

Comparison with Other Projections

Only Global Insights, Inc. (GII) produces a comprehensive energy projection with a time horizon similar to that of *AEO2007*. Other organizations, however, 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 *AEO2007* projections.

Economic Growth

In the *AEO2007* reference case, the projected growth in real GDP, based on 2000 chain-weighted dollars, is 2.9 percent per year from 2005 to 2030. The *AEO2007* projections for economic growth are based on the August short-term projection of GII, extended by EIA through 2030 and modified to reflect EIA's view on energy prices, demand, and production.

Projections of the average annual GDP growth rate for the United States from 2005 through 2010 range from 2.9 percent to 3.2 percent (Table 18). The *AEO2007* reference case projects annual growth of 3.0 percent over the period, matching the projection made by the Social Security Administration (SSA) and GII, but it is slightly lower than the 3.2-percent real GDP growth projected by the Office of Management and Budget (OMB), the CBO, and Energy Ventures Analysis, Inc. (EVA). The consensus Blue Chip projection is for 3.0-percent average annual growth from 2005 to 2010. Three other organizations—Interindustry Forecasting at the University of Maryland (INFORUM), the Bureau of Labor Statistics (BLS), and the International Energy Agency (IEA)—project somewhat lower annual growth of 2.9 percent

Table 18. Projections of annual average economic growth, 2005-2030

Projection	Average annual percentage growth			
	2005-2010	2010-2015	2015-2020	2020-2030
<i>AEO2006</i>	3.2	2.9	3.1	2.8
<i>AEO2007</i>				
Reference	3.0	2.8	3.0	2.8
Low growth	2.3	2.2	2.6	2.1
High growth	3.7	3.4	3.4	3.4
<i>GII</i>	3.0	2.7	2.9	2.8
<i>OMB</i>	3.2	NA	NA	NA
<i>CBO</i>	3.2	2.7	NA	NA
<i>Blue Chip</i>	3.0	3.0	NA	NA
<i>INFORUM</i>	2.9	2.7	2.7	NA
<i>SSA</i>	3.0	2.2	2.1	1.9
<i>BLS</i>	2.9	2.9	NA	NA
<i>EVA</i>	3.2	2.7	2.3	NA
<i>IEA</i>	2.9	2.9	1.9	1.9

NA = not available.

over the same period. The IEA projection of 2.9-percent average annual growth covers the period from 2004 through 2015.

Over the period from 2010 to 2015, the uncertainty in the projected rate of GDP growth is greater, with projections ranging from 2.2 to 3.0 percent per year (excluding the *AEO2007* alternative cases); however, all but one projection falls in the range of 2.7 to 3.0 percent—SSA with projected average growth of 2.2 percent per year. The *AEO2007* reference case projection of 2.8 percent average annual economic growth from 2010 to 2015 is in the middle of the range, excluding the SSA projection. The Blue Chip consensus projection is 3.0 percent, and both BLS and the IEA project 2.9 percent, from 2010 to 2015. Projections slightly below the *AEO2007* reference case, at 2.7 percent, include GII, CBO, INFORUM, and EVA.

There are few public or private projections of GDP growth rates for the United States that extend to 2030. The *AEO2007* 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 of the *AEO2007* projections with other oil price projections are shown in Table 19. The world oil prices in the *AEO2007* reference case generally are higher than other world oil price projections available for comparison. Three of the six publicly available long-term projections—Deutsche Bank AG (DB), Strategic Energy and Economic Research, Inc. (SEER), and EVA—anticipate that world oil prices will decline faster than in the *AEO2007* reference case in the near term, with their projections for 2010 falling below that in the *AEO2007* low price case. All

Table 19. Projections of world oil prices, 2010-2030 (2005 dollars per barrel)

Projection	2010	2015	2020	2025	2030
<i>AEO2006</i> (reference case)	48.72	49.24	52.24	55.72	58.69
<i>AEO2007</i>					
Reference	57.47	49.87	52.04	56.37	59.12
Low price	49.21	33.99	34.10	34.89	35.68
High price	69.21	79.57	89.12	94.40	100.14
<i>GII</i>	57.11	46.54	45.06	43.21	40.25
<i>IEA</i> (reference)	51.50	47.80	50.20	52.60	55.00
<i>EEA</i>	56.94	49.80	47.42	45.16	NA
<i>DB</i>	39.66	40.11	39.73	39.95	40.16
<i>SEER</i>	44.21	45.27	45.87	46.23	46.60
<i>EVA</i>	42.28	42.35	45.76	49.45	NA

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the projections—except for the price projection from EVA, which was not available for comparison in last year’s outlook—have raised their price expectations for 2010 and in the longer term relative to last year’s releases.

The world oil price measures are, by and large, comparable across projections. For *AEO2007*, EIA reports the price of imported low-sulfur, light crude oil, approximately the same as the WTI prices that are widely cited as a proxy for world oil prices in the trade press. The only series that does not report projections in WTI terms is the IEA’s *World Energy Outlook 2006*, where prices are expressed as the IEA crude oil import price.

Recent variability in crude oil prices demonstrates the uncertainty inherent in the projections. The *AEO2007* reference case and DB define the range of projected prices among the comparative series throughout the projection period. The range among the projections is \$18 per barrel in 2010 (from a low price of \$39.66 per barrel to a high of \$57.47 per barrel), declining to \$10 per barrel in 2015 and then widening to \$19 per barrel in 2030 (from a low of \$40.16 per barrel to a high of \$59.12 per barrel).

Excluding the *AEO2007* high and low price cases, there are four distinct views proffered by the comparative series beginning in 2010: (1) prices moderate by 2015 before beginning a steady increase; (2) prices do not moderate over the mid-term but increase toward the end of the projection; (3) prices decline throughout the projection; and (4) prices remain relatively flat throughout. In the *AEO2007* reference case, prices decline from about \$57 per barrel in 2010 to \$50 per barrel in 2015 and rise steadily to \$59 per barrel in 2030 (all prices expressed in real 2005 dollars). IEA projects a similar trend. In the EVA projection, prices remain flat until after 2015, then begin to rise. Although GII and Energy and Environmental Analysis, Inc. (EEA) anticipate a (rather sharper) decline in prices over the 2010 to 2015 period compared to the *AEO2007* reference case, both expect the decline to continue, albeit slowly, through the end of their respective projection periods. Finally, DB and SEER expect oil prices to remain relatively flat or increase slightly from 2010 to 2030.

