

Comparisons With Other Forecasts, and Performance of Past *IEO* Forecasts for 1990, 1995, and 2000

Forecast Comparisons

Three organizations provide forecasts comparable with those in the *International Energy Outlook 2004* (*IEO2004*). The International Energy Agency (IEA) provides “business as usual” projections to the year 2030 in its *World Energy Outlook 2002*; Petroleum Economics, Ltd. (PEL) publishes world energy forecasts to 2020; and Petroleum Industry Research Associates (PIRA) provides projections to 2015. For this comparison, 2000 is used as the base year for all the forecasts (because IEA does not publish data for any other historical years), and the comparisons extend only to 2020. Although IEA’s forecast extends to 2030, it does not publish a projection for 2025. In addition to forecasts from other organizations, the *IEO2004* projections are also compared with those in last year’s report (*IEO2003*).

Regional breakouts among the forecasting groups vary, complicating the comparisons. For example, *IEO2004* includes Mexico in North America and IEA includes Mexico in Organization for Economic Cooperation and

Development (OECD) North America, but the two other forecasts include Mexico in Latin America. As a result, for purposes of this comparison, Mexico has been removed from North America in the *IEO2004* projections and added to Central and South America to form a “Latin America” country grouping that matches the other series. PIRA includes only Japan in industrialized Asia, whereas industrialized Asia in the *IEO2004* forecast comprises Japan, Australia, and New Zealand. *IEO2004* includes Turkey in the Middle East, but IEA includes Turkey, as well as the Czech Republic, Hungary, and Poland, in “OECD Europe” (which is designated as “Western Europe” for this comparison). PEL also places Turkey in Western Europe but includes the Czech Republic, Hungary, and Poland in Eastern Europe, as does *IEO2004*. Although most of the differences involve fairly small countries, they contribute to the variations among the forecasts.

All the forecasts provide projections out to the year 2010 (Table F1). The growth rates for energy consumption among the reference case forecasts for 2000-2010 range

Table F1. Comparison of Energy Consumption Growth Rates by Region, 2000-2010
(Average Annual Percent Growth)

Region	<i>IEO2004</i>			<i>IEO2003</i>	IEA	PIRA	PEL
	Low Growth	Reference	High Growth				
Industrialized Countries	0.7	1.0	1.3	1.1	1.1	0.8	1.1
United States and Canada	0.9	1.2	1.5	1.3	1.1	0.7	1.3
Western Europe	0.3	0.6	0.9	0.8	1.1	0.9	0.9
Pacific	0.8	1.1	1.3	1.2	1.2	0.6 ^a	0.6
EE/FSU	0.6	1.2	2.0	2.4	1.8	2.5	1.4
Developing Countries	2.0	2.7	3.2	2.7	3.2	4.1	3.2
Asia	2.5	3.2	3.8	3.2	3.4	4.1	3.6
China	3.3	4.0	4.6	3.9	3.2	4.7	4.1
Other Asia ^b	1.8	2.5	3.0	2.5	3.6	3.6	3.1
Middle East	1.2	2.1	2.5	2.1	2.8	3.0	3.2
Africa	1.1	2.0	2.7	1.9	3.3	2.4	2.6
Latin America	1.3	1.9	2.3	2.2	3.0	1.6	1.9
Total World	1.2	1.7	2.1	1.9	1.9	2.0	1.9

^aJapan only.

^bOther Asia includes India and South Korea.

Sources: *IEO2004*: Energy Information Administration (EIA), System for the Analysis of Global Energy Markets (2004). *IEO2003*: EIA, *International Energy Outlook 2002*, DOE/EIA-0484(2003) (Washington, DC, May 2003), Table A1, p. 181. **IEA**: International Energy Agency, *World Energy Outlook 2002* (Paris, France, September 2002), pp. 410-497. **PIRA**: PIRA Energy Group, *Retainer Client Seminar* (New York, NY, October 2003). **PEL**: Petroleum Economics, Ltd., *World Long Term Oil and Energy Outlook* (London, United Kingdom, April 2003).

from 1.7 percent per year (*IEO2004*) to 2.0 percent per year (PIRA). Among the forecasts, PIRA's regional expectations for energy demand growth vary the most from the *IEO2004* projections. The PIRA forecast, for the most part, projects higher growth rates for energy use in the developing world than does *IEO2004* (with the exception of Latin America) and in the EE/FSU region. PIRA's projected growth rates from 2000 to 2010 for China and other developing Asia, the Middle East, and the EE/FSU all fall above the projections in the *IEO2004* high economic growth case. On the other hand, PIRA is more pessimistic than *IEO2004* about the potential for energy demand growth in the industrialized regions. The PIRA growth rates for the United States and Canada and for industrialized Asia fall below those in the *IEO2004* low economic growth case.

The IEA projections for the developing world are also generally higher than the *IEO2004* projections. The IEA growth rates exceed the *IEO2004* growth rates projected for each developing region, except China. For China, IEA's projection of 3.2-percent annual growth in energy demand between 2000 and 2010 falls below the *IEO2004* low economic growth case; and its projected growth rates for other developing Asia, the Middle East, Africa, and Latin America all exceed the *IEO2004* high economic growth case. For the industrialized world, IEA largely agrees with *IEO2004*, except that the IEA growth rate for Western Europe (which in the IEA forecast

includes Turkey, Hungary, Poland, and the Czech Republic) exceeds the rate in the *IEO2004* high economic growth case. In the PEL forecast, annual growth rates for energy demand fall within the range defined by the *IEO2004* low and high economic growth cases, except those for other developing Asia and the Middle East, both of which exceed those in the *IEO2004* high growth case.

