

Forecast Comparisons

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Only one other organization—Global Insight, Incorporated (GII)—produces a comprehensive energy projection with a time horizon similar to that of *AEO2005*. Other organizations address one or more aspects of the energy markets. The most recent projection from GII, as well as other forecasts that concentrate on economic growth, international oil prices, energy consumption, electricity, natural gas, petroleum, and coal, are compared here with the *AEO2005* projections.

Economic Growth

In *AEO2005* the projected growth in real GDP, based on 2000 chain-weighted dollars, is 3.1 percent per year from 2003 to 2025—slightly higher than the 3.0-percent average annual growth projected in *AEO2004* (Table 32). The *AEO2005* forecast is based on the May 2004 long-range forecast and the August short-term forecast of GII, modified to reflect EIA's view on energy prices, demand, and production.

The average annual GDP growth rate projections for the United States from 2003 through 2009 range from 3.4 to 3.6 percent. The *AEO2005* reference case and GII project the lowest rate at 3.4 percent, and the Office of Management and Budget (OMB) projects the highest rate at 3.6 percent, followed by the Congressional Budget Office (CBO) and Oxford Economic Forecasting (OEF) at 3.5 percent. When the projection period is extended to 2014, the uncertainty in the GDP growth rate is reflected by a widening of the range of GDP growth rate projections (3.1 to 3.5 percent). While *AEO2005* remains in the lower half of the range, the CBO projection reflects a considerable slowing of GDP growth during the 2010 to 2014 period. Because few commercial or private forecast organizations project GDP growth rates for the United States to 2025, comparisons over the entire period from 2003 to 2025 are not readily available. The *AEO2005* reference case projection reflects a slowing of the GDP growth rate after 2015, consistent with an expected slowing of population growth.

World Oil Prices

Comparisons with other oil price forecasts are shown in Table 33. The world oil price measure varies by forecast. In some projections, the measure is the spot price for WTI, Brent, or a basket of crude oils. *AEO2005* uses the annual average U.S. refiner's acquisition cost of imported crude oil, including transportation and fees. There is no simple way to put the forecasts for oil prices on a common basis. The

range between the *AEO2005* low and high B world oil price cases spans the range of published forecasts. In fact, the *AEO2005* high B world oil price case is considerably above all the other forecasts for 2025.

Recent variability in crude oil prices demonstrates the uncertainty inherent in forecasting crude oil markets, which generally widens as the time horizon extends into the future. The oil price paths proffered by several organizations (Table 33), including *AEO*, illustrate the uncertainty. For example, for 2010, the price range in the forecasts is from a low of about \$22 per barrel projected by Altos Partners (Altos) to a high of almost \$35 per barrel projected by Petroleum Industry Research Associates, Inc. (PIRA). The range in the forecasts for 2025 is somewhat narrower but

Table 32. Forecasts of annual average economic growth, 2003-2025

Forecast	Average annual percentage growth		
	2003-2009	2003-2014	2003-2025
<i>AEO2004</i>	3.5	3.2	3.0
<i>AEO2005</i>			
Reference	3.4	3.3	3.1
Low growth	2.9	2.8	2.5
High growth	4.1	3.9	3.6
GII	3.4	3.2	3.1
OMB	3.6	NA	NA
CBO	3.5	3.1	NA
OEF	3.5	3.5	NA

NA = not available.

Table 33. Forecasts of world oil prices, 2010-2025 (2003 dollars per barrel)

Forecast	2010	2015	2020	2025
<i>AEO2004</i> (reference case)	24.53	25.44	26.41	27.40
<i>AEO2005</i>				
Reference	25.00	26.75	28.50	30.31
High A world oil price	33.99	34.24	36.74	39.24
High B world oil price	37.00	40.67	44.33	48.00
October oil futures	30.99	32.33	33.67	35.00
Low world oil price	20.99	20.99	20.99	20.99
GII	27.08	25.58	26.66	27.12
IEA (reference scenario)	23.25	25.37	27.48	29.07
IEA (high oil price case)	37.00	37.00	37.00	37.00
Altos	21.92	22.67	23.93	24.60
PEL	25.00	27.00	27.00	29.00
PIRA	34.75	39.15	NA	NA
DB	24.00	24.00	24.00	24.00
EEA	26.58	25.55	24.93	NA
SEER	26.13	28.40	28.25	29.00
EVA	28.99	28.39	30.97	34.77

NA = not available.

still substantial, from a low of \$24 per barrel projected by Deutsche Bank, A.G. (DB) to a high of nearly \$35 per barrel projected by Energy Ventures Analysis, Incorporated (EVA).

