

# World Oil Markets

*In the IEO2001 forecast, periodic production adjustments by OPEC members are not expected to have a significant long-term impact on world oil markets. Prices are projected to rise gradually through 2020 as the oil resource base is expanded.*

Crude oil prices remained above \$25 per barrel in nominal terms for most of 2000 and have been near \$30 per barrel in the early months of 2001. Prices were influenced by the disciplined adherence to announced cutbacks in production by members of the Organization of Petroleum Exporting Countries (OPEC). OPEC's successful market management strategy was an attempt to avoid a repeat of the ultra-low oil price environment of 1998 and early 1999.

Three additional factors contributed to the resiliency of oil prices in 2000. First, oil companies were slow to commit capital to major oil field development efforts, fearing a return to low prices. Even a full year of robust prices did not significantly relax the industry's tight profitability standards, especially for riskier offshore, deepwater projects. Second, oil demand in the recovering economies of the Pacific Rim rebounded more rapidly than anticipated after their 1997-1999 recession. Third, oil companies were reluctant to refill abnormally low inventories, because they feared a return to the low price environment of 1998.

Oil consumption in 2000 rose by slightly less than 1 million barrels per day, with nonindustrialized nations accounting for all the increase. Oil demand in the developing economies of the Pacific Rim and China was responsible for about 50 percent of the increase. Although the developing Asian economies are no longer in recession, their current growth is modest by comparison with the rapid economic expansion in the region during the early and mid-1990s. Latin American oil demand also experienced only modest growth in 2000. Perhaps the most significant story in oil demand in 2000 is the former Soviet Union (FSU). For the first time in more than a decade, oil demand in the FSU grew slightly [1].

At their meeting on January 17, 2001, OPEC members (not including Iraq) agreed to cut back production quotas by a total of 1.5 million barrels per day, in response to indications of some demand weakness in the near-term market. Because some OPEC members were not producing at their previous quota levels, however, actual production is expected to be reduced by only 1 million barrels per day. It is anticipated that the cutbacks will keep the world oil price (refiner acquisition cost for imports) well within OPEC's target range of \$22 to \$28

per barrel throughout 2001, although additional production corrections are certainly possible. Prices are not expected to decline toward the lower end of the target range until 2002 or later. Iraq's oil production and exports have been falling off in response to Iraqi efforts to have United Nations sanctions lifted. Those efforts are assumed to continue throughout much of 2001.

Historically, OPEC's market management strategies have often ended in failure. OPEC's recent successes 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; and OPEC's consensus building is made easier as a result. However, non-OPEC production is expected to show significant increases in the near future, and several members of OPEC have announced plans to expand production capacity over the next several years. In an oil market environment where substantial spare capacity exists, it will be much more difficult for OPEC to achieve the unanimity among its members that dictates a successful market management strategy.

Although non-OPEC producers have been somewhat slow in reacting to higher oil prices, there remains significant untapped production potential worldwide, especially in deepwater areas. Although the lag time between higher prices and increases in drilling activity seems to have increased in the aftermath of the low price environment, non-OPEC production increased by 1.2 million barrels per day in 2000 and is expected to increase by an additional 600 thousand barrels per day in 2001 and 800 thousand barrels per day in 2002. Almost half of the worldwide non-OPEC production increase over the next 2 years is expected to come from the FSU. The remainder of the expected increase is evenly divided between producers in industrialized nations and those in developing economies.

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 prices remain above \$20 per barrel even when the production targets of OPEC producers are raised and significant increases in non-OPEC production are once again expected? Will sustained and robust economic growth in developing countries continue even in the

face of the severe setback to the Asian economies in 1997-1999? Will technology guarantee that oil supply development will move forward even if a low world oil price environment returns?

Although oil prices more than doubled in real terms from 1998 to 1999, that development is not indicative of the trend in the *International Energy Outlook 2001 (IEO2001)* reference case. In the short term, oil prices are expected to continue at the levels seen during the later months of 1999 into 2000. As OPEC production cutbacks are relaxed and non-OPEC production increases over the next few years, oil prices are expected to fall back slightly from the 2000 level, then increase gradually out to 2020. When the economic recovery in Asia is complete, demand growth in developing countries throughout the world is expected to be sustained at robust levels. Worldwide oil demand is projected to reach almost 120 million barrels per day by 2020, requiring an increment to world production capability of almost 43 million barrels per day relative to current capacity. OPEC producers are expected to be the major beneficiaries of increased production requirements, but non-OPEC supply is expected to remain highly competitive, with major increments to supply expected to come from offshore resources, especially in the Caspian Basin and deep-water West Africa.

Over the past 25 years, oil prices have been highly volatile. In the future, one can expect volatile behavior to recur 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 in normal oil production and trading patterns. On the other hand, significant excursions from the reference price trajectory are not likely to be long sustained. High real prices deter consumption and encourage the emergence of significant competition from marginal but large sources of oil 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 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 down prices when such additional oil resources become part of the reserve base. The *IEO2001* low and high world oil price cases suggest that the projected trends in growth for oil production are sustainable without severe oil price escalation. There are oil market analysts, however, who find this viewpoint to be overly optimistic, based on what they consider to be a significant overestimation of both proven reserves and ultimately recoverable resources.

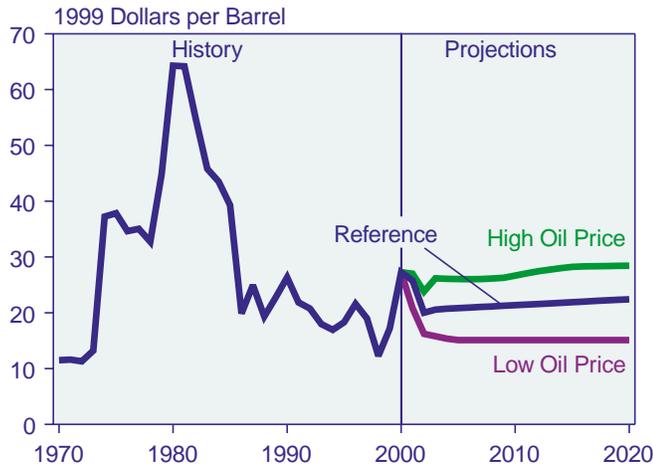
Highlights of the *IEO2001* projection for the world oil market are as follows:

- The reference case oil price projection shows declines of \$1.50 per barrel in 2001, about \$1 per barrel in 2002, and more than \$4 per barrel in 2003, followed by a gentle 0.3-percent average annual increase from 2003 to 2020.
- Deepwater exploration and development initiatives are generally 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. Technology and resource availability can sustain large increments in oil production capability at reference case prices. The low price environment of 1998 and early 1999 did slow the pace of development in some highly prospective areas, especially the Caspian Basin region.
- Economic development in Asia is crucial to long-term growth in oil markets. The projected evolution of Asian oil demand in the reference case would strengthen economic ties between Middle East suppliers and Asian markets.
- 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 oil and other sources of energy (particularly natural gas).
- The uncertainties associated with the *IEO2001* reference case projections are significant. Sustained economic recovery in developing Asia, Japan's economic turnaround, China's economic reforms and human rights record, trickle-down effects from Brazil to other Latin American economies, and economic recovery prospects for 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 Prices

The near-term price trajectory in the *IEO2001* reference case is somewhat different from that in *IEO2000*. In last year's reference case price path, significant relief was expected in 2001 from the high oil prices of late 1999 and 2000, primarily because adherence to announced OPEC production cutbacks by member nations had a long history of being unsuccessful. This year's reference case price path shows prices above \$25 per barrel through 2001, based on the assumption that OPEC will be able to manage the oil market effectively during the year but not after that. In both outlooks, the price trajectory in the

**Figure 24. World Oil Prices in Three Cases, 1970-2020**



Sources: **History:** Energy Information Administration (EIA), *Annual Energy Review 1999*, DOE/EIA-0384(99) (Washington, DC, July 2000). **Projections:** 2000-2002—EIA, *Short-Term Energy Outlook*, on-line version (January 8, 2001), web site [www.eia.doe.gov/emeu/steo/pub/contents.html](http://www.eia.doe.gov/emeu/steo/pub/contents.html). 2003-2020—EIA, *Annual Energy Outlook 2001*, DOE/EIA-0383(2001) (Washington, DC, December 2000).

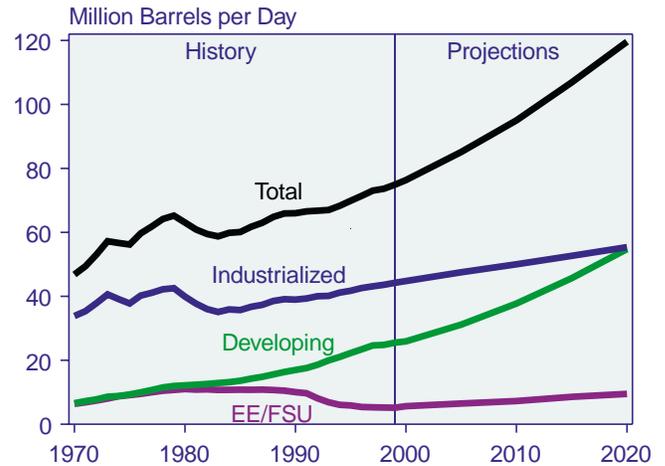
reference case beyond 2005 shows a gradual increase of about 0.3 percent per year out to 2010. Three possible long-term price paths are shown in Figure 24.

In all the *IEO2001* 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 rise in oil consumption ranges from a low of 39 million barrels per day to as much as 52 million barrels per day. There is widespread agreement that resources are not a key constraint on world oil demand to 2020. Rather more important are the political, economic, and environmental circumstances that could shape developments in oil supply and demand.