The *IEO2004* reference case forecast is lower than in last year's outlook for the 2000 to 2010 time period, particularly for the EE/FSU and Latin American regions. For the EE/FSU, projected growth in energy use is substantially lower in *IEO2004* than in *IEO2003* (with demand growth averaging 1.2 percent and 2.4 percent per year, respectively, in the two forecasts). Expectations for efficiency gains in the coming decade have been raised in this year's report, accounting for the lower projected growth in energy demand over the 10-year period. In the case of Latin America, the lower forecast in *IEO2004* reflects a substantial lowering of expectations for economic growth in Mexico. From 2000 to 2010, Mexico's gross domestic product (GDP) was projected to expand at an average rate of 4.7 percent per year in *IEO2003*, compared with only 2.7 percent per year in *IEO2004*.

IEO2004, PIRA, and PEL provide forecasts for energy use in 2015 (Table F2), which is the end of the PIRA forecast horizon. Their projections for worldwide growth in

Table F2. Comparison of Energy Consumption Growth Rates by Region, 2000-2015
(Average Annual Percent Growth)

Region	<i>IEO2004</i>			<i>IEO2003</i>	PIRA	PEL
	Low Growth	Reference	High Growth			
Industrialized Countries	0.7	1.1	1.3	1.1	0.8	1.0
United States and Canada	1.0	1.3	1.6	1.4	0.8	1.2
Western Europe	0.3	0.7	1.0	0.7	0.9	0.9
Pacific	0.7	1.0	1.3	1.2	0.6	0.3
EE/FSU	0.7	1.4	2.2	2.1	2.5	1.5
Former Soviet Union	0.7	1.4	2.2	2.3	—	1.6
Eastern Europe	0.7	1.3	1.9	1.6	—	1.3
Developing Countries	2.0	2.8	3.4	2.9	3.4	3.1
Asia	2.5	3.2	3.9	3.3	4.0	3.4
China	3.2	3.9	4.6	3.9	4.4	3.8
Other Asia ^a	1.8	2.6	3.3	2.7	3.6	3.1
Middle East	1.2	2.1	2.7	2.3	3.3	3.0
Africa	1.2	2.3	3.2	2.0	2.4	2.5
Latin America	1.5	2.0	2.5	2.6	1.9	2.1
Total World	1.2	1.7	2.2	1.9	2.1	1.9

^aOther Asia includes India and South Korea.

Sources: *IEO2004*: Energy Information Administration (EIA), System for the Analysis of Global Energy Markets (2004). *IEO2003*: EIA, *International Energy Outlook 2003*, DOE/EIA-0484(2003) (Washington, DC, May 2003), Table A1, p. 181. **PIRA**: PIRA Energy Group, *Retainer Client Seminar* (New York, NY, October 2003), Tables II-4, II-6, and II-7. **PEL**: Petroleum Economics, Ltd., *World Long Term Oil and Energy Outlook* (London, United Kingdom, April 2003), Table 2i.

energy consumption between 2000 and 2015 are similar, ranging from 1.7 percent per year (*IEO2004*) to 2.1 percent per year (PIRA), with PEL expecting average annual growth of 1.9 percent. As it does for 2000-2010, PIRA forecasts much faster growth in energy use for the EE/FSU and for the developing regions from 2000 to 2015 than does *IEO2004*. The PIRA growth rates are higher than those in the *IEO2004* high economic growth case for “other Asia” and the Middle East. In the PEL forecast, 2000-2015 growth rates for energy demand in the developing are generally higher than the *IEO2004* reference case projections (except for China), but only one (for the Middle East) exceeds the *IEO2004* high economic growth case. The *IEO2004* reference case projections for energy demand growth in the United States and Canada and in industrialized Asia are higher than PIRA’s, which fall below those of the *IEO2004* low growth case, as does the PEL growth rate for industrialized Asia.

The *IEO2004* reference case projection of worldwide growth in energy use, at 1.7 percent per year for the 2000-2015 period, is slightly lower than was projected in *IEO2003*. By region, the largest differences between the two forecasts are for the EE/FSU and Latin America. *IEO2004* projects a higher growth rate than *IEO2003* for energy use in Africa. The differences for the EE/FSU are largely attributed to the FSU region, where growth in energy use has been revised downward to 1.4 percent per year for the 2000-2015 time period, compared with

2.3 percent per year in *IEO2003*. The difference represents a reevaluation of the potential for energy efficiency improvements in the FSU. In *IEO2004*, efficiency improvements have been strengthened substantially, reflecting the expectation of more rapid replacement of old, inefficient capital stock.

For Latin America, the revisions from *IEO2003* to *IEO2004* for the 2000-2015 period are explained in large part by a lower assumption in this year’s forecast for Mexico’s GDP growth. In *IEO2003*, robust economic growth of 5.2 percent per year was projected for Mexico. The *IEO2004* reference case projects GDP growth of only 3.1 percent per year for Mexico, reflecting a less optimistic view of Mexico’s ability to attract the foreign investment needed to support rapid economic expansion in the mid-term. For Africa, on the other hand, *IEO2004* projects average annual GDP growth of 4.1 percent per year from 2000 to 2015, up from the *IEO2003* projection of 3.7 percent per year, reflecting a reevaluation of Africa’s economic potential in the mid-term.

IEO2004, PEL, and IEA provide energy consumption projections for 2020 (Table F3). The three forecasts have similar projections for energy demand growth from 2000 to 2020, all projecting an average 1.8-percent annual increase in the world’s total energy consumption. The highest growth rates are projected for the developing world and the slowest for the industrialized world. The largest variations among the regional forecasts are for

Table F3. Comparison of Energy Consumption Growth Rates by Region, 2000-2020
(Average Annual Percent Growth)

Region	<i>IEO2004</i>			<i>IEO2003</i>	IEA	PEL
	Low Growth	Reference	High Growth			
Industrialized Countries	0.8	1.1	1.3	1.1	1.0	1.0
United States and Canada	1.0	1.3	1.6	1.3	1.1	1.2
Western Europe	0.4	0.7	0.9	0.7	0.9	0.8
Pacific	0.7	1.0	1.3	1.1	1.0	0.5
EE/FSU	0.5	1.5	2.3	1.9	1.5	1.6
Former Soviet Union	0.5	1.5	2.3	2.0	—	1.7
Eastern Europe	0.6	1.5	2.1	1.8	—	1.6
Developing Countries	2.0	2.8	3.5	2.9	3.1	3.0
Asia	2.4	3.2	3.9	3.2	3.1	3.3
China	3.1	3.8	4.5	3.8	3.0	3.6
Other Asia ^a	1.8	2.6	3.3	2.7	3.3	3.0
Middle East	1.2	2.1	2.8	2.3	2.5	2.9
Africa	1.3	2.3	3.5	2.1	3.4	2.5
Latin America	1.6	2.2	2.7	2.7	2.9	2.1
Total World	1.2	1.8	2.3	1.9	1.8	1.8

^aOther Asia includes India and South Korea.

