

## Comparison with Other Projections

Only Global Insights, Inc. (GII) produces a comprehensive energy projection with a time horizon similar to that of *AEO2008*. Other organizations, however, address one or more aspects of the U.S. energy market. 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 *AEO2008* projections.

### Economic Growth

Projections of the average annual GDP growth rate for the United States from 2006 through 2010 range from 2.4 percent to 2.8 percent (Table 7). GDP grows at an annual rate of 2.4 percent in the *AEO2008* reference case over the period, significantly lower than the projections made by the Office of Management and Budget (OMB), the Congressional Budget Office (CBO), the Interindustry Forecasting Project at the University of Maryland (INFORUM), the Social Security Administration (SSA), and Energy Ventures Analysis, Inc. (EVA). The *AEO2008* projection is slightly lower than the projections by the International Energy Agency (IEA) and GII. The consensus Blue Chip projection is for 2.5-percent average annual growth from 2006 to 2010.

The range of GDP growth rates is wider for the period from 2010 to 2015, with projections ranging from 2.3 to 2.9 percent per year. The average annual GDP growth of 2.7 percent in the *AEO2008* reference case from 2010 to 2015 is around the middle of the range. The Blue Chip consensus projection is 2.9 percent, CBO projects 2.8 percent, and EVA projects 2.7 percent for the annual rate of GDP growth from 2010 to 2015. The GII, INFORUM, SSA, and IEA projections all are below the *AEO2008* reference case projection.

**Table 7. Projections of annual average economic growth rates, 2006-2030**

Projection	Average annual percentage growth rates			
	2006-2010	2010-2015	2015-2020	2020-2030
<i>AEO2007 (reference case)</i>	2.9	2.8	3.0	2.8
<i>AEO2008 (reference case)</i>	2.4	2.7	2.4	2.4
GII	2.5	2.5	2.5	2.4
OMB	2.7	NA	NA	NA
CBO	2.6	2.8	NA	NA
Blue Chip	2.5	2.9	NA	NA
INFORUM	2.6	2.5	2.3	2.3
SSA	2.7	2.3	2.1	2.0
EVA	2.8	2.7	2.4	2.1
IEA	2.6	2.6	2.2	2.2

NA = not available.

There are few public or private projections of GDP growth rates for the United States that extend to 2030. The *AEO2008* reference case reflects a GDP growth rate after 2015 that is consistent with the trend in expected labor force and productivity growth.

### World Oil Prices

Comparisons of the *AEO2008* cases with other oil price projections are shown in Table 8. In the *AEO2008* reference case, world oil prices fall from current levels through 2016 and then gradually rise to about \$70 in real terms (2006 dollars). Given current prices, this pattern of falling and then rising oil prices is seen in all the long-term projections, with the exception of GII's, which consistently declines. The world oil price measures are, by and large, comparable across projections. EIA reports the price of imported low-sulfur, light crude oil, approximately the same as the West Texas Intermediate (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 IEA's *World Energy Outlook 2007*, where prices are expressed as the IEA crude oil import price.

Recent volatility in crude oil prices demonstrates the uncertainty inherent in the projections. GII and Deutsche Bank AG (DB) define the range of crude oil price projections for 2030, from a low of about \$46 per barrel (GII) to a high of \$80 per barrel (DB). The *AEO2008* reference case projects a world oil price of about \$70 per barrel in 2030.

### Total Energy Consumption

The *AEO2008* reference case projects growth in end-use consumption of natural gas and coal, in contrast to the decline that occurred from 1980 to 2006 (Table 9). Natural gas consumption increases 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

**Table 8. Projections of world oil prices, 2010-2030 (2006 dollars per barrel)**

Projection	2010	2015	2020	2025	2030
<i>AEO2007 (reference case)</i>	59.21	51.37	53.61	58.07	60.91
<i>AEO2008 (reference case)</i>	74.03	59.85	59.70	64.49	70.45
GII	68.25	61.40	54.80	48.20	45.70
IEA (reference)	59.03	57.30	58.87	60.43	62.00
DB	56.65	60.00	66.00	72.00	80.00
SEER	69.41	58.85	60.83	62.88	65.00

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heating. Coal consumption as a boiler fuel in the commercial and industrial sectors declines 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 becomes competitive at the level of oil prices in the *AEO2008* reference case.

The projected growth in consumption of liquids, including ethanol blends and biodiesel, from 2006 to 2030 is about one-half the average from 1980 to 2006. Transportation is the only sector for which liquids consumption grows significantly, offsetting a moderate decline in the industrial sector. Continued growth in fuel use for transportation is expected despite high prices and newly tightened fuel economy standards. With economic growth, an increasing population, and rising per capita income, demand for personal and freight travel increases. Although the average fuel efficiency of vehicles and airplanes continues to improve, the changes under currently enacted laws and regulations are insufficient to offset the projected increase in transportation demand.

Growth in electricity use continues in the *AEO2008* reference case, but the pace slows to one-half the historical rate. 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 *AEO2008* reference case includes higher growth in primary and delivered energy from 2006 to 2030 than is shown in the outlook from GII. GII projects little growth in end-use natural gas consumption, whereas the *AEO2008* reference case projects continued growth in the industrial and buildings sectors (see Table 11). GII's projected growth rates for liquids consumption are somewhat higher than those in the *AEO2008* reference case, which includes the impacts of EISA2007 on vehicle fuel economy (see Table 12). Differences between the *AEO2008* reference case and the GII projections for end-use coal consumption result from a projected increase in coal use for CTL in the *AEO2008* reference case (see Table 13).