## World Oil Demand

Petroleum consumption is projected to grow by 44.7 million barrels per day in the *IEO2001* reference case, from 74.9 million barrels per day in 1999 to 119.6 million barrels per day in 2020 (Figure 25). The expected increment is 59 percent larger than the increment of 28.1 million barrels per day in worldwide oil use between 1970 and 1999. The growth in oil demand over the past three decades was tempered somewhat by declines in world oil demand after the oil shocks of 1973 and 1979. Since 1983, however, worldwide oil use has increased steadily. Demand is projected to increase at an average annual rate of 2.3 percent per year in the *IEO2001* reference case, as compared with the average of 1.6 percent per year over the past three decades.

**Figure 25. World Oil Consumption by Region, 1970-2020**



Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use, International Statistics Database and *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **Projections:** EIA, World Energy Projection System (2001).

World oil demand growth slowed significantly between 1997 and 1998 when several countries, primarily in Asia and the FSU, posted declines in consumption. In Asia (excluding China) oil demand fell by more than 500 thousand barrels per day, and in the FSU demand fell by 100 thousand barrels per day. Total world oil demand rose by only 585 thousand barrels per day in 1998 over the previous year, which was about one-third of the average increase from 1993 to 1997. Turmoil in financial markets, beginning in southeast Asia but also spreading to Russia with the devaluation of the ruble in August 1998, led to marked slowdowns in economic growth, resulting in lower demand for energy in 1998.

Demand began to recover in 1999, as most of the Asian countries that had suffered from the economic recession that began in the spring of 1997 were in strong economic recovery. In addition, Russia and Ukraine, the largest economies of the FSU region, enjoyed their greatest economic performance since the collapse of the Soviet Union in the early 1990s. Although FSU oil use fell by about 50 thousand barrels per day in 1999, it recovered by 15 thousand barrels per day in 2000 as strong economic growth continued, propelled by domestic industrial growth and high world oil prices that benefited oil producers in the region. In Japan and the developing Asian countries (excluding China, where oil use continued to grow even while the rest of Asia was mired in recession), total oil use increased in 1999 by 200 thousand barrels per day and in 2000 by another 400 thousand barrels per day, despite the high oil price environment [2].

The industrialized countries continue to consume more of the world's petroleum products than do the developing countries, but the gap is projected to close significantly. By 2020, consumption in developing countries is expected to be nearly equal to that in the industrialized world. The projected increase in oil use in the industrialized world is attributed mostly to the transportation sector, but projected growth in oil demand in the developing world is projected to occur in all end-use sectors. Developing countries are projected to account for 65

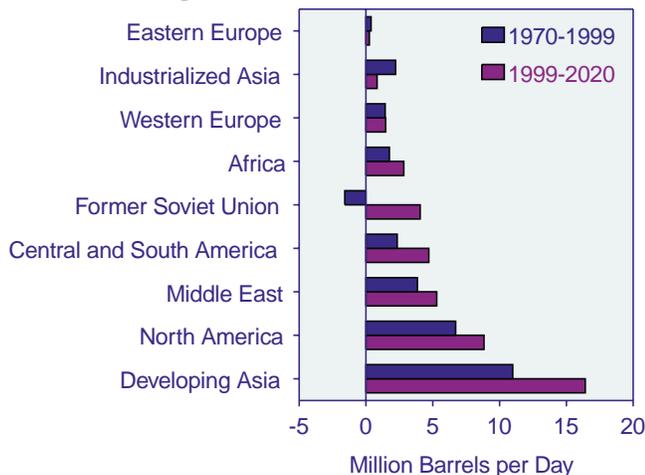
percent of the world's increment in oil use over the projection period.

Among the regions of the developing world, developing Asia is expected to show the largest increase in oil demand. Petroleum consumption is projected to rise by 16 million barrels per day over the next two decades (Figure 26), fueled by strong economic growth and increasing demand for personal motorization. After developing Asia, the Middle East (5.3 million barrels per day), Central and South America (4.7 million barrels per day), and the former Soviet Union (4.1 million barrels per day) are also projected to make significant contributions to the growth in world oil demand.

On a per capita basis, world oil consumption has remained flat since the mid-1980s (Figure 27), primarily because declines in per capita consumption in the FSU (caused by the economic collapse in the region after the dissolution of the Soviet Union in the 1990s) offset increases in the rapidly expanding economies of the developing world and, to a lesser extent, in the industrialized world. Per capita world oil consumption is expected to continue to rise steadily in the reference case, surpassing the levels of the 1970s by 2015. In contrast, however, the amount of oil consumed per unit of GDP is expected to decline (Figure 28) as increasing economic prosperity leads to more energy-efficient and less energy-intensive uses. Oil intensity peaked in 1973, and it is expected to decline to about half the 1973 level by 2020.

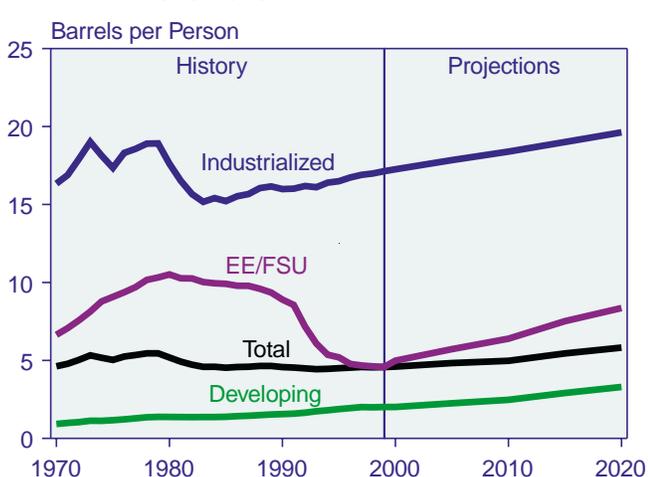
Petroleum consumption continues to grow most rapidly in the transportation sector. The decline in consumption in 1998 affected primarily the nontransportation uses of

**Figure 26. Increments in Oil Consumption by Region, 1970-1999 and 1999-2020**



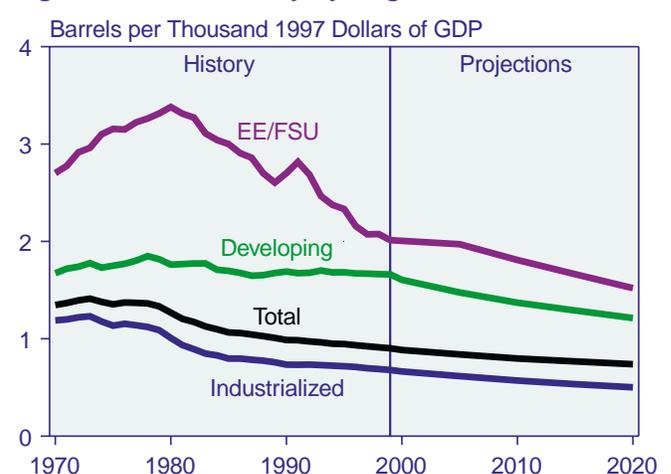
Sources: **1970 and 1999:** Energy Information Administration (EIA), Office of Energy Markets and End Use, International Statistics Database and *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **2020:** EIA, World Energy Projection System (2001).

**Figure 27. Oil Consumption per Capita by Region, 1970-2020**



Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use, International Statistics Database and *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **Projections:** EIA, World Energy Projection System (2001).

**Figure 28. Oil Intensity by Region, 1970-2020**



Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use, International Statistics Database and *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **Projections:** EIA, World Energy Projection System (2001).

petroleum, whereas oil consumed in the transportation sector increased by about the same amount as in each of the three previous years. Nontransportation oil consumption, on the other hand, declined in nearly all regions worldwide. As a result, petroleum use for transportation in 1998 equaled nontransportation uses for the first time. Figure 29 shows historical and projected petroleum consumption by sector in the industrialized and developing nations for selected years from 1980. Only the transport sector has shown a substantial increase from 1980. Of the 44.7 million barrels per day increase in the reference case forecast, 29.7 million barrels per day are projected to take place in the transportation sector.

Transportation consumption makes up nearly all of the projected increase in oil demand in the industrialized countries (Figure 29). In the developing countries, oil consumption for uses other than transportation is still larger than transport consumption and strong growth is expected to continue in these sectors. Transportation consumption in developing countries, however, is projected to outpace other uses so that, by 2020, consumption for transportation exceeds the total of all other uses.

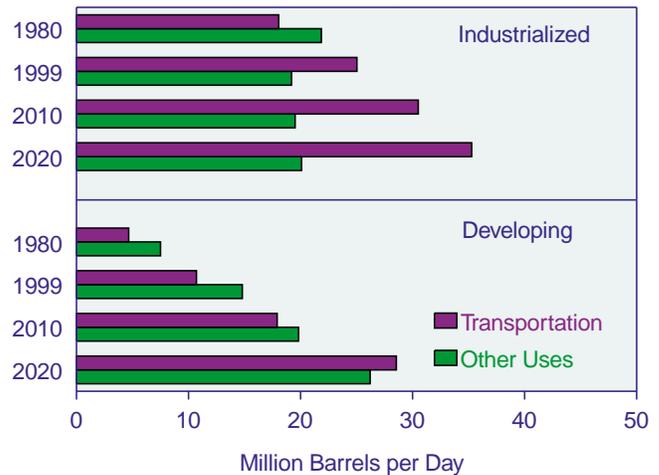
### Developing Asia

The largest increase in oil demand is projected for the developing countries of Asia, where consumption is expected to increase by 3.9 percent per year between 1999 and 2020 (Figure 30). This region alone is expected to account for 37 percent of the increase in world oil demand in the forecast period, the highest regional growth in the world. Strong expected economic growth in developing Asia fuels the demand for additional oil consumption, both in terms of increasing demand for transportation sector energy use and for other industrial, electricity sector, and building uses.