Sources: *IEO2004*: Energy Information Administration (EIA), System for the Analysis of Global Energy Markets (2004). *IEO2003*: EIA, *International Energy Outlook 2003*, DOE/EIA-0484(2003) (Washington, DC, May 2003), Table A1, p. 181. **IEA**: International Energy Agency, *World Energy Outlook 2002* (Paris, France, September 2002), pp. 410-497. **PEL**: Petroleum Economics, Ltd., *World Long Term Oil and Energy Outlook* (London, United Kingdom, April 2003), Table 2i.

Africa, where growth expectations for energy use range from 2.3 percent per year (*IEO2004*) to 3.4 percent per year (IEA). IEA also remains more optimistic than the other forecasts about energy demand growth in Latin America, where the 2.9-percent annual rate projected by IEA exceeds the rate in the *IEO2004* high economic growth case. Both IEA and PEL expect higher growth in the Middle East than is projected in the *IEO2004* reference case, and PEL's projection is higher than the *IEO2004* high economic growth case. On the other hand, IEA expects much slower growth in energy use in China than do the other forecasts, and its projection of a 3.0-percent average annual increase in China's energy consumption is lower than the *IEO2004* low economic growth case.

As was the case for the 2000-2010 and 2000-2015 comparison periods, the EE/FSU is the region with the largest differences between the *IEO2004* and *IEO2003* reference case forecasts for 2000-2020; however, the differences are somewhat smaller when the longer time horizon to 2020 is considered. The impact of efficiency gains projected for the region in the early years of the forecast lessens after 2015, and the difference between the economic growth rates projected for 2000-2020 in the *IEO2004* and

IEO2003 reference case forecasts is only 0.4 percentage points, as compared with the difference of 1.2 percentage points for the 2000-2010 period.

The forecasts vary not only with respect to levels of total energy demand but also with respect to the mix of primary energy inputs. All the forecasts provide energy consumption projections by fuel in 2010 (Table F4). In terms of oil consumption, all the forecasts expect similar growth worldwide between 2000 and 2010: 1.4 percent per year in the PEL forecast and 1.7 percent per year in the three others. The *IEO2004* projection for worldwide growth in natural gas use is substantially lower than the previous year's (*IEO2003*) projection, and its projection for nuclear power is higher. The three other forecasts show much higher growth in natural gas consumption than does the *IEO2004* reference case, and all are higher than the *IEO2004* high economic growth case. The IEA forecast has a much higher projection for growth in renewable energy use than any of the other forecasts—2.8 percent per year, compared with 1.8 percent (PIRA and *IEO2004*) and 2.0 percent per year (PEL).

PEL, PIRA, and *IEO2004* provide world energy consumption projections by fuel for 2015 (Table F5). In the

Table F4. Comparison of World Energy Consumption Growth Rates by Fuel, 2000-2010
(Average Annual Percent Growth)

Fuel	<i>IEO2004</i>			<i>IEO2003</i>	IEA	PIRA	PEL
	Low Growth	Reference	High Growth				
Oil	1.1	1.7	2.2	1.5	1.7	1.7	1.4
Natural Gas	1.3	1.7	2.3	2.5	3.0	2.8	2.9
Coal	1.0	1.4	1.8	1.7	1.4	2.3	1.7
Nuclear	1.1	1.6	1.6	1.3	1.1	0.8	1.3
Renewable/Other	1.3	1.8	2.3	2.4	2.8	1.8	2.0
Total	1.2	1.7	2.1	1.9	1.9	2.0	1.9

Sources: *IEO2004*: Energy Information Administration (EIA), System for the Analysis of Global Energy Markets (2004). *IEO2003*: EIA, *International Energy Outlook 2002*, DOE/EIA-0484(2003) (Washington, DC, May 2003), Table A1, p. 181. *IEA*: International Energy Agency, *World Energy Outlook 2002* (Paris, France, September 2002), pp. 410-497. *PIRA*: PIRA Energy Group, *Retainer Client Seminar* (New York, NY, October 2003). *PEL*: Petroleum Economics, Ltd., *World Long Term Oil and Energy Outlook* (London, United Kingdom, April 2003).

Table F5. Comparison of World Energy Consumption Growth Rates by Fuel, 2000-2015
(Average Annual Percent Growth)

Fuel	<i>IEO2004</i>			<i>IEO2003</i>	PIRA	PEL
	Low Growth	Reference	High Growth			
Oil	1.2	1.8	2.4	1.7	1.7	1.5
Natural Gas	1.4	1.9	2.5	2.8	3.0	3.0
Coal	1.0	1.5	1.9	1.6	2.2	1.5
Nuclear	1.1	1.4	1.4	1.1	0.6	0.7
Renewable/Other	1.4	1.9	2.4	2.1	2.0	2.1
Total	1.2	1.7	2.2	1.9	2.1	1.9

Sources: *IEO2004*: Energy Information Administration (EIA), System for the Analysis of Global Energy Markets (2004). *IEO2003*: EIA, *International Energy Outlook 2003*, DOE/EIA-0484(2003) (Washington, DC, May 2003). *PIRA*: PIRA Energy Group, *Retainer Client Seminar* (New York, NY, October 2003). *PEL*: Petroleum Economics, Ltd., *World Long Term Oil and Energy Outlook* (London, United Kingdom, April 2003).