### Electricity

Table 10 provides a summary of the results from the *AEO2008* cases and compares them with other projections. Electricity sales in 2015 range from a low of 4,059 billion kilowatthours in the *AEO2008*

reference case to a high of 4,319 billion kilowatthours in the EVA projection. EVA shows higher sales in the commercial and residential sectors and somewhat less growth in industrial sales than do the *AEO2008* reference case and GII. The projections for total electricity sales in 2030 are about the same (4,705 billion kilowatthours) in the *AEO2008* reference case and GII, which are the only projections available that include 2030. The annual rate of demand growth in both projections is about 1.1 percent per year from 2006 to 2030. In 2030, GII includes lower growth in the commercial sector and higher growth in the residential and industrial sectors compared with the *AEO2008* reference case.

The *AEO2008* 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 higher fossil fuel prices and capital expenditures in the *AEO2008* reference case result in an increase in the average electricity price, from 8.5 cents per kilowatthour in 2015 to 8.8 cents per kilowatthour in 2030. GII shows slightly declining prices over the projection period.

Total generation and imports of electricity in 2015 are similar in the *AEO2008* reference case, EVA, and GII. In contrast, the IEA projection for electricity generation in its *World Energy Outlook 2007* is higher than the other projections. Generation in the IEA projection for the United States (which exclude imports of electricity) are higher than in any of the *AEO2008* cases. Consistent with higher total electricity generation, the IEA projection includes higher

**Table 9. Projections of average annual growth rates for energy consumption, 2006-2030 (percent)**

Energy use	History 1980-2006	Projections	
		AEO2008	GI
<i>Delivered energy*</i>			
<i>Petroleum liquids**</i>	0.9	0.4	0.6
<i>Natural gas</i>	-0.1	0.6	0.3
<i>Coal</i>	-1.7	0.6	-0.1
<i>Electricity</i>	2.2	1.1	1.0
<i>Total</i>	0.7	0.7	0.6
<i>Electricity losses</i>	1.8	0.8	0.4
<i>Primary energy</i>	0.9	0.7	0.6

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

\*\*Includes ethanol and biodiesel used as transportation fuels.

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**Table 10. Comparison of electricity projections, 2015 and 2030 (billion kilowatthours, except where noted)**

Projection	2006	AEO2008 reference case	Other projections		
			GII	EVA	IEA
<b>2015</b>					
<b>Average end-use price (2006 cents per kilowatthour)</b>	<b>8.9</b>	<b>8.5</b>	<b>8.8</b>	<b>NA</b>	<b>NA</b>
Residential	10.4	10.2	10.2	10.98	NA
Commercial	9.5	8.7	9.3	9.82	NA
Industrial	6.1	5.9	6.0	6.37	NA
<b>Total generation plus imports</b>	<b>4,069</b>	<b>4,496</b>	<b>4,531</b>	<b>4,547</b>	<b>4,959</b>
Coal	1,988	2,182	2,171	2,219	2,552
Oil	63	57	64	66	133
Natural gas <sup>a</sup>	811	909	920	936	858
Nuclear	787	807	827	825	849
Hydroelectric/other <sup>b</sup>	403	529	533	486	567
Net imports	18	11	17	15	NA
<b>Electricity sales</b>	<b>3,659</b>	<b>4,059</b>	<b>4,116</b>	<b>4,319</b>	<b>NA</b>
Residential	1,351	1,472	1,553	1,625	NA
Commercial/other <sup>c</sup>	1,306	1,529	1,489	1,683	NA
Industrial	1,002	1,058	1,074	1,011	NA
<b>Capability, including CHP (gigawatts)<sup>d</sup></b>	<b>983</b>	<b>1,016</b>	<b>1,019</b>	<b>1,050</b>	<b>NA</b>
Coal	314	329	326	341	NA
Oil and natural gas	444	437	430	482	NA
Nuclear	100	102	104	104	NA
Hydroelectric/other	125	148	160	123	NA
<b>2030</b>					
<b>Average end-use price (2006 cents per kilowatthour)</b>	<b>8.9</b>	<b>8.8</b>	<b>8.7</b>	<b>NA</b>	<b>NA</b>
Residential	10.4	10.5	10.1	NA	NA
Commercial	9.5	8.9	9.2	NA	NA
Industrial	6.1	6.0	5.8	NA	NA
<b>Total generation plus imports</b>	<b>4,069</b>	<b>5,258</b>	<b>5,180</b>	<b>NA</b>	<b>5,947</b>
Coal	1,988	2,836	2,557	NA	3,148
Oil	63	66	55	NA	102
Natural gas <sup>a</sup>	811	745	905	NA	896
Nuclear	787	917	888	NA	933
Hydroelectric/other <sup>b</sup>	403	670	761	NA	869
Net imports	18	23	14	NA	NA
<b>Electricity sales</b>	<b>3,659</b>	<b>4,705</b>	<b>4,706</b>	<b>NA</b>	<b>NA</b>
Residential	1,351	1,722	1,793	NA	NA
Commercial/other <sup>c</sup>	1,306	1,950	1,724	NA	NA
Industrial	1,002	1,033	1,189	NA	NA
<b>Capability, including CHP (gigawatts)<sup>d</sup></b>	<b>983</b>	<b>1,204</b>	<b>1,086</b>	<b>NA</b>	<b>NA</b>
Coal	314	414	378	NA	NA
Oil and natural gas	444	504	375	NA	NA
Nuclear	100	115	115	NA	NA
Hydroelectric/other	125	172	218	NA	NA

<sup>a</sup>Includes supplemental gaseous fuels. For EVA, represents total oil and natural gas. <sup>b</sup>“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. <sup>c</sup>“Other” includes sales of electricity to government, railways, and street lighting authorities. <sup>d</sup>EIA capacity is net summer capability, including CHP plants. GII capacity is nameplate, excluding cogeneration plants.