In China, the largest oil consumer in developing Asia, oil demand is projected to increase by 6.1 million barrels per day from 1999 to 2020. Much of the increment is expected in the transportation sector, where the need to transport people and goods will be increasingly important for economic growth. More than two-thirds of the increase in China's oil use is expected in the transportation sector, and the transportation share of the country's oil use is expected to increase from about one-third in 1999 to 55 percent in 2020.

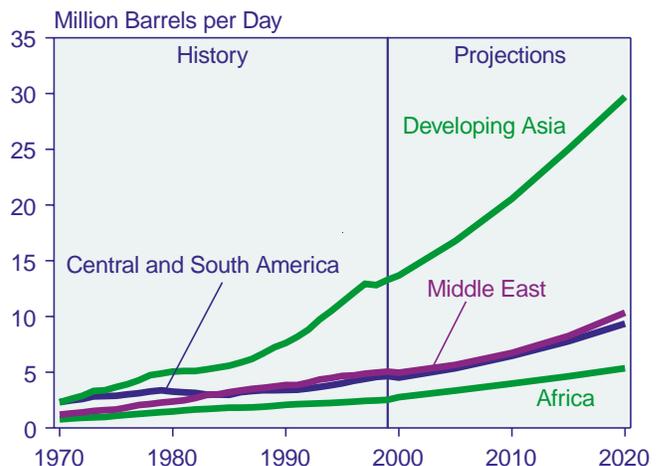
While much of the motor vehicle population in China is owned by institutions (primarily the government), increasing wealth is expected to spur demand for personal motor vehicles that can be used for private travel. Already, there are signs that China's "newly rich" and small businesses that have succeeded as a result of increasing economic liberalization are starting to obtain private vehicles. The most dramatic example is the

**Figure 29. Oil Consumption for Transportation and Other Uses in Industrialized and Developing Nations, 1980-2020**



Sources: **1990 and 1999:** Energy Information Administration (EIA), *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **Projections:** EIA, World Energy Projection System (2001).

**Figure 30. Oil Consumption in the Developing World by Region, 1970-2020**



Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use, International Statistics Database and *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **Projections:** EIA, World Energy Projection System (2001).

number of minivans being used by burgeoning taxi companies [3]. Moreover, China's trucking industry has increasingly been deregulated over the past decade, which should also encourage the growth of the transportation sector.

Nontransportation oil demand in China is projected to increase by an average of 2.4 percent per year—a faster growth rate than that for total oil demand in most industrialized countries. The industrial sector is expected to account for more than 40 percent of China's oil

consumption. In addition, China is one of the world's largest consumers of oil for chemical uses, and its chemical industry consumed about 13 percent of the petroleum used in China in 1997. Increases are also expected in other end-use sectors, including the electricity sector as China attempts to diversify away from its heavy reliance on coal.

From 1970 to 1999, oil consumption in South Korea grew at an average rate that was among the highest in the world. Despite a decline of 419 thousand barrels per day in 1998 and a modest increase of 67 thousand barrels per day in 1999, petroleum consumption grew at an average annual rate of 8.4 percent from 1970 to 1999, much of it attributed to substantial increases in personal motorization during the period. The projected growth rate in energy use slows markedly over the projection period as the transportation sector reaches saturation levels. Still, South Korea is expected to add 1.2 million barrels per day to world oil demand in the forecast period, only slightly less than Western Europe.

While the proportion of South Korea's transportation oil use increases slightly over the forecast years, non-transportation consumption is projected to account for 59 percent of the increase in oil demand from 1999 to 2020. As in Japan and China, the chemical industry in South Korea is a large user of oil, consuming about one-fifth of the total oil used. The residential and commercial sectors also make up a significant portion of South Korea's oil market.

India's oil demand is projected to rise from 1.9 million barrels per day in 1999 to 5.8 million barrels per day in 2020. At 5.4 percent per year, the projected growth rate for oil use in India is the highest among the countries and regions in the forecast. The transportation sector currently makes up half of the oil market in India, and 86 percent of the projected increase is expected to be used for transport. Although thus far the poor state of India's transportation infrastructure has constrained fast-paced growth in automobile ownership, rapid expansion of private motorization and of the corresponding demand for transportation fuels is expected to follow as the infrastructure improves. At present, automobile ownership in India is largely viewed as a symbol of emerging wealth. The industrial sector is the next largest user of oil with more than 10 percent of India's oil consumed by the chemical industry, although analysts expect that future growth in the chemical industry will be fueled by natural gas and electricity rather than oil [4].

*IEO2001* also projects strong growth in petroleum consumption for the other developing countries in Asia. For the other Asia group, oil demand is expected to increase from 5.0 million barrels per day in 1999 to 10.2 million barrels per day in 2020, at an average rate of 3.5 percent per year. The transportation sector's share of oil demand

for this group as a whole is expected to remain just below 50 percent throughout the forecast period.

The oil markets in the other Asia developing country group are diverse, as demonstrated by the three largest oil consumers, Indonesia, Taiwan, and Thailand. Oil consumed for transport in Indonesia leads other uses but makes up less than half the market. The industrial, residential, and power generation sectors are all significant oil users in Indonesia. In Taiwan, oil use for industry leads the other sectors, with a share of nearly 20 percent for the chemical industry alone; transportation consumption is slightly lower than industrial consumption; and oil use for power generation makes up more than 15 percent of total oil demand. The oil market in Thailand is dominated by the transportation sector, with industrial uses a distant second.

### **Middle East**

The second largest increment in oil demand among the developing countries is expected for the Middle East. Oil consumption in the Middle East is projected to increase from 5.0 million barrels per day in 1999 to 10.3 million barrels per day in 2020, at an average rate of 3.5 percent per year. In Turkey (included in the Middle East projections), oil demand is projected to grow by 3.6 percent per year, to 1.3 million barrels per day in 2020. Much stronger growth is expected for nontransportation oil uses in Turkey than for the country's transportation sector. Industrial oil consumption in Turkey is nearly as high as oil use in the transportation sector, and its oil use for agriculture is considerably higher than the average for the Organization for Economic Cooperation and Development (OECD), of which Turkey is a member.

Saudi Arabia and Iran are the largest oil users among the other Middle East countries. Saudi Arabia consumed about 1.3 million barrels per day in 1999 and Iran 1.2 million barrels per day. Transportation sector oil consumption is projected to grow more rapidly than other oil use in the forecast period in the Middle East region, accounting for 57 percent of the expected increase, but growth is constrained by the fact that women, a sizable portion of the population, are not permitted to drive in a number of Middle Eastern countries. The residential and commercial sectors are also large oil users, and oil consumption for chemical uses is expected to increase as Saudi Arabia plans to expand its chemical industry [5].

### **Africa**

Oil demand in Africa is projected to grow at an average annual rate of 3.6 percent, from 2.5 million barrels per day in 1999 to 5.4 million barrels per day in 2020. Although transportation demand in Africa is projected to nearly double from 1999 to 2020, it is expected to contribute less, on a percentage basis, to the overall increase than in any other region except the FSU. Africa's underdeveloped transportation infrastructure is expected to

inhibit growth in oil use for transportation. The industrial sector consumes the most oil among Africa's non-transportation oil sectors, followed by power generation and the residential and commercial sectors. The proportion of oil used for power generation and in the residential and commercial sectors in Africa is similar to the average for non-OECD countries, which is much higher than in most of the industrialized countries.

Egypt and South Africa are the largest oil consumers in Africa. As in many countries, the transportation and industrial sectors are the largest users of oil in Egypt. In contrast to most other countries, however, a much larger share (about 20 percent) of petroleum is used for power generation in Egypt. In South Africa, the transportation sector consumes about 75 percent of the oil used, and virtually none is used for power generation.

### Central and South America

The developing nations of Central and South America are projected to add 4.7 million barrels per day to world oil demand from 1999 to 2020, at an average annual growth rate of 3.4 percent. Relative to other non-OECD countries, transportation consumption tends to have a larger share of the region's oil market and power generation a smaller share.

In the countries outside of Brazil, oil consumption for nontransportation uses is expected to grow at 0.5 percent per year while transport oil demand is projected to rise at 4.5 percent per year. By 2020, two-thirds of the oil is projected to be consumed for transportation. Argentina and Venezuela are the largest oil consuming countries outside of Brazil. Argentina's large agricultural sector uses a relatively large share of petroleum products. Venezuela consumes more than 60 percent of its oil for transportation.

Brazil, at 2.0 million barrels per day in 1999, is by far the largest oil user in Central and South America. Brazil's oil consumption is projected to increase to 4.5 million barrels per day in 2020, at an average annual growth rate of 4.1 percent. Transportation consumption is projected to increase by 4.8 percent per year between 1999 and 2020. Brazil also has a relatively large chemical industry. Nontransportation oil demand is projected to increase at 3.4 percent per year from 1999 to 2020, a much faster pace than the Other Central and South America group.

