2005), pp. 40-50, web site www.eia.doe.gov/oiaf/aeo/. The reference case will be reconsidered for the next *AEO*. Based on information available as of July 2005, the *AEO2006* reference case will likely incorporate world oil prices higher than those in the *IEO2005* reference case.

falling back somewhat. The *AEO2005* October oil futures case is based on an extrapolation of oil prices loosely corresponding to the mid-term profile of prices on the NYMEX futures market in October 2004.

The low world oil price case reflects a future market where oil production becomes more competitive and plentiful. There are several ways in which this could come about. First, the OPEC countries could become less cohesive, with each producer attempting to sell as much of its production capacity as the market will allow. Another possibility would be a decline in the costs of non-OPEC oil production or the viable development of competitive alternatives. To forestall the penetration of alternatives and other sources of competition, OPEC would be expected to lower its price band and increase production. The high price case, in contrast, assumes that world oil prices will remain close to current levels for the foreseeable future.

Although oil prices rose by more than \$9 per barrel over the course of 2004 and are expected to add an additional \$7 per barrel in 2005, such developments are not indicative of the long-term trend in the *IEO2005* reference case. From anticipated high levels throughout 2005, oil prices are expected to decline gradually to \$31 per barrel in 2010, then rise by about 0.8 percent per year to \$35 in 2025 (all price projections in 2003 dollars unless otherwise noted).

The near-term price trajectory in the *IEO2005* reference case is considerably different from that in the *International Energy Outlook 2004* (*IEO2004*). Last year's reference case price path did not reflect the upward price pressure in 2004 brought about by the conditions that have led to market tightness. In both the *IEO2004* and *IEO2005* reference cases, oil prices rise gradually from about 2010 through 2025. This price path reflects the recognition that OPEC has been able to limit production for the purpose of firming up prices and that continued robust projections for oil demand, especially among the emerging economies, will to some extent maintain pressure on oil markets.

Three alternative long-term price paths are shown in Figure 30. In the *IEO2005* reference case, projected prices reach \$35 per barrel in 2025 in 2003 dollars. In nominal dollars, the reference case price is expected to approach \$60 per barrel in 2025. In the low price case, prices are projected to reach \$21 per barrel in 2009 and to remain at about that level out to 2025. In the high price case, prices are projected to reach \$37 per barrel in 2013 and increase steadily to \$48 per barrel in 2025. While the three cases shown in Figure 30 vary widely, they do not span the full range of possible scenarios.

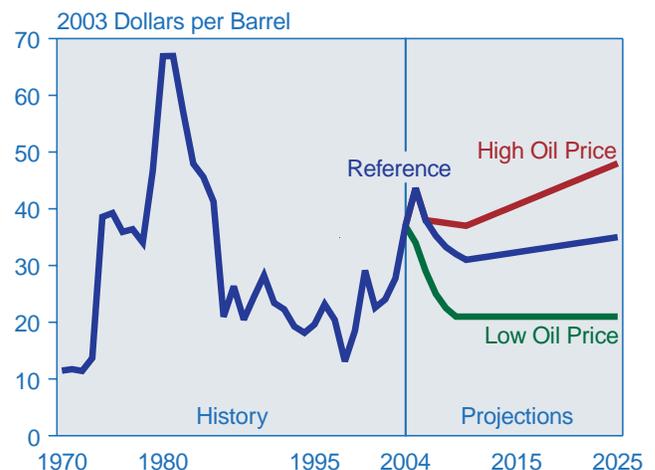
In all the *IEO2005* oil price cases, oil demand is expected to rise significantly over the projection period. In the high and low world oil price cases, the projected

increases in oil consumption from 2002 to 2025 are 35 million barrels per day and 53 million barrels per day, respectively. Resources are not expected to be a key constraint on world demand to 2025. Rather more important are the political, economic, and environmental circumstances that could shape developments in oil supply and demand.