Total Energy Consumption

The *AEO2005* forecast of end-use sector energy consumption shows higher growth for petroleum and natural gas than occurred from 1980 to 2003 but lower projected growth in electricity consumption (Table 34). Much of the projected growth in petroleum consumption is driven by increased demand in the industrial sector for petrochemical and manufacturing applications as economic activity expands, and in the transportation sector as improvements in efficiency fail to offset increases in miles traveled. Natural gas consumption is expected to increase in the residential, commercial, and industrial sectors as environmental and economic pressures benefit natural gas at the expense of petroleum and coal consumption. Coal consumption in those end-use sectors is expected to decline slightly as a result of increased fuel switching and growing concern about emissions.

Electricity is expected to remain the fastest growing source of delivered energy. Its growth does not outpace historical rates, however, because many traditional uses of electricity (such as for air conditioning) approach saturation while average equipment efficiencies rise. The *AEO2005* projections are generally consistent with the outlook from GII; however, GII projects slower growth in natural gas consumption, electricity consumption, and electricity losses, as well as slightly faster growth in petroleum consumption, resulting from differences in relative prices and projected growth in each sector.

Table 34. Forecasts of average annual growth rates for energy consumption, 2003-2025 (percent)

Energy use	History 1980-2003	Projections	
		AEO2005	GII
Petroleum*	0.8	1.5	1.6
Natural gas*	0.2	1.0	0.7
Coal*	-1.7	-0.6	-0.4
Electricity	2.2	1.9	1.6
Delivered energy	0.7	1.4	1.3
Electricity losses	1.9	1.4	0.9
Primary energy	1.0	1.4	1.2

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

Electricity

The *AEO2005* projections for the electricity generation sector assume that wholesale electricity markets in most U.S. regions will be restructured, resulting in average wholesale electricity prices that approach long-run marginal costs. The same cannot be said for retail markets at the State level: as of 2003, only 17 States and the District of Columbia had competitive retail markets in operation. Further, a number of States have delayed opening competitive retail markets, Arkansas has repealed retail restructuring, and California has suspended restructuring. The *AEO-2005* 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 *AEO2005* reference case, GII, and EVA forecasts shows some variation in projected electricity sales (Table 35). The forecasts for total electricity sales in 2025 range from 4,982 billion kilowatthours (GII) to 5,396 billion kilowatthours (EVA). The rate of demand growth ranges from 1.6 percent (GII) to 2.0 percent (EVA). All price forecasts reflect competition in wholesale markets and slow growth in electricity demand relative to GDP growth, exerting downward pressure on real electricity prices through 2025. Rising natural gas prices balance some of the downward pressure and tend to push electricity prices up in the later years of the forecasts.

The *AEO2005* reference case projects a slight decline in real electricity prices over the full period of the forecast (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 forecast as lower natural gas prices to generators (\$4.23 per million Btu in the GII forecast, compared with \$5.44 per million Btu in the *AEO2005* reference case in 2025) contribute to a small decrease in average electricity prices, from 7.2 cents per kilowatthour in 2015 to 7.1 cents per kilowatthour in 2025. The higher natural gas price projected in the *AEO2005* reference case leads to an increase in average electricity price, from 6.9 cents per kilowatthour in 2015 to 7.3 cents per kilowatthour in 2025.

Both the *AEO2005* reference case and GII projections include some planned capacity additions in the near

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Table 35. Comparison of electricity forecasts, 2015 and 2025 (billion kilowatthours, except where noted)