IEO2004 reference case, worldwide growth in energy consumption is expected to be slower (1.7 percent per year between 2000 and 2015) than in the PEL (1.9 percent per year) and PIRA (2.1 percent per year) forecasts. PEL and PIRA remain much more bullish in their projections for natural gas demand over this time period, in both cases exceeding the *IEO2004* high economic growth case. *IEO2004* projects growth in nuclear power that is double that in the two other forecasts, both of which fall below the *IEO2004* low growth case.

IEO2004, PEL, and IEA provide energy consumption projections for 2020 (Table F6). Although total growth in energy use is projected at 1.8 percent per year between 2000 and 2020 in each of the forecasts, the projected fuel mixes differ. Whereas *IEO2004* expects nuclear power generation to grow by 1.1 percent per year from 2000 to 2020, both IEA and PEL project much slower growth (0.3 percent and 0.2 percent per year, respectively), and both fall below the *IEO2004* low economic growth case. *IEO2004* projects smaller increases in natural gas demand than the other two forecasts, and PEL's projection of 3.0-percent average annual growth in natural gas consumption is higher than the *IEO2004* high growth case. IEA is more optimistic about the growth potential of renewable energy sources, projecting 2.7-percent annual growth between 2000 and 2020, as compared with the *IEO2004* projection of 1.8 percent in the reference case and 2.3 percent in the high economic growth case.

There has been a fairly significant shift in the projected mix of energy fuel use between the *IEO2003* and *IEO2004* forecasts, with lower growth in natural gas and higher growth in nuclear power expected in the *IEO2004* forecast. The growth rates in demand for other fuels in *IEO2004* are, for the most part, similar to those in *IEO2003*. For natural gas, the lower forecast in *IEO2004* is the result of a slightly lower assumption for worldwide economic growth, a slower projected decline in nuclear power generation (which competes with natural

gas in the electric power sector), and concerns about the long-term ability of natural gas producers to bring sufficient resources to market at prices competitive with those of other fuels. For nuclear power, the increased growth rate results from a reassessment of prospects for nuclear power in light of higher capacity utilization rates reported for many existing nuclear facilities and the expectation that fewer retirements of existing plants will occur than previously projected.

Performance of Past *IEO* Forecasts for 1990, 1995, and 2000

In an effort to measure how well the *IEO* projections have estimated future energy consumption trends over the 19-year history of the series, a comparison of *IEO* forecasts produced for the years 1990, 1995, and 2000 is presented here. The forecasts are compared with actual data published in EIA's *International Energy Annual 2001*, as part of EIA's commitment to provide users of the *IEO* with a set of performance measures to assess the forecasts produced by this agency.

The *IEO* has been published since 1985. In *IEO85*, mid-term projections were derived only for the world's market economies. That is, no projections were prepared for the centrally planned economies (CPE) of the Soviet Union, Eastern Europe, Cambodia, China, Cuba, Laos, Mongolia, North Korea, and Vietnam. The *IEO85* projections extended to 1995 and included forecasts of energy consumption for 1990 and 1995 and primary consumption of oil, natural gas, coal, and "other fuels." *IEO85* projections were also presented for several individual countries and subregions: the United States, Canada, Japan, the United Kingdom, France, West Germany, Italy, the Netherlands, other OECD Europe, other OECD (Australia, New Zealand, and the U.S. Territories), OPEC, and other developing countries. Beginning with *IEO86*, nuclear power projections were published separately from the "other fuel" category.

Table F6. Comparison of World Energy Consumption Growth Rates by Fuel, 2000-2020
(Average Annual Percent Growth)

Fuel	<i>IEO2004</i>			<i>IEO2003</i>	IEA	PEL
	Low Growth	Reference	High Growth			
Oil	1.2	1.8	2.5	1.7	1.7	1.5
Natural Gas	1.5	2.1	2.7	2.8	2.7	3.0
Coal	1.0	1.5	2.0	1.6	1.4	1.4
Nuclear	0.9	1.1	1.1	0.8	0.3	0.2
Renewable/Other	1.3	1.8	2.3	1.9	2.7	2.2
Total	1.2	1.8	2.3	1.9	1.8	1.8

Sources: *IEO2004*: Energy Information Administration (EIA), System for the Analysis of Global Energy Markets (2004). *IEO2003*: EIA, *International Energy Outlook 2003*, DOE/EIA-0484(2003) (Washington, DC, May 2003). *IEA*: International Energy Agency, *World Energy Outlook 2002* (Paris, France, September 2002). *PEL*: Petroleum Economics, Ltd., *World Long Term Oil and Energy Outlook* (London, United Kingdom, April 2003).

Regional aggregations have changed from report to report. In 1990, the report coverage was expanded for the first time from only the market economies to the entire world. Projections for China, the FSU, and other CPE countries were provided separately. Starting with *IEO94*, the regional presentation was changed from market economies and CPE countries to OECD, Eurasia (China, FSU, and Eastern Europe), and “Rest of World.” Beginning in 1995 and essentially continuing until the current issue, the regional presentation changed to further group the world according to economic development: industrialized nations (essentially the OECD before the entry of South Korea and the Eastern European nations, the Czech Republic, Hungary, Poland, and Slovakia), the transitional economies of the EE/FSU, and the developing world (including China and India).

The forecast time horizon has also changed over the years (Table F7). In the first edition of the report, *IEO85*, projections were made for 1990 and 1995. *IEO86* saw the addition of projection year 2000. In *IEO91*, forecasts were no longer published for 1990, but forecasts for 2010 were added to the report. The projection horizon remained the same until *IEO96*, when projection year 2015 was added. In 1998, the forecast was extended again, out to 2020. The *IEO2003* and *IEO2004* forecasts extend to 2025.