### North America

Petroleum product consumption in North America is projected to increase by 8.8 million barrels per day from 1999 to 2020, at an average annual growth rate of 1.5 percent. This is by far the largest expected increase among the industrialized regions (Figure 31), with projected increases of 6.3 million barrels per day in the United

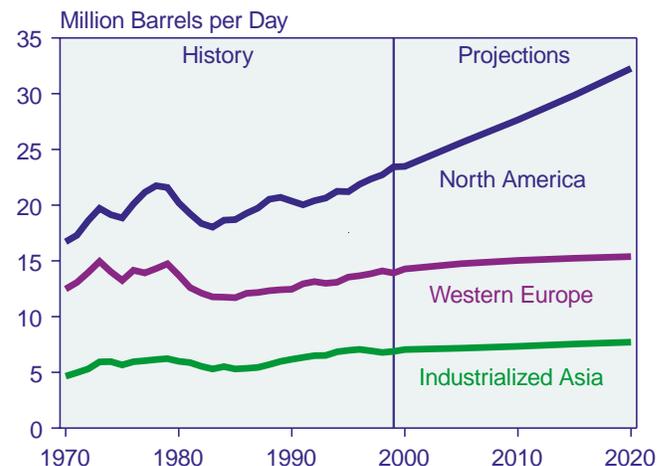
States, 2.2 million barrels per day in Mexico, and 0.3 million barrels per day in Canada.

Much of the increase in U.S. oil consumption is projected to occur in the transportation sector, which already accounts for two-thirds of U.S. petroleum use. In recent years, relatively low fuel prices and higher personal income have resulted in consumer demand for larger and more powerful vehicles. Further, vehicle fuel efficiency is not expected to improve as rapidly over the next two decades as it did in the 1980s. Fuel efficiency standards for light-duty vehicles (cars, vans, pickup trucks, and sport utility vehicles) are assumed to remain at current levels [6].

Oil use in the U.S. industrial sector currently accounts for 26 percent of the Nation's total oil use and is expected to increase from 5.2 million barrels per day in 1999 to 6.2 million barrels per day in 2020. Most of the increase is expected in the petrochemical, construction, and refining sectors [7]. Petroleum use for heating and for electricity generation is, in contrast, projected to decline over the forecast horizon as oil loses market share to natural gas. For electricity generation, oil-fired steam plants are being retired in favor of natural gas combined-cycle units.

Petroleum product consumption in the transportation sector in Mexico is projected to increase by 1.6 million barrels per day from 1999 to 2020, accounting for about 70 percent of the total expected increase in Mexico's oil demand. Mexico also consumes a much larger share of oil for power generation than do most other

**Figure 31. Oil Consumption in the Industrialized World by Region, 1970-2020**



Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use, International Statistics Database and *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **Projections:** EIA, World Energy Projection System (2001).

industrialized countries. Nearly one-fourth of the oil consumed in Mexico is for power generation, compared with about 5 percent for the OECD as a whole.<sup>4</sup> As a result, Mexico consumes a much larger proportion of residual fuel (about 25 percent in 1997) than most industrialized countries. Over the forecast period, however, the share of oil used for power generation is expected to decline as natural gas makes significant inroads in this sector [8]. With the fuel slate expected to become lighter in the future, plans are being considered to upgrade the Mexican refining sector in order to produce more light products and less residual fuel [9].

In Canada, virtually all the increase in oil consumption from 1999 to 2020 is expected to occur in the transportation sector. Canada's extensive hydroelectric and natural gas resources are widely used for power generation, industrial, and building uses. The North American Free Trade Agreement has largely unified the Canadian transportation sector with that of the United States. Although Canadian consumers are expected to follow U.S. trends in terms of demanding larger and more powerful motor vehicles over the forecast period, a much smaller Canadian population relative to the United States keeps the total projected increment in transportation fuel use in Canada at a modest 0.3 million barrels per day between 1999 and 2020.

### Western Europe

Oil consumption in Western Europe is projected to increase by 1.5 million barrels per day from 1999 to 2020, at an average growth rate of 0.5 percent per year. Growth is expected mainly in the transportation sector, and the use of petroleum products in other sectors is projected to decline over the forecast period. Expanding access to natural gas is expected to lead to a decreasing share of oil in Western Europe's energy mix. The industrial sector is the largest nontransportation consumer of oil, with a substantial portion used by chemical industries; however, analysts expect that in many countries of Western Europe oil will also lose market share to natural gas in the industrial sector over the next two decades [10].

Germany is Western Europe's largest oil-consuming country, at 2.8 million barrels per day in 1999. Transportation consumption makes up nearly 50 percent of the total. Germany is Europe's largest user of oil as a feedstock for the chemical industry and, in addition, consumes a much larger proportion of oil for domestic uses in the residential and commercial sectors, where efforts to reduce coal consumption in East Germany's building sector after the reunification of the two Germanies in the early 1990s led to a switch from brown coal to heating oil.

The newest trend in upgrading the East German infrastructure is a move to replace oil with natural gas [11]. The share of petroleum product consumption in the residential and commercial sectors is nearly 25 percent, just slightly below that in the industrial sector, and is much larger than the 10-percent share for residential and commercial consumption for the OECD as a whole. Petroleum consumption outside the transportation sector in Germany is projected to decline slightly over the forecast period.

The second largest oil consumer in Western Europe is Italy. Nearly 60 percent of Italy's oil use is outside the transportation sector, a much larger proportion than in most other European countries. Oil use in the industrial sector makes up about one-fourth of Italy's total petroleum consumption, as does the electricity generation sector; however, natural gas is projected to take on an increasingly important role in the country's energy markets as it attempts to diversify away from heavy reliance on petroleum. Italy has worked to establish a natural gas distribution network that already reaches most Italian cities with a potential for district heating [12], and natural gas is now the dominant fuel in the building sector. As a result, nontransportation oil demand is projected to remain essentially flat in Italy from 1999 to 2020, while transportation sector oil use increases by 0.6 percent per year.

### Industrialized Asia

Oil demand in industrialized Asia is projected to grow at an average annual rate of 0.5 percent over the forecast period, considerably less than the average increase of 1.4 percent per year from 1970 to 1999. Less than 1 million barrels per day is expected to be added to the region's petroleum consumption.

Japan is the second largest oil-consuming country in the world, and its demand for petroleum products is projected to increase by about 350 thousand barrels per day from 1999 to 2020, at an average growth rate of 0.3 percent per year. The transportation sector's share of the oil market, at 35 percent, is the lowest among the industrialized countries. Japan uses a much larger proportion of oil to power the industrial sector than does the United States or the OECD as a whole, mostly because Japan does not have easy access to natural gas or coal. Power generation in Japan also has a larger share of the oil market than in most other industrialized countries. Nevertheless, about 82 percent of the increase in the forecast period is projected for the transportation sector.

Australasia—dominated by Australia but also including New Zealand and the U.S. Territories—is projected to have a much higher growth rate in oil consumption than

<sup>4</sup>Calculations based on International Energy Agency statistics.

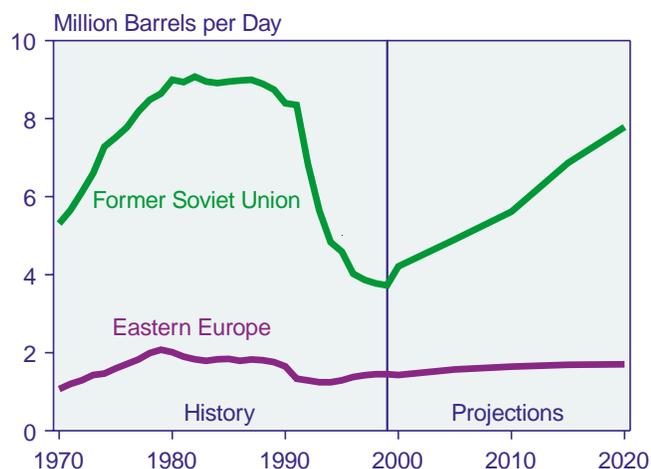
is Japan. Australia, in particular, is a geographically large country with a widespread population, and its transportation sector is projected to account for the largest increment in petroleum consumption over the forecast period. Motorization levels are high in Australasia at 642 vehicles per thousand persons, as compared with 569 vehicles per thousand in Japan, and they are projected to reach saturation levels by the end of the projection period.

### Eastern Europe and the Former Soviet Union

The economic and political collapse of the Soviet Union in the early 1990s caused petroleum consumption in the FSU region to fall sharply in the 1990s, to 3.7 million barrels per day in 1999, after having risen to more than 9 million barrels per day in the early 1980s (Figure 32). As economic recovery in the FSU continues, oil demand is projected to increase to 7.8 million barrels per day in 2020. Nontransportation uses are expected to make up about 71 percent of the increase. Russia, which consumed about 64 percent of the FSU total in 1999, uses relatively large proportions of oil for agriculture and power generation.

Oil demand in Eastern Europe has also fallen sharply from the levels of the 1980s although not as severely as in the FSU. Petroleum consumption was 1.5 million barrels per day in 1999 and is projected to rise to 1.7 million barrels per day in 2020, remaining well below the peak of 2.1 million barrels per day in 1979. The economies of Eastern Europe have largely been in recovery since the mid-1990s, and their oil use is expected to grow by 0.8 percent per year on average between 1999 and 2020—a more rapid rate than is projected for Western Europe.

**Figure 32. EE/FSU Oil Consumption by Region, 1970-2020**



Sources: **History:** Energy Information Administration (EIA), Office of Energy Markets and End Use, International Statistics Database and *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **Projections:** EIA, World Energy Projection System (2001).

Oil demand in Eastern Europe's transportation sector is projected to increase by 2.6 percent per year, and non-transportation uses are expected to decline in the forecast period.

Poland and Romania are the largest oil-consuming countries in Eastern Europe. About half of the oil consumed in Poland is used for transportation. Agriculture also has a relatively large proportion of the oil market. In contrast, Romania's transportation sector is much smaller, and nearly one-third of its oil consumption is for electricity generation.