Total Energy Consumption

The *AEO2007* reference case projects higher growth in end-use sector consumption of petroleum, natural gas, and coal than occurred from 1980 to 2005 but

lower growth in electricity consumption (Table 20). 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 include its use in CTL plants, a technology that is expected to become competitive at the level of oil prices assumed in the *AEO2007* reference case.

While strong growth in electricity use is projected to continue in the *AEO2007* reference case, 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 *AEO2007* reference case generally includes greater growth in primary energy consumption through 2030 than is shown in the outlook from GII. GII projects little growth in end-use natural gas consumption, whereas the *AEO2007* reference case projects continued growth in the industrial and buildings sectors. Some of the difference can be attributed to the higher natural gas price assumptions in the GII projection. End-use natural gas prices in

Table 20. Projections of average annual growth rates for energy consumption, 2005-2030 (percent)

Energy use	History	Projections	
	1980-2005	AEO2007	GII
Petroleum*	0.9	1.0	0.9
Natural gas*	0.0	0.9	0.1
Coal*	-1.7	1.4	-0.2
Electricity	2.2	1.4	1.3
Delivered energy	0.7	1.1	0.8
Electricity losses	1.9	1.0	0.7
Primary energy	1.0	1.1	0.7

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

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the *AEO2007* reference case decline rapidly from 2006 to 2013 before resuming a slow upward trend. In contrast, GII projects a more moderate decline in natural gas prices from 2005 to 2015, with little further change by 2025. GII projects an industrial natural gas price of \$7.91 per thousand cubic feet in 2025, compared with \$6.40 per thousand cubic feet in the *AEO2007* reference case (2005 dollars). GII's projected growth rates for petroleum and electricity consumption are similar to those in the *AEO2007* reference case. Differences between the *AEO2007* reference case and the GII projections for end-use coal consumption result from a projected increase in coal use for CTL in the *AEO2007* reference case.

Electricity

The *AEO2007* projections of retail electricity prices are based on average costs for electricity. The projections include supply regions that still are regulated, regions that are competitive and where marginal rather than average prices are assumed, and regions with a mix of regulated and competitive markets where average and marginal prices are weighted by the amount of load that serves regulated and competitive markets. As of 2005, 4 of the 13 electricity market regions had fully competitive retail markets in operation, 7 regions had mixed competitive and regulated retail markets, and 2 regions had fully regulated markets. The *AEO2007* cases assume that no additional retail markets will be restructured and that partial restructuring (in wholesale markets) will lead to increased competition in the electric power industry. Competition is assumed to lower operating and maintenance costs and to cause the retirement of uneconomical generating units. The *AEO2007* electricity projections assume continuation of current laws and regulations. Other projections may reflect explicit assessments of the nature and likelihood of policy developments over the next 25 years.

Comparisons of the *AEO2007* projections and those from other organizations are shown in Table 21. The projections for electricity sales in 2015 range from a low of 4,133 billion kilowatthours in the *AEO2007* low economic growth case to a high of 4,433 billion kilowatthours in the EVA projection. EVA projects higher sales in the commercial and residential sectors, with somewhat less growth in industrial sales, than are projected by the *AEO2007* reference case, GII, and EEA. The projections for total electricity sales in 2030 range from 4,682 billion kilowatthours (*AEO2007* low economic growth case) to 5,654 billion

kilowatthours (*AEO2007* high economic growth case). The annual rate of demand growth ranges from 1.0 percent (*AEO2007* low economic growth case) to 1.8 percent (*AEO2007* high economic growth case). GII projects lower growth in the commercial sector and higher growth in the industrial and, to a lesser extent, residential sectors in 2030 than is projected in the *AEO2007* reference case.

The *AEO2007* reference case shows a decline in real electricity prices early in the projection period and then rising prices at the end of the period because of increases in the cost of fuels used for generation and increases in capital expenditures for construction of new capacity. The rising fossil fuel prices and increased capital outlays in the *AEO2007* reference case lead to an increase in average electricity prices, from 7.7 cents per kilowatthour in 2015 to 8.1 cents per kilowatthour in 2030. GII projects increases in prices initially and then a slight decline at the end of the period.

Projections of total electricity generation in 2015 are similar for the *AEO2007* reference case, EVA, and EEA. In contrast, the projection by GII is lower than the others because of lower projected growth in electricity sales. The GII projection of total electricity generation in 2015 is similar to that in the *AEO2007* low economic growth case. Although GII projects a lower level of total electricity generation in 2030 than is projected in the *AEO2007* reference and high economic growth cases, its projection for renewable generation in 2030 is considerably higher than the *AEO2007* reference case projection.

The need for new generating capacity is driven by growth in electricity sales and the need to replace existing units that are no longer economical to operate. Consistent with its projection of higher growth in electricity sales, EVA projects greater growth in requirements for new fossil-fuel-fired generating plants as well as nuclear plants in 2015 compared with the *AEO2007* reference case and GII. Except for nuclear plants, the EVA projections for generating capacity are similar to EEA's projections for 2015. As noted above, the GII projections for renewable capacity in 2030 are higher than those in the *AEO2007* reference and high and low economic growth cases. The projections for nuclear capacity additions from 2005 to 2030 as a result of the incentives in EPACT2005 range from 28 gigawatts in the *AEO2007* high economic growth case to 6 gigawatts in the *AEO2007* low economic growth case. The *AEO2007* cases assume

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Table 21. Comparison of electricity projections, 2015 and 2030 (billion kilowatthours, except where noted)