Comparisons of Forecasts for Market Economies

Projections for market economies were made in the eight issues of the *IEO* that were published between 1985 and 1993 (no *IEO* was published in 1988). Historical data for

Table F7. Years Included in *IEO* Projections by Edition, 1985-2004

Edition	1990	1995	2000	2005	2010	2015	2020	2025
<i>IEO85</i>	x	x						
<i>IEO86</i>	x	x	x					
<i>IEO87</i>	x	x	x					
<i>IEO89</i>	x	x	x					
<i>IEO90</i>		x	x		x			
<i>IEO91</i>		x	x		x			
<i>IEO92</i>		x	x		x			
<i>IEO93</i>		x	x		x			
<i>IEO94</i>			x	x	x			
<i>IEO95</i>			x	x	x			
<i>IEO96</i>		x	x	x	x	x		
<i>IEO97</i>			x	x	x	x		
<i>IEO98</i>			x	x	x	x	x	
<i>IEO99</i>			x	x	x	x	x	
<i>IEO2000</i> . .				x	x	x	x	
<i>IEO2001</i> . .				x	x	x	x	
<i>IEO2002</i> . .				x	x	x	x	
<i>IEO2003</i> . .				x	x	x	x	x
<i>IEO2004</i> . .					x	x	x	x

Sources: Energy Information Administration, *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

total regional energy consumption in 1990 show that the *IEO* projections from those early years were consistently lower than the actual data for the market economies. For the four editions of the *IEO* printed between 1985 and 1989 in which 1990 projections were presented, total projected energy consumption in the market economies ran between 3 and 7 percent below the actual amounts published in the *International Energy Annual 2001* (Figure F1).

In addition, market economy projections for 1995 in the 1985 through 1993 *IEO* reports (EIA did not release forecasts for 1995 after the 1993 report) were consistently lower than the actual, historical 1995 data (Figure F2). Most of the difference is attributed to those market economy countries outside the OECD. Through the years, EIA’s economic growth assumptions for OPEC and other market economy countries outside the OECD have been low. The 1993 forecast was, as one might expect, the most accurate of the forecasts for 1995, but its projection for OPEC and the other market economy countries was still more than 10 percent below the actual number.

Similarly to the year 1995 projections, year 2000 projections were also consistently lower than actual 2000 data in each of the *IEOs* published between 1986 and 1993 (Figure F3). The consumption estimates for the market economies increased in each edition, from 265 quadrillion Btu in *IEO86* to 292 quadrillion Btu in *IEO93*. As late as 1993, the *IEO* forecasts were underestimating consumption of all energy sources in the market economies, by between 2 percent (oil) and 7 percent (natural gas and nuclear power).

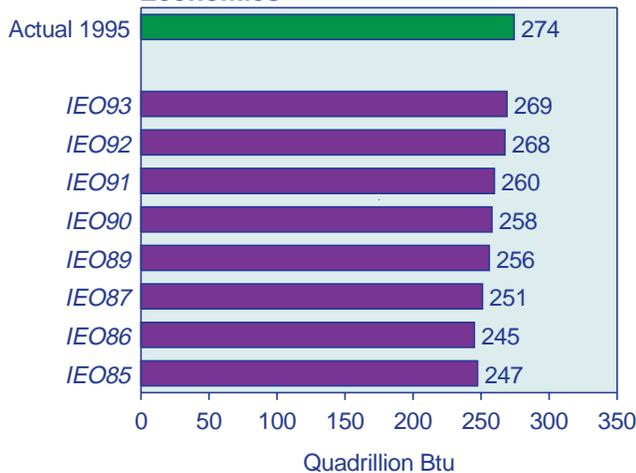
Figure F1. Comparison of *IEO* Forecasts with 1990 Energy Consumption in Market Economies



Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

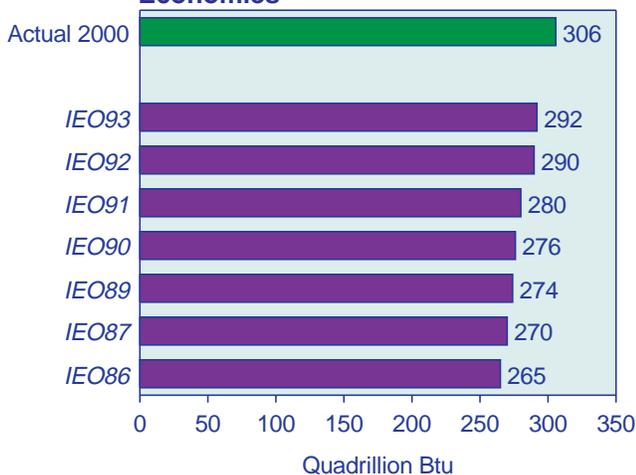
As noted above, in the 1994 edition of the *IEO*, the regional aggregation “market economies” was dropped altogether and replaced with delineation of member countries of the OECD, Eurasia, and Rest of World (ROW). As a result of that reorganization, it is not possible to recreate a forecast for the CPE countries: except for China, the FSU, and Eastern Europe, the remaining CPE countries—*noted above*—were included in “other ROW.”

Figure F2. Comparison of *IEO* Forecasts with 1995 Energy Consumption in Market Economies



Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

Figure F3. Comparison of *IEO* Forecasts with 2000 Energy Consumption in Market Economies



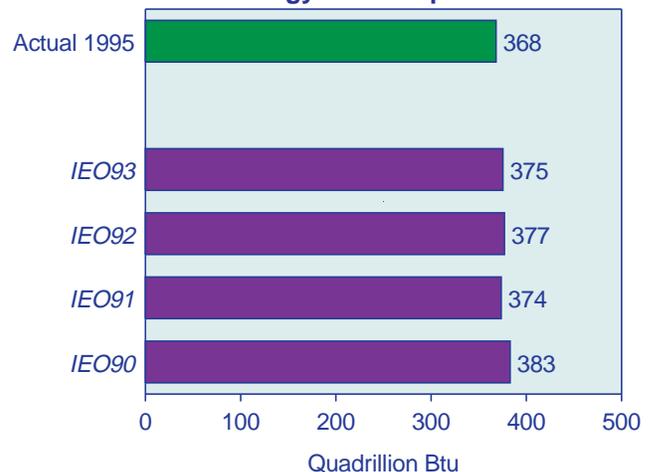
Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