Projection	2003	AEO2005			Other forecasts				
		Reference	Low economic growth	High economic growth	GII	EVA	EEA	SEER	PIRA
2015									
Average end-use price (2003 cents per kilowatthour)	7.4	6.9	6.7	7.1	7.2	NA	NA	NA	NA
Residential	8.7	8.1	7.7	8.3	8.3	8.1	NA	NA	NA
Commercial	7.9	7.3	6.9	7.5	7.7	7.4	NA	NA	NA
Industrial	5.1	5.0	4.7	5.2	4.8	4.7	NA	NA	NA
Net energy for load, including CHP	3,857	4,912	4,762	5,082	4,667	5,131	4,913	4,472	4,706
Coal	1,971	2,306	2,269	2,354	2,325	2,190	2,255	2,230	2,115
Oil	135	150	146	149	45	22	77	97	97
Natural gas ^a	632	1,171	1,077	1,285	1,035	1,523	1,306	815	1,237
Nuclear	764	826	826	826	800	822	813	794	805
Hydroelectric/other ^b	350	438	426	448	446	538	383	356	430
Nonutility sales to grid ^c	28	59	53	67	NA	NA	41	179	NA
Net imports	5	21	18	20	16	36	38	NA	23
Electricity sales	3,482	4,430	4,295	4,583	4,244	4,571	4,415	NA	NA
Residential	1,280	1,584	1,569	1,604	1,569	1,673	1,561	NA	NA
Commercial/other ^d	1,233	1,680	1,657	1,703	1,539	1,699	1,588	NA	NA
Industrial	969	1,166	1,069	1,276	1,136	1,200	1,266	NA	NA
Capability, including CHP (gigawatts)^e	948	1,002	981	1,030	989	1,074	1,074	NA	NA
Coal	314	320	316	325	347	330	335	NA	NA
Oil and natural gas	415	455	439	476	408	329	500	NA	NA
Nuclear	99	102	102	102	100	102	102	NA	NA
Hydroelectric/other	119	125	123	126	134	312	138	NA	NA
2025									
Average end-use price (2003 cents per kilowatthour)	7.4	7.3	7.0	7.6	7.1	NA	NA	NA	NA
Residential	8.7	8.3	8.0	8.7	8.2	8.1	NA	NA	NA
Commercial	7.9	7.6	7.3	8.1	7.7	7.3	NA	NA	NA
Industrial	5.1	5.4	5.1	5.7	4.7	4.7	NA	NA	NA
Net energy for load, including CHP	3,857	5,780	5,444	6,117	5,475	6,100	NA	5,309	NA
Coal	1,971	2,890	2,613	3,179	2,932	2,597	NA	2,578	NA
Oil	135	163	158	168	26	19	NA	94	NA
Natural gas ^a	632	1,406	1,371	1,409	1,267	1,831	NA	1,181	NA
Nuclear	764	830	830	830	773	888	NA	816	NA
Hydroelectric/other ^b	350	480	461	519	464	727	NA	398	NA
Nonutility sales to grid ^c	28	91	74	110	NA	NA	NA	242	NA
Net imports	5	11	11	12	13	40	NA	NA	NA
Electricity sales	3,482	5,219	4,914	5,518	4,982	5,396	NA	NA	NA
Residential	1,280	1,810	1,748	1,850	1,851	2,007	NA	NA	NA
Commercial/other ^d	1,233	2,123	2,047	2,196	1,846	2,058	NA	NA	NA
Industrial	969	1,286	1,119	1,472	1,285	1,331	NA	NA	NA
Capability, including CHP (gigawatts)^e	948	1,190	1,129	1,248	1,140	1,246	NA	NA	NA
Coal	314	398	361	438	435	390	NA	NA	NA
Oil and natural gas	415	555	535	567	466	387	NA	NA	NA
Nuclear	99	103	103	103	100	110	NA	NA	NA
Hydroelectric/other	119	134	130	141	139	358	NA	NA	NA

^aIncludes 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. ^cFor AEO2005, includes only net sales from combined heat and power plants. ^d“Other” includes sales of electricity to government, railways, and street lighting authorities. ^eEIA capacity is net summer capability, including combined heat and power plants. GII capacity is nameplate, excluding cogeneration plants. ^fEVA “other” includes all CHP.

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

Sources: **AEO2005**: AEO2005 National Energy Modeling System, runs AEO2005.D102004A (reference case), LM2005.D102004A (low economic growth case), and HM2005.D102004A (high economic growth case). **GII**: Global Insight, Inc., *Summer 2004 U.S. Energy Outlook* (August 2004). **EVA**: Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2004). **EEA**: Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2004). **SEER**: Strategic Energy and Economic Research, Inc., *2004 Energy Outlook* (October 2004). **PIRA**: PIRA Research Group (October 2004).

term, with the *AEO2005* reference case expecting about 28 gigawatts through 2005 and GII expecting about 14 gigawatts. Virtually all the projected capacity additions are natural gas fired. These two forecasts project that prices will fall in the near term as a result of excess total capacity.

All the forecasts except for GII project that demand will grow fastest in the commercial sector, and that more cycling and baseload capability will be built than peaking units. All the forecasts show significant net additions to coal-fired capacity: 84 gigawatts through 2025 in the *AEO2005* reference case and 121 gigawatts through 2025 in the GII forecast. Both GII and the *AEO2005* reference case project no nuclear retirements; however, EVA projects 8 gigawatts of nuclear capacity additions by 2025.

The fuel mix in the EVA forecast differs from that in the *AEO2005* reference case and the other forecasts. All the forecasts, except for EVA, project that coal will provide about one-half and natural gas about one-quarter of the growth in electricity generation over the forecast period. The EVA forecast assumes that legislation similar to the Clear Skies Act—including further restrictions on SO₂, NO_x, and mercury emissions—will be in effect by 2010. The EVA forecast also includes a tax of \$5 per ton on carbon dioxide emissions, beginning in 2013. *AEO2005* does not assume either passage of the Clear Skies Act or any carbon tax throughout the forecast horizon. In the EVA forecast, the combination of further environmental restrictions and a tax on carbon dioxide leads to greater growth in hydroelectric generation.

Natural Gas

There are considerable differences among published forecasts of natural gas prices, production, consumption, and imports (Table 36). The differences highlight the uncertainty of future market trends. Because the forecasts depend heavily on the underlying assumptions that shape them, the assumptions made in each forecast should be considered when different projections are compared.

