Forecast Comparisons

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Only GII produces a comprehensive energy projection with a time horizon similar to that of *AEO2006*. Other organizations address one or more aspects of the energy markets. The most recent projection from GII, as well as others that concentrate on economic growth, international oil prices, energy consumption, electricity, natural gas, petroleum, and coal, are compared here with the *AEO2006* projections.

Economic Growth

In the *AEO2006* reference case, the projected growth in real GDP, based on 2000 chain-weighted dollars, is 3.0 percent per year from 2004 to 2030 (Table 19). For the period from 2004 to 2025, real GDP growth in the *AEO2006* reference case is similar to the average annual growth projected in *AEO2005*. The *AEO2006* projections of economic growth are based on the August short-term forecast of GII, extended by EIA through 2030 and modified to reflect EIA's view on energy prices, demand, and production.

The projected average annual GDP growth rate for the United States from 2004 through 2010 ranges from 2.8 percent to 3.3 percent. The *AEO2006* reference case projects annual growth of 3.3 percent, matching the average annual real GDP growth projected by the Office of Management and Budget (OMB), the Congressional Budget Office (CBO), and the consensus Blue Chip forecast. GII and Energy Ventures Analysis, Inc. (EVA) project real GDP growth at 3.2 percent per year. Two other organizations project somewhat lower annual growth: Interindustry Forecasting at the University of Maryland (INFORUM) at 2.9 percent and Energy and Environmental Analysis, Inc. (EEA) at 2.8 percent.

When the projection period is extended to 2015, the uncertainty in the projected rate of GDP growth is reflected in the wider range of the projections (2.5 to 3.2 percent per year). *AEO2006* remains in the upper half of the range, whereas the CBO projection shows a considerable slowing of GDP growth from 2010 through 2015. There are few public or private projections of GDP growth rates for the United States that extend to 2030. The *AEO2006* reference case projection reflects a slowing of the GDP growth rate after 2020, consistent with an expected slowing of population growth.

World Oil Prices

Comparisons with other oil price projections are shown in Table 20. The world oil prices in EIA's *AEO2006* are generally toward the high end of the oil price projections. Of the nine other publicly available long-term projections, only two—Petroleum Industry Research Associates, Inc. (PIRA) and Petroleum Economics, Ltd. (PEL)—have projections of world oil prices for specific years after 2010 that exceed the *AEO2006* reference case projections. Four of the nine—GII, Altos Partners (Altos), Strategic Energy and Economic Research, Inc. (SEER), and the International Energy Agency (IEA) Reference Scenario—have prices lower than those in the *AEO2006* low price case for at least some years. All the projections—except for the price forecast from Altos, which has not been revised since July 2003—have raised their long-term price expectations relative to last year's releases.

Table 19. Forecasts of annual average economic growth, 2004-2030

Forecast	Average annual percentage growth			
	2004-2010	2010-2015	2015-2020	2020-2030
AEO2005	3.2	3.1	3.0	NA
AEO2006				
Reference	3.3	3.0	3.1	2.8
Low growth	2.6	2.3	2.7	2.4
High growth	3.9	3.5	3.4	3.7
GII	3.2	3.0	3.0	2.8
OMB	3.3	NA	NA	NA
CBO	3.3	2.6	NA	NA
Blue Chip	3.3	3.2	NA	NA
INFORUM	2.9	2.5	2.6	NA
EEA	2.8	2.8	2.8	2.8
EVA	3.2	NA	NA	NA

NA = not available.

Table 20. Forecasts of world oil prices, 2010-2030 (2004 dollars per barrel)

Forecast	2010	2015	2020	2025	2030
AEO2005 (reference case)	27.18	28.97	30.88	32.95	NA
AEO2006					
Reference	47.29	47.79	50.70	54.08	56.97
High price	62.65	76.30	85.06	90.27	95.71
Low price	40.29	33.78	33.99	34.44	33.73
GII	37.82	34.06	31.53	33.50	34.50
Altos	27.58	31.14	34.02	37.89	40.03
IEA (reference)	35.00	36.00	37.00	38.00	39.00
IEA (deferred investment)	41.00	43.50	46.00	49.00	52.00
PEL	47.84	47.84	49.80	50.77	NA
PIRA	44.10	49.95	63.35	NA	NA
EEA	46.74	43.85	42.79	41.76	NA
DB	31.75	31.75	31.75	31.75	31.75
SEER	29.54	31.00	32.00	34.18	36.50
Delphi	NA	52.50	57.50	62.50	72.50

NA = not available.

The world oil price measure does vary by projection. In some cases, the measure is the WTI spot price, Brent equivalent, weighted average U.S. refiner acquisition cost of imported crude oil, or a basket of crude oils. For *AEO2006*, EIA redefined its world oil price path to represent the average U.S. refiners acquisition price of imported low-sulfur light crude oil (see "Issues in Focus" for discussion). Those prices are considered comparable to the WTI prices most often cited in the trade press as a proxy for world oil prices. The different price measures used in the various projections do not wholly explain the different price expectations among the projections. For instance, GII publishes a WTI spot price forecast that is considerably lower than the *AEO2006* reference case prices, and PIRA publishes a WTI spot price forecast that is considerably higher than the *AEO2006* reference case prices in most years (Table 20).

Recent variability in crude oil prices demonstrates the uncertainty inherent in projections for crude oil markets. The oil price paths projected by several organizations, including EIA, illustrate the uncertainty. For example, for 2010, the price range in the projections is from a low of about $28 per barrel by Altos to a high of almost $48 per barrel projected by PEL. The range in the projections widens in 2020, from a low of $32 per barrel (GII and DB) to a high of $63 per barrel (PIRA). In 2030, the band of prices represented by the published projections narrows to $23 per barrel, probably in part because the PIRA forecast horizon ends in 2020.

To construct the world oil price cases for *AEO2006*, EIA employed input from a Delphi group of energy analysts. In August 2005, an informal, nonrandom sample of expert oil analysts from outside DOE were invited to participate, with the stipulation that the responses were to reflect the analysts' personal views and not necessarily the views of the organizations with which they were affiliated. In addition, the analysts were told that their responses would be anonymous. Seventeen analysts were surveyed, and eight responses were received. The median response from the Delphi group was generally higher than any of the other published projections, though still falling within the range defined by the *AEO2006* low and high price cases (Table 20). The group expected oil prices to continue rising through the 2005-2030 time period, to nearly $73 per barrel in 2030—more than $20 per barrel higher than the nearest alternative, the Deferred Investment Scenario published by IEA.