Oil prices have been highly volatile over the past 25 years, and periods of price volatility can be expected in the future principally because of unforeseen political and economic circumstances. It is well recognized that tensions in the Middle East, for example, could give rise to serious disruptions of normal oil production and trading patterns. On the other hand, market forces can play a significant role in restoring balance over an extended period. High real prices deter consumption and encourage the emergence of significant competition from large marginal sources of oil, which currently are uneconomical to produce, and other energy supplies. Persistently low prices have the opposite effects.

Limits to long-term oil price escalation include substitution of other fuels (such as natural gas) for oil, marginal sources of conventional oil that become reserves (i.e., economically viable) when prices rise, and nonconventional sources of oil that become reserves at still higher prices. Advances in exploration and production technologies are likely to bring prices down when such additional oil resources become part of the reserve base. There are some oil market analysts, however, who find this viewpoint overly optimistic, based on what they consider to be a significant overestimation of both proven reserves and ultimately recoverable resources.

Figure 30. World Oil Prices in Three Cases, 1970-2025



Sources: **History:** Energy Information Administration (EIA), *Annual Energy Review 2003*, DOE/EIA-0384(2003) (Washington, DC, September 2004), web site www.eia.doe.gov/emeu/aer/. **Projections:** EIA, *Annual Energy Outlook 2005*, DOE/EIA-0383(2005) (Washington, DC, February 2005). Note: *IEO2005* uses the *AEO2005* October oil futures case as its reference case.

The Composition of World Oil Supply

A three-step approach was used to determine the composition of world oil supply in the three *IEO2005* oil price cases. The first step determined whether the oil resource base would be sufficiently robust to meet worldwide demand. The second step determined how much non-OPEC oil (both conventional and nonconventional) could be produced at the assumed price path. An important criterion in the second step was whether producers would receive an adequate rate of return on their investment (usually 10 percent). With total non-OPEC supply having been established, the third step assumed that the remainder of the worldwide demand would be met by OPEC producers and determined an appropriate production capacity for each OPEC producer.

It is important to note what this simple three-step approach did and did not assume. A business-as-usual oil market environment was assumed. Disruptions in oil supply for any reason (war, terror, weather, geopolitics) were not assumed. It was assumed that all non-OPEC oil projects that show a favorable rate of return on investment would be funded, and that OPEC would act as the residual supplier of oil to the world. For the forecast period out to 2025, there is sufficient oil to meet worldwide demand. Peaking of world oil production is not anticipated until after 2030.

In the *IEO2005* reference case, world oil supply in 2025 is projected to exceed the 2002 level by almost 41 million barrels per day. Increases in production are expected for both OPEC and non-OPEC producers; however, only about 41 percent of the total increase is expected to come from non-OPEC areas. Over the past two decades, the growth in non-OPEC oil supply has resulted in an OPEC market share substantially under its historic high of 52 percent in 1973. New exploration and production technologies, aggressive cost-reduction programs by industry, and attractive fiscal terms to producers by governments all contribute to the outlook for continued growth in non-OPEC oil production.

The reference case projects that about 59 percent of the increase in petroleum demand over the next two decades will be met by an increase in production by members of OPEC rather than by non-OPEC suppliers. OPEC production in 2025 is projected to be more than 24 million barrels per day higher than it was in 2002 (Figure 31). The *IEO2005* estimates of OPEC production capacity in 2010 are slightly less than those projected in *IEO2004*, reflecting a shift toward non-OPEC supply projects in scenarios with higher prices. Some analysts suggest that OPEC members might pursue significant price escalation through conservative capacity expansion decisions rather than undertake major production expansion

programs. Such behavior would tend to raise world oil prices.