Comparisons of Forecasts for Year 1995

IEO90 marked the first release of a worldwide energy consumption forecast. In *IEO90* through *IEO93*, the forecasts for worldwide energy demand in 1995 were between 1 and 4 percent higher than the actual amounts consumed (Figure F4). Much of the difference can be explained by the unanticipated collapse of the Soviet Union economies in the early 1990s. The *IEO* forecasters could not foresee the extent to which energy consumption would fall in the FSU region. In *IEO90*, total energy consumption in the FSU was projected to reach 67 quadrillion Btu in 1995. The projection was reduced steadily in the next three *IEO* reports, but even in *IEO93* energy demand for 1995 in the FSU region was projected to be 53 quadrillion Btu, as compared with actual 1995 energy consumption of 43 quadrillion Btu—a difference equivalent to about 5 million barrels of oil per day.

Forecasts for 1995 can also be compared in terms of their depiction of the fuel mix. Every *IEO* after 1990 projected the share of each energy source relative to total energy consumption within 3.5 percentage points of the actual 1995 distribution. The earliest *IEOs* tended to be too optimistic about the growth of coal use in the market economies (Figure F5) and too pessimistic about the recovery of oil consumption after the declines in the early 1980s that followed the price shocks caused by oil embargoes in 1973 and 1974 and the 1979-1980 revolution in Iran (Figure F6). The *IEO85* and *IEO86* reports projected that oil would account for only about 40 percent of total energy consumption for the market economies in 1995, whereas oil actually accounted for 45 percent of the total in 1995.

Figure F4. Comparison of *IEO* Forecasts with 1995 World Energy Consumption



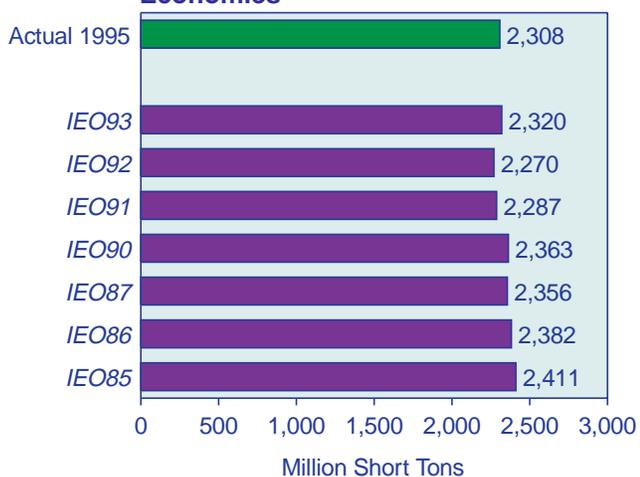
Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

The 1995 forecasts for world coal consumption that appeared in the *IEOs* printed between 1990 and 1993 were consistently high, between 3 and 19 percent higher than actual coal use (Figure F7), largely because of overestimates for the FSU and Eastern Europe—regions that experienced substantial declines in coal consumption during the years following the collapse of the Soviet Union. Most of the projections for the FSU by fuel were greater than the actual consumption numbers, with the exception of hydroelectricity and other renewable resources (Figure F8). Natural gas use did not decline as

much as oil and coal use, because gas is a plentiful resource in the region and was used extensively to fuel the domestic infrastructure; however, even the *IEO* estimates for 1995 natural gas use were 16 to 22 percent higher than the actual use.

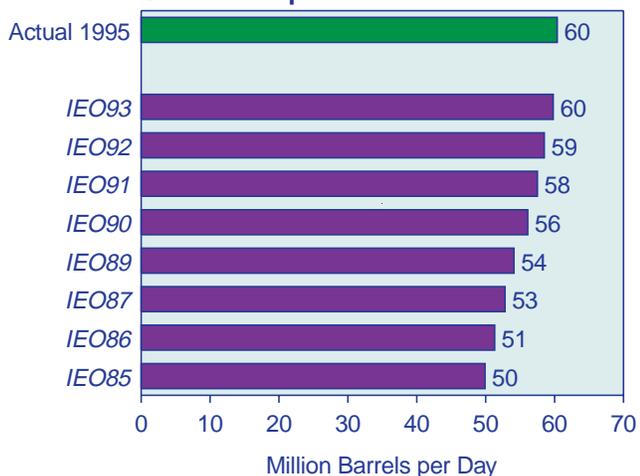
The *IEO* projections for total energy consumption in China were below the actual 1995 consumption level in *IEO90* (by 13 percent) and *IEO91* (by 8 percent) but higher in *IEO92* (by 6 percent) and about the same in *IEO93*. The underestimates in the earlier *IEOs* balanced, in part, the overestimates for the EE/FSU countries; however, even the 4- to 17-percent underestimate of projected 1995 coal use in China could not make up for the 31- to 55-percent overestimate of FSU coal use. In terms of other fuels, the *IEO* forecasts consistently overestimated China's gas consumption and underestimated its oil consumption. Nuclear power forecasts were fairly close for China, within 5 percent of the actual consumption (Figure F9). It is noteworthy, however, that consumption of natural gas and nuclear power was quite small in 1995, so that any variation between actual historical consumption and the projections results in a large percentage difference. EIA consistently underestimated economic growth in China. As late as 1993, EIA expected GDP in China to grow by about 7.3 percent per year during the decade of the 1990s, whereas it actually grew by 10.7 percent per year between 1990 and 1995.