Total Energy Consumption

The *AEO2006* projects higher growth in end-use sector consumption of petroleum, natural gas, and coal than occurred from 1980 to 2004 but lower growth in electricity consumption (Table 21). Much of the projected growth in petroleum consumption is driven by increased demand in the transportation sector, with continued growth in personal travel and freight transport projected to result from demographic trends and economic expansion. Natural gas consumption is expected to increase in the residential, commercial, and industrial sectors, despite relatively high prices. Natural gas is cleaner than other fuels, does not require on-site storage, and has tended to be priced competitively with oil for heating. Coal consumption as a boiler fuel in the commercial and industrial sectors is expected to decline slightly, with potential use in new boilers limited by environmental restrictions; however, the projections for industrial coal consumption include its use in CTL plants, a technology that is expected to become competitive at the high oil prices assumed in *AEO2006*.

While strong growth in electricity use is projected to continue in the *AEO2006* projections, the pace slows from historical rates. Some rapidly growing applications, such as air conditioning and computers, slow as penetration approaches saturation levels. Electrical efficiency also continues to improve, due in large part to efficiency standards, and the impacts tend to accumulate with the gradual turnover of appliance stocks.

The *AEO2006* projections are generally consistent with the outlook from GII; however, GII projects slightly faster growth in petroleum and natural gas consumption and slightly slower growth in electricity

Table 21. Forecasts of average annual growth rates for energy consumption, 2004-2030 (percent)

		Projections	
Energy use	*History 1980-2004*	*AEO2006*	*GII*
*Petroleum**	0.9	1.2	1.3
*Natural gas**	0.2	0.7	0.9
*Coal**	-1.5	2.0	-0.4
Electricity	2.2	1.6	1.5
Delivered energy	0.7	1.1	1.1
Electricity losses	1.9	1.2	0.9
Primary energy	1.0	1.2	1.1

**Excludes consumption by electricity generators in the electric power sector; includes consumption for end-use combined heat and power generation.*

consumption and losses. The differences can be attributed largely to the higher oil and natural gas prices assumed in *AEO2006*. Differences between the *AEO2006* and GII projections for coal result from an increase in coal use for CTL in *AEO2006*.

Electricity

The *AEO2006* projections for the electricity generation sector assume that new generating capacity will be built by independent power producers rather than utilities. Retail price projections are based on average costs for electricity supply regions that are still regulated; marginal costs for regions that are competitive; and a mixture of average and marginal costs, weighted by the amounts of load, in regions with a mix of regulated and competitive markets. As of 2005, only four electricity market regions had fully competitive retail markets in operation; seven had mixed competitive and regulated retail markets; and two had fully regulated markets. The *AEO2006* cases assume that no additional retail markets will be restructured, but that partial restructuring (particularly in wholesale markets) will lead to increased competition in the electric power industry, lower operating and maintenance costs, and early retirement of inefficient generating units.

Comparison of the *AEO2006* and GII projections shows some variation in electricity sales (Table 22). The projections for total electricity sales in 2030 range from 4,828 billion kilowatthours (*AEO2006* low economic growth case) to 5,854 billion kilowatthours (*AEO2006* high economic growth case). The rate of demand growth ranges from 1.2 percent (*AEO2006* low economic growth) to 1.9 percent (*AEO2006* high economic growth). All price projections reflect competition in wholesale markets and slow growth in electricity demand relative to GDP growth, exerting downward pressure on real electricity prices through 2030. Rising natural gas and coal prices balance some of the downward pressure and tend to push electricity prices up in the later years of the projections.

The *AEO2006* reference case shows a slight decline in real electricity prices over the full period of the projection (except for the industrial sector), although average prices increase slightly during the last several years as capacity margins tighten and natural gas prices climb. In contrast, GII projects a decline in electricity prices over the second half of the projection, as lower delivered natural gas prices to generators ($5.08 per million Btu in the GII projection, compared with $6.26 in the *AEO2006* reference case in 2030) contribute to a small decrease in average electricity prices, from 7.6 cents per kilowatthour in 2015 to 7.4 cents per kilowatthour in 2030. The higher natural gas price in the *AEO2006* reference case leads to an increase in average electricity price, from 7.1 cents per kilowatthour in 2015 to 7.5 cents per kilowatthour in 2030.

Both the *AEO2006* reference case and GII projections include some planned capacity additions in the near term, with the *AEO2006* reference case expecting about 29 gigawatts through 2006 and GII expecting about 25 gigawatts. Virtually all the projected capacity additions are natural gas fired. Both projections show electricity prices falling in the near term as a result of excess total capacity.

Except for GII, all the projections for electricity demand show the fastest growth in the commercial sector, and more additions of cycling and baseload capability than peaking units. All the projections show significant net additions to coal-fired capacity, including 167 gigawatts through 2030 in the *AEO2006* reference case and 136 gigawatts through 2030 in the GII projection. Both GII and the *AEO2006* reference case project no nuclear retirements; however, each of the three *AEO2006* cases (reference and high and low economic growth) projects 6 gigawatts of nuclear capacity additions by 2030 as a result of the incentives in EPACT2005.

The fuel mix in the EVA projection differs from that in the *AEO2006* reference case and the other projections. Except for EVA, all the projections show coal meeting about one-half and natural gas about one-quarter of the growth in electricity generation capacity over the projection period. The EVA projection assumes that legislation similar to the Clear Skies Act—including further restrictions on SO_2, NO_x, and mercury emissions—will be in effect by 2010. The EVA projection also includes a tax of $5 per ton on CO_2 emissions, beginning in 2013. *AEO2006* includes the impact of the EPA's new CAIR and CAMR regulations, which have environmental effects similar to those of the Clear Skies Act; however, *AEO2006* does not assume any tax on CO_2 emissions. In the EVA projection, the combination of further environmental restrictions, a tax on CO_2, and aggregate State-level RPS requirements leads to greater growth in nonhydroelectric generation.