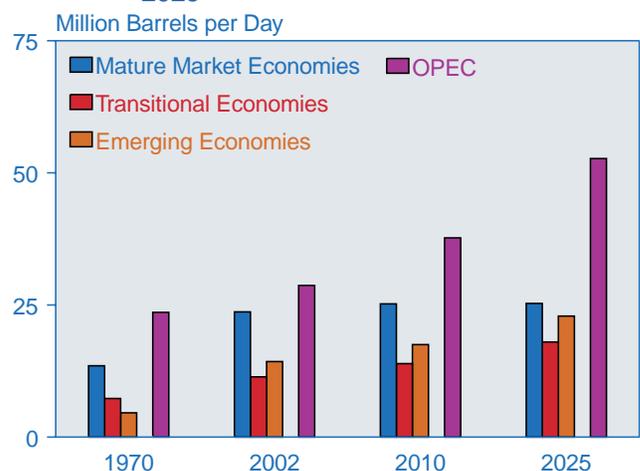
Reserves and Resources

Table 4 shows estimates of the conventional oil resource base by region out to the year 2025. Proved reserves are from the annual assessment of worldwide reserves published by *Oil & Gas Journal* [4]. Reserve growth and undiscovered estimates are based on the World Petroleum Assessment 2000 by the U.S. Geological Survey (USGS). The oil resource base is defined by three categories: remaining reserves (oil that has been discovered but not produced); reserve growth (increases in reserves resulting mainly from technological factors that enhance a field's recovery rate); and undiscovered (oil that remains to be found through exploration). The information in Table 4 is derived from the USGS mean estimate, which is an average assessment over a wide range of uncertainty for reserve growth and undiscovered resources. The *IEO2005* oil production forecast is based on the USGS mean estimate.

Expansion of OPEC Production Capacity

It is generally acknowledged that OPEC members with large reserves and relatively low costs for expanding production capacity can accommodate sizable increases in petroleum demand. In the *IEO2005* reference case, the production call on OPEC suppliers is projected to grow at a robust annual rate of 2.7 percent through 2025 (Table 5 and Figure 32). OPEC capacity utilization is expected to increase slightly after 2002, reaching almost 95 percent by 2015 and remaining at about that level for the duration of the projection period.

Figure 31. World Oil Production in the Reference Case by Region, 1970, 2002, 2010, and 2025



Sources: **1970 and 2002:** Energy Information Administration (EIA), *International Energy Annual 2002*, DOE/EIA-0219 (2002) (Washington, DC, March 2004), web site www.eia.doe.gov/iea/. **2010 and 2025:** EIA, *System for the Analysis of Global Energy Markets* (2005).

Amidst enormous uncertainty, Iraq's role in OPEC in the next several years will be of particular interest. In 1999, Iraq expanded its production capacity to 2.8 million barrels per day in order to reach the slightly more

than \$5.2 billion in oil exports allowed by United Nations Security Council resolutions. The expansion was required because of the low price environment of early 1999. In the *IEO2005* reference case, Iraq is

Table 4. Estimated World Oil Resources, 1995-2025
(Billion Barrels)

Region	Proved Reserves	Reserve Growth	Undiscovered	Total
Mature Market Economies				
United States	21.9	76.0	83.0	180.9
Canada	178.8	12.5	32.6	223.9
Mexico	14.6	25.6	45.8	86.0
Western Europe	15.8	19.3	34.6	69.7
Japan	0.1	0.1	0.3	0.5
Australia/New Zealand	1.5	2.7	5.9	10.1
Transitional Economies				
Former Soviet Union	77.8	137.7	170.8	386.3
Eastern Europe	1.5	1.5	1.4	4.4
Emerging Economies				
China	18.3	19.6	14.6	52.5
India	5.4	3.8	6.8	16.0
Other Emerging Asia	11.0	14.6	23.9	49.5
Middle East	729.6	252.5	269.2	1,251.3
Africa	100.8	73.5	124.7	299.0
Central and South America	100.6	90.8	125.3	316.7
Total World	1,277.7	730.2	938.9	2,946.8
OPEC	885.2	395.6	400.5	1,681.3
Non-OPEC	392.5	334.6	538.4	1,265.5

Note: Reserves include crude oil (including lease condensates) and natural gas plant liquids.

Sources: **Proved Reserves as of January 1, 2005:** *Oil & Gas Journal*, Vol. 102, No. 47 (December 20, 2004), pp. 22-23. **Reserve Growth (Total) and Undiscovered:** U.S. Geological Survey, *World Petroleum Assessment 2000*, web site <http://greenwood.cr.usgs.gov/energy/WorldEnergy/DDS-60>. **Estimates of Regional Reserve Growth:** Energy Information Administration, *International Energy Outlook 2002*, DOE/EIA-0484(2002) (Washington, DC, March 2002), p. 32.

