



The Burke Chair in Strategy

The International Energy Outlook 2005: **It is Hard to Make Predictions, Especially about the Future**

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Reports by the Energy Information Agency (EIA) and the International Energy Agency (IEA) are considered by many in government, business, journalism, and academia as a key reference for energy reporting, analysis. They are also the most reliable picture of how the US government sees the future of world energy supply and demand. The annual *International Energy Outlook* of the EIA has long been considered the best of these reports and a key tool in analyzing energy policy.

The EIA of the US Department of Energy published its annual *International Energy Outlook 2005 (IEO2005)* on July 29, 2005. This report has been issued at a time when oil prices are at all time high due to geopolitical and security risks, surges in the demand for oil, the US refining capacity bottleneck, and the limited spare production capacity in some oil producing nations. The key question is whether the *IEO2005* provides a realistic picture of the future energy market?

The answer is no. The EIA's report does focus on a wide range of energy related issues. It attempts to analyze world energy supply and demand in addition to outlining major developments in the world market for oil, natural gas, coal, and electricity. It also forecasts major indicators in the energy market such as crude oil production capacity and world energy consumption by fuel.

However, it fails to come to grips with the most important single development in world energy supply. Last year's report by the EIA, the *IEO2004*, was criticized by experts for not adjusting its forecasts high oil prices, and was considered out of date before it came out in April 2004.

This year, the EIA did adjust its price forecast to take into account much higher high oil prices, with a price range of \$21 to \$48 a barrel, and the introduction of the *IEO2005* even indicates that the "high price" case may be the most likely case.

Unfortunately, however, *IEO2005* states that such high prices could radically reduce future oil consumption, and then makes almost no meaningful analysis of the

implications of such drastic shifts in the oil market and global energy balances. Its focus is almost solely on a reference case of \$35 a barrel and different levels of global economic growth.

Why High Prices Can Be So Important

The price of oil is a major uncertainty that affects every aspect of global energy demand, production capacity, investment, and the elasticity of demand and supply. As mentioned earlier, the *IEO2004* used unrealistically low prices. Analysts hoped that the *IEO2005* will shed some light on the current energy market taking into account high oil prices and realistic long-term effects of conservation and alternative on the elasticity of demand. The *IEO2004* projected that oil price in 2025 will be \$17/barrel for the low price case, \$27/barrel for the reference case, and \$35/barrel for the high price case.

According to the *IEO2005*, during 2004, oil prices rose by more than \$9. The *IEO2005* forecasts is based on three cases for 2025: \$21/barrel for the low price case, \$35/barrel for the reference case, and \$48/barrel for the high price case. The report forecasts that oil prices will continue to rise in 2005, adding around \$11/barrel in 2005.

The report summarized the reasons for high oil prices:

First, world petroleum demand grew at a robust 3.4 percent (2.7 million barrels per day) in 2004, reflecting dramatic increases in China's demand for oil-generated power and oil-based transportation fuels, as well as a rebound in U.S. oil demand. Second, oil prices typically are sensitive to any incremental tightening of supply during periods of high economic growth. On the supply side, there was very little spare upstream capacity, and the spare downstream capacity was not always properly configured to produce the required slate of products. World oil inventories, in terms of "days of supply," were unusually low. Next, geopolitical tensions in major oil-producing countries—including the continuing the war in Iraq and uncertain prospects for a return to normalcy in Iraq's oil sector—and potential unrest in Nigeria and Venezuela contributed to the volatility in world oil markets. (*IEO2005*, P. 25)

The three scenarios presented in the *IEO2005* forecasts do use far more realistic price ranges than those used in the *IEO2004*. As has been touched upon earlier, however, the "reference case" used in the EIA forecasts assumes the price per barrel of oil will start declining, and reach \$31 in 2010 and \$35 in 2025. It never really addresses a "high price" future, and the rationale for the steep decline in the future price of oil in the "reference case" is not clear.