Table 22. Comparison of electricity forecasts, 2015 and 2030 (billion kilowatthours, except where noted)

Projection	2004	AEO2006			Other forecasts				
		Reference	Low economic growth	High economic growth	GII	EVA	EEA	SEER	PIRA
		2015							
Average end-use price (2003 cents per kilowatthour)	**7.6**	**7.1**	**6.9**	**7.3**	**7.6**	**NA**	**NA**	**NA**	**NA**
Residential	8.9	8.3	8.1	8.5	8.8	9.0	NA	NA	NA
Commercial	8.0	7.4	7.2	7.6	8.2	8.0	NA	NA	NA
Industrial	5.3	5.1	4.9	5.3	5.2	5.8	NA	NA	NA
Net energy for load, including CHP	**3,614**	**4,813**	**4,642**	**4,984**	**4,663**	**4,966**	**4,970**	**4,875**	**4,658**
Coal	1,977	2,277	2,245	2,360	2,217	2,267	2,281	2,211	2,293
Oil	136	120	116	126	56	37	96	126	90
Natural gas [a]	326	1,018	929	1,069	1,080	1,286	1,323	1,238	1,004
Nuclear	789	829	807	840	814	842	811	826	819
Hydroelectric/other [b]	349	482	469	495	496	521	381	457	452
Nonutility sales to grid [c]	26	62	57	70	NA	NA	41	NA	NA
Net imports	11	23	19	25	17	13	38	17	22
Electricity sales	**3,567**	**4,300**	**4,147**	**4,449**	**4,239**	**4,638**	**4,456**	**NA**	**NA**
Residential	1,293	1,576	1,539	1,613	1,593	1,697	1,575	NA	NA
Commercial/other [d]	1,253	1,620	1,583	1,650	1,493	1,718	1,602	NA	NA
Industrial	1,021	1,103	1,024	1,185	1,153	1,225	1,278	NA	NA
Capability, including CHP (gigawatts) [e]	**965**	**1,002**	**977**	**1,026**	**1,008**	**1,055**	**1,046**	**NA**	**NA**
Coal	314	326	323	336	331	338	331	NA	NA
Oil and natural gas	433	439	422	451	429	487	478	NA	NA
Nuclear	100	104	101	105	101	105	102	NA	NA
Hydroelectric/other	118	133	131	134	147	125	136	NA	NA
		2030							
Average end-use price (2002 cents per kilowatthour)	**7.6**	**7.5**	**7.2**	**7.8**	**7.4**	**NA**	**NA**	**NA**	**NA**
Residential	8.9	8.5	8.2	8.8	8.5	NA	NA	NA	NA
Commercial	8.0	7.8	7.4	8.2	8.0	NA	NA	NA	NA
Industrial	5.3	5.4	5.2	5.7	5.0	NA	NA	NA	NA
Net energy for load, including CHP	**3,614**	**6,119**	**5,496**	**6,748**	**5,828**	**NA**	**NA**	**6,237**	**NA**
Coal	1,977	3,381	2,835	3,897	3,032	NA	NA	3,221	NA
Oil	136	131	121	138	27	NA	NA	127	NA
Natural gas [a]	326	993	1,010	990	1,453	NA	NA	1,407	NA
Nuclear	789	871	856	871	774	NA	NA	926	NA
Hydroelectric/other [b]	349	550	517	609	542	NA	NA	528	NA
Nonutility sales to grid [c]	26	179	143	229	NA	NA	NA	NA	NA
Net imports	11	14	13	15	12	NA	NA	28	NA
Electricity sales	**3,567**	**5,341**	**4,828**	**5,854**	**5,289**	**NA**	**NA**	**NA**	**NA**
Residential	1,293	1,897	1,759	2,036	2,001	NA	NA	NA	NA
Commercial/other [d]	1,253	2,182	1,997	2,366	1,926	NA	NA	NA	NA
Industrial	1,021	1,262	1,073	1,453	1,362	NA	NA	NA	NA
Capability, including CHP (gigawatts) [e]	**965**	**1,248**	**1,134**	**1,362**	**1,209**	**NA**	**NA**	**NA**	**NA**
Coal	314	481	405	555	449	NA	NA	NA	NA
Oil and natural gas	433	513	483	545	501	NA	NA	NA	NA
Nuclear	100	109	107	109	101	NA	NA	NA	NA
Hydroelectric/other	118	145	139	154	158	NA	NA	NA	NA

[a]Includes supplemental gaseous fuels. [b]"Other" includes conventional hydroelectric, pumped storage, geothermal, wood, wood waste, municipal waste, other biomass, solar and wind power, plus a small quantity of petroleum coke. [c]For *AEO2006*, includes only net sales from combined heat and power plants. [d]"Other" includes sales of electricity to government, railways, and street lighting authorities. [e]EIA capacity is net summer capability, including combined heat and power plants. GII capacity is nameplate, excluding cogeneration plants.

CHP = combined heat and power. NA = not available.

Sources: ***2004 and AEO2006:*** AEO2006 National Energy Modeling System, runs AEO2006.D111905A (reference case), LM2006.D113005A (low economic growth case), and HM2006.D112505B (high economic growth case). **GII:** Global Insight, Inc., *Summer 2005 U.S. Energy Outlook* (August 2005). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2005). **EEA:** Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2005). **SEER:** Strategic Energy and Economic Research, Inc., *2005 Energy Outlook* (October 2005). **PIRA:** PIRA Energy Group (October 2005).

Natural Gas

Published projections of natural gas prices, production, consumption, and imports (Table 23) differ considerably. The differences highlight the uncertainty of future market trends. Because the projections depend heavily on the underlying assumptions that shape them, the assumptions made in each should be considered when they are compared.

The *AEO2006* reference case in general projects lower total natural gas consumption than in the other projections, and it is the only one showing a period of decline. The exception is in the early part of the projection period: in 2015, PIRA and Deutsche Bank AG (DB) project lower natural gas consumption than the *AEO2006* reference case, but by 2025 the *AEO2006* reference case projects lower consumption than any of the others. The primary reason is that *AEO2006* expects a stronger demand response to higher natural gas prices, particularly in the electricity generation sector.