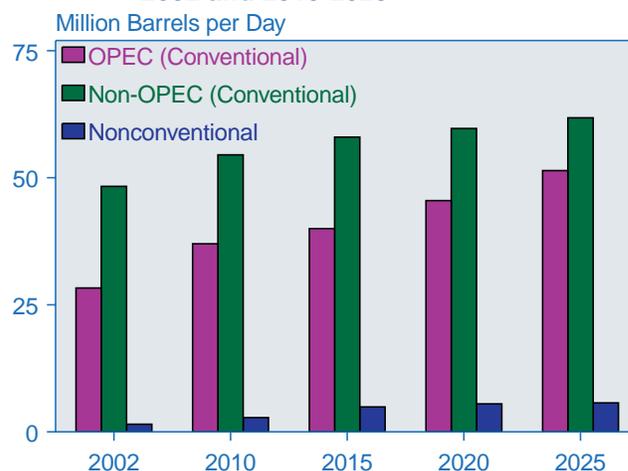
Table 5. OPEC Oil Production, 1990-2025
(Million Barrels per Day)

Year	Reference Case	High Oil Price	Low Oil Price
History			
1990	24.6	—	—
2002	28.7	—	—
Projections			
2010	37.7	33.3	42.8
2015	41.3	33.0	49.3
2020	46.8	35.4	57.3
2025	52.7	37.9	65.2

Note: Includes the production of crude oil, natural gas plant liquids, refinery gain, and other liquid fuels.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2002*, DOE/EIA-0219 (2002) (Washington, DC, March 2004), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2005). Note: *IEO2005* uses the *AEO2005* October oil futures case as its reference case.

Figure 32. OPEC, Non-OPEC, and Nonconventional Oil Production in the Reference Case, 2002 and 2010-2025



Sources: **2002:** Energy Information Administration (EIA), *International Energy Annual 2002*, DOE/EIA-0219 (2002) (Washington, DC, March 2004), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2005).

assumed to maintain its current oil production capacity of about 2.0 million barrels per day into 2005. Iraq has indicated a desire to expand its production capacity aggressively, to more than 6 million barrels per day, once the oil sector is deemed safe from terrorist activities. Preliminary discussions of exploration projects have already been held with potential outside investors, including France, Russia, and China. Such a significant increase in Iraqi oil exports would ease market tightness.

Given the requirements for OPEC production capacity expansion implied by the *IEO2005* estimates, much attention has been focused on the oil development, production, and operating costs of individual OPEC producers. With Persian Gulf producers enjoying a reserve-to-production ratio that exceeds 108 years, substantial capacity expansion clearly is feasible.

Production costs in Persian Gulf OPEC nations are less than \$3 per barrel, and the capital investment required to increase production capacity by 1 barrel per day is less than \$5,940 [5]. Assuming the *IEO2005* low price trajectory, total development and operating costs over the entire projection period would be about 24 percent of gross oil revenues. Thus, Persian Gulf OPEC producers can expand capacity at a cost that is a relatively small percentage of projected gross revenues.

For OPEC producers outside the Persian Gulf, the cost to expand production capacity by 1 barrel per day is considerably greater, exceeding \$13,270 in some member nations; yet those producers can expect cost-to-revenue ratios of about 41 percent on investments to expand production capacity over the long term, even in the low price case [5]. Venezuela has the greatest potential for capacity expansion and could aggressively increase its production capacity by more than 1.0 million barrels per day, to between 4 and 5 million barrels per day in the mid-term. It is unclear, however, whether the current political climate will support the outside investment required for any substantial expansion of Venezuela's production capacity. Tables E1-E6 in Appendix E show the ranges of production potential for both OPEC and non-OPEC producers.

The reference case projection implies aggressive efforts by OPEC member nations to apply or attract investment capital to implement a wide range of production capacity expansion projects. The combination of potential profitability and the threat of competition from non-OPEC suppliers provides a rationale for the assumption of a relatively aggressive expansion strategy.