Projection	2005	AEO2007			Other projections		
		Reference	Low economic growth	High economic growth	GII	EVA	EEA
2015							
Average end-use price (2005 cents per kilowatthour)	8.1	7.7	7.5	7.9	8.6	NA	NA
Residential	9.4	8.9	8.7	9.1	10.0	9.7	NA
Commercial	8.6	8.0	7.7	8.2	9.2	8.7	NA
Industrial	5.7	5.6	5.4	5.9	5.8	5.6	NA
Total generation plus imports	4,063	4,729	4,597	4,865	4,610	4,720	4,766
Coal	2,015	2,295	2,235	2,353	2,244	2,336	NA
Oil	122	103	100	105	92	NA	NA
Natural gas ^a	756	1,023	959	1,068	934	982	NA
Nuclear	780	812	809	837	829	860	NA
Hydroelectric/other ^b	365	487	485	493	492	523	NA
Net imports	25	8	8	10	20	20	NA
Electricity sales	3,660	4,251	4,133	4,370	4,186	4,433	4,302
Residential	1,365	1,591	1,560	1,622	1,592	1,665	1,597
Commercial/other ^c	1,274	1,557	1,532	1,583	1,485	1,709	1,507
Industrial	1,021	1,103	1,041	1,165	1,110	1,059	1,198
Capability, including CHP (gigawatts)^d	988	997	981	1,018	1,011	1,045	1,035
Coal	315	329	322	336	333	351	346
Oil and natural gas	448	430	422	440	429	453	457
Nuclear	100	102	102	106	104	108	102
Hydroelectric/other	125	136	135	136	146	132	130
2030							
Average end-use price (2005 cents per kilowatthour)	8.1	8.1	7.8	8.4	8.5	NA	NA
Residential	9.4	9.1	8.8	9.6	9.9	NA	NA
Commercial	8.6	8.3	7.9	8.7	9.1	NA	NA
Industrial	5.7	5.9	5.6	6.3	5.6	NA	NA
Total generation plus imports	4,065	5,810	5,255	6,375	5,586	NA	NA
Coal	2,015	3,330	2,871	3,672	2,999	NA	NA
Oil	122	107	104	112	76	NA	NA
Natural gas ^a	756	942	924	1,010	952	NA	NA
Nuclear	780	896	845	1,010	826	NA	NA
Hydroelectric/other ^b	365	522	499	555	719	NA	NA
Net imports	25	13	12	15	15	NA	NA
Electricity sales	3,660	5,168	4,682	5,654	5,071	NA	NA
Residential	1,365	1,896	1,773	2,016	1,921	NA	NA
Commercial/other ^c	1,274	2,073	1,907	2,234	1,872	NA	NA
Industrial	1,021	1,199	1,003	1,403	1,278	NA	NA
Capability, including CHP (gigawatts)^d	988	1,220	1,112	1,331	1,157	NA	NA
Coal	315	465	403	511	443	NA	NA
Oil and natural gas	448	500	464	544	404	NA	NA
Nuclear	100	113	106	127	109	NA	NA
Hydroelectric/other	125	142	138	149	202	NA	NA

^aIncludes supplemental gaseous fuels. For EVA, represents total oil and natural gas. ^b“Other” includes conventional hydroelectric, pumped storage, geothermal, wood, wood waste, municipal waste, other biomass, solar and wind power, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, petroleum coke, and miscellaneous technologies. ^c“Other” includes sales of electricity to government, railways, and street lighting authorities. ^dEIA 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: **2005 and AEO2007:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A (reference case), LM2007.D112106A (low economic growth case), and HM2007.D112106A (high economic growth case). **GII:** Global Insight, Inc., *2006 U.S. Energy Outlook* (November 2006). **EVA:** Energy Ventures Analysis, Inc., *FUELCAS: Long-Term Outlook* (August 2006). **EEA:** Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2006).

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that 2.6 gigawatts of nuclear capacity will be retired by 2030 because their operating licenses will have expired.

Environmental regulations have an important influence on the technology choices made for electricity generation. EVA assumes that legislation similar to the Clear Skies Act (including new restrictions on SO₂, NO_x, and mercury emissions) will be in effect by 2010. EVA also includes a tax of \$6 per ton on CO₂ emissions beginning in 2013. The combination of stronger environmental restrictions, a tax on CO₂ emissions, and aggregate State-level RPS program requirements leads to greater growth in nonhydroelectric renewable generation in the EVA projection than in the other projections in 2015. The *AEO2007* cases reflect EPA's recently enacted CAIR and CAMR regulations. Because *AEO2007* generally includes only current laws and regulations, it does not assume any policies to address CO₂ emissions. As noted above, restrictions on CO₂ emissions could change the mix of technologies used to generate electricity.

Natural Gas

In the *AEO2007* reference case, natural gas consumption is projected to grow steadily through 2020 and then level off as higher projected natural gas prices cause natural gas to lose market share to coal for electricity generation. With the exception of GII, this is a major difference between the *AEO2007* reference and high price cases and the other projections (Table 22), which show natural gas consumption generally increasing throughout the projection period, both overall and for electricity generation. The lowest projected overall growth is in the GII projection, with 2030 consumption that is 2.4 trillion cubic feet less than in the *AEO2007* reference case. The DB, SEER, and Altos projections expect natural gas consumption in 2030 to exceed the *AEO2007* reference case projection by 1.1, 4.1, and 4.8 trillion cubic feet, respectively; the two latter projections even exceed the *AEO2007* low price case projection. Although GII projects less total natural gas consumption than does the *AEO2007* reference case, the GII projection for consumption by electricity generators exceeds that in the *AEO2007* reference case, further highlighting a fundamental difference between the *AEO2007* reference case and the other projections.

Natural gas consumption by electricity generators grows from 2005 to 2015 in all the projections. With the exception of the *AEO2007* reference and high

price cases, the projected growth continues through 2025. DB is the only projection with less growth in natural gas consumption by electricity generators than the *AEO2007* reference case from 2005 to 2015. Natural gas consumption in the DB projection in 2015 is 6 percent below the *AEO2007* reference case value, and the other projections are between 2 percent (GII) and 32 percent (Altos) above the *AEO2007* reference case. In 2025, natural gas consumption by electricity generators in all the other projections exceeds that in the *AEO2007* reference case by 6 percent (DB) to 69 percent (Altos). In 2030, consumption in the other projections is 20 percent (DB) to 109 percent (Altos) higher than in the *AEO2007* reference case. Only the GII and DB projections for natural gas consumption by electricity generators are consistently lower than those in the *AEO2007* low price case.