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

Sources: **2006 and AEO2008:** AEO2008 National Energy Modeling System, run AEO2008.D030208F. **GII:** Global Insight, Inc., *Global Petroleum Outlook, Fall 2007* (Lexington, MA, November 2007). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2007). **IEA:** International Energy Agency, *World Energy Outlook 2007* (Paris, France, November 2007).

levels of generation from fossil and renewable technologies in 2030 than do the *AEO2008* cases. The requirements for generating capacity are driven by growth in electricity sales and the need to replace existing units that are uneconomical or are being retired for other reasons. Consistent with its projections of electricity sales, EVA shows higher growth in fossil-based generating capacity through 2015 compared with the *AEO2008* reference case and GII; however, EVA projects considerably less renewable capacity in 2015 than do *AEO2008* and GII.

Renewable generating capacity in 2030 is higher in the GII projection than in the *AEO2008* reference case. Nuclear capacity in 2030 is 115 gigawatts in both *AEO2008* and GII, as a result of the incentives included in EPACT2005. The *AEO2008* reference case includes 2.7 gigawatts of uprates for nuclear capacity and 4.5 gigawatts of nuclear plant retirements by 2030 as their operating licenses expire. Environmental regulations are important determinants in the selection of the technologies used for electricity generation. In addition to existing environmental program requirements for electric utilities, EVA assumes that new, stricter national emissions limits will be adopted for emissions of SO<sub>2</sub> and NO<sub>x</sub> by 2015. EVA also includes an escalating penalty on CO<sub>2</sub> emissions, starting at \$6 per ton in 2013.

The *AEO2008* cases include the impact of the EPA's CAIR regulation [90]. Because *AEO2008* includes only current laws and regulations, however, it does not assume any tax on CO<sub>2</sub> emissions. Restrictions on CO<sub>2</sub> emissions could change the mix of technologies used to generate electricity.

### Natural Gas

In the *AEO2008* reference case, total natural gas consumption increases through 2016 and then declines through 2030 as higher natural gas prices cause natural gas to lose market share to coal for electricity generation. With the exception of the Altos and Strategic Energy and Economic Research, Inc. (SEER) projections, all the other projections show total natural gas consumption increasing throughout the projection period (Table 11). Altos shows a slight decline in natural gas consumption after 2025, and SEER shows almost the same level of natural gas consumption in 2025 and 2030.

The *AEO2008* reference case projects the lowest level of natural gas consumption in 2030, followed by GII (about 1.0 trillion cubic feet more than in the

*AEO2008* reference case). The Altos projection includes the highest growth rate for natural gas consumption, reaching 31.4 trillion cubic feet in 2030 (8.7 trillion cubic feet more than in the *AEO2008* reference case). The DB and SEER projections show natural gas consumption in 2030 exceeding the *AEO2008* reference case projection by 1.8 and 2.6 trillion cubic feet, respectively. Although GII projects lower natural gas consumption in 2030 in the residential and commercial sectors than is projected in the *AEO2008* reference case, natural gas consumption for electricity generation in the GII projection is much greater, resulting in higher aggregate natural gas demand than in the *AEO2008* reference case, highlighting a fundamental difference between the *AEO2008* reference case and GII projections. This difference can also be seen in a comparison of the *AEO2008* reference case with the Altos and SEER projections.

Natural gas consumption in the electricity generation sector grows from 2006 to 2015 in all the projections. (DB does not include projections by sector.) Growth in natural gas consumption in the electricity generation sector is projected to continue through 2025 in the EVA and Altos projections. The *AEO2008* reference case shows the lowest level of natural gas consumption for electric power in 2025, at 5.3 trillion cubic feet, followed by GII at 6.9 trillion cubic feet.

All the projections show a decline in natural gas consumption in the electric power sector between 2025 and 2030, with the largest decline in the Altos projection (0.8 trillion cubic feet). Despite the large decline in natural gas consumption in the power sector in the Altos projection, it remains the most optimistic, with 2030 consumption projected to be 13.6 trillion cubic feet—almost three times higher than that in the *AEO2008* reference case. The SEER and GII projections for natural gas consumption in the electric power sector in 2030 are higher than the *AEO2008* reference case projection by 2.0 trillion cubic feet and 1.8 trillion cubic feet, respectively.

Each of the projections—with the exception of GII, which expects a slight decline between 2015 and 2030—shows steady growth in natural gas consumption in the combined residential and commercial sectors. Altos projects the highest level of natural gas consumption in the residential and commercial sectors in 2030 (9.3 trillion cubic feet), followed by SEER (9.0 trillion cubic feet) and the *AEO2008* reference case (8.8 trillion cubic feet). Each of the projections

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shows an increase in natural gas consumption in the industrial sector between 2006 and 2015. That growth is projected to continue through 2025 in each of the projections except for the *AEO2008* reference case. The *AEO2008* projection shows a decline in industrial sector natural gas consumption between 2025 and 2030, whereas the other projections show increases.