In the *IEO2005* reference case, OPEC members outside the Persian Gulf are expected to increase their production potential substantially, despite their higher capacity expansion costs. There is much optimism regarding Nigeria's offshore production potential, although it is

unlikely to be developed until the middle to late part of this decade. In addition, increased optimism about the production potential of Algeria, Libya, and Venezuela supports the possibility of reducing the world's dependence on Persian Gulf oil.

Non-OPEC Supply

The growth in non-OPEC oil supplies played a significant role in the erosion of OPEC's market share over the past three decades, as non-OPEC supply became increasingly diverse. North America dominated non-OPEC supply in the early 1970s, the North Sea and Mexico evolved as major producers in the 1980s, and much of the new production in the 1990s came from the emerging economies of Latin America, West Africa, the non-OPEC Middle East, and China. In the *IEO2005* reference case, non-OPEC supply from proven reserves is expected to increase steadily, from 49.4 million barrels per day in 2002 to 66.2 million barrels per day in 2025 (Table 6).

There are several important differences between the *IEO2005* production profiles and those published in *IEO2004*:

- The U.S. production decline was somewhat more severe in the *IEO2004* projections than in this year's forecast, with *IEO2005* projecting lower exploration and production costs coupled with more optimistic finding rates in the National Petroleum Reserve-Alaska.
- The outlook for growth in Russia's oil production is slightly more optimistic in *IEO2005* as Russian companies in alliance with Western service companies continue to surprise industry experts with productivity increases in West Siberia.

Table 6. Non-OPEC Oil Production, 1990-2025
(Million Barrels per Day)

Year	Reference Case	High Oil Price	Low Oil Price
History			
1990	42.1	—	—
2002	49.4	—	—
Projections			
2010	56.6	59.6	55.0
2015	61.7	66.7	59.0
2020	63.9	70.7	60.5
2025	66.2	75.1	62.4

Note: Includes the production of crude oil, natural gas plant liquids, refinery gain, and other liquid fuels.

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2002*, DOE/EIA-0219 (2002) (Washington, DC, March 2004), web site www.eia.doe.gov/iea/. **Projections:** EIA, *System for the Analysis of Global Energy Markets* (2005). Note: *IEO2005* uses the *AEO2005* October oil futures case as its reference case.

- The outlook for production of nonconventional liquids (especially from oil sands and ultra-heavy oils) is somewhat more optimistic in *IEO2005* as production costs decline and markets evolve.
- In the *IEO2005* projections, Caspian output is expected to exceed 3.3 million barrels per day in 2010 and to increase steadily thereafter. There still remains a great deal of uncertainty about export routes from the Caspian Basin region.

In *IEO2005*, the decline in North Sea production is slowed slightly, based on the implementation of strategies for redeveloping mature fields. Production from Norway, Western Europe's largest producer, is expected to peak at about 3.6 million barrels per day in 2006 and then decline gradually to about 2.5 million barrels per day by the end of the forecast period with the maturing of some of its larger and older fields. The United Kingdom sector is expected to produce about 2.2 million barrels per day in 2010, followed by a decline to 1.4 million barrels per day in 2025.

Two non-OPEC Persian Gulf producers are expected to increase output gradually through 2010. Enhanced recovery techniques are expected to increase current output in Oman by more than 190,000 barrels per day, with only a gradual production decline anticipated after 2010. Current oil production in Yemen is expected to increase by at least 50,000 barrels per day within the next 5 years, and those levels could show a slight increase throughout the projection period. Syria is expected to hold its production flat out to 2015, but little in the way of new resource potential will allow anything except declining production volumes from 2015 to 2025.

Oil producers in the Pacific Rim are expected to increase their production volumes significantly as a result of enhanced exploration and extraction technologies. India's deepwater prospects are expected to show some encouraging production increases in this decade, with the potential for significant increases near the end of the forecast period. Deepwater fields offshore from the Philippines have resulted in an improved reserve picture, with production expected to exceed 75,000 barrels per day by the end of the forecast period. Vietnam's long-term production potential still is viewed with considerable optimism, although exploration activity has been slower than originally hoped. Output from Vietnamese fields is projected to exceed 375,000 barrels per day in 2015.