Such a case is always possible, but is anything but certain as a "reference." It is all too clear that the *IEO2005* should have used a parametric range of oil prices in a climate of much uncertainty. Economic forecasting always involves significant uncertainty, and history has shown predicting oil price is even more uncertain due to the many variables that can affect the oil market. In fact, even the introduction to the *IEO2005* questions where its "reference case" is the most probable case.

Using both the high price case and the reference case seem to be the proper basis for more realistic forecasts than the low price case. The low price scenario can happen if a practical alternative to oil is reached, massive oil reserves are discovered, the world stop using oil, or oil producing nations have no control over short-term market.

Moreover, the definition of “world oil price” is misleading. The *IEO2005* defines oil prices as “average refiner acquisition cost” of importer oil to the US, or IRAC. According to the *IEO2005*, on average IRAC tends to be less than the higher quality WTI. IRAC, however, provides a good benchmark as to what refiners are paying for crude oil and how much suppliers are getting. It also gives us a better idea of how the bottleneck in the US refining capacity may have a direct influence on the “world price of oil.”

Oil Production and Production Capacity Forecasts

These may seem like small technical issues and analytic quibbles, but they have truly massive policy implications. As Table 1 shows, the high price case of \$48 in the *IEO2005* analysis radically reduces the need for new oil production capacity and actual production, and radically increases unconventional oil production from sources like Canadian tar sands and Venezuelan heavy crude – production that was not even analyzed in *IEO2004*.

There are problems in the EIA modeling approach that make it extremely difficult to estimate the credibility of such projections. The fact is that any assumptions about the impact of sustained high oil prices on petroleum supply, unconventional oil, the production of competing sources of energy like nuclear and coal, and conservation and efficiency is highly speculative. Moreover, few analysts and oil experts outside the EIA and IEA have ever believed that world oil production and production capacity could or would ever reach the levels projected in the low price case for either *IEO2004* or *IEO2005*, and many have doubted the credibility of the levels called for in the reference case.

Nevertheless, no one can disregard the potential importance of the IEO high price projections. They indicate that market forces would solve many supply problems if oil did reach the prices called for in this case, and that price rises produce a much steeper drop in demand that most analysts have previously thought.

This illustrates a policy gap critical problem in the *IEO2004* projections, which only used comparatively low prices, and which largely assumed oil production capacity could rise to meet demand regardless of current country plans. As a result, it called for unrealistically high oil demand and production capacity, very high levels of oil imports, and created the impression of a potential global crisis in supply.

This is clear from a brief comparison of the key conclusions in the 2004 and 2005 editions of the IEO. Actual total world production capacity in 2002 was 80.0 MMBD. The *IEO2004* forecast that total world production capacity for 2025 would be 137.0 MMBD for the low price case, 126.1 MMBD for the reference case, and 117.3 MMBD for the high price case.

In contrast, the *IEO2005* forecasts the total world production capacity in 2025 for the low, medium, and high price cases as follows: 135.2 MMBD for the low price case, 122.2 MMBD for the reference case; and 115.5 MMBD for the high price case. In both the 2004 and 2005 cases, the projected increase in total world production capacity is still significant. By 2010, it could increase from 14.6 MMBD to as high as 21.6 MMBD. The

“high price” case, however, is far easier to achieve in the real world than the “reference” or “low price” cases.

As is clear from these numbers, as the price oil decreases, production capacity increases. One notable exception is that Non-OPEC countries’ production capacities have the opposite reaction to a change in the price of oil. OPEC countries largely drive this relationship between price and production capacity. From an economics point of view, a decrease in the price of oil decreases the willingness of suppliers to produce and sell oil. The *IEO2005*, however, shows the opposite effect for OPEC countries. One possible explanation is that OPEC countries control the price of oil with their quotas.