The highest projected level of total natural gas consumption is in the EVA projection, due to strong growth in natural gas consumption for electric power

Table 23. Comparison of natural gas forecasts, 2015, 2025, and 2030 (trillion cubic feet, except where noted)

Projection	2004	AEO2006 reference case	Other forecasts						
			GII [a]	EEA [b]	EVA	PIRA	DB	SEER	Altos
					2015				
Dry gas production [c]	**18.46**	**20.36**	**19.19**	**21.12**	**18.64** [d]	**17.61**	**21.38**	**19.68**	**20.74**
Net imports	**3.40**	**5.10**	**6.80**	**7.11**	**9.67**	**7.33**	**4.30**	**7.86**	**7.92**
Pipeline	*2.81*	*2.05* [e]	*2.17*	*2.82*	*4.78*	*3.28*	*1.75*	*3.00*	*1.82*
LNG	*0.59*	*3.05*	*4.63*	*4.29*	*4.89*	*4.05*	*2.55*	*4.85*	*6.10*
Consumption	**22.41**	**25.91**	**26.16**	**27.98**	**28.32**	**25.32**	**25.67**	**28.18**	**NA**
Residential	*4.88*	*5.36*	*5.15*	*5.49*	*5.33*	*5.24*	*5.53*	*5.45*	*5.41*
Commercial	*3.00*	*3.36*	*3.09*	*3.35*	*3.41*	*3.53*	*3.53*	*3.28*	*3.54*
Industrial [f]	*7.41*	*8.08*	*7.57* [g]	*6.98* [h]	*7.99* [i]	*6.61* [j]	*8.17*	*7.83*	*7.53*
Electricity generators [k]	*5.32*	*7.14*	*8.44* [l]	*10.08* [m]	*9.42*	*8.01* [n]	*6.63*	*9.61*	*9.30*
Other [o]	*1.80*	*1.97*	*1.92*	*2.08*	*2.17* [p]	*1.95*	*1.81*	*2.01*	*NA*
Lower 48 wellhead price (2004 dollars per thousand cubic feet)	**5.49**	**4.52**	**4.73**	**5.91**	**5.53**	**5.55** [q]	**5.03**	**4.65**	**4.15**
End-use prices (2004 dollars per thousand cubic feet)									
Residential	*10.72*	*10.11*	*9.21*	*9.33*	*NA*	*NA*	*NA*	*9.68*	*NA*
Commercial	*9.38*	*8.37*	*8.11*	*8.57*	*NA*	*NA*	*NA*	*7.97*	*NA*
Industrial [f]	*6.29*	*5.32*	*6.09* [r]	*6.81*	*NA*	*NA*	*NA*	*5.75*	*NA*
Electricity generators [k]	*6.07*	*5.21*	*5.13*	*6.62*	*NA*	*NA*	*NA*	*5.32*	*NA*
					2025				
Dry gas production [c]	**18.46**	**21.16**	**20.46**	**21.38**	**19.27** [d]	**NA**	**18.95**	**21.53**	**25.77**
Net imports	**3.40**	**5.37**	**8.64**	**8.89**	**11.80**	**NA**	**8.19**	**8.47**	**7.69**
Pipeline	*2.81*	*1.24* [e]	*1.61*	*1.81*	*3.64*	*NA*	*4.75*	*1.90*	*0.70*
LNG	*0.59*	*4.13*	*7.03*	*7.07*	*8.16*	*NA*	*3.44*	*6.57*	*6.99*
Consumption	**22.41**	**26.99**	**29.28**	**30.33**	**31.08**	**NA**	**27.74**	**30.44**	**NA**
Residential	*4.88*	*5.57*	*5.61*	*5.88*	*5.44*	*NA*	*6.11*	*5.89*	*6.09*
Commercial	*3.00*	*3.77*	*3.34*	*3.56*	*3.76*	*NA*	*3.99*	*3.49*	*4.19*
Industrial [f]	*7.41*	*8.51*	*8.14* [g]	*7.64* [h]	*8.95* [i]	*NA*	*9.03*	*8.37*	*7.73*
Electricity generators [k]	*5.32*	*7.05*	*10.10* [l]	*11.14* [m]	*10.55*	*NA*	*6.97*	*10.50*	*11.37*
Other [o]	*1.80*	*2.08*	*2.09*	*2.12*	*2.38* [p]	*NA*	*1.64*	*2.19*	*NA*
Lower 48 wellhead price (2003 dollars per thousand cubic feet)	**5.49**	**5.43**	**4.52**	**6.45**	**6.07**	**NA**	**5.03**	**5.13**	**5.67**
End-use prices (2003 dollars per thousand cubic feet)									
Residential	*10.72*	*11.10*	*8.82*	*9.71*	*NA*	*NA*	*NA*	*9.92*	*NA*
Commercial	*9.38*	*9.11*	*7.73*	*8.99*	*NA*	*NA*	*NA*	*8.30*	*NA*
Industrial [j]	*6.29*	*6.18*	*5.81* [r]	*7.22*	*NA*	*NA*	*NA*	*6.07*	*NA*
Electricity generators [o]	*6.07*	*6.02*	*4.90*	*6.86*	*NA*	*NA*	*NA*	*5.61*	*NA*

NA = not available. See notes and sources at end of table.

generation. Altos projects the strongest growth in residential and commercial sector natural gas consumption through both 2025 and 2030, whereas the GII and EVA projections have the lowest projected consumption levels. The *AEO2006* reference case projection for residential natural gas consumption in 2030 is lower than all but the EVA projection, but its commercial sector projection is higher than the GII, EVA, and SEER projections. Natural gas consumption in the industrial and electric power sectors is more difficult to compare, given potential definitional differences. The combined total of industrial and electric power sector natural gas consumption from 2004 to 2030 is projected to grow the fastest in the EVA and Altos projections; the DB projection shows much slower growth but still faster than is projected in the *AEO2006* reference case. The DB combined total in 2030 exceeds the *AEO2006* reference case by less than 10 percent, whereas the GII, EVA, SEER, and Altos projections all exceed the *AEO2006* by more than 25 percent.