Australia has continued to make additions to its proved reserves, and it is possible that its oil production could exceed 800,000 barrels per day by the end of this decade. Malaysia shows little potential for any significant new finds, and its output is expected to peak at around 750,000 barrels per day in this decade and then decline

gradually to less than 700,000 barrels per day in 2025. Papua New Guinea continues to add to its reserve posture and is expected to achieve production volumes approaching 110,000 barrels per day by the end of this decade, followed by only a modest decline over the remainder of the forecast period. Exploration and test-well activity have pointed to some production potential for Bangladesh and Myanmar, but significant output is not expected until after 2010.

Oil producers in Central and South America have significant potential for increasing output over the next decade. Brazil became a million barrel per day producer in 1999, with considerable production potential waiting to be tapped. Brazil's production is expected to rise throughout the forecast period and to top 3.5 million barrels per day in 2025. Colombia's current economic downturn and civil unrest have delayed development of its upstream sector, but its output is expected to top 610,000 barrels per day within the decade and continue to show modest increases for the remainder of the forecast period. In both Brazil and Colombia, the oil sector would benefit significantly from the creation of favorable climates for foreign investment. Argentina is expected to increase its production volumes by at least 65,000 barrels per day over the next 3 years, and by the end of the decade it could possibly become a million barrel per day producer. Although the current political situation in Ecuador is in transition, there is still optimism that Ecuador will double production volumes over the forecast period.

Several West African producers—Angola, Cameroon, Chad, Congo (Brazzaville), Equatorial Guinea, Gabon, Mauritania, Niger, Sao Tome and Principe, and Ivory Coast—are expected to reap the benefits of substantial exploration activity, especially if the current high prices persist. Angola is expected to become a million barrel per day producer by the end of this decade. Given the excellent deepwater exploration results, Angola could produce volumes of up to 3.4 million barrels per day in the later years of the forecast. The other West African producers with offshore tracts are expected to increase output by up to 1.1 million barrels per day for the duration of the forecast.

North African producers Egypt and Tunisia produce mainly from mature fields and show little promise of adding to their reserve posture. As a result, their production volumes are expected to decline gradually over the forecast period. In East Africa, Sudan is expected to produce significant volumes by the end of this decade and could exceed 500,000 barrels per day by the end of the forecast period. Eritrea, Somalia, and South Africa also have some resource potential, but they are not expected to produce significant volumes until late in the forecast.

In North America, moderately declining U.S. output is expected to be supplemented by significant production increases in Canada and Mexico. Canada's conventional oil output is expected to contract steadily, by about 600,000 barrels per day over the next 20 years, but an additional 3.5 million barrels per day of nonconventional output from oil sands projects is expected to be added. Expected production volumes in Mexico exceed 4.2 million barrels per day by the end of the decade and continue to increase out to the end of the forecast period, by another 500,000 barrels per day.

With higher oil prices assumed to continue, oil production in the FSU is expected to exceed 15.0 million barrels per day in 2015, based in large part on a more optimistic outlook for investment in Russia. The long-term production potential for the FSU still is regarded with considerable optimism, especially for the resource-rich Caspian Basin region. The *IEO2005* reference case shows FSU output exceeding 17.5 million barrels per day in 2025, implying export volumes of more than 12 million barrels per day. In China, oil production is expected to decline slightly to about 3.5 million barrels per day in 2025. China has voiced an interest in expanding its domestic oil resource base and perhaps developing coal-to-liquids technologies.

The estimates for non-OPEC production potential presented in this outlook are based on such parameters as numbers of exploration wells, finding rates, reserve-to-production ratios, advances in both exploration and extraction technologies, and sensitivity to changes in the world oil price. A critical component of the forecasting methodology is the constraint placed on the exploration and development of non-OPEC undiscovered resources. For the purpose of the three *IEO2005* price cases, no more than 15, 30, and 45 percent of the mean USGS estimate of non-OPEC undiscovered oil is developed over the forecast period in the low, reference, and high price cases, respectively. In all price cases, OPEC producers are assumed to be the source of the required residual supply.