Domestic natural gas production increases through 2015 in each of the projections, with Altos showing

the highest production level in 2015, at 21.9 trillion cubic feet. The *AEO2008* reference case and GII show domestic natural gas production continuing to increase through 2025, whereas DB, SEER, and Altos show production declines over the same period. For example, DB shows domestic natural gas production declining by 3.0 trillion cubic feet from 2015 to 2025. All the projections show a decline in production from 2025 to 2030, with DB projecting the lowest level of production in 2030 (3.0 trillion cubic feet lower than in the *AEO2008*

**Table 11. Comparison of natural gas projections, 2015, 2025, and 2030 (trillion cubic feet, except where noted)**

Projection	2006	AEO2008 reference case	Other projections				
			GII	EVA	DB	SEER	Altos
<b>2015</b>							
<b>Dry gas production<sup>a</sup></b>	<b>18.51</b>	<b>19.52</b>	<b>18.66</b>	<b>NA</b>	<b>19.66</b>	<b>20.33</b>	<b>21.90</b>
<b>Net imports</b>	<b>3.46</b>	<b>4.03</b>	<b>4.55</b>	<b>7.81</b>	<b>NA</b>	<b>4.71</b>	<b>6.75</b>
Pipeline	2.94	1.91	1.90	3.05	NA	1.68	2.03
LNG	0.52	2.12	2.65	4.75	3.04	3.03	4.72
<b>Consumption</b>	<b>21.66</b>	<b>23.66</b>	<b>23.36</b>	<b>25.56</b>	<b>23.74</b>	<b>25.79</b>	<b>26.98</b>
Residential	4.37	5.01	4.98	5.06	NA	5.08	5.05
Commercial	2.83	3.20	3.03	3.23	NA	3.12	3.44
Industrial <sup>b</sup>	6.49	7.00	6.65	7.09	NA	6.66	7.54 <sup>c</sup>
Electricity generators <sup>d</sup>	6.24	6.56	6.97	8.24	NA	9.03	10.95
Other <sup>e</sup>	1.73	1.88	1.73	1.94	NA	1.89	NA
<b>Lower 48 wellhead price (2006 dollars per thousand cubic feet)<sup>f</sup></b>	<b>6.42</b>	<b>5.36</b>	<b>6.54</b>	<b>5.49</b>	<b>7.75</b>	<b>6.89</b>	<b>6.07</b>
<b>End-use prices (2006 dollars per thousand cubic feet)</b>							
Residential	13.80	11.54	11.98	NA	NA	11.45	NA
Commercial	11.85	9.97	10.69	NA	NA	9.97	NA
Industrial <sup>g</sup>	7.89	6.33	8.38	NA	NA	6.97	NA
Electricity generators	7.07	6.10	7.15	NA	NA	7.61	NA
<b>2025</b>							
<b>Dry gas production<sup>a</sup></b>	<b>18.51</b>	<b>19.60</b>	<b>18.73</b>	<b>NA</b>	<b>16.68</b>	<b>19.43</b>	<b>19.60</b>
<b>Net imports</b>	<b>3.46</b>	<b>3.28</b>	<b>4.64</b>	<b>9.49</b>	<b>NA</b>	<b>5.48</b>	<b>13.86</b>
Pipeline	2.94	0.68	1.28	2.44	NA	0.44	2.76
LNG	0.52	2.60	3.36	7.05	8.77	5.04	11.10
<b>Consumption</b>	<b>21.66</b>	<b>22.99</b>	<b>23.52</b>	<b>28.21</b>	<b>24.26</b>	<b>25.27</b>	<b>31.70</b>
Residential	4.37	5.19	4.98	5.09	NA	5.31	5.15
Commercial	2.83	3.53	2.98	3.51	NA	3.40	3.87
Industrial <sup>b</sup>	6.49	6.96	6.96	7.99	NA	7.08	8.29 <sup>c</sup>
Electricity generators <sup>d</sup>	6.24	5.30	6.90	9.45	NA	7.49	14.39
Other <sup>e</sup>	1.73	2.02	1.71	2.17	NA	2.00	NA
<b>Lower 48 wellhead price (2006 dollars per thousand cubic feet)<sup>f</sup></b>	<b>6.42</b>	<b>5.86</b>	<b>6.63</b>	<b>5.40</b>	<b>7.75</b>	<b>6.40</b>	<b>7.00</b>
<b>End-use prices (2006 dollars per thousand cubic feet)</b>							
Residential	13.80	12.29	11.89	NA	NA	11.13	NA
Commercial	11.85	10.78	10.63	NA	NA	9.40	NA
Industrial <sup>g</sup>	7.89	6.76	8.42	NA	NA	6.47	NA
Electricity generators	7.07	6.44	7.20	NA	NA	7.03	NA

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

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reference case). The *AEO2008* reference case shows domestic natural gas production of 19.4 trillion cubic feet in 2030—the highest of all the projections.

Net imports of natural gas are projected to increase between 2006 and 2015 in each of the projections. EVA projects the highest level of net imports at 7.8 trillion cubic feet, followed by Altos at 6.8 trillion cubic feet. The *AEO2008* reference case shows a drop in net imports between 2015 and 2030. Each of the other projections shows net imports increasing steadily from 2006 to 2030 (Altos expects an increase of 12.1 trillion cubic feet over the period). In addition, all the projections show the increases in net imports coming primarily from LNG. Altos projects LNG net import levels in 2030 that are more than four times higher than in the *AEO2008* reference case, at 12.6 trillion cubic feet. The projections have LNG imports accounting for between 13 and 40 percent of consumption in 2030.