Domestic natural gas production provides a decreasing share and net imports an increasing share of total natural gas supply in all the projections. The EVA projection shows the greatest increase in the net import share of supply, at more than 41 percent of total supply in 2030. More than 34 percent of supply is projected to come from imports in 2030 in the DB projection, and GII and SEER both show net imports

Table 23. Comparison of natural gas forecasts, 2015, 2025, and 2030 (continued)
(trillion cubic feet, except where noted)

Projection	2004	AEO2006 reference case	Other forecasts						
			GII[a]	EEA[b]	EVA	PIRA	DB	SEER	Altos
		2030							
Dry gas production[c]	**18.46**	**20.83**	**21.40**	**NA**	**18.96[d]**	**NA**	**18.95**	**21.70**	**28.13**
Net imports	**3.40**	**5.57**	**9.06**	**NA**	**13.30**	**NA**	**9.86**	**9.33**	**7.92**
Pipeline	*2.81*	*1.22[e]*	*1.37*	*NA*	*2.80*	*NA*	*1.75*	*1.00*	*0.20*
LNG	*0.59*	*4.36*	*7.68*	*NA*	*10.50*	*NA*	*8.11*	*8.33*	*7.72*
Consumption	**22.41**	**26.86**	**30.64**	**NA**	**32.39**	**NA**	**28.81**	**31.56**	**NA**
Residential	*4.88*	*5.64*	*5.84*	*NA*	*5.49*	*NA*	*6.42*	*6.12*	*6.48*
Commercial	*3.00*	*3.99*	*3.48*	*NA*	*3.96*	*NA*	*4.20*	*3.63*	*4.56*
Industrial[f]	*7.41*	*8.81*	*8.48[g]*	*NA*	*9.45[i]*	*NA*	*9.49*	*8.73*	*7.85*
Electricity generators[k]	*5.32*	*6.38*	*10.67[l]*	*NA*	*11.01*	*NA*	*7.14*	*10.85*	*12.54*
Other[o]	*1.80*	*2.04*	*2.17*	*NA*	*2.48[p]*	*NA*	*1.56*	*2.24*	*NA*
Lower 48 wellhead price (2004 dollars per thousand cubic feet)	**5.49**	**5.92**	**4.65**	**NA**	**6.52**	**NA**	**5.02**	**5.42**	**6.30**
End-use prices (2004 dollars per thousand cubic feet)									
Residential	*10.72*	*11.67*	*8.86*	*NA*	*NA*	*NA*	*NA*	*10.16*	*NA*
Commercial	*9.38*	*9.58*	*7.79*	*NA*	*NA*	*NA*	*NA*	*8.60*	*NA*
Industrial[f]	*6.29*	*6.65*	*5.90[r]*	*NA*	*NA*	*NA*	*NA*	*6.37*	*NA*
Electricity generators[k]	*6.07*	*6.41*	*5.02*	*NA*	*NA*	*NA*	*NA*	*5.92*	*NA*

NA = not available.

[a]February 2005 (previously DRI-WEFA). Conversion factors: 1,000 cubic feet = 1.027 million Btu for production, 1.028 million Btu for end-use consumption, 1.019 million Btu for electric power. [b]The EEA projection shows a cyclical price trend; forecast values for an isolated year may be misleading. [c]Does not include supplemental fuels. [d]Includes supplemental fuels. [e]Includes LNG imports into Florida via the Bahamas. [f]Includes consumption for industrial combined heat and power (CHP) plants and a small number of electricity-only plants; excludes consumption by nonutility generators. [g]Excludes gas used in cogeneration or other nonutility generation. [h]Includes natural gas consumed in cogeneration. [i]Includes transportation fuel consumed in natural gas vehicles. [j]Excludes gas demand for nonutility generation. [k]Includes consumption of energy by electricity-only and CHP plants whose primary business is to sell electricity, or electricity and heat, to the public; includes electric utilities, small power producers, and exempt wholesale generators. [l]Includes gas used in cogeneration or other nonutility generation. [m]Includes independent power producers; excludes cogenerators. [n]Equals the sum of natural gas demand for nonutility generation (NUG) and for utility generation. [o]Includes lease, plant, and pipeline fuel and fuel consumed in natural gas vehicles. [p]Includes lease, plant, and pipeline fuel. [q]Henry Hub daily cash price for natural gas, in 2004 dollars per thousand cubic feet. [r]On-system sales or system gas (i.e., does not include gas delivered for the account of others).

Sources: **2004 and *AEO2006*:** AEO2006 National Energy Modeling System, run AEO2006.D111905A (reference case). **GII:** Global Insight, Inc., *Summer 2005 U.S. Energy Outlook* (August 2005). **EEA:** Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2005). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2005). **PIRA:** PIRA Energy Group (October 2005). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on October 31, 2005. **SEER:** Strategic Energy and Economic Research, Inc., *2005 Energy Outlook* (October 2005). **Altos:** Altos Partners North American Regional Gas Model (NARG) Long-Term Base Case (October 7, 2005).

providing about 30 percent of total natural gas supply. The *AEO2006* reference case and Altos project that net imports will meet the smallest share of total supply—21 percent and 22 percent, respectively—in 2030. Most of the projections show a notable decline in pipeline imports over the forecast period. Only DB shows an increase from 2015 to 2025. EVA's pipeline import projection, although significantly greater than the rest, also declines after 2015. Much of the variation in imports reflects different projections of net LNG imports in 2030, ranging from a low of 4.4 trillion cubic feet in the *AEO2006* reference case to 10.5 trillion cubic feet in the EVA projection.

The *AEO2006* reference case projections for wellhead natural gas prices in 2025 and 2030 fall within the range of the other projections, with the EEA, EVA, and Altos projections higher than *AEO2006* and the others lower. In the earlier years, however, all the projections with the exception of Altos show wellhead natural gas prices exceeding those in the *AEO2006* reference case. Of the three projections that project end-use prices for 2030 (*AEO2006*, GII, and SEER), the *AEO2006* reference case and SEER show the highest end-use-to-wellhead margins for the electric power sector ($0.50 and $0.51, respectively). The *AEO2006* reference case shows the lowest end-use-to-wellhead margins for the industrial sector. While GII's margins for the electric power sector are the lowest, some of the difference may be definitional. For the residential and commercial sectors, the projected margins in the *AEO2006* reference case exceed the other projections by more than 15 percent.