The expectation in the late 1980s and early 1990s was that non-OPEC production in the longer term would stagnate or decline gradually in response to resource constraints. The relatively insignificant cost of developing oil resources within OPEC countries (especially those in the Persian Gulf region) was considered such an overwhelming advantage that non-OPEC production potential was viewed with considerable pessimism. In actuality, however, despite several periods of relatively low prices, non-OPEC production has risen every year since 1993, adding more than 6.9 million barrels per day between 1993 and 2002.

It is expected that non-OPEC producers will continue to increase output, producing an additional 7.2 million

barrels per day in 2010. Three factors generally are given credit for the impressive resiliency of non-OPEC production: development of new exploration and production technologies, efforts by the oil industry to reduce costs, and efforts by producer governments to promote exploration and development by encouraging outside investors with attractive fiscal terms.

Worldwide Petroleum Trade

In 2002, the mature market economies imported 16.6 million barrels of oil per day from OPEC producers. Of that total, 10.1 million barrels per day came from the Persian Gulf region. Oil movements to mature market economies represented 67 percent of the total petroleum exported by OPEC member nations and 60 percent of all Persian Gulf exports (Table 7). By the end of the forecast period, OPEC exports to mature market economies in the reference case are estimated to be about 10.3 million barrels per day higher than their 2002 level, and more than one-half of the increase is expected to come from the Persian Gulf region.

Despite such a substantial increase, the share of total petroleum exports that goes to the mature market economy nations in 2025 is projected to be almost 11 percentage points below their 2002 share, and the share of Persian Gulf exports going to the mature market economies is projected to fall by about 17 percent. The significant shift expected in the balance of OPEC export shares between the mature market economies and emerging economies is a direct result of the economic growth anticipated for the economically developing nations of the world, especially those of Asia. OPEC petroleum exports to emerging economies are expected to increase by 17 million barrels per day over the forecast period, with more than 70 percent of the increase going to the emerging economies of Asia. China, alone, is likely to import about 7.3 million barrels per day from OPEC in 2025, virtually all of which is expected to come from Persian Gulf producers.

North America's petroleum imports from the Persian Gulf in the reference case are expected to more than double over the forecast period (Figure 33). At the same time, over 46 percent of total North American imports in 2025 are expected to be from Atlantic Basin producers and refiners, with significant increases anticipated in crude oil imports from Latin American producers, including Venezuela, Brazil, Colombia, and Mexico. West African producers, including Nigeria and Angola, are also expected to increase their export volumes to North America. Caribbean Basin refiners are expected to account for most of the increase in North America's imports of refined products.

With a moderate decline in North Sea production, Western Europe is expected to import increasing amounts

from Persian Gulf producers and from OPEC member nations in both northern and western Africa. Substantial imports from the Caspian Basin are also expected. Mature market Asian nations are expected to increase their already heavy dependence on Persian Gulf oil. The emerging economies of the Pacific Rim are expected to more than double their total petroleum imports between 2002 and 2025.

Worldwide crude oil distillation capacity was about 82 million barrels per day at the beginning of 2003. To meet the projected growth in international oil demand in the reference case, worldwide refining capacity would have

to increase by more than 45 million barrels per day by 2025. Substantial growth in distillation capacity is expected in the Middle East, Central and South America, and especially in the Asia Pacific region. Refiners in North America and Europe, while making only modest additions to their distillation capacity, are expected to continue improving product quality and enhancing the usefulness of the heavier portion of the barrel through investment in downstream capacity. Likewise, future investments by emerging economies are expected to include more advanced configurations designed to meet the anticipated increase in demand for lighter products, especially transportation fuels.