Given that the average wellhead price for natural gas in 2006 was \$6.42 per thousand cubic feet, each of the projections shows a decline in natural gas prices between 2006 and 2015, except GII, DB, and SEER. The *AEO2008* reference case projects the lowest average wellhead prices in 2015, at \$5.36 per thousand cubic feet. EVA's natural gas price projection for 2025 is lower than that in the *AEO2008* reference case, by about \$0.46 per thousand cubic feet. DB consistently projects relatively high average wellhead prices between 2006 and 2030. Among the other projections, only GII and SEER project an average natural gas wellhead price below that in the *AEO2008* reference case in 2030. In the GII and SEER projections, natural gas wellhead prices in 2030 are below the *AEO2008* reference case projection by \$0.15 and \$0.13 per thousand cubic feet, respectively, and wellhead prices in the DB and Altos projections exceed the *AEO2008* reference case projection by \$1.12 and \$0.82 per thousand cubic feet, respectively.

**Table 11. Comparison of natural gas projections, 2015, 2025, and 2030 (continued)**  
(trillion cubic feet, except where noted)

Projection	2006	AEO2008 reference case	Other projections				
			GII	EVA	DB	SEER	Altos
<b>2030</b>							
<b>Dry gas production<sup>a</sup></b>	<b>18.51</b>	<b>19.43</b>	<b>18.68</b>	<b>NA</b>	<b>16.44</b>	<b>18.63</b>	<b>18.90</b>
<b>Net imports</b>	<b>3.46</b>	<b>3.18</b>	<b>4.86</b>	<b>NA</b>	<b>NA</b>	<b>6.33</b>	<b>15.57</b>
Pipeline	2.94	0.33	0.76	NA	NA	0.20	2.95
LNG	0.52	2.84	4.10	NA	9.84	6.13	12.62
<b>Consumption</b>	<b>21.66</b>	<b>22.72</b>	<b>23.69</b>	<b>NA</b>	<b>24.53</b>	<b>25.29</b>	<b>31.42</b>
Residential	4.37	5.17	4.94	NA	NA	5.44	5.17
Commercial	2.83	3.67	2.97	NA	NA	3.57	4.12
Industrial <sup>b</sup>	6.49	6.87	7.18	NA	NA	7.29	8.50 <sup>c</sup>
Electricity generators <sup>d</sup>	6.24	4.99	6.83	NA	NA	6.98	13.63
Other <sup>e</sup>	1.73	2.02	1.76	NA	NA	2.01	NA
<b>Lower 48 wellhead price (2006 dollars per thousand cubic feet)<sup>f</sup></b>	<b>6.42</b>	<b>6.63</b>	<b>6.48</b>	<b>NA</b>	<b>7.75</b>	<b>6.50</b>	<b>7.45</b>
<b>End-use prices (2006 dollars per thousand cubic feet)</b>							
Residential	13.80	13.30	11.67	NA	NA	11.30	NA
Commercial	11.85	11.78	10.42	NA	NA	9.44	NA
Industrial <sup>g</sup>	7.89	7.50	8.26	NA	NA	6.53	NA
Electricity generators	7.07	7.13	7.05	NA	NA	6.28	NA

NA = not available.

<sup>a</sup>Does not include supplemental fuels. <sup>b</sup>Includes consumption for industrial CHP plants, a small number of electricity-only plants, and GTL plants for heat and power production; excludes consumption by nonutility generators. <sup>c</sup>Includes lease and plant fuel. <sup>d</sup>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. <sup>e</sup>Includes lease, plant, and pipeline fuel and fuel consumed in natural gas vehicles. <sup>f</sup>2006 wellhead natural gas prices for GII, DB, and SEER are \$6.41, \$6.42, and \$6.24 per thousand cubic feet, respectively. <sup>g</sup>The 2006 industrial natural gas price for GII is \$8.89 per thousand cubic feet.

Sources: **2006 and AEO2008:** AEO2008 National Energy Modeling System, run AEO2008.D030208F. **GII:** Global Insight, Inc., *2007 U.S. Energy Outlook* (October 2007). **EVA:** Energy Ventures Analysis, Inc., *FUELCAS: Long-Term Outlook* (August 2007). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on November 18, 2007. **SEER:** Strategic Energy and Economic Research, Inc., *Natural Gas Scenarios* (March 2008). **Altos:** Altos World Gas Trade (September 2007).

## Comparison with Other Projections

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The price margins for delivered natural gas can vary significantly from year to year. In 2006, margins in the residential, commercial, industrial, and transportation sectors were notably higher than the historical average, and margins in the electricity generation sector were somewhat lower than the historical average. Starting from a level more representative of the historical average, margins in the electricity generation and industrial sectors generally decline in the *AEO2008* reference case. In contrast, margins in the residential and commercial sectors increase, because the fixed costs are spread over lower per-customer volumes as consumption is reduced by efficiency improvements.