Petroleum

As discussed earlier in this report, crude oil prices in the *AEO2006* reference case are substantially higher than they were in earlier *AEO*s. They are also considerably higher than those in most of the other projections. The *AEO2006* reference case shows the weighted average refiners acquisition cost of imported crude oil (the price basis used in most of the other forecasts) ranging from $43 to $50 per barrel (2004 dollars) between 2015 and 2030 and the average refiners acquisition cost of imported low-sulfur light crude oil (the reference price used in *AEO2006*) ranging from $48 to $57 per barrel (2004 dollars) over the same period. DB assumes that the refiners acquisition cost of crude oil will average $31.75 per barrel from 2010 through 2030; GII assumes that the refiners acquisition cost of crude oil will be between $28 and $31 per barrel from 2015 through 2030. PIRA gives its oil price forecast in terms of WTI, a low-sulfur, light crude oil, assuming prices of $50 per barrel in 2015 and $63 per barrel in 2020.

Despite much lower crude oil price projections, GII and DB project gasoline consumption levels that are essentially the same as those in the *AEO2006* reference case (Table 24). The GII and DB projections for gasoline demand are within 1 percent of the *AEO2006* reference case from 2015 to 2030. PIRA sees slower growth in gasoline demand, 14 percent below the *AEO2006* reference case in 2015, due to more rapid improvement in vehicle efficiency.

In comparison with the *AEO2006* reference case, projected distillate consumption is about 2 percent lower in the DB and PIRA projections in 2015 and 5 percent lower in 2030 in the DB projection. GII also projects lower levels of distillate consumption than the *AEO2006* reference case, 6 percent less in 2015 and 13 percent less in 2030. Most of the variation is accounted for by the projected level of highway diesel consumption.

The projected pattern of growth in jet fuel consumption varies significantly by projection, and the basis of the variation is not always clear. Relative to the *AEO2006* reference case, PIRA projects slightly higher jet fuel consumption in 2015, whereas GII projects higher jet fuel consumption only toward the end of the projection (25 percent higher in 2030 but 4 percent lower in 2015). DB also projects lower jet fuel consumption in the middle years, 9 percent below the *AEO2006* reference case in 2015, but is nearly identical with the *AEO2006* reference case in the later years of the projection.

The projections also differ substantially on the projected future use of residual fuel oil. PIRA and GII project a steady decline in residual fuel oil consumption, but DB sees some growth in the future. In the GII projection, residual fuel oil consumption is 3 percent below that in the *AEO2006* reference case in 2015 and 18 percent below in 2030. Both GII and PIRA project deep declines in residual fuel oil consumption for electricity generation. The *AEO2006* reference case projects more modest reductions through 2015 and then slow growth for the remainder of the projection. The DB projections are 14 percent and 17 percent above the *AEO2006* reference case in 2015 and 2030, respectively.

Domestic crude oil production declines in all the projections, but at different rates. As compared with the *AEO2006* reference case, domestic crude oil production declines more rapidly in the earlier years and much more slowly in the later years of the GII projection. GII projects domestic crude oil production 14 percent lower than in the *AEO2006* reference case in 2015 but essentially the same in 2030. DB and PIRA project a much more rapid decline in domestic crude oil production: both are about 15 percent below the *AEO2006* reference case in 2015, and DB projects a further decline, to 19 percent below the *AEO2006* reference case in 2030.

The projections do not agree on domestic production of NGL. The *AEO2006* reference case projects NGL production slightly above current levels in 2015 and 2030, with peak production in 2020. DB is bearish on NGL production, projecting 19 percent lower levels than in the *AEO2006* reference case in 2015 and 42 percent lower in 2030. GII, on the other hand, is bullish on NGL production, projecting domestic production 24 percent above the levels in the *AEO2006* reference case in 2015 and 38 percent above in 2030. EVA and DB project the lowest totals of domestic crude oil and NGL production in 2015 and 2030.

Declining domestic production of crude oil and rising petroleum product demand imply greater dependence on imports in all the projections. The decreases in crude oil production are offset somewhat by projected increases in NGL production in the *AEO2006* reference case and GII. DB projects substantial declines in crude oil and NGL production and therefore projects the highest levels of net imports of crude and petroleum products. DB projects import shares 9 percentage points above the *AEO2006* reference case in 2015 and 14 percentage points above in 2030. GII projects import shares that are 8 percentage points above the *AEO2006* reference case in 2015 and 2030.

AEO2006 also includes alternative price cases. The *AEO2006* low price case assumes that the average

Table 24. Comparison of petroleum forecasts, 2015 and 2030 (million barrels per day, except where noted)

Projection	2004	AEO2006			Other forecasts			
		Reference	Low price	High price	GII	DB	EVA	PIRA
		2015						
Crude oil and NGL production	**7.23**	**7.72**	**7.34**	**6.49**	**6.56**	**NA**	**7.88**	**7.61**
Crude oil	5.42	5.84	5.02	4.98	NA	4.99	5.99	5.76
Natural gas liquids	1.81	1.88	2.32	1.51	NA	NA	1.89	1.85
Total net imports	**12.11**	**13.23**	**15.08**	**15.31**	**NA**	**14.37**	**14.06**	**11.87**
Crude oil	10.06	10.47	11.28	NA	NA	11.74	11.06	9.65
Petroleum products	2.05	2.76	3.79	NA	NA	2.63	3.00	2.22
Petroleum demand	**20.76**	**23.53**	**23.71**	**23.43**	**NA**	**23.01**	**24.48**	**22.21**
Motor gasoline	9.10	10.63	10.69	10.39	NA	9.14	11.07	9.85
Jet fuel	1.63	2.06	1.98	1.88	NA	2.11	2.09	2.03
Distillate fuel	4.06	4.91	4.60	4.81	NA	4.83	5.05	4.72
Residual fuel	0.87	0.73	0.71	0.83	NA	0.72	0.83	0.66
Other	5.10	5.20	5.74	5.51	NA	6.21	5.44	4.95
Import share of product supplied (percent)	**58**	**56**	**64**	**65**	**NA**	**62**	**57**	**53**
		2030						
Crude oil and NGL production	**7.23**	**6.44**	**7.17**	**4.78**	**4.70**	**NA**	**6.41**	**6.85**
Crude oil	5.42	4.57	4.59	3.69	NA	NA	4.49	4.96
Natural gas liquids	1.81	1.87	2.58	1.09	NA	NA	1.92	1.89
Total net imports	**12.11**	**17.24**	**19.69**	**21.13**	**NA**	**NA**	**20.21**	**13.28**
Crude oil	10.06	13.51	13.01	NA	NA	NA	15.51	11.24
Petroleum products	2.05	3.73	6.67	NA	NA	NA	4.70	2.04
Petroleum demand	**20.76**	**27.57**	**28.24**	**27.74**	**NA**	**NA**	**29.57**	**25.17**
Motor gasoline	9.10	12.49	12.59	12.25	NA	NA	13.68	10.96
Jet fuel	1.63	2.31	2.89	2.29	NA	NA	2.33	2.09
Distillate fuel	4.06	6.09	5.31	5.81	NA	NA	6.29	5.99
Residual fuel	0.87	0.78	0.64	0.91	NA	NA	1.01	0.70
Other	5.10	5.89	6.80	6.49	NA	NA	6.26	5.44
Import share of product supplied (percent)	**58**	**62**	**70**	**76**	**NA**	**NA**	**68**	**53**