OPEC actual production capacity in 2002 was 20.6 MMBD. As Table 1 shows, the *IEO2004* forecast that OPEC production capacity in 2025 as: 75.7 MMBD for the low price case, 61.5 MMBD for the reference case, and 46.8 MMBD for the high price case. In contrast, the *IEO2005* forecasts OPEC production capacity in 2025 as follows: 72.80 MMBD for the low price case, 56.00 MMBD for the reference case, and 40.40 MMBD for the high price case.

Price sensitivity in the current projection is indicated by the fact the high price level of production capacity for 2005 is 75.1% of the low price estimate and 87.7% of the reference case estimate. If the high price level is compared to the 2004 case, the high price level of production capacity for 2005 is only 53.4% of the low price estimate and 65.7% of the reference case estimate. This indicates that sustaining an average oil price of around \$45 dollars per barrel would have an almost incredible impact in reducing past estimate of petroleum demand and supply.

**Table 1: World Oil Production and Production Capacity in 2025:
IEO2004 vs. IEO2005**

(Million Barrels Per Day)

Region	2002	IEO2004			IEO2005*		
	Actual	Low Price	Reference	High Price	Low Price	Reference	High Price
Price: \$/Barrel	\$23.78	\$17.00	\$27.00	\$35.00	\$21.00	\$35.00	\$48.00
Production Capacity							
Persian Gulf	18.70	56.80	45.00	32.90	50.00	39.30	27.80
Algeria	1.30	3.00	2.70	2.20	3.70	2.80	2.20
Libya	1.50	3.10	2.90	2.40	3.90	2.90	2.20
Other Middle East	1.40	2.60	2.80	3.10	2.70	2.80	3.00
OPEC	27.20	75.70	61.50	46.80	72.80	56.00	40.40
World Total	69.40	137.00	126.10	117.30	135.20	122.20	115.50
Persian Gulf as % of Total	26.95%	41.46%	35.69%	28.05%	36.98%	32.16%	24.07%
Production							
Middle East	19.00	29.90	42.10	54.00	48.40	36.90	25.70
OPEC	28.70	40.10	54.90	7.30	67.60	52.70	35.00
Unconventional Oil	0.00	6.50	4.70	3.90	4.30	5.70	10.50
Canada	0.00	3.90	3.30	2.80	2.90	3.50	4.70
Latin America	0.00	2.60	1.40	1.10	1.20	1.50	3.00
World Total	78.10	112.70	12.60	132.50	130.90	118.90	112.90
Persian Gulf as % of Total	24.30%	26.50%	34.80%	40.70%	37.00%	31.00%	18.40%

Source: *IEO2004* and *IEO2005*.

*IEO Totals include conventional and nonconventional oil. Nonconventional oil production is dominated by Canadian Tar Sands and Venezuelan heavy crude, which were not broken out as separate categories in the IEO2004 analysis. Total unconventional production is assumed to reach 5.7 MMBD in the reference case by 2025. The figure is 10.5 MMBD for the high price case and 4.3 MMBD for the low price case. Total Middle Eastern unconventional oil production is only 0.1 MMBD in the reference case, 0.6 MMBD in the high price case, and 0.0 MMBD in the low price case.

Solving All the Supply Issues Relating to Middle Eastern Oil?

The potential impact of high oil prices in easy the strain on world oil supplies becomes even clearer when one looks at the impact of oil prices on the need for Middle East and North Africa (MENA) conventional oil production capacity.

- The IEO analysis for 2004 called for major increases in MENA oil production capacity. It forecast that Saudi Arabia's production capacity in 2025 would be 31.5 MMBD for the low price case, 22.5 MMBD for the reference case, and 16.0 MMBD for the high price case.
- The *IEO2005* forecasts that conventional MENA production capacity in 2025 will be 51.1 MMBD for the low price case, 39.5 MMBD for the reference case, and only 28.1 MMBD for the high price case.