End-use prices in the GII and SEER projections imply declining margins in all sectors, with the exception of the residential and electricity generation sectors in the SEER projection, which increase from 2025 to 2030. As a result, the GII and SEER margins in the residential and commercial sectors are lower than those in the *AEO2008* reference case projection by between \$1.20 and \$2.20 per thousand cubic feet in 2030. The industrial margin in the GII projection remains appreciably higher throughout the projection period, whereas the industrial margin in the SEER projection is between \$0.83 and \$0.90 per thousand cubic feet lower than the margins in the *AEO2008* reference case projection from 2015 to 2030. In fact, the SEER industrial margins appear to be only a few pennies in all years.

### Petroleum

In the DB projection, real crude oil prices increase from \$57 per barrel in 2010 to \$80 per barrel in 2030. In the *AEO2008* reference case, real prices decline from current levels to a low of \$57 per barrel in 2016 before recovering to \$70 per barrel in 2030 (Table 8).

Despite the higher crude oil prices in 2030, the import share of product supplied is much higher in the DB projection than in the *AEO2008* reference case (74 percent and 54 percent, respectively). Although this may seem counterintuitive given the relative price projections, it makes sense in terms of the projections for domestic crude oil production. In the DB projection, U.S. crude oil production declines sharply after 2015, to 4.8 million barrels per day in 2030 (as compared with 7.2 million barrels per day in 2030 in the *AEO2008* reference case) (Table 12). In fact, U.S. crude oil production is lower in all the other projections than in the *AEO2008* reference case.

It is clear that expectations about U.S. crude oil production potential are among the main factors accounting for the differences between the *AEO2008* reference case and the other projections. In addition, unlike the DB analysis, the *AEO2008* reference case incorporates the effects of the new RFS mandate under EISA2007, which was signed into law in December 2007. With the new RFS mandate, biofuel consumption is projected to increase significantly through 2022, with more than 23 billion gallons of ethanol and almost 4 billion gallons of biomass-based diesel consumed in 2030, which would displace a significant amount of fossil fuel use in the transportation sector and, thereby, further reduce imports.

GII's long-term projections for the crude oil price in 2025 (\$48 per barrel) and 2030 (\$46 per barrel) are much lower than those in the *AEO2008* reference case (see Table 8). The GII projection for import share of product supplied is therefore higher than the *AEO2008* reference case projection.

In contrast with crude oil production, projections for NGL production are similar (remaining relatively constant) in the EVA, GII, and *AEO2008* reference case projections through 2030. The exception is DB, which projects a 26-percent decrease in domestic NGL production from 2015 to 2030.

Based on expectations of continued economic growth, all the petroleum projections show continued growth in product demand; however, growth in demand for individual petroleum products varies considerably. In particular, motor gasoline demand, which in the DB projections increases to 11.2 million barrels per day in 2030, is much lower in the GII and *AEO2008* reference case projections. Motor gasoline demand declines over time in the GII and *AEO2008* reference case projections (although it increases slightly from 2025 to 2030 in the *AEO2008* reference case). The GII projection includes a substantial increase in ethanol use (not shown in the Table 12) stemming from new, unspecified motor fuel policies, with ethanol making up more than 30 percent of total U.S. motor gasoline sales in 2030. A 30-percent share is in excess of even the new RFS mandate incorporated in *AEO2008*.

Looking at other petroleum products, the GII projections for jet fuel and distillate demand are higher than those in the DB and *AEO2008* reference case projections. The most likely explanation is that, although long-term GDP growth rates are similar in