Over the period from 2007 to 2025, the *AEO2005* reference case is within the range of projections for total natural gas consumption in the other forecasts. The lowest projected totals for natural gas consumption in 2005 are from the DB forecast, and the highest are from the EVA forecast. For residential and commercial natural gas consumption, DB projects the strongest growth from 2003 to 2025, and the GII forecast

has the lowest projected consumption levels. The *AEO2005* reference case projections for 2025 fall in the high end of the range for residential consumption and in the mid-range for commercial consumption. Natural gas consumption in the industrial and electric power sectors is more difficult to compare, given potential definitional differences. The EVA forecast shows the fastest growth in natural gas consumption from 2003 to 2025 in combined totals for the industrial and electric power sectors, whereas the DB forecast shows much slower growth than the other forecasts.

Natural gas for domestic consumption is supplied by domestic production and net imports. All forecasts show domestic production providing a decreasing share of total natural gas supply. The Altos forecast shows a smaller shift in that direction, with significantly lower net imports and significantly higher domestic production. Three of the forecasts—*AEO2005* reference case, GII, and DB—project that net imports will supply about 30 percent of end-use consumption by 2025. EVA projects that 36 percent of consumption will be supplied by net imports, Strategic Energy & Economic Research, Incorporated (SEER) projects 26 percent, and Altos 18 percent (for Altos, the percentage is calculated as net imports divided by the sum of production and net imports).

The volume of net imports varies significantly among the forecasts, as does the mix of net imports. GII, SEER, and Altos expect a decline in net pipeline imports of more than 50 percent between 2003 and 2025, the *AEO2005* reference case projects a more modest decline of about 20 percent, and EVA anticipates an increase in net pipeline imports of 30 percent (DB is not included in this comparison because of definitional differences). All the forecasts project strong growth in LNG imports, with net LNG imports in 2025 ranging from 4.6 trillion cubic feet in the Altos forecast to 8.3 trillion cubic feet in the EVA forecast (again, DB is excluded from this comparison). The *AEO2005* reference case is more conservative than most of the forecasts for LNG imports: GII, EVA, and SEER all project higher levels of LNG imports in 2025 than are projected in the *AEO2005* reference case.

Wellhead natural gas price projections for 2025 in the *AEO2005* reference case are higher than those in all the other available forecasts, with the exception of Altos. Wellhead natural gas prices in the EEA and PIRA forecasts exceed those in the *AEO2005* reference case in 2015. Of the three forecasts that project

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Table 36. Comparison of natural gas forecasts, 2015 and 2025 (trillion cubic feet, except where noted)

Projection	2003	AEO2005 reference case	Other forecasts						
			GII ^a	EEA ^b	EVA	PIRA	DB	SEER	Altos
2015									
Lower 48 wellhead price (2003 dollars per thousand cubic feet)	4.98	4.16	3.84	4.69	3.71	5.14 ^c	3.66	3.90	3.92
Dry gas production^d	19.07	20.77	19.28	21.39 ^e	20.22 ^f	17.34	21.24	20.24	22.48
Net imports	3.30	7.02	6.94	7.97	9.82	9.77	3.76	6.98	5.78
Pipeline	2.86	2.69	1.63	2.94	4.64	4.66	2.75 ^g	2.71	1.15
LNG ^h	0.44	4.33	5.31	5.03	5.18	5.11	1.01 ⁱ	4.26	4.63
Consumption	21.97	27.96	26.29	28.87	29.72	27.22	24.99	27.21	NA
Residential	5.10	5.74	5.40	5.75	5.52	5.39	5.71	5.57	NA
Commercial	3.14	3.58	3.24	3.56	3.68	3.56	3.65	3.58	NA
Industrial ^j	7.03	8.26	7.67 ^k	7.73 ^l	8.00 ^m	6.30 ⁿ	7.90	8.09	NA
Electricity generators ^o	4.93	8.39	8.01 ^p	9.59 ^q	10.24	9.88 ^r	5.93	7.81	NA
Other ^s	1.77	1.99	1.96	2.23	2.28 ^t	2.09	1.81	2.17	NA
End-use prices (2003 dollars per thousand cubic feet)									
Residential	9.62	8.45	8.36	8.29	NA	NA	NA	8.89	NA
Commercial	8.32	7.54	7.22	7.50	NA	NA	NA	7.63	NA
Industrial ^j	5.72	4.96	5.15 ^u	5.79	NA	NA	NA	5.25	NA
Electricity generators ^o	5.55	4.90	4.21	5.49	NA	NA	NA	4.77	NA
2025									
Lower 48 wellhead price (2003 dollars per thousand cubic feet)	4.98	4.79	3.96	NA	3.98	NA	3.66	4.26	5.78
Dry gas production^d	19.07	21.83	20.43	NA	21.51 ^f	NA	18.84	21.99	24.10
Net imports	3.30	8.66	8.49	NA	12.01	NA	8.19	7.84	5.15
Pipeline	2.86	2.29	0.97	NA	3.72	NA	4.75 ^g	1.31	0.51
LNG ^h	0.44	6.37	7.52	NA	8.29	NA	3.44 ⁱ	6.53	4.64
Consumption	21.97	30.67	29.00	NA	33.58	NA	27.03	29.83	NA
Residential	5.10	5.99	5.87	NA	5.88	NA	6.30	5.88	NA
Commercial	3.14	4.05	3.52	NA	4.07	NA	4.13	4.04	NA
Industrial ^j	7.03	9.00	8.06 ^k	NA	8.96 ^m	NA	8.72	8.95	NA
Electricity generators ^o	4.93	9.43	9.42 ^p	NA	12.10	NA	6.23	8.60	NA
Other ^s	1.77	2.20	2.13	NA	2.57 ^t	NA	1.64	2.35	NA
End-use prices (2003 dollars per thousand cubic feet)									
Residential	9.62	9.33	8.34	NA	NA	NA	NA	9.48	NA
Commercial	8.32	8.19	7.22	NA	NA	NA	NA	7.99	NA
Industrial ^j	5.72	5.63	5.22 ^u	NA	NA	NA	NA	5.61	NA
Electricity generators ^o	5.55	5.55	4.31	NA	NA	NA	NA	5.13	NA