These contrasts are even more striking for Saudi Arabia. For many years, most of OPEC's projected increase in production capacity in both the EIA and IEA models has been driven by Saudi Arabia. In recent times, the Saudi production capacity has received a lot of attention. Some analysts have questioned the Kingdom's ability to meet sudden surges in demand because of its lack of spare production capacity, and others – like

Matthew Simmons – have estimated that Saudi production may be moving towards a period of sustained decline.

In 2002, Saudi Arabia had an oil production capacity of 9.2 MMBD. This capacity was roughly 9.0-10.5 MMBD in 2004, and has so far averaged 10.5-11 MMBD in 2005. Like most of its predecessors, the IEO analysis for 2004 called for truly massive increases in Saudi oil. It forecast that Saudi Arabia's production capacity in 2025 would be 31.5 MMBD for the low price case, 22.5 MMBD for the reference case, and 16.0 MMBD for the high price case.

As Table 2 shows, the *IEO2005* forecasts that Saudi Arabia's production capacity in 2025 will be 20.4 MMBD for the low price case, 16.3 MMBD for the reference case, *but only 11.0 MMBD for the high price case. Yet, Saudi Arabia already plans to increase its production capacity to 12.5 MMBD.*

Most analysts, including current and former Saudi Aramco officials, believe that the 20.0 MMBD is an unattainable production capacity. At this point, one can argue that the Kingdom could reach this production capacity only if two things happen: there are major technological breakthroughs that enhance recovery of existing oil fields or help find new reservoirs and there are major supply disruptions that forces Saudi Arabia to meet the shortages in supply.

Massive Geostrategic Impact with Minimal Transparency and Uncertain Credibility

Table 2 shows similar, if less dramatic trends for most of OPEC, and the trends apply to most of the non-OPEC states not shown on this table. Non-OPEC production capacity is also expected to show large increases in the mid-term. These increases will come mainly from deepwater exploration in the North Sea, the Caspian Sea, the Gulf of Guinea, and the Gulf of Mexico. With advanced exploration and recovery technology, experts believe that offshore production can have significant influence on the world energy market in the mid to long-term.

High prices defer not only many of the issues relating to future oil supply, *but also most of the issues relating to any geopolitical competition for oil imports.* The projected increases in production capacity at the high price case for IEO2005 are far more achievable and sustainable in terms of the flow of global imports than any past EIA and IEA projections.

They would effectively eliminate the kind of struggle postulated in scenarios showing Chinese and Western competition for imports. The only problem is that the EIA does not explicitly address any of these issues, or provide the kind of data on overall energy balances and assumptions about supply and demand elasticities in other sectors of energy that would give such data meaning and credibility.

Table 2: OPEC Oil Production Capacity 2005-2025
(In Million Barrels Per Day)

	2005	2010			2025		
	June	Low Price	Reference	High Price	Low Price	Reference	High Price
Algeria	1.300	2.200	2.000	1.800	3.700	2.800	2.200
Indonesia	0.950	1.200	1.500	1.400	1.500	1.500	1.400
Iran	4.000	4.800	4.000	4.000	6.600	5.000	4.500
Iraq	1.900	4.000	3.500	3.100	8.600	6.600	4.000
Kuwait	2.500	3.600	2.900	2.900	6.200	5.200	3.500
Libya	1.625	2.200	2.000	1.800	3.900	2.900	2.200
Nigeria	2.500	3.300	2.600	2.400	6.400	3.900	2.900
Qatar	0.800	0.800	0.600	0.600	0.900	0.800	0.800
Saudi	11.000	15.600	14.000	10.400	20.400	16.300	11.000
UAE	2.500	4.000	3.300	3.400	7.000	5.400	4.000
Venezuela	2.500	4.600	3.500	3.200	7.300	5.600	3.900
Total	31.575	46.300	39.900	35.000	72.500	56.000	40.400

Source: Energy Information Agency (EIA), *International Energy Outlook 2005*, Appendix E, and the EIA *Short-Term Energy Outlook*, Table 3a.