## Comparison with Other Projections

**Table 12. Comparison of petroleum projections, 2015, 2025, and 2030 (million barrels per day, except where noted)**

Projection	2006	AEO2008 reference case	Other projections			
			GII	EVA	DB	IEA
<b>2015</b>						
<b>Crude oil and NGL production</b>	<b>6.84</b>	<b>7.86</b>	<b>6.37</b>	<b>7.40</b>	<b>6.47</b>	<b>6.70</b>
Crude oil	5.10	6.16	4.63	5.60	4.92	NA
Natural gas liquids	1.74	1.70	1.75	1.80	1.55	NA
<b>Total net imports</b>	<b>12.45</b>	<b>11.36</b>	<b>13.79</b>	<b>NA</b>	<b>14.00</b>	<b>NA</b>
Crude oil	10.09	9.89	12.02	NA	NA	NA
Petroleum products	2.36	1.47	1.77	NA	NA	NA
<b>Petroleum demand</b>	<b>20.65</b>	<b>21.68</b>	<b>22.36</b>	<b>NA</b>	<b>22.07</b>	<b>22.45</b>
Motor gasoline	9.25	9.73	9.83	NA	9.84	NA
Jet fuel	1.63	1.85	1.92	NA	1.71	NA
Distillate fuel	4.17	4.68	4.79	NA	4.63	NA
Residual fuel	0.69	0.69	0.68	NA	0.71	NA
Other	4.91	4.73	5.14	NA	5.18	NA
<b>Import share of product supplied (percent)</b>	<b>60</b>	<b>52</b>	<b>62</b>	<b>NA</b>	<b>63</b>	<b>NA</b>
<b>2025</b>						
<b>Crude oil and NGL production</b>	<b>6.84</b>	<b>7.65</b>	<b>5.47</b>	<b>5.80</b>	<b>5.28</b>	<b>NA</b>
Crude oil	5.10	6.04	3.71	4.10	4.01	NA
Natural gas liquids	1.74	1.61	1.75	1.70	1.27	NA
<b>Total net imports</b>	<b>12.45</b>	<b>11.38</b>	<b>15.13</b>	<b>NA</b>	<b>17.25</b>	<b>NA</b>
Crude oil	10.09	10.11	13.70	NA	NA	NA
Petroleum products	2.36	1.27	1.43	NA	NA	NA
<b>Petroleum demand</b>	<b>20.65</b>	<b>22.25</b>	<b>23.54</b>	<b>NA</b>	<b>24.25</b>	<b>NA</b>
Motor gasoline	9.25	8.84	9.08	NA	10.77	NA
Jet fuel	1.63	2.16	2.36	NA	1.90	NA
Distillate fuel	4.17	5.19	5.98	NA	5.16	NA
Residual fuel	0.69	0.69	0.65	NA	0.75	NA
Other	4.91	5.37	5.47	NA	5.67	NA
<b>Import share of product supplied (percent)</b>	<b>60</b>	<b>51</b>	<b>64</b>	<b>NA</b>	<b>71</b>	<b>NA</b>
<b>2030</b>						
<b>Crude oil and NGL production</b>	<b>6.84</b>	<b>7.16</b>	<b>5.05</b>	<b>NA</b>	<b>4.78</b>	<b>6.30</b>
Crude oil	5.10	5.59	3.30	NA	3.63	NA
Natural gas liquids	1.74	1.57	1.75	NA	1.15	NA
<b>Total net imports</b>	<b>12.45</b>	<b>12.29</b>	<b>15.63</b>	<b>NA</b>	<b>18.75</b>	<b>NA</b>
Crude oil	10.09	11.03	14.51	NA	NA	NA
Petroleum products	2.36	1.26	1.12	NA	NA	NA
<b>Petroleum demand</b>	<b>20.65</b>	<b>22.80</b>	<b>24.04</b>	<b>NA</b>	<b>25.30</b>	<b>23.87</b>
Motor gasoline	9.25	8.91	8.47	NA	11.20	NA
Jet fuel	1.63	2.31	2.61	NA	2.00	NA
Distillate fuel	4.17	5.53	6.69	NA	5.43	NA
Residual fuel	0.69	0.70	0.63	NA	0.77	NA
Other	4.91	5.35	3.35	NA	5.90	NA
<b>Import share of product supplied (percent)</b>	<b>60</b>	<b>54</b>	<b>65</b>	<b>NA</b>	<b>74</b>	<b>NA</b>

NA = Not available.

Sources: **2006 and AEO2008:** AEO2008 National Energy Modeling System, run AEO2008.D030208F. **GII:** Global Insight, Inc., *2007 U.S. Energy Outlook* (October 2007). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2007). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on November 18, 2007. **IEA:** International Energy Agency, *World Energy Outlook 2007* (Paris, France, November 2007).

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the GII and *AEO2008* projections, the long-term cost of crude oil, as noted above, is much lower in the GII projection, leading to cheaper refined products and therefore higher demand. Finally, among the outside projections, IEA projects the lowest level of U.S. petroleum demand in 2030—probably as a result of IEA’s assumption of slower U.S. economic growth. Further, although IEA’s projection for U.S. petroleum demand in 2030 (23.9 million barrels per day) is higher than in the *AEO2008* reference case (22.8 million barrels per day), it would in fact be about 1 million barrels per day *lower* if *AEO2008* had not included the EISA2007 RFS mandate.

### Coal

Coal production, trade, and price projections vary considerably across the three projections shown in Table 13. The coal projection in the *AEO2008* reference case reflects existing environmental laws that regulate SO<sub>2</sub>, NO<sub>x</sub>, and mercury emissions. The *AEO2008* reference case projections for coal consumption, production, and imports are generally higher than the projections from other sources.

All the projections show increases in total coal consumption over their projection periods. In the *AEO2008* reference case, total coal consumption

**Table 13. Comparison of coal projections, 2015, 2025, and 2030 (million short tons, except where noted)**

Projection	2006	AEO2008 reference case	Other projections	
			GIJ	EVA
<b>2015</b>				
<b>Production</b>	<b>1,163</b>	<b>1,215</b>	<b>1,135</b>	<b>1,225</b>
<b>Consumption by sector</b>				
Electric power	1,026	1,125	1,055	1,121
Coke plants	23	21	23	23
Coal-to-liquids	0	16	NA	NA
Other industrial/buildings	65	64	65	71
<b>Total</b>	<b>1,114</b>	<b>1,225</b>	<b>1,143</b>	<b>1,216</b>
<b>Net coal exports</b>	<b>15.3</b>	<b>3.3</b>	<b>-8.0</b>	<b>13.2</b>
Exports	49.6	45.3	31.8	45.9
Imports	34.3	42.0	39.7	32.7
<b>Minemouth price</b>				
(2006 dollars per short ton)	24.63	23.38	19.68	25.14
(2006 dollars per million Btu)	1.21	1.17	0.94 <sup>a</sup>	1.23
<b>Average delivered price to electricity generators</b>				
(2006 dollars per short ton)	33.85	34.24	31.92	NA
(2006 dollars per million Btu)	1.69	1.74	1.52 <sup>a</sup>	NA
<b>2025</b>				
<b>Production</b>	<b>1,163</b>	<b>1,363</b>	<b>1,140</b>	<b>1,311</b>
<b>Consumption by sector</b>				
Electric power	1,026	1,303	1,058	1,224
Coke plants	23	20	22	21
Coal-to-liquids	0	46	NA	NA
Other industrial/buildings	65	62	66	67
<b>Total</b>	<b>1,114</b>	<b>1,431</b>	<b>1,146</b>	<b>1,311</b>
<b>Net coal exports</b>	<b>15.3</b>	<b>-57.3</b>	<b>-5.9</b>	<b>-1.9</b>
Exports	49.6	35.5	31.1	43.3
Imports	34.3	92.8	36.9	45.2
<b>Minemouth price</b>				
(2006 dollars per short ton)	24.63	22.75	18.75	26.49
(2006 dollars per million Btu)	1.21	1.16	0.89 <sup>a</sup>	1.31
<b>Average delivered price to electricity generators</b>				
(2006 dollars per short ton)	33.85	34.03	30.61	NA
(2006 dollars per million Btu)	1.69	1.74	1.46 <sup>a</sup>	NA