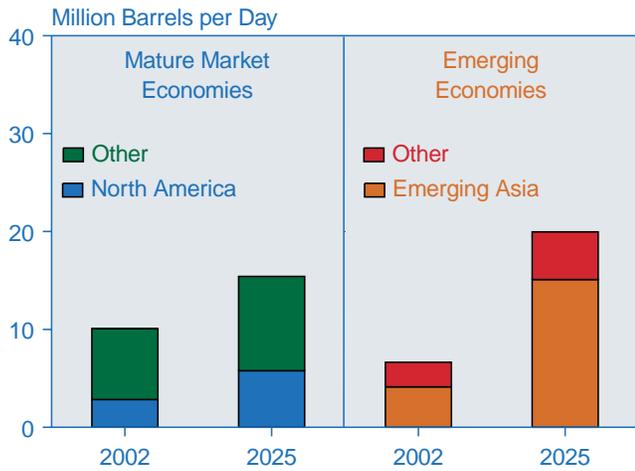
Table 7. Worldwide Petroleum Trade in the Reference Case, 2002 and 2025
(Million Barrels per Day)

Exporting Region	Importing Region								Total Exports
	Mature Market Economies				Emerging Market Economies				
	North America	Western Europe	Asia	Total	Pacific Rim	China	Rest of World	Total	
2002									
OPEC									
Persian Gulf	2.8	2.9	4.4	10.1	3.2	0.9	2.5	6.6	16.7
North Africa	0.6	2.1	0.0	2.7	0.1	0.0	0.0	0.1	2.8
West Africa	1.1	0.5	0.1	1.7	0.5	0.0	0.1	0.6	2.3
South America	1.7	0.1	0.1	1.9	0.1	0.0	0.3	0.4	2.3
Asia	0.0	0.0	0.2	0.2	0.4	0.0	0.0	0.4	0.6
Total OPEC	6.2	5.6	4.8	16.6	4.3	0.9	2.9	8.1	24.7
Non-OPEC									
North Sea	0.6	4.5	0.0	5.1	0.0	0.0	0.0	0.0	5.1
Caribbean Basin	0.6	0.1	0.0	0.7	0.1	0.0	0.1	0.2	0.9
Former Soviet Union	0.3	3.6	0.3	4.2	0.2	0.0	0.1	0.3	4.5
Other Non-OPEC	5.5	3.6	1.2	10.3	3.0	1.3	5.7	10.0	20.3
Total Non-OPEC	7.0	11.8	1.5	20.3	3.3	1.3	5.9	10.5	30.8
Total Petroleum Imports . . .	13.2	17.4	6.3	36.9	7.6	2.2	8.8	18.6	55.5
2025									
OPEC									
Persian Gulf	5.8	4.5	5.1	15.4	8.7	6.4	4.9	20.0	35.4
North Africa	0.5	3.1	0.1	3.7	0.8	0.3	0.5	1.6	5.3
West Africa	1.6	1.1	0.3	3.0	1.8	0.5	0.2	2.5	5.5
South America	3.9	0.1	0.4	4.4	0.1	0.0	0.4	0.5	4.9
Asia	0.1	0.0	0.3	0.4	0.6	0.1	0.2	0.9	1.3
Total OPEC	11.9	8.8	6.2	26.9	12.0	7.3	6.2	25.5	52.4
Non-OPEC									
North Sea	0.5	3.4	0.0	3.9	0.3	0.0	0.2	0.5	4.4
Caribbean Basin	1.4	0.5	0.2	2.1	0.6	0.0	0.8	1.4	3.5
Former Soviet Union	0.5	3.3	0.6	4.4	0.7	3.1	1.5	5.3	9.7
Other Non-OPEC	6.8	2.9	0.4	10.1	3.1	0.3	2.5	5.9	16.0
Total Non-OPEC	9.2	10.1	1.2	20.5	4.7	3.4	5.0	13.1	33.6
Total Petroleum Imports . . .	21.1	18.9	7.4	47.4	16.7	10.7	11.2	38.6	86.0

Notes: Totals may not equal sum of components due to independent rounding.

Sources: **2002:** Energy Information Administration (EIA), Energy Markets and Contingency Information Division. **2025:** EIA, Office of Integrated Analysis and Forecasting, IEO2005 WORLD Model run IEO2005.B25 (2005).

Figure 33. Imports of Persian Gulf Oil by Importing Region, 2002 and 2025



Sources: **2002:** Energy Information Administration (EIA), *International Energy Annual 2002*, DOE/EIA-0219 (2002) (Washington, DC, March 2004), web site www.eia.doe.gov/iea/. **Projections:** EIA, *System for the Analysis of Global Energy Markets* (2005).

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