NA = Not available.

Sources: ***2004 and AEO2006:*** AEO2006 National Energy Modeling System, runs AEO2006.D111905A (reference case), LP2006.D113005A (low price case), and HP2006.D120105A (high price case). **GII:** Global Insight, Inc., *Summer 2005 U.S. Energy Outlook* (August 2005). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on October 31, 2005. **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2005). **PIRA:** PIRA Energy Group (October 2005).

refiners acquisition cost of imported crude oil will remain at about $28 per barrel from 2015 to 2030 (2004 dollars), and that the average refiners acquisition cost of imported low-sulfur light crude oil will remain at about $34 per barrel over the same period. The *AEO2006* low price case is somewhat lower than GII's crude oil price path. The *AEO2006* high price case assumes that the average refiners acquisition cost of imported crude oil will range between $72 and $90 per barrel from 2015 to 2030, and that the average refiners acquisitions cost of imported low-sulfur light crude oil will range between $76 and $96 per barrel over the same period. The crude oil prices in the *AEO2006* high price case are well above PIRA's projected levels. The *AEO2006* low price case shows the highest levels of total petroleum demand in 2015 and 2030, and the *AEO2006* high price case shows the lowest. The projected demand reduction in the *AEO-2006* high price case also results in the least reliance on imports to meet petroleum demand in 2015 and 2030. The DB projection shows the greatest reliance on petroleum imports, because it assumes the lowest levels of domestic crude oil and NGL production.

Coal

The coal projections for the *AEO2006* reference case and economic growth cases (Table 25) incorporate CAAA90, CAIR, and CAMR. EVA's forecast assumes legislation similar to the Clear Skies Act but also includes a fee of $5 per ton on CO_2 emissions, beginning in 2013. The *AEO2006*, PIRA, and GII projections do not include assumptions about reductions in CO_2 emissions for the United States. In addition to environmental assumptions, differences among the

Table 25. Comparison of coal forecasts, 2015, 2025, and 2030 (million short tons, except where noted)

Projection	2004	AEO2006			Other forecasts		
		Reference	Low economic growth	High economic growth	PIRA	EVA	GII
				2015			
Production	**1,125**	**1,272**	**1,251**	**1,318**	**1,250**	**1,234**	**1,149**
Consumption by sector							
Electric power	1,015	1,161	1,145	1,199	1,171	1,140	1,071
Coke plants	24	22	21	23	NA	29	19
Coal-to-liquids	0	22	19	27	NA	NA	NA
Industrial/other	65	71	69	72	88 [a]	65	66
Total	**1,104**	**1,276**	**1,254**	**1,321**	**1,259**	**1,234**	**1,156**
Net coal exports	**20.7**	**-4.8**	**-4.8**	**-4.8**	**-8.0**	**-17.3**	**-7.7**
Exports	48.0	22.0	22.0	22.0	NA	28.0	28.6
Imports	27.3	26.7	26.7	26.8	NA	45.3	36.3
Minemouth price							
(2004 dollars per short ton)	20.07	20.39	20.04	20.67	NA	19.69 [b]	17.82 [d]
(2004 dollars per million Btu)	0.98	1.01	0.99	1.02	NA	0.99 [c]	0.86 [d]
Average delivered price to electricity generators							
(2004 dollars per short ton)	27.43	28.12	27.74	28.50	NA	29.45 [b]	28.17 [e]
(2004 dollars per million Btu)	1.36	1.40	1.39	1.42	NA	1.48 [b]	1.36
				2025			
Production	**1,125**	**1,530**	**1,394**	**1,710**	**NA**	**1,404**	**1,296**
Consumption by sector							
Electric power	1,015	1,354	1,248	1,486	NA	1,329	1,226
Coke plants	24	21	19	23	NA	26	16
Coal-to-liquids	0	146	115	192	NA	NA	NA
Industrial/other	65	71	68	73	NA	60	67
Total	**1,104**	**1,592**	**1,450**	**1,774**	**NA**	**1,415**	**1,309**
Net coal exports	**20.7**	**-62.8**	**-57.9**	**-65.5**	**NA**	**-29.2**	**-15.1**
Exports	48.0	19.6	19.6	18.4	NA	30.1	23.4
Imports	27.3	82.4	77.4	84.0	NA	59.3	38.5
Minemouth price							
(2004 dollars per short ton)	20.07	20.63	19.40	21.73	NA	20.15 [b]	16.12 [d]
(2004 dollars per million Btu)	0.98	1.03	0.98	1.09	NA	1.02 [c]	0.78 [d]
Average delivered price to electricity generators							
(2004 dollars per short ton)	27.43	29.02	27.48	30.87	NA	30.12 [b]	25.84 [e]
(2004 dollars per million Btu)	1.36	1.44	1.37	1.52	NA	1.53 [b]	1.25

Btu = British thermal unit. NA = Not available. See notes and sources at end of table.

AEO2006, EVA, PIRA, and GII projections reflect variation in other assumptions, including those about economic growth, the natural gas outlook, and world oil prices.