NA = not available.

^aSummer 2004 (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. ^bThe EEA projection shows a cyclical price trend; forecast values for an isolated year may be misleading. ^cHenry Hub daily cash natural gas price in 2003 dollars per thousand cubic feet. ^dDoes not include supplemental fuels. ^eIncludes Alaska production. ^fWet natural gas production. ^gIncludes net pipeline imports from Mexico, Canada, and the Bahamas. ^hIncludes LNG imports into Florida via the Bahamas. ⁱIncludes net LNG imports into the United States only. ^jIncludes consumption for combined heat and power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public; excludes consumption by nonutility generators. ^kExcludes gas used in cogeneration or other nonutility generation. ^lIncludes natural gas consumed in cogeneration. ^mIncludes transportation fuel consumed in natural gas vehicles. ⁿExcludes gas demand for nonutility generation. ^oIncludes consumption of energy by electricity-only and CHP plants; includes small power producers and exempt wholesale generators. ^pIncludes gas used in cogeneration or other nonutility generation. ^qIncludes independent power producers and excludes cogenerators. ^rEquals the sum of gas demand for nonutility generation plus gas demand for utility generation. ^sIncludes lease, plant, and pipeline fuel and fuel consumed in natural gas vehicles. ^tIncludes lease, plant, and pipeline fuel. ^uOn-system sales or system gas (i.e., does not include gas delivered for the account of others).

Sources: **2003 and AEO2005:** AEO2005 National Energy Modeling System, run AEO2005.D102004A (reference case). **GII:** Global Insight, Inc., *U.S. Energy Outlook* (Summer 2004). **EEA:** Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2004). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2004). **PIRA:** PIRA Energy Group (October 2004). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on November 11, 2004. **Altos:** Altos North American Regional Gas Model (NARG) Base Case (September 2004).

end-use prices for 2025 (*AEO2005*, GII, and SEER), SEER shows the highest end-use-to-wellhead margins for the electric power sector, and the *AEO2005* reference case shows the lowest end-use-to-wellhead margins for the industrial sector. For the residential and commercial sectors, the projected margins in the *AEO2005* reference case fall between GII on the low end and SEER on the high end of the available forecasts. Industrial sector margins are notably lower in the *AEO2005* reference case than in the other forecasts, and electric power sector margins are notably lower in the GII forecast (where some of the differences may reflect definitional variations) than in the other forecasts.

Petroleum

The *AEO2005* projections for petroleum can be compared with forecasts from DB, GII, EVA, and PIRA. The basis of comparison varies, depending on the coverage of the other forecasts. The *AEO2005* projections for petroleum product demand, domestic production of crude oil and natural gas liquids, and imports of crude oil and petroleum products through 2025 are compared with the DB and GII forecasts in Table 37, which also shows comparisons with the EVA forecast for total U.S. imports of crude oil and petroleum products through 2025 and with the PIRA forecast through 2015.

Consistent with expected economic growth, rising demand for petroleum products is a feature of all the forecasts. DB, GII, and the *AEO2005* reference case expect total product demand in 2025 to be about 40 percent higher than in 2003. DB and GII, however, project a different slate of products. Both expect gasoline and distillate demand in 2025 that is several hundred thousand barrels per day below the *AEO2005* reference case levels. GII's projected distillate demand is 710,000 barrels per day lower in 2025 than the *AEO2005* reference case, and gasoline demand is 410,000 barrels per day lower in 2025 than the *AEO2005* reference case.