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

## Comparison with Other Projections

grows by an average of 1.1 percent annually from 2006 to 2015, to 1,225 million tons in 2015. Although the reference case projection is 82 million tons higher than the corresponding projection from GII, it is similar to the EVA projection for total coal consumption in 2015. For 2025, both EVA and GII project lower levels of total coal consumption than the *AEO2008* reference case (8 percent and 20 percent lower, respectively). For 2030, GII projects total coal consumption of 1,175 million tons, 370 million tons less than in the *AEO2008* reference case.

Coal use in the electricity sector accounts for a large percentage of total coal consumption in all years across all the projections. Relative to the *AEO2008* 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 of 1,224 million tons in 2025, 79 million tons less than in the *AEO2008* reference case. The GII projection for coal consumption in the electric power sector is 1,088 million tons in 2030, 313 million tons less than in the *AEO2008* reference case.

The *AEO2008* reference case includes the introduction of CTL production before 2015, with coal use at

CTL plants increasing to 64 million tons (4 percent of total coal consumption) in 2030. Projections for CTL production from the other organizations are not available for comparison [91].

The *AEO2008* reference case, GII, and EVA projections show relatively constant coal consumption levels both at coke plants and in the other industrial/buildings sector. The EVA projections do not extend to 2030. GII shows 21 million tons of coal consumption at coke plants and 66 million tons in the other industrial/buildings sector in 2030, both somewhat higher than in the *AEO2008* reference case (18 and 62 million tons, respectively).

In the *AEO2008* reference case, minemouth coal prices are generally flat over the projection period. EVA projects an increase to \$26.49 in 2025, the highest among the projections compared, whereas the *AEO2008* reference case projection for 2025 is \$22.75 per ton. In GII's projection, the minemouth coal price falls to \$18.42 per ton in 2030. GII also projects a decline in delivered coal prices to the electric power sector through 2030, from \$31.92 per ton in 2015 to \$30.42 per ton in 2030—\$4.61 per ton less than in the *AEO2008* reference case.

**Table 13. Comparison of coal projections, 2015, 2025, and 2030 (continued)**  
(million short tons, except where noted)

Projection	2006	AEO2008 reference case	Other projections	
			GI	EVA
			<b>2030</b>	
<b>Production</b>	<b>1,163</b>	<b>1,455</b>	<b>1,168</b>	<b>NA</b>
<b>Consumption by sector</b>				
Electric power	1,026	1,401	1,088	NA
Coke plants	23	18	21	NA
Coal-to-liquids	0	64	NA	NA
Other industrial/buildings	65	62	66	NA
<b>Total</b>	<b>1,114</b>	<b>1,545</b>	<b>1,175</b>	<b>NA</b>
<b>Net coal exports</b>	<b>15.3</b>	<b>-77.7</b>	<b>-7.0</b>	<b>NA</b>
Exports	49.6	34.6	30.8	NA
Imports	34.3	112.3	37.8	NA
<b>Minemouth price</b>				
(2006 dollars per short ton)	24.63	23.32	18.42	NA
(2006 dollars per million Btu)	1.21	1.19	0.88 <sup>a</sup>	NA
<b>Average delivered price to electricity generators</b>				
(2006 dollars per short ton)	33.85	35.03	30.42	NA
(2006 dollars per million Btu)	1.69	1.78	1.45 <sup>a</sup>	NA

Btu = British thermal unit. NA = Not available.

<sup>a</sup>Imputed using heat conversion factor implied by US steam coal consumption figures for the electricity sector.

Sources: **2006 and AEO2008:** AEO2008 National Energy Modeling System, run AEO2008.D030208F. **GI:** Global Insight, Inc., 2007 U.S. Energy Outlook (October 2007). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2007).

## Comparison with Other Projections

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In the *AEO2008* and EVA projections, domestic coal production increases to meet rising demand. Production grows most rapidly in the *AEO2008* reference case, averaging 0.9 percent per year from 2006 to 2030. The EVA projection through 2025 closely resembles that in the *AEO2008* reference case, and the GII projection is significantly lower. In the GII projection, coal production totals 1,168 million tons in 2030, 20 percent less than in the *AEO2008* reference case (1,455 million tons).

U.S. coal exports represent a small percentage of domestic coal production in all the projections. Coal exports decline to less than 35 million tons in 2030 in the *AEO2008* reference case and GII projections, and the United States is represented as a net importer of coal after 2015 in all the projections. In the EVA projection, U.S. coal imports increase to 45 million tons in 2025, and exports are 43 million tons in 2025. In the *AEO2008* reference case, U.S. coal imports in 2015, 2025, and 2030 are higher than in the other projections.