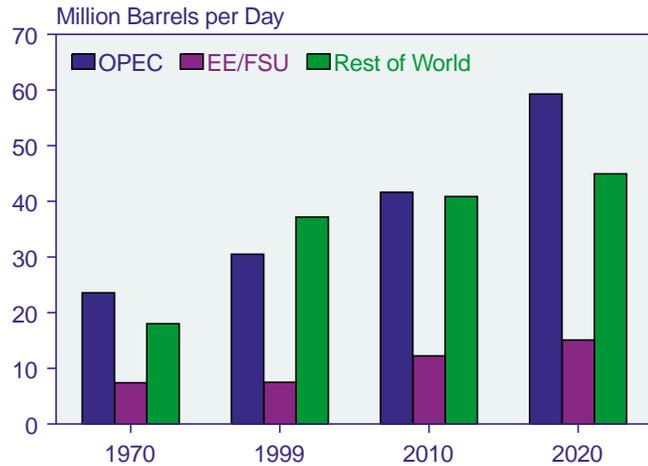
### The Composition of World Oil Supply

The *IEO2001* reference case projects an increase in world oil supply of 45 million barrels per day over the projection period. Gains in production are expected for both OPEC and non-OPEC producers; however, less than one-third of the production rise 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.

While the long-term outlook for non-OPEC supply remains optimistic, the low oil price environment of 1998 and early 1999 had a definite impact on exploration and development activity. By the end of 1998, drilling activity in North America had fallen by more than 25 percent from its level a year earlier. Worldwide, only the Middle East region registered no decline in drilling activity during 1998. In general, onshore drilling fell more sharply than offshore drilling. Worldwide, offshore rig utilization rates were generally sustained at levels better than 80 percent of capacity [13].

The reference case projects that more than two-thirds 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 2020 is projected to be 30 million barrels per day higher than it was in 1999 (Figure 33). The *IEO2001* estimates of OPEC production capacity out to 2005 are slightly less than those projected in *IEO2000*, reflecting a shift toward non-OPEC supply projects in the current high price environment. Some analysts suggest that OPEC might pursue significant price escalation through conservative capacity expansion decisions rather than undertake ambitious production expansion programs; however, the low and high world oil price forecasts in this outlook do not support such suggestions.

**Figure 33. World Oil Production in the Reference Case by Region, 1970, 1999, 2010 and 2020**



Sources: **History:** Energy Information Administration (EIA), *International Petroleum Monthly*, DOE/EIA-0520(2000/12) (Washington, DC, December 2000). **Projections:** EIA, World Energy Projection System (2001).

### 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 *IEO2001* reference case, the production call on OPEC suppliers is projected to grow at a robust annual rate of 3.4 percent (Table 11 and Figure 34). OPEC capacity utilization is expected to increase sharply after 2000, reaching 95 percent by 2015 and remaining there for the duration of the projection period.

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 the United Nations Security Council resolutions. The expansion was required because of the low price environment of early 1999. In the *IEO2001* reference case, Iraq is assumed to maintain its current oil production capacity of 3.1 million barrels per day into 2001, and its exports are assumed to average between 1.5 and 1.7 million barrels per day. The Security Council sanctions are assumed to remain in place through 2002. Iraq has indicated a desire to expand its production capacity aggressively, to about 6 million barrels per day, once the sanctions are lifted. 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 offset a significant portion of the price stimulus associated with current OPEC production cutbacks.

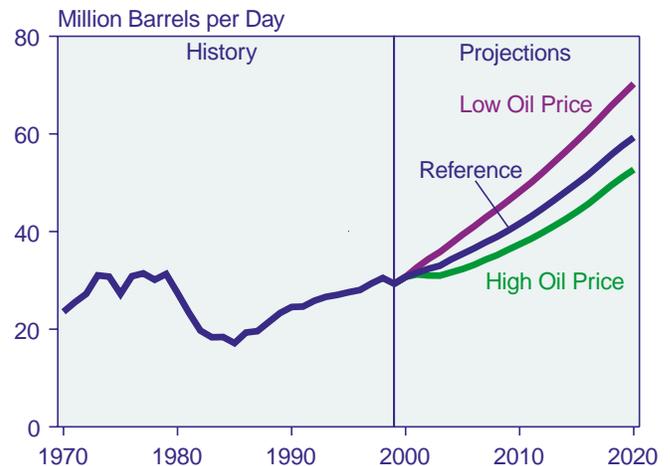
**Table 11. OPEC Oil Production, 1990-2020 (Million Barrels per Day)**

Year	Reference Case	High Oil Price	Low Oil Price
<b>History</b>			
1990 . . . . .	24.5	—	—
1999 . . . . .	29.3	—	—
<b>Projections</b>			
2005 . . . . .	35.4	32.3	39.4
2010 . . . . .	41.6	37.4	48.2
2015 . . . . .	49.9	44.0	58.5
2020 . . . . .	59.3	52.7	70.3

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

Sources: **History:** Energy Information Administration (EIA), *International Petroleum Monthly*, DOE/EIA-0520(2000/12) (Washington, DC, December 2000), Table 1.4. **Projections:** EIA, World Energy Projection System (2001).

**Figure 34. OPEC Oil Production in Three Oil Price Cases, 1970-2020**



Sources: **History:** Energy Information Administration (EIA), *International Petroleum Monthly*, DOE/EIA-0520(2000/12) (Washington, DC, December 2000). **Projections:** EIA, World Energy Projection System (2001).

Given the requirements for OPEC production capacity expansion implied by the *IEO2001* 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 exceeding 85 years, substantial capacity expansion clearly is feasible.

Production costs in Persian Gulf OPEC nations are less than \$1.50 per barrel, and the capital investment required to increase production capacity by 1 barrel per day is less than \$5,000 [14]. Assuming the *IEO2001* low price trajectory, total development and operating costs

over the entire projection period, expressed as percentage of gross oil revenues, would be less than 20 percent. 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 \$10,000 in some member nations. However, even this group of producers can still expect margins in excess of 35 percent on investments to expand production capacity over the long term, even in the low price case [15]. Venezuela has the greatest potential for capacity expansion and could aggressively increase its production capacity to 4.6 million barrels per day by 2005. It is unclear, however, whether the current political climate will support the outside investment required for any substantial expansion of production capacity. Tables D1-D10 in Appendix D 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. If those projects were not undertaken, world oil prices could escalate; however, the combination of potential profitability and the threat of competition from non-OPEC suppliers argues for the pursuit of an aggressive expansion strategy.

In the *IEO2001* forecast, OPEC members outside the Persian Gulf region 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 two 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 into the 1980s, and much of the new production in the 1990s has come from the developing countries of Latin America, the non-OPEC Middle East, and China. In the *IEO2001* reference case, non-OPEC supply from proven reserves is expected to increase steadily, from 44.6 million barrels per day in 1999 to 60 million barrels per day in 2020 (Table 12).

There are several important differences between the *IEO2001* production profiles and those published in *IEO2000*:

- The U.S. production decline is slightly less severe in the *IEO2001* projections as a result of higher near-term oil prices and technological advances and lower costs for deep exploration and production in the Gulf of Mexico.
- The resilient near-term oil prices coupled with enhanced subsea and recovery technologies delay the *IEO2000* estimated peak for North Sea production to 2005-2006 and slightly tempers the production decline out to 2020.
- Resource development in the Caspian Basin region was expected to be delayed significantly in the *IEO2000* forecast due to the prospects of a prolonged low price environment. In *IEO2001*, Caspian output is expected to rise to almost 2.8 million barrels per day by 2005 and to increase steadily thereafter. There still remains a great deal of uncertainty about export routes from the Caspian Basin region.
- *IEO2000* anticipated significant delays in exploration and development activities for deepwater projects worldwide. Significant output from such projects was not anticipated until oil prices returned to and remained in the \$20 to \$25 per barrel range for a significant period. With the current resiliency in prices, output from deepwater projects in the U.S. Texas Gulf, the North Sea, West Africa, the South China Sea, Brazil, Colombia, and the Caspian Basin is accelerated in the *IEO2001* forecast by 1 to 2 years.

**Table 12. Non-OPEC Oil Production, 1990-2020**  
(Million Barrels per Day)

Year	Reference Case	High Oil Price	Low Oil Price
<b>History</b>			
1990 . . . . .	42.2	—	—
1999 . . . . .	44.6	—	—
<b>Projections</b>			
2005 . . . . .	49.4	50.5	48.2
2010 . . . . .	53.1	54.4	51.2
2015 . . . . .	56.7	58.6	54.3
2020 . . . . .	60.0	62.0	57.2

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

Sources: **History:** Energy Information Administration (EIA), *International Petroleum Monthly*, DOE/EIA-0520(2000/12) (Washington, DC, December 2000), Table 1.4. **Projections:** EIA, World Energy Projection System (2001).

In the *IEO2001* forecast, North Sea production reaches a peak in 2006, at almost 6.6 million barrels per day. Production from Norway, Western Europe's largest producer, is expected to peak at about 3.7 million barrels per day in 2004 and then gradually decline to about 3.1 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 is expected to produce about 3.1 million barrels per day by the middle of this decade, followed by a decline to 2.7 million barrels per day by 2020.

Two non-OPEC Persian Gulf producers are expected to increase output gradually for the first half of this decade. Enhanced recovery techniques are expected to increase current output in Oman by more than 175,000 barrels per day, with only a gradual production decline anticipated beyond 2005. Current oil production in Yemen could increase by at least 120,000 barrels per day within the next couple of years, and those levels would show little decline throughout the forecast period. Syria is expected to hold its production flat through the first half of this decade, but little in the way of new resource potential will allow anything except declining production volumes.

Oil producers in the Pacific Rim are expected to increase their production volumes significantly as a result of enhanced exploration and extraction technologies. India is expected to show some modest production increase early in this decade and only a modest decline in output thereafter. Deepwater fields offshore from the Philippines have resulted in an improved reserve picture. By the middle of this decade, production is expected to reach almost 260,000 barrels per day. Vietnam is still viewed with considerable optimism regarding long-term production potential although exploration activity has been slower than originally anticipated. Output levels from Vietnamese fields are expected to exceed 400,000 barrels per day by 2020.