World Economic Growth and Consumption

One major difference between the *IEO2005* and the *IEO2004* is the regional redefinition into three major areas based on their level of “economic development:” mature markets economies (US, Canada, Mexico, Western Europe, Japan, Australia); transitional economies (FSU and Eastern Europe); and energy economies (China, India, South Korea, “other Asia,” Brazil, “other C and S America,” Africa, Middle East).

The *IEO2005* forecasts that total energy consumption will increase by 57% from 2002 to 2025. Much of this growth will be fueled by high economic growth in emerging markets in Asia. In fact, the *IEO2005* claims that increases in energy consumption in the transition economies and the mature market economies will be “modest.” It forecasts emerging economies to grow by 5.1%, mature economies growth rate will be 2.5%, and transitional economies will add 4.3% as measured in the growth of GDP in purchasing power terms.

World oil consumption in 2002 was 78.2 MMBD, for the reference case, total world oil consumption is expected to rise to 103.2 MMBD, to 111.0 MMBD in 2020, and to 119.2 MMBD in 2025. During the 2002-2025 period, China’s consumption is forecasted to rise from 5.2 MMBD in 2002, 9.2 MMBD in 2010, 10.7 MMBD in 2015, 12.3 MMBD in 2020, and 14.2 MMBD in 2025. Between 2002 and 2010, China’s oil consumption will increase by 7.5%, but the growth rate will gradually decline.

The *IEO2005* demand forecast adjusts for the higher prices (*IEO2004* forecast that in 2025 total world oil consumption would be 121 MMBD compared 119.2 MMBD). The projection, however, does not address the effect of conservation and alternative sources of energy. Moreover, the report does not enough data for analysis of the demand-price elasticity.

One key example is renewables. The EIA forecasts in *IEO 2005* show they will have little future impact on mid to long-term world oil demand as measured in quadrillions of BTUs (Quads). If one excludes oil, natural gas, coal, and nuclear, all other sources of energy only increase by an average of 1.9% in the reference case. As a result, their total contribution to world energy supply drops from 7.8% in 2002 to 7.6% in 2025 – in spite of all of the political focus on increasing such sources.

Because the *IEO2005* does not examine the impact of high oil prices on world energy balances, there is no way to guess at how much this would change if oil prices remained high. The two excursions the EIA does examine do not even hint at such impacts. All other energy supplies drop to 7.3% of world supply in the “high economic growth” case, and 7.5% in the “low economic growth” case.

Major areas of Uncertainty in the *IEO2005*

In short, the *IEO2005* raises dramatic issues for energy policy planning, but does not provide a meaningful basis for energy analysis in today’s world. Adjusting the *IEO* models to address all of the implications of the high oil price are a vital and necessary first step. So is making all of the assumptions and uncertainties involved in such analysis transparent.

There are, however, several other major areas that also need improvements. It is all too clear that forecasts like the one provided by *IEO* are difficult due to the complicated nature of the energy market, the limited hard country-by-country data, and the “immeasurable” risks involved in forecasting. There areas where reports like the *IEO* could provide a better benchmark for the global energy market if they addressed the gaps and uncertainties left by the *IEO2005*.

The key gaps and areas of uncertainty in the *IEO2005*:

- It does not provide any parametric analysis of its oil price forecast. With the exception of the introduction, the other sections are putting the appendices in words.
- The report does not provide sufficient explanation as to how the rates of economic growth interact with the price of oil and how the price-elasticity of demand changes over time given an economic growth rate.
- It states that it has taken into account country-by-country plans in forecasting oil production capacity, but there is little explanation of how such plans have changed their forecast from lasts and how unrealistic those plans are.
- The report does not make estimates of indirect imports of oil from the Gulf and other regions in terms of the energy required to produce finished goods. The US, for example, indirectly important very significant amounts of oil in the form of manufactures from Asian countries dependent on Middle East oil imports.
- It does not provide a breakdown of the FSU, the Caspian Seam, the North Sea, Africa, and other South and Central American countries production forecasts. These areas are considered to have the greatest potential for enhancing production and new discoveries. These areas should be broken down by country, e.g. Russia should not be lumped in with smaller FSU states.