GII's forecast assumes that light and heavy vehicles will travel fewer miles in 2025 than assumed in the *AEO2005* reference case. Light vehicles use primarily gasoline, and heavy vehicles use primarily distillate. For air travel, GII assumes stronger growth than *AEO2005*, and the GII projection of jet fuel demand is 460,000 barrels per day higher than the *AEO2005* reference case in 2025. GII projects that "other" petroleum product demand will be about 730,000 barrels per day higher than shown in the *AEO2005* reference

case in 2025, due mostly to higher industrial consumption of petroleum. DB's jet fuel projection for 2025 is slightly below the *AEO2005* reference case, but its "other" petroleum product projection is 880,000 barrels per day higher.

PIRA's forecast is the only one that envisions a reversal of gasoline demand growth in the future. In 2015, PIRA projects gasoline demand that is 380,000 barrels per day lower than its projection for 2010. The PIRA projections of gasoline demand and total petroleum product demand in 2015 are the lowest of all the forecasts, at 1.89 and 1.55 million barrels per day below the respective *AEO2005* reference case projections. Diesel displaces gasoline between 2010 and 2015 in PIRA's forecast, which also assumes somewhat less highway travel than does the *AEO2005* reference case. Jet fuel demand in 2015 is slightly higher in the PIRA forecast, and "other" petroleum product demand is 820,000 barrels per day higher than projected in the *AEO2005* reference case.

In all the forecasts, imports are needed to meet more than one-half of U.S. petroleum demand, and the import share of total demand is projected to increase. In 2003, 56 percent of demand was met by imports, and that share is projected to rise to 68 percent in 2025 in *AEO2005*. DB is less optimistic about domestic oil and gas production. In 2025, DB projects that crude oil production will be 710,000 barrels per day lower and natural gas liquids 760,000 barrels per day lower than projected in the *AEO2005* reference case. With DB's total petroleum demand projection about the same as that in the *AEO2005* reference case, the fraction of demand projected to be met by imports in 2025 is more than 6 percentage points above the *AEO2005* reference case projection.

GII is somewhat more optimistic about domestic crude oil and natural gas liquids production in 2025 than the *AEO2005* reference case. In 2025, GII projects that total crude oil production will be 90,000 barrels per day higher and natural gas liquids production 320,000 barrels per day higher than projected in the *AEO2005* reference case. GII is less optimistic than the *AEO2005* reference case, however, about domestic refinery expansion. Crude oil imports are 3.76 million barrels per day lower in 2025 in the GII forecast, but petroleum product imports are 3.84 million barrels per day higher than in the *AEO2005* reference case. Despite somewhat lower total demand and lower crude imports, GII projects an import share that is 0.9 percentage points higher in 2025 than in the

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AEO2005 reference case. The reason is that volume gains from domestic processing of imported crude are counted as domestic production. Substitution of product imports for crude imports therefore increases the import share of product supplied.

PIRA expects the lowest level of crude oil and petroleum product imports in 2015 among the forecasts compared, due in part to relatively low projections of product demand. EVA projects the highest level of crude oil and petroleum product imports among all the forecasts, 2.18 million barrels per day above the *AEO2005* reference case in 2025.

Coal

There is a great deal of uncertainty about the possible enactment of environmental regulations that would affect coal demand in the United States. Various programs that would restrict emissions of mercury, fine

particulates (PM_{2.5}) and greenhouse gases are being discussed and introduced by the U.S. Environmental Protection Agency and the U.S. Congress. The *AEO2005* reference case does not anticipate when and how new environmental requirements may take effect, whereas the other forecasts may include such assumptions. All the coal forecasts included in Table 38 incorporate the current requirements of the Clean Air Act Amendments of 1990 and the NO_x SIP call that affects 19 eastern and midwestern States over the forecast period. EVA assumes that legislation similar to the Clean Air Interstate Rule and the Clean Air Mercury Rule will be enacted and will include further restrictions on emissions of SO₂, NO_x, and mercury. EVA's forecast also includes a \$5 per ton fee on carbon dioxide emissions beginning in 2013. The *AEO2005*, Hill, and GII forecasts do not include mandated reductions in mercury or carbon dioxide emissions.

Table 37. Comparison of petroleum forecasts, 2015 and 2025 (million barrels per day, except where noted)