All the projections show steady growth in natural gas consumption in the combined residential and commercial sectors, with the exception of GII, which expects a slight decline in consumption from 2025 to 2030. The *AEO2007* reference case shows higher industrial natural gas consumption than all the other projections over the entire 2005-2030 period. With the exception of GII and EEA, all the other organizations project growth in industrial natural gas consumption from 2005 to 2015 and through the end of the projection period. Growth in residential, commercial, and industrial natural gas consumption in the *AEO2007* reference case is offset, however, by the decline in natural gas consumption by electricity generators.

Domestic natural gas production is projected to decline in the GII, EVA, and Altos projections over the next decade; in all the other projections it increases over the same period. GII and EVA expect the decline to be reversed in 2025, with production slightly exceeding 2005 production levels. DB and Altos are more pessimistic, projecting that natural gas production will have declined by about 10 percent in 2025 relative to 2005 levels. Altos expects domestic natural gas production in 2030 to be 21 percent below 2005 levels. The *AEO2007* high price case shows domestic natural gas production of 20.9 trillion cubic feet in 2030, one of the more optimistic projections. It is exceeded only by the SEER projection of 21.2 trillion cubic feet in 2030.

With the exception of the *AEO2007* high price case, net imports increase significantly from 2005 to 2030 in all the projections, with increases ranging from

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approximately 50 percent in the *AEO2007* reference case and GII projections to 255 percent in the Altos projection. The increase is expected to come from LNG. With the exception of the DB projection and the *AEO2007* high price case, all the projections show higher LNG imports than the *AEO2007* reference case in 2015. Net LNG imports in 2015 in the Altos projection, at 6.8 trillion cubic feet, are significantly higher than those in the other projections; and Altos remains the most optimistic projection in 2030, at 12.0 trillion cubic feet of net LNG imports. Net LNG imports are 4.5 trillion cubic feet in 2030 in the *AEO2007* reference case, by far the lowest level of

imports of any of the projections, with DB and Altos projecting more than double that level. LNG imports in the *AEO2007* high price case are even lower, at 2.3 trillion cubic feet in 2030. The *AEO2007* reference case also projects the lowest percentage of consumption accounted for by LNG imports. LNG imports account for slightly under 17 percent of total natural gas consumption in 2025 in the *AEO2007* reference case—about the same as in the EEA projection—whereas the other organizations expect LNG imports to account for between 21 and 40 percent of consumption.

Table 22. Comparison of natural gas projections, 2015, 2025, and 2030 (trillion cubic feet, except where noted)

Projection	2005	AEO2007			Other projections					
		Refer- ence	Low price	High price	GII ^a	EVA	EEA ^b	DB	SEER	Altos
2015										
Dry gas production^c	18.23	19.60	19.82	18.77	17.45	17.93	20.42	19.53	18.87	18.19
Net imports	3.57	5.62	6.46	4.81	5.73	7.95	5.40	4.90	6.50	8.06
Pipeline	3.01	2.63	2.48	2.52	NA	3.73	2.26	2.60	2.80	1.22
LNG	0.57	2.99	3.98	2.29	NA	4.22	3.13	2.29	3.70	6.84
Consumption	21.98	25.32	26.40	23.71	23.38	25.67	26.00	24.20	25.37	25.87 ^d
Residential	4.84	5.19	5.29	5.11	4.99	5.14	5.49	5.30	5.12	5.41
Commercial	3.05	3.53	3.65	3.42	3.05	3.11	3.40	3.42	3.18	3.54
Industrial ^e	6.64	7.67	7.71	7.44	6.48	6.95	6.39	7.19	6.99	7.53 ^f
Electricity generators ^g	5.78	7.11	7.89	5.99	7.26	8.50	8.53	6.71	8.10	9.39
Other ^h	1.66	1.83	1.86	1.75	1.61	1.97	2.18	1.59	1.99	NA
Lower 48 wellhead price (2005 dollars per thousand cubic feet)ⁱ	7.51	4.99	4.01	5.83	6.10	5.55	6.51	6.07	5.12	5.60
End-use prices (2005 dollars per thousand cubic feet)										
Residential	12.80	10.55	9.48	11.48	11.28	NA	10.95	NA	10.59	NA
Commercial	11.54	8.73	7.68	9.64	10.05	NA	9.98	NA	8.83	NA
Industrial ^j	8.41	5.82	4.80	6.70	7.87	NA	7.95	NA	6.45	NA
Electricity generators	8.42	5.66	4.74	6.40	6.68	NA	7.54	NA	6.11	NA
2025										
Dry gas production^c	18.23	20.59	20.44	20.73	18.26	18.82	22.61	16.67	20.91	16.41
Net imports	3.57	5.58	8.70	3.32	5.23	9.93	6.28	9.54	7.80	12.59
Pipeline	3.01	1.20	1.58	1.03	NA	2.11	1.24	1.25	1.80	1.10
LNG	0.57	4.38	7.11	2.29	NA	7.82	5.04	8.29	6.00	11.49
Consumption	21.98	26.30	29.27	24.13	23.69	28.53	29.03	26.18	28.71	29.01 ^d
Residential	4.84	5.29	5.38	5.21	4.97	5.18	5.86	5.85	5.64	6.03
Commercial	3.05	3.98	4.06	3.82	3.07	3.42	3.55	3.87	3.45	4.14
Industrial ^e	6.64	8.42	8.09	7.94	6.53	7.95	7.10	7.94	7.66	7.69 ^f
Electricity generators ^g	5.78	6.59	9.71	4.82	7.45	9.74	10.25	6.98	9.78	11.15
Other ^h	1.66	2.02	2.03	1.99	1.67	2.24	2.27	1.54	2.18	NA
Lower 48 wellhead price (2005 dollars per thousand cubic feet)ⁱ	7.51	5.62	4.75	6.70	6.21	6.06	6.83	5.71	5.61	6.96
End-use prices (2005 dollars per thousand cubic feet)										
Residential	12.80	11.30	10.32	12.43	11.21	NA	10.95	NA	11.19	NA
Commercial	11.54	9.23	8.29	10.34	10.02	NA	10.08	NA	9.51	NA
Industrial ^j	8.41	6.40	5.52	7.51	7.91	NA	8.22	NA	7.12	NA
Electricity generators	8.42	6.22	5.56	7.18	6.78	NA	7.85	NA	6.78	NA