- The report does not explicitly analyze technological improvements and their role in improving oil recovery and exploration for new oil reservoirs, development that have significant affects on future oil supply and the oil market.
- The report does not credibly explain the interactions between different oil prices, and level of oil supply and demand, and changes in the supply and demand of gas, coal, nuclear power, renewables, electricity, and conservation.
- No effort is made to determine the very different patterns of elasticity in supply and demand for gas, coal, nuclear power, renewables, electricity, and conservation that have to emerge over time if oil prices remain so much higher than in the past, or the major uncertainties that will inevitably result from such changes.
- The impact of growing Asian demand, especially China, is subject to only limited sensitivity analysis. A Chinese recession/depression case is one such example.
- Major shift in energy cost and different levels of economic growth are treated largely as independent assumptions and variables.
- The report does not address the impact of key options the US energy policy or of the energy bill that was recently passed by congress, especially options relating alternative energy sources and possible “strategies” to decrease dependence on foreign sources of energy.
- It does not analyze the effect of alternative source of energy or conservation, and provides little data for any elasticity based analysis.
- It does not analyze the impact of a persistently high oil price on consumption of oil, production capacity, or conservation. Moreover, the report provides the three estimates (low, reference, and high), but provides no analysis of what they mean to the global energy market and how they relate to the world energy demand.
- It had limited historical or current data to enable us to make conclusions about the effect of conservation or alternative sources of energy on countries production capacities.

One key aspect of these problems is the lack of any correlation between the EIA projections and either the Bush Administration’s energy policies and the energy legislation passed by Congress. The is important in the case of the Bush Administration because the potential impact of its various energy policies have never been explicitly analyzed in the forecasts of either the IEO reports or the EIA’s annual report on US energy.

It is important in the case of the recent energy bill passed by Congress because if the IEO2005 report is right, a sustained increase in oil prices would have far more impact on US energy needs than the measures in the bill. It also would have far more impact on US energy imports, although any realistic projection of the impact of the Bush Administration’s policies, the energy bill, and/or high oil prices would still not change the level of US strategic dependence on oil imports.

In all three cases, the US will be critically dependent on direct and indirect oil imports through 2025. In the case of the Bush Administration policies and energy bill, the potential impact not only will be limited, but the basic policy is fatally flawed. It assumes that America’s problems can be solved by focusing on American imports. The reality is that the US is steadily more dependent on the global economy and on the global flow of energy imports. Playing with marginal reductions in US oil imports is of virtually no strategic importance at all.

Still the Best Game in Town

It should be stressed that the EIA is so far the only major agency to even begin to address the prospect of sustained high oil prices, and react to real world trends. Furthermore the structural problems in the EIA projections are no different from the demand-driven modeling of the IEA and OPEC—and that used in virtually all government reports. In fact, the EIA's modeling and analysis is far more transparent than that of the IEA—which generally sets very low standards in this area.

The future of energy, however, is of enormous importance, and such a report can provide significant insight in the energy market. The *IEO2005* has attempted to fill the gaps that existed in the *IEO2004*. Unfortunately, it highlights the critical impact that oil prices may have on world oil demand and supply and then does not analyze these effects on any other aspect of energy supply and demand or energy balances.

Moreover, the report does not cover many important areas such as the role of technological improvement and the effect of alternative sources of energy on production capacity and world energy demand respectively. As such, the EIA's failure is even more critical because the IEA and OPEC have so far done nothing meaningful to update their analyses to deal with the possibility of long-term "high price" cases.

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