Australia has made significant recent additions to its proven reserves and is likely to become a million barrel per day producer by the middle of this decade. Malaysia shows little potential for any significant new finds, and its output is expected to peak around 825,000 barrels per day early in this decade and then gradually decline to 650,000 barrels per day by 2020. Papua New Guinea continues to add to its reserve posture and is expected to achieve production volumes approaching 200,000 barrels per day by the middle of this decade followed by only a modest decline over the forecast period. Exploration and test-well activity have pointed to some production potential for Bangladesh and Mongolia, but significant output is not expected until the middle of this decade.

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 2.5 million barrels per day by 2020. Colombia's current economic downturn has somewhat delayed its bid to join the relatively short list of worldwide million barrel per day producers, but its output is expected to top a million barrels per day within the decade and show little decline for the remainder of the forecast period. In both countries, the oil sector would benefit significantly from the creation of a favorable climate for foreign investment.

Argentina is expected to increase its production volumes by at least 100,000 barrels per day over the next 2 years, and by the middle 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 increase production by more than 300,000 barrels per day within the next couple of years.

Several West African producers (Angola, Cameroon, Chad, Congo, Gabon, and Ivory Coast) are expected to reap the benefits of substantial offshore exploration activity, especially considering the recent rebound in oil prices. Angola is expected to become a million barrel per day producer early in this decade. Given the excellent exploration results, Angola could produce volumes of up to 2 million barrels per day well into the later years of the forecast period. The other West African producers with offshore tracts are expected to increase output by up to 300,000 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. Their production volumes are expected to decline gradually throughout the forecast. Sudan and Equatorial Guinea are expected to produce modest volumes early in this decade. Eritrea, Somalia, and South Africa also have some resource potential, but they are not expected to produce significant amounts until after 2005.

In North America, falling U.S. output is expected to be more than offset by production increases in Canada and Mexico. Canada's projected output is expected to increase by more than 200,000 barrels per day over the next 2 years, mainly from Newfoundland's Hibernia oil project, which could produce more than 150,000 barrels per day at its peak sometime in the next several years. Canada is projected to add an additional 600,000 barrels per day in output from a combination of frontier area offshore projects and oil from tar sands. Higher near-term prices, technological advances, and lower costs for deepwater exploration and production in the Gulf of Mexico temper the projected decline in U.S.

production. Mexico is expected to adopt energy policies that encourage the efficient development of its vast resource base. Expected production volumes in Mexico exceed 4 million barrels per day by the end of the decade and show little decline out to 2020.

With the resiliency in near-term oil prices, oil production in the FSU is expected to reach 9.6 million barrels per day by 2005—a level that could be significantly higher if the outlook for investment in Russia were not so pessimistic. The long-term production potential for the FSU is still regarded with considerable optimism, especially for the resource-rich Caspian Basin region. The *IEO2001* reference case shows FSU output exceeding 14.7 million barrels per day by 2020, implying export volumes exceeding 8 million barrels per day. In China, oil production is projected to decline to 3.0 million barrels per day by 2020. China's import requirements are expected to be as large as its domestic production by 2010 and to continue growing as its petroleum consumption increases.

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 undiscovered resources. For the purpose of the three *IEO2001* price cases, no more than 15 percent of the mean United States Geological Survey estimate of undiscovered oil was allowed to be developed over the forecast period. Tables D1-D10 in Appendix D show the ranges of production potential for both OPEC and non-OPEC producers.

The expectation in the late 1980s and early 1990s was that non-OPEC production in the longer term would be stagnant 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 a relatively low price environment, non-OPEC production has risen every year since 1993, adding more than 5 million barrels per day between 1993 and 2000.

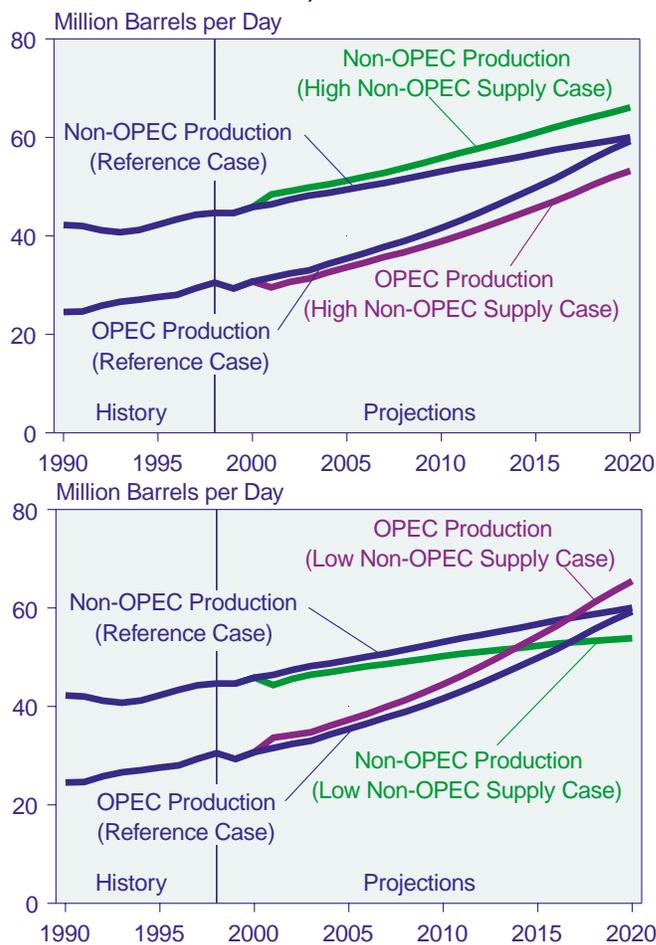
It is expected that non-OPEC producers will continue to increase output, producing an additional 8.5 million barrels per day by 2010. Three factors are generally given credit for the impressive resiliency of non-OPEC production: development of new exploration and production technologies, efforts by the oil industry to reduce costs, and efforts by producer governments to promote

exploration and development by encouraging outside investors with attractive fiscal terms.

### Alternative Non-OPEC Supply Cases

The only variable affecting the estimates of non-OPEC production potential in the three *IEO2001* world oil price cases is the price assumption. As a result, the range of projected non-OPEC supply is modest, varying by only slightly less than 4.8 million barrels per day by the end of the forecast period. In fact, improved technology and a better understanding of the underlying resource potential have been major factors sustaining non-OPEC supply in the recent past. To examine the effects of those factors, two additional cases—the high and low non-OPEC supply cases—were developed. Figure 35 compares OPEC and non-OPEC production estimates in the reference case with those in the two alternative non-OPEC supply cases. The alternative cases used reference case assumptions except for the following departures.

**Figure 35. OPEC and Non-OPEC Oil Production in Three Cases, 1990-2020**



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, January 2001). **Projections:** EIA, World Energy Projection System (2001).

### High Non-OPEC Supply Case:

- Due to increased optimism regarding the offshore production potential in the FSU, Latin America, West Africa, and the South China Sea, undiscovered oil in those regions is assumed to be 15 percent greater than the estimates in the reference case.
- One-third of the world's (non-OPEC, non-U.S.) undiscovered oil is considered economical to develop over the forecast period.
- Technology improvements over the forecast period are assumed to be transferrable worldwide.
- A reserve-to-production ratio of 15 years (slightly less than the current non-OPEC ratio) is used as a lower bound for production estimates.

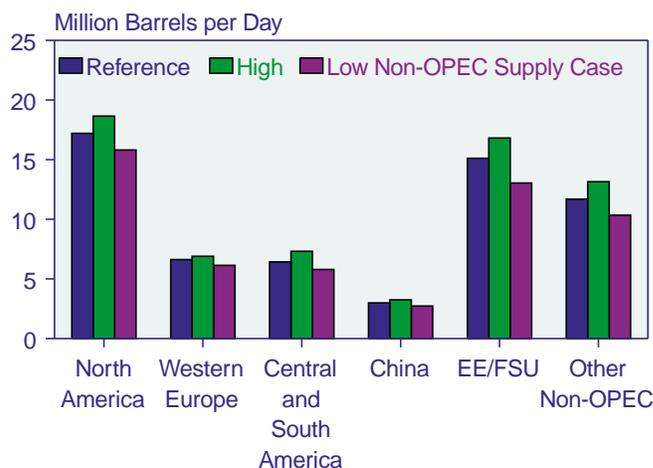
### Low Non-OPEC Supply Case:

- The amount of oil production from undiscovered reserves in deepwater areas is assumed to be 25 percent less than the reference case estimate as a result of persistent low oil prices and the finding of more natural gas deposits than oil deposits.
- Only one-fifth of the undiscovered oil in non-OPEC areas is considered economical to develop over the forecast period.
- There are assumed to be no significant technology improvements over the forecast period, and worldwide oil recovery rates are assumed to average only 35 percent.
- There are assumed to be no significant technology improvements over the forecast period, and worldwide oil recovery rates are assumed to average only 35 percent. The reference case assumes a gradual increase in worldwide recovery rates to 45 percent by 2020.
- Russia's oil production is assumed to be one-third of that estimated in the reference case.

The high non-OPEC supply case assumptions result in a projection of 1.8-percent annual growth in non-OPEC production over the forecast period, as compared with a 1.4-percent growth rate in the reference case. Non-OPEC oil production reaches 66.1 million barrels per day in the high case in 2020, compared with 60 million barrels per day in the reference case. Figure 36 compares production levels for six non-OPEC regions in the reference, high non-OPEC supply, and low non-OPEC supply cases.