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

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For the most part, all the projections expect natural gas wellhead prices to decline significantly from the 2005 level of \$7.51 per thousand cubic feet. The *AEO2007* low price case shows the lowest projection for natural gas wellhead prices in 2015 [174], followed by the *AEO2007* reference case. Natural gas wellhead prices in the *AEO2007* reference and low price cases in 2025 are at or below the levels in all the other projections. Among the other organizations, only DB projects a natural gas wellhead price below that in the *AEO2007* reference case for 2030, and only Altos projects a price that exceeds the 2005 price. In the GII and SEER projections, natural gas wellhead prices in 2030 exceed the *AEO2007* reference case projection by less than 2 percent, and the Altos price projection for 2030 exceeds the *AEO2007* reference case projection by 26 percent.

Delivered natural gas price margins [175] to electricity generators are consistently the lowest in the *AEO2007* high price case and GII projections. Both are notably lower than the historically high margins in 2005. The margins in the SEER projection exceed those in the *AEO2007* reference case in all years by up to 120 percent. While the industrial sector margins in the other projections exceed those in the *AEO2007* reference case in all years by as much as 120 percent [176], the disparity is largely attributable to definitional differences, which can be seen by comparing the 2005 values provided with the other projections. All projections show a decline in industrial margins across the projection period relative to their 2005 values. SEER shows the greatest percentage decline from 2005 to 2025, at 17 percent; EEA shows the smallest decline at 5 percent; and the rest show

Table 22. Comparison of natural gas projections, 2015, 2025, and 2030 (continued)
(trillion cubic feet, except where noted)

Projection	2005	AEO2007			Other projections					
		Refer- ence	Low price	High price	GII ^a	EVA	EEA ^b	DB	SEER	Altos
2030										
Dry gas production^c	18.23	20.53	20.64	20.90	18.27	NA	NA	16.32	21.17	14.33
Net imports	3.57	5.45	8.85	3.17	5.25	NA	NA	10.72	9.08	12.67
Pipeline	3.01	0.92	1.31	0.84	NA	NA	NA	1.25	1.44	0.70
LNG	0.57	4.53	7.54	2.33	NA	NA	NA	9.47	7.64	11.97
Consumption	21.98	26.12	29.74	24.09	23.74	NA	NA	27.20	30.26	30.95 ^d
Residential	4.84	5.31	5.40	5.20	4.92	NA	NA	6.15	5.92	6.34
Commercial	3.05	4.24	4.32	4.01	3.07	NA	NA	4.06	3.56	4.44
Industrial ^e	6.64	8.65	8.34	8.18	6.79	NA	NA	8.34	7.82	7.78 ^f
Electricity generators ^g	5.78	5.92	9.64	4.37	7.27	NA	NA	7.12	10.74	12.39
Other ^h	1.66	2.01	2.05	2.00	1.68	NA	NA	1.52	2.22	NA
Lower 48 wellhead price (2005 dollars per thousand cubic feet)ⁱ	7.51	5.98	5.06	7.63	6.08	NA	NA	5.45	6.07	7.55
End-use prices (2005 dollars per thousand cubic feet)										
Residential	12.80	11.77	10.71	13.52	10.98	NA	NA	NA	11.58	NA
Commercial	11.54	9.58	8.58	11.32	9.81	NA	NA	NA	9.96	NA
Industrial ^j	8.41	6.76	5.82	8.46	7.74	NA	NA	NA	7.58	NA
Electricity generators	8.42	6.51	5.88	8.02	6.65	NA	NA	NA	7.25	NA

NA = not available.

^aPreviously 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; projected values for isolated years may be misleading. ^cDoes not include supplemental fuels. ^dExcludes consumption for transportation and pipeline fuels. ^eIncludes consumption for industrial CHP plants and a small number of electricity-only plants; excludes consumption by nonutility generators. ^fIncludes lease and plant fuel. ^gIncludes 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. ^hIncludes lease, plant, and pipeline fuel and fuel consumed in natural gas vehicles. ⁱ2005 wellhead natural gas prices for EEA, EVA, and DB are \$7.77, \$8.84, and \$8.36, respectively. ^jThe 2005 industrial natural gas prices in other projections are nearly a dollar higher than EIA's.

Sources: **2005 and AEO2007:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A (reference case), LP2007.D112106A (low price case), HP2007.D112106A (high price case). **GII:** Global Insight, Inc., *2006 U.S. Energy Outlook* (November 2006). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2006). **EEA:** Energy and Environmental Analysis, Inc., *EEA's Compass Service Base Case* (October 2006). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on November 27, 2006. **SEER:** Strategic Energy and Economic Research, Inc., *Natural Gas Outlook* (April 2006). **Altos:** Altos Partners North American Regional Gas Model (NARG) Long-Term Base Case (November 2006).

declines of around 13 percent. Residential and commercial sector margins are, on average, about \$5.40 and \$3.70, respectively, with residential sector margins in the *AEO2007* reference case generally higher than those in the projections from other organizations, and commercial sector margins generally lower.