Figure F5. Comparison of *IEO* Forecasts with 1995 Coal Consumption in Market Economies



Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

Figure F6. Comparison of *IEO* Forecasts with 1995 Oil Consumption in Market Economies

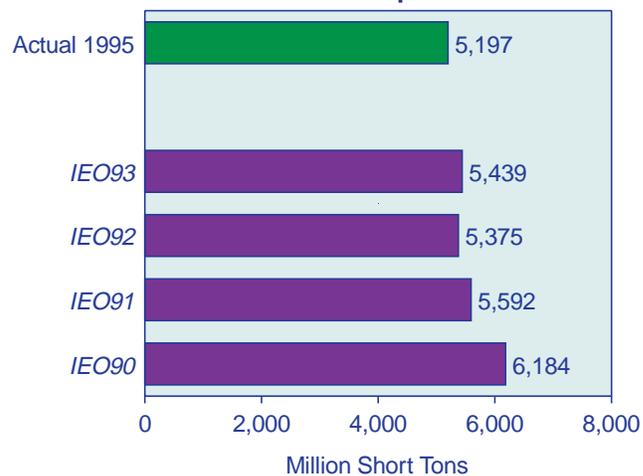


Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

Comparisons of Forecasts for Year 2000

Ten editions of the *IEO* report contained worldwide forecasts for the year 2000 (*IEO90* through *IEO99*). The forecasts of total world energy consumption for 2000 were all above, but within 5 percent of, the actual total

Figure F7. Comparison of *IEO* Forecasts with 1995 World Coal Consumption



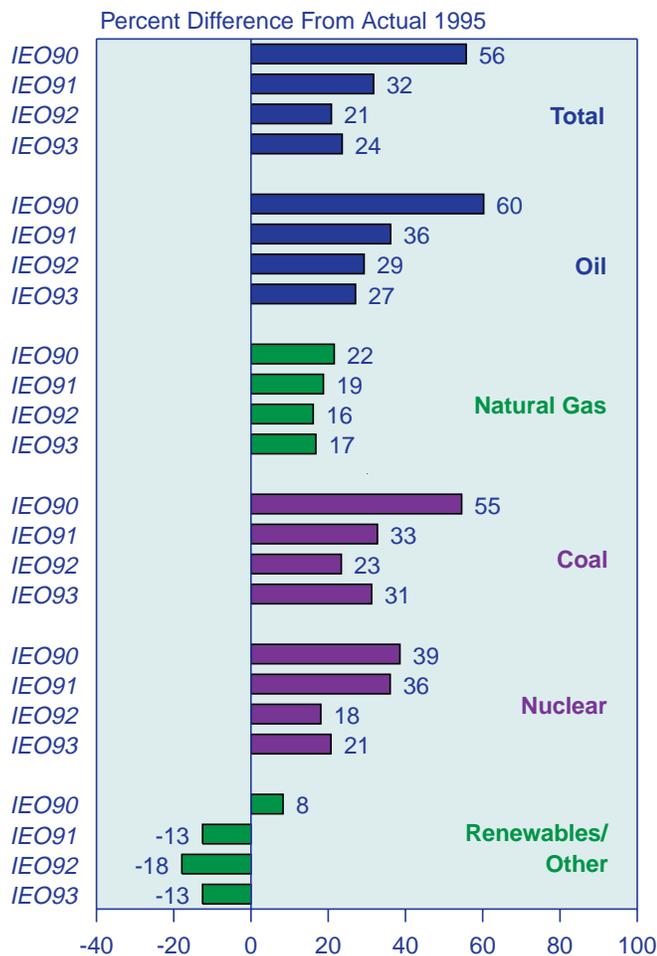
Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

(Figure F10). *IEO97* provided the highest estimate of world energy use in 2000. This may seem surprising at first glance, but it is also true that the economic recession that would take hold in 1998 among the emerging economies of southeast Asia had not occurred and was not foreseen in the *IEO97* forecast. In fact, *IEO97* overestimated year 2000 energy use in developing Asia by 10 quadrillion Btu, or about 14 percent (Figure F11), and in industrialized Asia by 2 quadrillion Btu (8 percent). Projections for the EE/FSU in *IEO97* were also too optimistic, overestimating the rate of economic recovery in the region and as a result overestimating the growth in energy consumption by 7 quadrillion Btu (13 percent). *IEO97* did not anticipate the August 1998 devaluation of the Russian ruble and the economic recession that followed in the FSU region. By *IEO99*, total EE/FSU energy use had been adjusted downward to 52 quadrillion

Btu—just slightly lower than the region’s actual consumption in 2000.

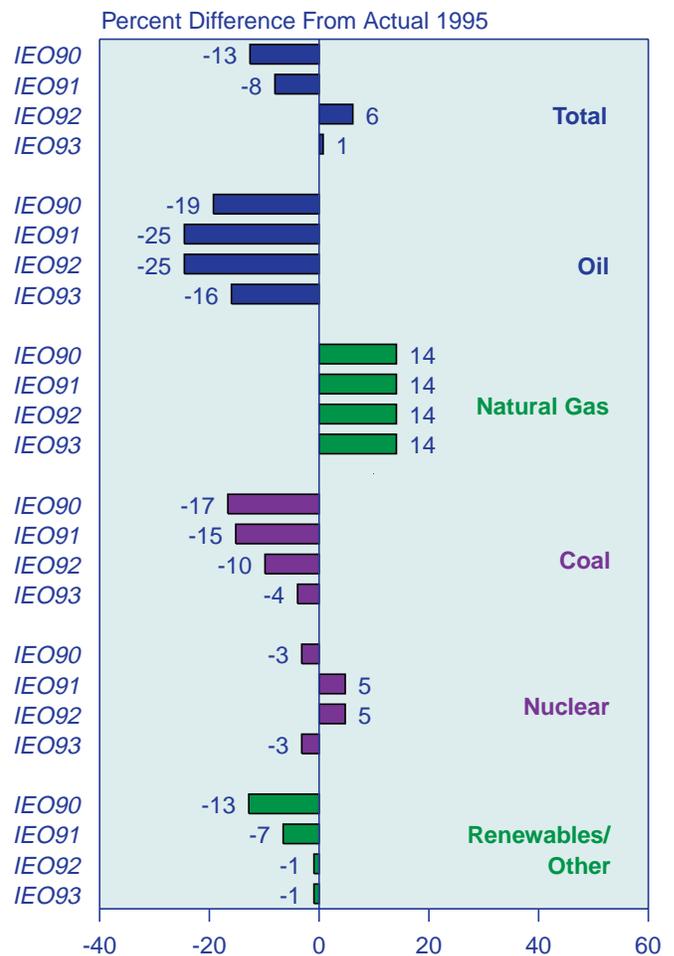
The projections for year 2000 by fuel were mixed in terms of accuracy. For all energy sources except coal, total world consumption forecasts fell within 12 percent of the actual levels. As was the case with forecasts for the years 1990 and 1995, world coal consumption projections were consistently high relative to actual consumption in 2000. The world coal forecast presented in *IEO90* was 30 percent higher than actual 2000 values. The forecasts for the CPE countries were responsible for the large discrepancy between projected *IEO90* and actual coal consumption in 2000. In fact, *IEO90* projected that the market economies would consume 2,801 million short tons of coal in 2000, and the actual estimate for coal use among the market economies was 2,904. However, in