In the reference case, OPEC production reaches 59.3 million barrels per day, and the OPEC share of worldwide production reaches almost 50 percent by 2020. In the high non-OPEC supply case, OPEC production rises to 53.2 million barrels per day and never assumes a market share above 45 percent. The low non-OPEC supply case

Figure 36. Non-OPEC Oil Production by Region in Three Cases, 2020



Source: Energy Information Administration, World Energy Projection System (2001).

projects only a modest 0.9-percent annual growth for non-OPEC production over the forecast period. Non-OPEC production rises to 53.9 million barrels per day in 2020. OPEC production reaches 65.4 million barrels per day in 2020, with a 59-percent majority share of the world market.

## Worldwide Petroleum Trade in the Reference Case

In 1998, industrialized countries imported 16.9 million barrels of oil per day from OPEC producers. Of that total, 10.3 million barrels per day came from the Persian Gulf region. Oil movements to industrialized countries represented more than two-thirds of the total petroleum exported by OPEC member nations and more than 63 percent of all Persian Gulf exports (Table 13). By the end of the forecast period, OPEC exports to industrialized countries are estimated to be about 5.7 million barrels per day higher than their 1998 level, and more than half the increase is expected to come from the Persian Gulf region.

Despite such a substantial increase, the projected share of total petroleum exports in 2020 that goes to the industrialized nations is considerably lower than their 1998 share, slightly over 50 percent. Their share of all Persian Gulf exports falls even more dramatically, to almost 38 percent. This significant shift in the balance of OPEC export shares between the industrialized and developing nations is a direct result of the robust economic growth anticipated for the developing nations of the world, especially those of Asia. OPEC petroleum exports to developing countries are expected to increase by more than 18.6 million barrels per day over the forecast period, with more than half the increase going to the developing countries of Asia. China, alone, will most

**Table 13. Worldwide Petroleum Trade in the Reference Case, 1998 and 2020**  
(Million Barrels per Day)

Exporting Region	Importing Region							
	Industrialized				Nonindustrialized			
	North America	Western Europe	Asia	Total	Pacific Rim	China	Rest of World	Total
<b>1998</b>								
<b>OPEC</b>								
Persian Gulf . . . . .	2.2	4.0	4.1	<b>10.3</b>	4.2	0.4	1.3	<b>5.9</b>
North Africa . . . . .	0.4	2.0	0.0	<b>2.4</b>	0.0	0.0	0.1	<b>0.1</b>
West Africa . . . . .	0.8	0.5	0.0	<b>1.3</b>	0.1	0.0	0.1	<b>0.2</b>
South America . . . . .	1.8	0.2	0.0	<b>2.0</b>	0.1	0.0	0.9	<b>1.0</b>
Asia . . . . .	0.1	0.0	0.8	<b>0.9</b>	0.1	0.0	0.0	<b>0.1</b>
<b>Total OPEC . . . . .</b>	<b>5.2</b>	<b>6.7</b>	<b>5.0</b>	<b>16.9</b>	<b>4.6</b>	<b>0.4</b>	<b>2.4</b>	<b>7.4</b>
<b>Non-OPEC</b>								
North Sea . . . . .	0.7	5.6	0.0	<b>6.3</b>	0.0	0.0	0.0	<b>0.0</b>
Caribbean Basin . . . . .	2.4	0.5	0.0	<b>3.0</b>	0.2	0.0	2.1	<b>2.3</b>
Former Soviet Union . . . . .	0.0	2.6	0.0	<b>2.7</b>	0.1	0.0	0.1	<b>0.2</b>
Other Non-OPEC . . . . .	2.7	2.0	0.5	<b>5.2</b>	7.7	0.5	1.3	<b>9.5</b>
<b>Total Non-OPEC . . . . .</b>	<b>5.8</b>	<b>10.7</b>	<b>0.6</b>	<b>17.1</b>	<b>8.0</b>	<b>0.5</b>	<b>3.5</b>	<b>12.0</b>
<b>Total Petroleum Imports . . . . .</b>	<b>11.0</b>	<b>17.4</b>	<b>5.5</b>	<b>34.0</b>	<b>12.6</b>	<b>0.9</b>	<b>5.9</b>	<b>19.3</b>
<b>2020</b>								
<b>OPEC</b>								
Persian Gulf . . . . .	4.7	3.7	4.8	<b>13.2</b>	8.2	5.3	8.3	<b>21.8</b>
North Africa . . . . .	0.5	2.6	0.0	<b>3.0</b>	0.1	0.0	0.6	<b>0.8</b>
West Africa . . . . .	0.9	1.2	0.3	<b>2.4</b>	0.1	0.0	1.1	<b>1.2</b>
South America . . . . .	3.2	0.5	0.1	<b>3.8</b>	0.2	0.0	1.9	<b>2.1</b>
Asia . . . . .	0.1	0.0	0.1	<b>0.2</b>	0.2	0.0	0.0	<b>0.2</b>
<b>Total OPEC . . . . .</b>	<b>9.4</b>	<b>7.9</b>	<b>5.4</b>	<b>22.6</b>	<b>8.9</b>	<b>5.3</b>	<b>11.9</b>	<b>26.0</b>
<b>Non-OPEC</b>								
North Sea . . . . .	0.7	5.1	0.0	<b>5.8</b>	0.1	0.0	0.0	<b>0.1</b>
Caribbean Basin . . . . .	4.3	0.4	0.1	<b>4.8</b>	0.2	0.0	2.1	<b>2.2</b>
Former Soviet Union . . . . .	0.4	4.4	0.2	<b>5.0</b>	3.6	0.6	0.2	<b>4.4</b>
Other Non-OPEC . . . . .	3.2	2.0	0.2	<b>5.4</b>	7.7	0.8	1.5	<b>10.0</b>
<b>Total Non-OPEC . . . . .</b>	<b>8.5</b>	<b>12.0</b>	<b>0.5</b>	<b>21.0</b>	<b>11.6</b>	<b>1.4</b>	<b>3.8</b>	<b>16.8</b>
<b>Total Petroleum Imports . . . . .</b>	<b>18.0</b>	<b>19.8</b>	<b>5.9</b>	<b>43.7</b>	<b>20.4</b>	<b>6.7</b>	<b>15.7</b>	<b>42.8</b>

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

Sources: **1998:** Energy Information Administration (EIA), Energy Markets and Contingency Information Division. **2020:** EIA, Office of Integrated Analysis and Forecasting, IEO2001 WORLD Model run IEO01.B20 (2001).

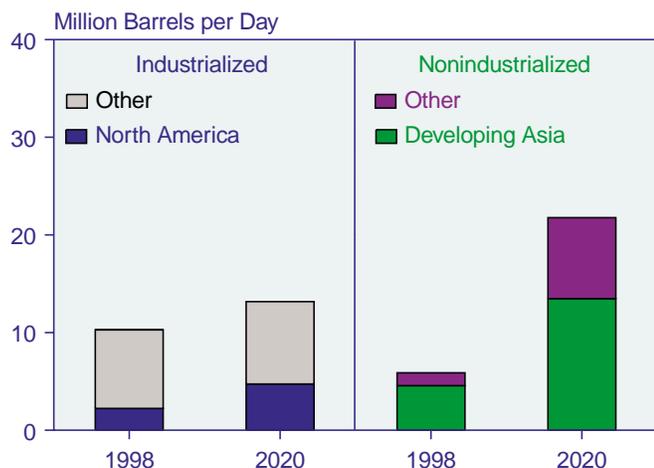
likely import about 5.3 million barrels per day from OPEC by 2020, virtually all of which is expected to come from Persian Gulf producers.

North America's petroleum imports from the Persian Gulf are expected to more than double over the forecast period (Figure 37). At the same time, more than half of total North American imports in 2020 are expected to be from Atlantic Basin producers and refiners, with significant increases in crude oil imports anticipated 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 American 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. Industrialized Asian nations are expected to increase their already heavy dependency on Persian Gulf oil. The developing countries of the Pacific Rim are expected to increase their total petroleum imports between 1998 and 2020 by almost 62 percent.

Worldwide crude oil distillation refining capacity was about 80.3 million barrels per day at the beginning of 1999. 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

**Figure 37. Imports of Persian Gulf Oil by Importing Region, 1998 and 2020**



Sources: **1998:** Energy Information Administration (EIA), Energy Markets and Contingency Information Division. **2020:** EIA, Office of Integrated Analysis and Forecasting, IEO2001 WORLD Model run IEO01.B20 (2001).

barrels per day by 2020. 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 developing countries are also expected to include more advanced configurations designed to meet the anticipated increase in demand for lighter products, especially transportation fuels.

## Other Views of Prices and Production

Several oil market analysis groups produce world oil price and production forecasts. Table 14 compares the *IEO2001* world oil price projections with similar forecasts from Standard & Poor's Platt's (S&P), the International Energy Agency (IEA), Petroleum Economics, Ltd. (PEL), Petroleum Industry Research Associates (PIRA), the Gas Research Institute (GRI), National Resources Canada (NRCAN), WEFA Energy (WEFA), and Deutsche Banc Alex.Brown (DBAB).

The collection of forecasts includes a wide range of price projections. The volatility of world oil prices in the late 1990s has helped to define this wide range with differing views about whether oil prices will sustain the higher levels achieved in 1999 given the recovery of many southeast Asian economies and the production quotas achieved by the OPEC member countries in 1999-2000. Prices for 2005 range from PEL's \$15.63 per barrel

(constant 1999 U.S. dollars) to PIRA's \$22.56 per barrel. It is interesting to note that NRCAN forecast was formulated in 1997 (but reaffirmed in 2000). While the forecast from NRCAN formed the upper limit in last year's range of forecasts for 2005, this year, after a year of sustained world oil prices above \$25 per barrel, the NRCAN forecast falls within the range of the other forecasts.