Petroleum

With significantly lower crude oil prices, the DB projections of U.S. petroleum demand in 2015 and 2030 are only 2 percent higher than those in the *AEO2007* reference case (Table 23). In the IEA reference case, total petroleum consumption in 2015 is within 1 percent of the total petroleum consumption in the *AEO2007* reference case; but in 2030, IEA's total petroleum demand projection is 7 percent lower than in the *AEO2007* reference case. Although the crude oil price is almost \$19 per barrel lower than that in the *AEO2007* reference case in 2030, total petroleum demand in the GII projection is lower than in the *AEO2007* reference case throughout the projection period. The GII projection shows the lowest level of petroleum demand among the projections reviewed, lower than the *AEO2007* high price case projection. The *AEO2007* low price case shows the highest levels of total petroleum demand in 2015 and 2030 among all the projections. The *AEO2007* high price case also shows higher petroleum demand than the GII projection in 2030, with projected crude oil prices that are almost \$60 per barrel higher. The extent to which the projections from other organizations reviewed above and summarized in Table 24 incorporate expectations of changes in vehicle efficiency standards or other policy actions that could influence petroleum demand is not clear.

The projection of domestic crude oil production in the *AEO2007* reference case differs significantly from the other projections; rising from 5.2 million barrels in 2005 to a peak of 5.9 million barrels per day in 2017 and then declining to 5.4 million barrels per day in 2030. With the exception of the IEA reference case, domestic crude oil production in the other projections declines throughout the projection period to levels more than a million barrels per day lower than in the *AEO2007* reference case. Domestic crude oil production falls to 3.4 million barrels per day in 2025 in the EVA projection and 3.5 million barrels per day in 2030 in the DB projection. In the IEA projection, domestic crude oil production increases until 2010, then declines to 4.0 million barrels per day in 2030.

The higher crude oil prices in the *AEO2007* reference case alone do not fully explain the differences in the projections for domestic crude oil production. For example, crude oil prices in the IEA projection are slightly higher than in the *AEO2007* reference case from 2012 through 2030, but domestic crude oil production in 2030 is more than 1 million barrels per day below domestic crude oil production in the *AEO2007* reference case. The *AEO2007* low price case, with crude oil prices in the mid-\$30 per barrel range from 2015 through 2030, shows the same pattern of domestic crude oil production as the *AEO2007* reference case. Production rises from current levels, peaks in 2015, and then gradually declines but still ends up slightly higher in 2030 than the current level of production. The *AEO2007* high price case projects increasing domestic crude oil production, peaking in 2030 at more than 6.0 million barrels per day.

The projections also differ on domestic NGL production. In the *AEO2007* reference case, NGL production increases from current levels to a peak of 1.8 million barrels per day in 2017 before falling back to 1.7 million barrels per day in 2030, about equal to the 2005 level. NGL production is 17 percent lower in 2015 in the DB projection and 37 percent lower in 2030 than in the *AEO2007* reference case. The GII projection is more bullish, with 2030 NGL production slightly higher than in the *AEO2007* reference case.

The differences in domestic crude oil production lead to very different conclusions about U.S. dependence on imported petroleum. In the *AEO2007* reference case, the import share of product supplied decreases from 60 percent in 2005 to below 55 percent in 2009 and then slowly rises back to 61 percent in 2030. The share of imported petroleum increases from 2005 levels in the DB and GII projections throughout the projection period, to 77 percent in 2030 in the DB projection and 75 percent in 2030 in the GII projection. Despite higher petroleum demand in the *AEO2007* low price case, the projected import share rises to only 67 percent in 2030. In the *AEO2007* high price case, the import share is projected to decline to 49 percent in 2030, well below 2005 levels.

Coal

The coal consumption, production, and price projections vary considerably, reflecting uncertainty about environmental regulations and economic growth, among many factors (Table 24). The coal projections from the *AEO2007* cases reflect existing environmental regulations, including CAAA90, CAIR, and CAMR,

Comparison with Other Projections

which restrict SO₂, NO_x, and mercury emissions beginning in 2010. The EVA projection incorporates similar regulations and also includes a carbon tax of \$6 per metric ton CO₂ equivalent beginning in 2013. In addition to differences in environmental assumptions, the AEO2007, EVA, and GII projections reflect different assumptions about the outlook for economic

growth rates, the natural gas prices, and world oil prices.

All the projections show increases in total coal consumption over their projection periods. Despite early similarities between the projections, total coal consumption in the AEO2007 reference case after 2015

Table 23. Comparison of petroleum projections, 2015, 2025, and 2030 (million barrels per day, except where noted)

Projection	2005	AEO2007			Other projections			
		Reference	Low price	High price	GII	EVA	DB	IEA
2015								
Crude oil and NGL production	6.90	7.73	8.02	7.41	6.47	6.09	6.28	NA
Crude oil	5.18	5.91	6.18	5.67	4.80	4.45	4.78	5.00
Natural gas liquids	1.72	1.82	1.84	1.74	1.67	1.64	1.50	NA
Total net imports	12.57	12.52	13.29	11.79	13.75	NA	15.37	NA
Crude oil	10.09	10.49	10.62	10.18	NA	NA	NA	NA
Petroleum products	2.48	2.03	2.67	1.61	NA	NA	NA	NA
Petroleum demand	20.75	22.86	23.61	21.87	20.22	NA	23.26	23.10
Motor gasoline	9.16	10.18	10.45	9.53	NA	NA	10.32	NA
Jet fuel	1.68	2.10	2.12	2.08	NA	NA	1.87	NA
Distillate fuel	4.12	4.86	5.04	4.72	NA	NA	4.81	NA
Residual fuel	0.92	0.82	1.03	0.73	NA	NA	0.78	NA
Other	4.87	4.89	4.96	4.81	NA	NA	5.48	NA
Import share of product supplied (percent)	60	55	56	54	68	NA	66	NA
2025								
Crude oil and NGL production	6.90	7.30	7.34	7.68	6.02	4.95	5.11	NA
Crude oil	5.18	5.58	5.60	5.97	4.27	3.35	3.91	NA
Natural gas liquids	1.72	1.72	1.74	1.70	1.75	1.60	1.20	NA
Total net imports	12.57	14.87	16.98	11.70	17.03	NA	19.31	NA
Crude oil	10.09	12.20	13.27	10.19	NA	NA	NA	NA
Petroleum products	2.48	2.67	3.71	1.51	NA	NA	NA	NA
Petroleum demand	20.75	25.34	26.77	23.50	23.05	NA	26.15	NA
Motor gasoline	9.16	11.71	12.26	10.14	NA	NA	11.57	NA
Jet fuel	1.68	2.22	2.24	2.12	NA	NA	2.14	NA
Distillate fuel	4.12	5.48	5.88	5.35	NA	NA	5.47	NA
Residual fuel	0.92	0.82	1.11	0.75	NA	NA	0.83	NA
Other	4.87	5.11	5.29	5.14	NA	NA	6.15	NA
Import share of product supplied (percent)	60	59	64	50	74	NA	74	NA
2030								
Crude oil and NGL production	6.90	7.10	6.98	7.75	5.79	NA	4.62	NA
Crude oil	5.18	5.39	5.25	6.04	4.04	NA	3.53	4.00
Natural gas liquids	1.72	1.72	1.73	1.71	1.75	NA	1.08	NA
Total net imports	12.57	16.37	19.31	12.04	17.03	NA	21.13	NA
Crude oil	10.09	13.09	14.35	10.59	NA	NA	NA	NA
Petroleum products	2.48	3.28	4.95	1.45	NA	NA	NA	NA
Petroleum demand	20.75	26.95	28.84	24.58	22.82	NA	27.54	25.00
Motor gasoline	9.16	12.53	13.23	10.47	NA	NA	12.16	NA
Jet fuel	1.68	2.27	2.29	2.06	NA	NA	2.27	NA
Distillate fuel	4.12	5.95	6.64	5.85	NA	NA	5.81	NA
Residual fuel	0.92	0.83	1.16	0.76	NA	NA	0.85	NA
Other	4.87	5.36	5.53	5.45	NA	NA	6.46	NA
Import share of product supplied (percent)	60	61	67	49	75	NA	77	NA