Figure F8. Comparison of *IEO* Forecasts with 1995 Energy Consumption in the Former Soviet Union by Fuel Type



Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

Figure F9. Comparison of *IEO* Forecasts with 1995 Energy Consumption in China by Fuel Type



Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

the CPE countries—including the EE/FSU—*IEO90* projected that coal use would climb to 3,841 million short tons in 2000, whereas actual coal consumption was only 2,211 million short tons.

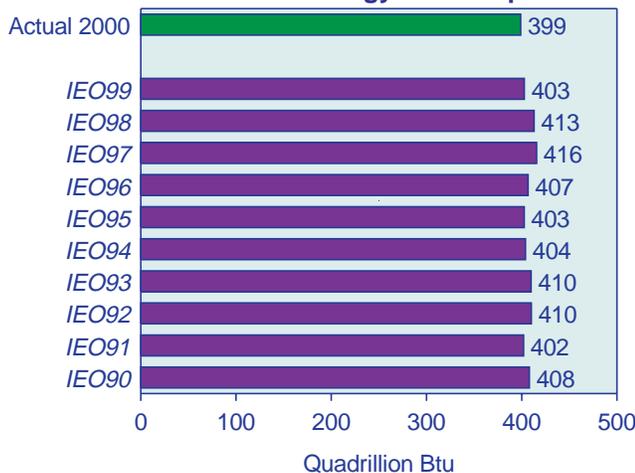
Much of the discrepancy between the *IEO90* projection and actual 2000 coal consumption can be attributed to the FSU. As noted above, *IEO90* did not foresee the collapse of the Soviet regime in 1990 when the report projections were prepared. Indeed, coal use in the FSU in *IEO90* was expected to expand to 1,132 million short tons in 2000, whereas in reality coal use in the FSU began to decline precipitously after 1990, hitting a low of 391 million short tons in 1998 before edging up somewhat to 421 million short tons in 2000. The story was similar for Eastern Europe and the other CPE countries (excluding China), where coal use in 2000 was overestimated by 157 percent in *IEO90*.

The year 2000 forecasts for oil, natural gas, and hydroelectricity and other renewable energy sources were, for the most part, higher than actual levels. In contrast, projections for nuclear power were consistently lower than the actual 2000 values. Interestingly, the forecasts for the United States were largely responsible for the underestimation. Even in *IEO99*—the latest *IEO* that included projections for 2000—analysts were expecting nuclear

power to begin to decline. In *IEO90* there was widespread pessimism about the future of nuclear power in the mid-term, given the aftermath of Chernobyl and the problems associated with nuclear waste disposal. In the political climate of the early 1990s, *IEO90* could not anticipate the life extensions and consistently improving efficiencies that have allowed nuclear power plants to generate more electricity and operate with shorter downtimes for maintenance, even without expanding their installed capacities.

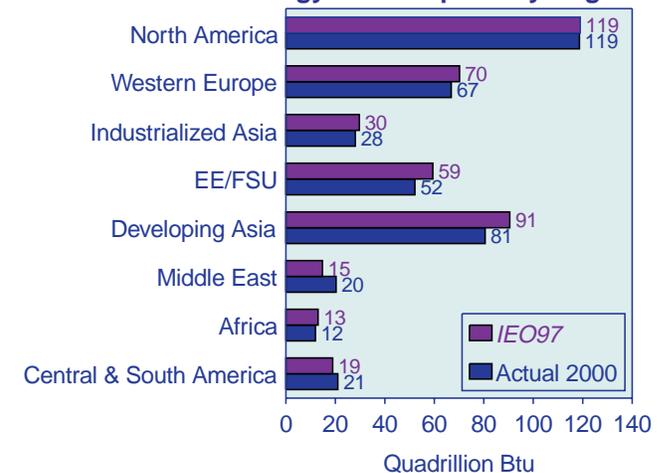
The comparison of *IEO* projections and historical data in the context of political and social events underscores the importance of those events in shaping the world's energy markets. Such comparisons also point out how important a model's assumptions are to the derivation of accurate forecasts. The political and social upheaval in the EE/FSU dramatically affected the accuracy of the projections for the region. If higher economic growth rates had been assumed for China, more accurate forecasts for that region might have been achieved. It is important for users of the *IEO* or any other projection series to realize the limitations of the forecasts. Failing an ability to predict future volatility in social, political, or economic events, the projections should be used as a plausible path or trend for the future and not as a precise prediction of future events.

Figure F10. Comparison of *IEO* Forecasts with 2000 World Energy Consumption



Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook*, DOE/EIA-0484 (Washington, DC, various years).

Figure F11. Comparison of *IEO97* Forecasts with 2000 Energy Consumption by Region



Sources: Energy Information Administration, *International Energy Annual 2001*, DOE/EIA-0219(2001) (Washington, DC, February 2003), web site www.eia.doe.gov/iea/, and *International Energy Outlook 1997*, DOE/EIA-0484(97) (Washington, DC, April 1997).