Projection	2003	AEO2005			Other forecasts			
		Reference	Low world oil price	High world oil price	GII	DB	EVA	PIRA
2015								
Crude oil and NGL production	7.41	7.46	7.32	7.83	7.41	6.51	NA	NA
Crude oil	5.69	5.49	5.37	5.81	5.17	4.91	NA	5.05
Natural gas liquids	1.72	1.96	1.95	2.02	2.24	1.61	NA	NA
Total net imports	11.24	15.40	16.19	14.10	15.18	16.17	17.70	14.68
Crude oil	9.65	13.28	13.73	12.74	11.07	NA	NA	NA
Petroleum products	1.58	2.12	2.45	1.36	4.11	NA	NA	NA
Petroleum demand	20.00	24.67	25.25	23.95	24.19	24.34	NA	23.12
Motor gasoline	8.93	11.17	11.38	10.76	10.98	10.86	NA	9.28
Jet fuel	1.57	2.15	2.16	2.13	2.23	1.96	NA	2.20
Distillate fuel	3.95	5.07	5.25	4.95	4.62	4.79	NA	4.72
Residual fuel	0.77	0.85	0.96	0.79	0.63	0.87	NA	0.68
Other	4.77	5.42	5.50	5.32	3.42	5.85	NA	6.24
Import share of product supplied (percent)	56.2	62.4	64.1	58.9	64.3	66.5	NA	64.0
2025								
Crude oil and NGL production	7.41	6.77	6.45	7.30	7.19	5.30	NA	NA
Crude oil	5.69	4.73	4.46	5.18	4.82	4.02	NA	NA
Natural gas liquids	1.72	2.04	1.99	2.12	2.36	1.28	NA	NA
Total net imports	11.24	19.11	21.19	16.48	19.19	20.83	21.29	NA
Crude oil	9.65	16.11	16.63	14.83	12.35	NA	NA	NA
Petroleum products	1.58	3.00	4.55	1.65	6.84	NA	NA	NA
Petroleum demand	20.00	27.93	29.55	26.85	27.71	27.92	NA	NA
Motor gasoline	8.93	12.89	13.37	12.33	12.48	12.30	NA	NA
Jet fuel	1.57	2.36	2.46	2.34	2.82	2.30	NA	NA
Distillate fuel	3.95	5.81	6.68	5.63	5.10	5.51	NA	NA
Residual fuel	0.77	0.88	1.03	0.79	0.60	0.96	NA	NA
Other	4.77	5.98	6.01	5.76	6.71	6.86	NA	NA
Import share of product supplied (percent)	56.2	68.4	71.7	63.1	69.3	74.6	NA	NA

NA = Not available.

Sources: **AEO2005**: AEO2005 National Energy Modeling System, runs AEO2005.D102004A (reference case), LW2005.D102004A (low world oil price case), and HW2005.D102004A (high world oil price case). **GII**: Global Insight, Inc., *U.S. Energy Outlook* (Summer 2004). **DB**: Deutsche Bank AG, e-mail from Adam Sieminski, November 11, 2004. **EVA**: Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2004). **PIRA**: PIRA Energy Group (October 2004).

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Table 38. Comparison of coal forecasts, 2015, 2020, and 2025 (million short tons, except where noted)

Projection	2003	AEO2005			Other forecasts		
		Reference	Low economic growth	High economic growth	EVA	Hill	GII
2015							
Production	1,083	1,270	1,249	1,294	1,150	1,239 ^a	1,189
Consumption by sector							
Electricity generation	1,004	1,185	1,166	1,208	1,082	1,173	1,100
Coking plants	24	18	17	18	21	23	20
Industrial/other	62	71	69	72	60	62	68
Total	1,095	1,273	1,252	1,297	1,163	1,258	1,188
Net coal exports	18.0	-2.8	-2.8	-2.8	-20.6	-19.0	-1.6
Exports	43.0	34.9	34.9	34.9	24.7	25.0	29.1
Imports	25.0	37.7	37.7	37.7	45.3	44.0	30.7
Minemouth price							
(2003 dollars per short ton)	17.93	16.89	16.62	17.10	19.35 ^b	17.28 ^{c,d}	NA
(2003 dollars per million Btu)	0.86	0.84	0.83	0.85	0.94 ^b	0.84 ^{c,d}	NA
Average delivered price to electricity generators							
(2003 dollars per short ton)	25.86	24.42	24.07	24.76	27.26 ^b	26.89 ^d	24.62 ^e
(2003 dollars per million Btu)	1.28	1.23	1.22	1.25	1.36 ^b	1.31 ^d	1.19
2020							
Production	1,083	1,345	1,295	1,397	1,231	1,285 ^a	1,287
Consumption by sector							
Electricity generation	1,004	1,267	1,219	1,317	1,174	1,233	1,204
Coking plants	24	15	15	15	20	22	18
Industrial/other	62	71	69	73	58	59	68
Total	1,095	1,352	1,303	1,405	1,252	1,314	1,290
Net coal exports	18.0	-6.6	-6.6	-7.2	-28.3	-29.0	-6.0
Exports	43.0	35.2	35.2	34.5	26.0	22.0	25.8
Imports	25.0	41.7	41.7	41.7	54.3	51.0	31.8
Minemouth price							
(2003 dollars per short ton)	17.93	17.25	16.79	17.89	19.38 ^b	17.85 ^{c,d}	NA
(2003 dollars per million Btu)	0.86	0.86	0.83	0.89	0.95 ^b	0.87 ^{c,d}	NA
Average delivered price to electricity generators							
(2003 dollars per short ton)	25.86	24.66	24.00	25.41	27.46 ^b	28.14 ^d	23.70 ^e
(2003 dollars per million Btu)	1.28	1.25	1.21	1.28	1.38 ^b	1.37 ^d	1.15
2025							
Production	1,083	1,488	1,373	1,597	1,328	NA	1,365
Consumption by sector							
Electricity generation	1,004	1,425	1,312	1,531	1,284	NA	1,288
Coking plants	24	13	13	13	18	NA	16
Industrial/other	62	71	68	73	55	NA	68
Total	1,095	1,508	1,393	1,617	1,357	NA	1,372
Net coal exports	18.0	-19.6	-18.8	-19.6	-36.9	NA	-9.2
Exports	43.0	26.1	26.9	26.1	27.4	NA	23.7
Imports	25.0	45.7	45.7	45.7	64.3	NA	32.9
Minemouth price							
(2003 dollars per short ton)	17.93	18.26	17.11	19.78	19.60 ^b	NA	NA
(2003 dollars per million Btu)	0.86	0.91	0.85	0.98	0.97 ^b	NA	NA
Average delivered price to electricity generators							
(2003 dollars per short ton)	25.86	25.95	24.46	27.76	27.75 ^b	NA	22.85 ^e
(2003 dollars per million Btu)	1.28	1.31	1.24	1.39	1.39 ^b	NA	1.10