NA = Not available.

Sources: **2005 and AEO2007**: AEO2007 National Energy Modeling System, runs AEO2007.D112106A (reference case), LP2007.D112106A (low price case), HP2007.D112106A (high price case). **GII**: Global Insight, Inc., *2006 U.S. Energy Outlook* (November 2006). **EVA**: Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2006). **DB**: Deutsche Bank AG, e-mail from Adam Sieminski on November 27, 2006. **IEA**: International Energy Agency, *World Energy Outlook 2006* (Paris, France, November 2006).

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increases more rapidly than in the EVA or GII projections. In the *AEO2007* reference case, total coal consumption grows by 14 percent from 2005 to 2015, to 1,282 million tons in 2015. With more restrictive environmental standards, EVA projects lower levels of total coal consumption (8 percent lower in 2025) than the *AEO2007* reference case. Between 2005 and 2025, coal consumption grows by 2.1 percent per year in the *AEO2007* reference case, which is substantially higher than the 1.3-percent growth rate projected by EVA for the same period. On a Btu basis between 2005 and 2015, GII projects growth in coal consumption similar to that in the *AEO2007* reference case. In 2030, however, coal consumption in the *AEO2007* reference case is 34.1 quadrillion Btu (19 percent) higher than the GII projection of 28.7 quadrillion Btu.

In all the projections, coal consumption in the electricity sector accounts for about 90 percent of total coal use. Coal consumption in the electricity sector in the early years of the EVA and GII projections closely matches that in the *AEO2007* reference case. Both EVA and GII project slower growth in coal consumption for the electric power sector over the entire projection period. EVA projects total coal consumption in the electricity sector at 1,361 million short tons in 2025, 50 million tons less than that in the *AEO2007* reference case. On a Btu basis, the GII projection for coal consumption in the electric power sector is 26.7 quadrillion Btu in 2030, 14 percent less than the 31.1 quadrillion Btu (1,570 million tons) projected for 2030 in the *AEO2007* reference case.

Table 24. Comparison of coal projections, 2015, 2025, and 2030 (million short tons, except where noted)

Projection	2005	AEO2007			Other projections		
		Reference	Low economic growth	High economic growth	GII ^a	EVA	Hill
2015							
Production	1,131	1,266	1,227	1,300	24.3	1,289	NA
Consumption by sector							
Electric power	1,039	1,178	1,151	1,202	22.5	1,179	NA
Coke plants	23	21	20	23	NA	24	NA
Coal-to-liquids	NA	16	6	25	NA	NA	NA
Other industrial/buildings	66	67	66	70	2.1 ^b	73	NA
Total	1,128	1,282	1,243	1,318	24.6	1,276	NA
Net coal exports	21.1	-4.6	-3.6	-7.3	-0.3	2.1	NA
Exports	49.9	37.4	38.4	36.5	NA	44.0	NA
Imports	28.8	42.0	42.0	43.8	NA	41.9	NA
Minemouth price							
(2005 dollars per short ton)	23.34	22.41	22.06	22.82	NA	22.73	19.85 ^c
(2005 dollars per million Btu)	1.15	1.11	1.09	1.13	NA	1.12	0.99 ^c
Average delivered price to electricity generators							
(2005 dollars per short ton)	30.83	31.84	31.43	32.42	NA	34.02 ^d	31.53 ^c
(2005 dollars per million Btu)	1.53	1.60	1.58	1.63	1.42	1.67 ^c	1.57 ^c
2025							
Production	1,131	1,517	1,367	1,669	26.8	1,452	NA
Consumption by sector							
Electric power	1,039	1,411	1,296	1,529	25.1	1,361	NA
Coke plants	23	21	18	24	NA	22	NA
Coal-to-liquids	NA	82	41	110	NA	NA	NA
Other industrial/buildings	66	68	65	71	2.0 ^b	68	NA
Total	1,128	1,582	1,420	1,734	27.1	1,452	NA
Net coal exports	21.1	-52.4	-39.7	-50.8	-0.3	-9.8	NA
Exports	49.9	26.6	35.1	26.6	NA	49.0	NA
Imports	28.8	79.0	74.8	77.4	NA	58.8	NA
Minemouth price							
(2005 dollars per short ton)	23.34	21.55	20.96	22.68	NA	23.77	25.62 ^c
(2005 dollars per million Btu)	1.15	1.09	1.06	1.15	NA	1.18	1.28 ^c
Average delivered price to electricity generators							
(2005 dollars per short ton)	30.83	32.20	30.92	33.39	NA	33.81 ^d	39.08 ^c
(2005 dollars per million Btu)	1.53	1.63	1.57	1.69	1.35	1.68 ^c	1.96 ^c

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

Comparison with Other Projections

The *AEO2007* reference case includes the introduction of CTL technology by 2011. Coal use at CTL plants increases to 112 million tons in 2030 in the *AEO2007* reference case, representing 6 percent of total coal consumption. CTL production does not appear to be included in any of the other projections.