While all the projections show increases in coal consumption over their projection horizons, the *AEO2006* reference case projects the highest level of total coal consumption. Given its more restrictive environmental assumptions after 2012 and an average economic growth rate of 2.5 percent per year from 2004, EVA projects lower levels of coal consumption (11 percent lower in 2025) than the *AEO2006* reference case. The EVA and PIRA projections for total coal consumption in the 2015-2020 period most closely resemble those in the *AEO2006* low economic growth case. GII's projection, which does not include a carbon tax, has the lowest projection of total coal consumption. Although the GII projection shows 21 percent less total coal consumption than the *AEO2006* reference case in 2030, GII's outlook for coal consumption in the electric power sector in 2030 is virtually identical to that in the *AEO2006* low economic growth case.

In contrast to the *AEO2006* reference case, the other projections show natural gas with a larger share of electricity generation than coal's. GII, PIRA, and EVA expect imports of LNG to be greater than projected in the *AEO2006* reference case. Although EVA and the *AEO2006* reference case project similar levels of generation in the electric power sector, the *AEO2006* reference case also projects 19 gigawatts of generation capacity at CTL plants by 2030, representing 11 percent of total coal consumption in 2030.

For coke plants, both GII and the *AEO2006* reference case project declining consumption of coal. EVA differs from the other projections and projects an increase in coal consumption at coke plants, peaking at around 30 million tons before falling to 26 million tons in 2025—2 million tons higher than 2004

Table 25. Comparison of coal forecasts, 2015, 2025, and 2030 (continued)
(million short tons, except where noted)

Projection	2004	AEO2006			Other forecasts		
		Reference	Low economic growth	High economic growth	PIRA	EVA	GII
		2030					
Production	**1,125**	**1,703**	**1,497**	**1,936**	**NA**	**NA**	**1,395**
Consumption by sector							
Electric power	*1,015*	*1,502*	*1,331*	*1,680*	*NA*	*NA*	*1,330*
Coke plants	*24*	*21*	*19*	*23*	*NA*	*NA*	*14*
Coal-to-liquids	*0*	*190*	*153*	*247*	*NA*	*NA*	*NA*
Industrial/other	*65*	*72*	*68*	*75*	*NA*	*NA*	*67*
Total	**1,104**	**1,784**	**1,571**	**2,025**	**NA**	**NA**	**1,411**
Net coal exports	**20.7**	**-82.7**	**-69.3**	**-89.0**	**NA**	**NA**	**-18.7**
Exports	*48.0*	*16.7*	*16.4*	*16.8*	*NA*	*NA*	*22.3*
Imports	*27.3*	*99.4*	*85.7*	*105.8*	*NA*	*NA*	*41.0*
Minemouth price							
(2004 dollars per short ton)	*20.07*	*21.73*	*19.91*	*23.05*	*NA*	*NA*	*15.65* [d]
(2004 dollars per million Btu)	*0.98*	*1.09*	*1.00*	*1.15*	*NA*	*NA*	*0.76* [d]
Average delivered price to electricity generators							
(2004 dollars per short ton)	*27.43*	*30.58*	*28.28*	*32.79*	*NA*	*NA*	*25.23* [e]
(2004 dollars per million Btu)	*1.36*	*1.51*	*1.41*	*1.61*	*NA*	*NA*	*1.22*

Btu = British thermal unit. NA = Not available.
[a]Includes coal consumed at coke plants.
[b]The average coal price is a weighted average of the projected spot market price for the electric power sector only and was converted from 2005 dollars to 2004 dollars to be consistent with *AEO2006*.
[c]Estimated by dividing the minemouth price in dollars per short ton by the average heat content of coal delivered to the electric power sector.
[d]The minemouth prices are average prices for the electric power sector only and are calculated as a weighted average from Census region prices.
[e]Calculated by multiplying the delivered price of coal to the electric power sector in dollars per million Btu by the average heat content of coal delivered to the electric power sector.
Sources: ***2004 and AEO2006*:** AEO2006 National Energy Modeling System, runs AEO2006.D111905A (reference case), LM2006.D113005A (low economic growth case), and HM2006.D112505B (high economic growth case). **PIRA:** PIRA Energy Group (October 2005). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2005). **GII:** Global Insight, Inc., *U.S. Energy Outlook* (Summer 2005).

consumption. In the GII projection, coke plants consume only 14 million tons of coal in 2030, compared with 21 million tons in the *AEO2006* reference case. The *AEO2006* reference case shows no change in industrial/other coal consumption, whereas EVA projects a drop in industrial/other consumption, to 60 million short tons in 2025.

In the GII projections, minemouth coal prices (electric power sector only) appear to peak by 2010 and then fall below 2004 levels by 2030 (in real dollars). The *AEO2006* reference case shows a similar downward trend after 2010 in its average national minemouth price (all sectors combined) through 2020; however, prices rise after 2020, in response to substantial growth in coal demand from the electric power sector and CTL. GII's average delivered price of coal to the electric power sector in 2030 is 19 percent lower than the *AEO2006* reference case (on a Btu basis). The average delivered price of coal to the electricity sector in the GII forecast is still 13 percent lower (on a Btu basis) than the *AEO2006* low economic growth case, despite comparable levels of coal consumption in the electricity sector.

All the forecasts reviewed meet coal demand primarily through domestic production. *AEO2006* projects the largest increase in production over the forecast horizon, 51 percent higher in 2030 than in 2004. As with consumption, the PIRA and EVA projections for coal production most closely resemble those in the *AEO2006* low economic growth case. GII projects coal consumption levels for 2015, 2025, and 2030 that are more than 100 million tons less than projected in the *AEO2006* reference case.

In all the projections, gross exports of coal represent a small and declining part of domestic coal production. EVA projects the most exports, 30 million tons in 2025, and the other projections are around 20 million tons. The *AEO2006* reference case shows coal exports falling to 17 million tons in 2030, and GII projects 22 million tons. In the *AEO2006* reference case, the export share of total U.S. coal production falls from 4 percent in 2004 to roughly 1 percent in 2030. Currently, coal is the only domestic U.S. energy resource for which exports exceed imports. All the projections expect the United States to become a net importer of coal over the projection period. GII projects the lowest level of coal imports, only 14 million tons in 2030. The *AEO2006* reference case projection for coal imports in 2025 is 23 million tons higher than the EVA projection, which is the next highest.