^aCoal production in the Hill & Associates forecast was estimated as total coal consumption minus imports plus exports.

^bThe average coal price is a weighted average of the projected spot market FOB mine price for all domestic coal.

^cThe minemouth price represents an average for domestic steam coal only. Exports and coking coal are not included in the average.

^dThe prices provided by Hill & Associates were converted from 2004 dollars to 2003 dollars in order to be consistent with AEO2005.

^eEstimated by multiplying the delivered price of coal in dollars per million Btu by the average heat content of coal delivered to electricity generators in million Btu per short ton.

Btu = British thermal unit. NA = Not available.

Sources: **AEO2005:** AEO2005 National Energy Modeling System, runs AEO2005.D102004A (reference case), LM2005.D102004A (low economic growth case), and HM2005.D102004A (high economic growth case). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2004). **Hill:** Hill & Associates, Inc., *The Outlook for U.S. Steam Coal: Long-Term Forecast to 2022* (August 2004). **GII:** Global Insight, Inc., *U.S. Energy Outlook* (Summer 2004). **PIRA:** PIRA Energy Group (October 2004).

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Given the more restrictive assumptions of the EVA forecast, it is not surprising that the *AEO2005* reference case and Hill forecasts project significantly higher levels of coal consumption than EVA. While GII projects total coal consumption levels that are the most similar to EVA's in 2025, its projection of industrial consumption over the forecast is similar to that in *AEO2005*. The *AEO2005* reference case projects higher coal consumption levels than Hill (by about 3 percent in 2020) and EVA (by about 10 percent in 2025). All four forecasts show significant increases in coal consumption over the forecast period.

Both *AEO2005* and Hill project a decline in real minemouth coal prices from 2003 to 2015 but expect growth in real prices thereafter. EVA forecasts an 8-percent price increase (based on short tons) between 2003 and 2015 and an additional small increase between 2015 and 2025. The EVA forecast includes lower coal consumption and higher minemouth coal prices over all periods than either the *AEO2005* reference case or the Hill forecast.

As western coal production makes further inroads into markets traditionally served by eastern coal, the average heat content of the coals produced and consumed will drop as well, reflecting the lower thermal content per ton of western coals. The *AEO2005* reference case and EVA forecasts indicate similar average heat content (calculated by dividing dollars per ton by dollars per million Btu). The average heat content of coal production in the *AEO2005* reference case, EVA, and Hill forecasts is roughly 20.1 to 20.6 million Btu per ton in 2015, 2020, and 2025, compared with the

2003 base level of 20.9 million Btu per ton. The forecast similarities suggest that comparable shares of western production are included in the three projections.

Gross exports of coal represent a small and declining part of domestic coal production. In the *AEO2005* reference case, the share of total production that is exported is projected to fall from 4 percent in 2003 to roughly 2 percent in 2025. Currently, coal is the only domestic energy resource for which exports still exceed imports. All the forecasts project that the United States eventually will import more coal than it exports. GII projects the lowest level of coal imports, only 8 million tons more in 2025 than in 2003. Both EVA and Hill project a faster rate of increase in net coal imports, with 19 to 21 million tons more coal imported than exported in 2015. EVA projects net coal imports in 2025 equal to almost twice the tonnage projected in the *AEO2005* reference case (37 million and 20 million tons, respectively). Strong price competition from other exporters and the loss of markets as Europe moves away from coal for environmental reasons are among the causes for the long-term decline in U.S. exports. The coal forecasts reflect the uncertainties facing the U.S. coal industry as it simultaneously adapts to pressures arising from increasing regulatory restrictions on coal production, domestic and international environmental regulations, restructuring of the U.S. electricity generation industry, and increasing competition from the relatively undeveloped coalfields of international competitors.