The *AEO2007* reference case shows relatively constant coal consumption levels for other industrial and buildings uses as well as at coke plants, in contrast to the other projections. In the EVA projection, other industrial/buildings coal consumption declines by 7 percent after 2015 to 68 million tons in 2025, nearly the same as the amount projected for 2015 in the *AEO2007* reference case. The *AEO2007* reference case projection for other industrial/buildings consumption in 2025 increases only slightly from 2015, to 68 million tons. Coal consumption at coke plants peaks in 2010 in the EVA projection at 26 million tons, slightly higher than the 22 million tons in the *AEO2007* reference case, then declines over the balance of the projection period. In 2025, the EVA and *AEO2007* reference case projections of coal

consumption are nearly the same for both coke plants and other industrial/buildings. The GII projection for other industrial/buildings includes coal consumption at coke plants. Compared with the *AEO2007* reference case, GII's projection is lower over the entire period, declining after 2010 to 1.9 quadrillion Btu in 2030—8 percent less than projected in the *AEO2007* reference case.

With growing coal demand for electric power generation, most of the projections show an upward trend in minemouth coal prices after 2020; however, Hill & Associates, Inc. (Hill) and EVA project average minemouth coal prices beginning to increase by 2015. Following a 10-year period of declining minemouth coal prices, the *AEO2007* reference case projects prices increasing by 5 percent from 2020 to 2030. Hill projects the lowest minemouth coal price in 2015, but it also projects the highest price in 2025, at \$25.62 per short ton (2005 dollars), with the greatest rate of increase over the projection period. Hill also projects the highest delivered coal price to the electric power sector in 2025, at \$39.08 per short ton, 21 percent

Table 24. Comparison of coal projections, 2015, 2025, and 2030 (continued)
(million short tons, except where noted)

Projection	2005	AEO2007			Other projections		
		Reference	Low economic growth	High economic growth	GII ^a	EVA	Hill
		2030					
Production	1.131	1.691	1.501	1.861	28.3	NA	NA
Consumption by sector							
Electric power	1.039	1.570	1.393	1.712	26.7	NA	NA
Coke plants	23	21	16	25	NA	NA	NA
Coal-to-liquids	NA	112	100	130	NA	NA	NA
Other industrial/buildings	66	69	64	73	1.9 ^b	NA	NA
Total	1.128	1.772	1.573	1.939	28.7	NA	NA
Net coal exports	21.1	-67.8	-59.7	-62.9	-0.4	NA	NA
Exports	49.9	27.2	25.8	26.4	NA	NA	NA
Imports	28.8	94.9	85.4	89.4	NA	NA	NA
Minemouth price							
(2005 dollars per short ton)	23.34	22.60	20.99	23.64	NA	NA	NA
(2005 dollars per million Btu)	1.15	1.15	1.07	1.20	NA	NA	NA
Average delivered price to electricity generators							
(2005 dollars per short ton)	30.83	33.52	31.69	34.57	NA	NA	NA
(2005 dollars per million Btu)	1.53	1.69	1.60	1.74	1.34	NA	NA

Btu = British thermal unit. NA = Not available.

^aCoal quantities provided in quadrillion Btu.

^bIncludes coal consumption at coke plants.

^cConverted from 2006 dollars to 2005 dollars to be consistent with *AEO2007*.

^dCalculated 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: **2005 and AEO2007:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A (reference case), LM2007.D112106A (low economic growth case), and HM2007.D112106A (high economic growth case). **GII:** Global Insight, Inc., *Preliminary 2006 U.S. Energy Outlook* (November 2006). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2006). **Hill:** Hill & Associates, Inc., *2006 Outlook for U.S. Steam Coal Long-Term Forecast* (November 2006).

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greater than in the *AEO2007* reference case. In contrast to the other projections, GII projects declining delivered coal prices to the electric power sector through 2030, falling from \$1.53 per million Btu (2005 dollars) in 2010 to \$1.34 per million Btu in 2030—\$0.26 per million Btu (16 percent) less than in the *AEO2007* low economic growth case.

Coal demand is met primarily through domestic production in all the projections. Both the *AEO2007* and EVA projections show U.S. coal production increasing at an average rate of just over 1 percent per year from 2005 to 2015. EVA projects coal production in 2025 at 1,452 million short tons, 65 million short tons (4 percent) less than in the *AEO2007* reference case. The *AEO2007* reference case shows the largest increase in coal production over the entire projection period, with output reaching 1,691 million tons in 2030, nearly 50 percent higher than in 2005. The GII projection for coal production in 2030 is 5.1 quadrillion Btu (15 percent) below the *AEO2007* reference case projection,

at a level below that in the *AEO2007* low economic growth case.

U.S. coal exports represent a small percentage of domestic coal production in all the projections. EVA projects the highest level of coal exports, 49 million tons in 2025, but in contrast with the other projections shows exports growing after 2010. Coal exports decline to 27 million short tons or less in 2030 in all the *AEO2007* cases. On a Btu basis, coal exports in the GII projection are lower than those in the *AEO2007* reference case in 2030. All the projections expect the United States to become a net importer of coal by 2020, with the *AEO2007* and GII projections anticipating the transition by 2015. U.S. coal imports reach 59 million tons in 2025 in the EVA projection, 20 million tons less than projected in the *AEO2007* reference case. The *AEO2007* reference case projects the highest level of coal imports, more than tripling over the projection period to 95 million tons in 2030.