*IEO2001* expects oil prices to decline from the high rates of 2000 to \$20.83 in 2005. This projection leans somewhat toward the higher end of the forecasts: only NRCAN and PIRA project higher world oil prices in 2005. Recent forecasts from S&P, DBAB, IEA, and GRI all expect that prices will be in the lower range of \$17 to just under \$20 per barrel in 2005.

The entire PEL price forecast series may be considered an outlier relative to the rest of the forecasts. PEL's price projections fall below those of the *IEO2001* low price path in 2010 and 2015, when the PEL time series ends. Even in 2005, the PEL projection is close to the *IEO2001* low price case projection of \$15.10. If the PEL series is omitted, the range of prices among the remaining series is much smaller in 2015, \$4.55 per barrel, with *IEO2001* at the high end of the range (\$21.89 per barrel) and DBAB at the low end (\$17.34 per barrel).

The *IEO2001* forecast tends to have higher prices than the other forecasts. Indeed, *IEO2001* prices are the highest of any other series across the 2005-2020 time period, with the exception of NRCAN in 2005 and IEA in 2020. It should be noted that IEA did not publish a price value for 2015 in its *World Energy Outlook 2000*, however, it states that "between 2010 and 2020, the price increases steadily," from \$19.83 dollars per barrel to \$27.04 dollars per barrel. A simple interpolation results in an oil price in 2015 in excess of \$23 per barrel, placing the IEA price assumption above the *IEO2001* estimate of \$21.89 per barrel.

The price forecasts are influenced by differing views of the projected composition of world oil production. Two factors are of particular importance: (1) expansion of OPEC oil production and (2) the timing of a recovery in EE/FSU oil production. All the forecasts agree that the recovery of EE/FSU production will be fairly slow, although most are somewhat more optimistic this year about EE/FSU production development than they were last year.

Higher world oil prices and a quickening economic recovery in Russia, the largest oil producer in the region currently, no doubt have influenced the production forecasts for the EE/FSU. Nevertheless, the share of EE/FSU production is not expected to rise above 13 percent of total world production in any of the forecasts (Table 15). S&P is the least optimistic about recovery in the region, and its projection never exceeds 8 percent. In

**Table 14. Comparison of World Oil Price Projections, 2005-2020**  
(1999 Dollars per Barrel)

Forecast	2005	2010	2015	2020
<i>IEO2001</i>				
Reference Case . . . . .	20.83	21.37	21.89	22.41
High Price Case . . . . .	26.04	26.66	28.23	28.42
Low Price Case. . . . .	15.10	15.10	15.10	15.10
S&P (October 2000) . . . . .	19.47	18.65	19.87	21.16
IEA (November 2000) . . . . .	19.83	19.83	—	27.04
PEL (February 2000) . . . . .	15.63	13.77	11.75	—
PIRA (October 2000) . . . . .	22.56	23.58	—	—
WEFA (February 2000) . . . . .	18.39	18.48	19.42	20.41
GRI (January 2000) . . . . .	18.17	18.17	18.17	—
NRCan (April 1997) . . . . .	21.24	21.24	21.24	21.24
DBAB (January 2001) . . . . .	17.08	16.98	17.34	17.68

Notes: *IEO2001* projections are for average landed imports to the United States. S&P, GRI, WEFA, and DBAB projections are for composite refiner acquisition prices. PEL projections are for Brent crude oil. PIRA projections are for West Texas Intermediate crude oil at Cushing.

Sources: **IEO2001**: Energy Information Administration, *Annual Energy Outlook 2001*, DOE/EIA-0383(2001) (Washington, DC, December 2000). **S&P**: Standard & Poor's Platt's, *U.S. Energy Outlook, Spring/Summer 2000* (Lexington, MA, October 2000). **IEA**: International Energy Agency, *World Energy Outlook 2000* (Paris, France, November 2000), p. 39. **PEL**: Petroleum Economics, Ltd., *Oil and Energy Outlook to 2015* (London, United Kingdom, February 2000). **PIRA**: PIRA Energy Group, *Retainer Client Seminar* (New York, NY, October 2000), Table II-3. **WEFA**: WEFA Group, *U.S. Energy Outlook 2000* (Eddystone, PA, February 2000), p. 1.17. **GRI**: Gas Research Institute, *2000 Data Book of the GRI Baseline Projections of U.S. Energy Supply and Demand to 2015*, Vol. 1 (Washington, DC, January 1999), p. SUM-21. **NRCan**: Natural Resources Canada, *Canada's Energy Outlook, 1996-2020*, Annex C2 (Ottawa, Ontario, Canada, April 1997) (reaffirmed in January 2000). **DBAB**: Deutsche Banc Alex. Brown, Inc., "World Oil Supply and Demand Estimates," e-mail from Adam Sieminski (January 9, 2001).

fact, S&P's forecast of Russia's share of world oil production (oil production estimates for the entire region are not available from S&P) falls to 7 percent in 2010 and still further, to 6 percent, at the end of the projection period. *IEO2001* and DBAB are the most optimistic forecasts for the region, with the EE/FSU share of world oil production reaching 12 percent and 11 percent, respectively, in 2005 and rising to 13 percent and 12 percent in 2010 and to 13 percent in both forecasts for 2015 and 2020.

The forecasts that provide projections through 2020 (*IEO2001*, S&P, DBAB, and IEA) all expect OPEC to provide incremental production of between 20 and 30 million barrels per day between 1997 and 2020 (Table 15).<sup>5</sup> There is more variation in expectations among these four forecast services for the "other" non-OPEC suppliers. S&P expects a substantial increase of 15 million barrels per day of supply from other suppliers, whereas IEA expects a decline in production from these sources of 0.8 million barrels per day. IEA projects that the "other" share of world oil production will fall to 29 percent by 2020 while the OPEC share increases to 54 percent. *IEO2001* and DBAB expect more moderate growth from "other" non-OPEC supply, at 7 to 9 million barrels per day from 1997 to 2020.

<sup>5</sup>The comparisons use 1997 as a base year rather than 1998 or 1999, because the latest historical year of data available in IEA's *World Energy Outlook 2000* is 1997. Because there is some small variation between historical estimates, the oil production increments are calculated separately for each forecast.

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**Table 15. Comparison of World Oil Production Forecasts**

Forecast	Percent of World Total			Million Barrels per Day			
	OPEC	EE/FSU	Rest of World	OPEC	EE/FSU	Rest of World	Total
<b>History</b>							
1997 . . . . .	39	10	50	28.3	7.3	36.1	<b>71.8</b>
<b>Projections</b>							
<b>2005</b>							
IEO2001. . . . .	42	12	47	35.4	9.9	39.5	<b>84.8</b>
S&P <sup>a</sup> . . . . .	44	8	45	38.0	6.6	38.6	<b>86.4</b>
PEL . . . . .	42	9	46	36.3	8.1	39.6	<b>85.9</b>
PIRA. . . . .	37	11	52	31.8	9.4	44.2	<b>85.4</b>
DBAB . . . . .	42	11	45	36.0	9.2	37.9	<b>85.1</b>
<b>2010</b>							
IEO2001. . . . .	44	13	43	41.6	12.2	40.9	<b>94.7</b>
S&P <sup>a</sup> . . . . .	46	7	44	44.5	6.8	41.9	<b>95.1</b>
IEA <sup>b</sup> . . . . .	46	11	38	44.1	10.3	36.6	<b>95.9</b>
PEL . . . . .	46	9	42	44.2	8.9	40.2	<b>95.4</b>
PIRA. . . . .	38	12	50	35.9	11.5	46.7	<b>94.1</b>
DBAB . . . . .	45	12	40	43.1	11.4	38.5	<b>95.1</b>
<b>2015</b>							
IEO2001. . . . .	47	13	40	49.9	13.9	42.8	<b>106.6</b>
S&P <sup>a</sup> . . . . .	47	7	43	50.0	7.3	46.4	<b>107.5</b>
PEL . . . . .	51	10	38	53.5	10.1	39.9	<b>105.8</b>
DBAB . . . . .	47	13	38	49.3	13.2	40.2	<b>105.1</b>
<b>2020</b>							
IEO2001. . . . .	50	13	38	59.3	15.1	44.9	<b>119.3</b>
S&P <sup>a</sup> . . . . .	46	6	44	54.1	7.6	51.3	<b>116.6</b>
IEA <sup>b</sup> . . . . .	54	11	29	61.8	12.3	33.8	<b>114.7</b>
DBAB . . . . .	48	13	36	56.0	15.3	42.5	<b>116.5</b>

<sup>a</sup>In the S&P projections, EE/FSU includes only Russia.

<sup>b</sup>IEA total supply numbers include processing gains and unconventional oil. As a result, regional percentages do not add to 100.

Note: IEA, S&P, PEL, and DBAB report processing gains separately from regional production numbers. As a result, the percentages attributed to OPEC, EE/FSU, and Other Non-OPEC do not add to 100.

Sources: **IEO2001**: Energy Information Administration, World Energy Projection System (2001) and "DESTINY" International Energy Forecast Software (Dallas, TX: Petroconsultants, 2001). **S&P**: Standard & Poor's Platt's, *Oil Market Outlook: Long Term Focus, Second Quarter 2000* (Lexington, MA, 2000), p. 14. **IEA**: International Energy Agency, *World Energy Outlook 2000* (Paris, France, November 2000), p. 77. **PEL**: Petroleum Economics, Ltd., *Oil and Energy Outlook to 2015* (London, United Kingdom, February 2000). **PIRA**: PIRA Energy Group, *Retainer Client Seminar* (New York, NY, October 2000). **DBAB**: Deutsche Banc Alex.Brown, fax from Adam Sieminski (January 9, 2001).

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