Comparison With Other Projections

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Only IHS Global Insight (IHSGI) produces a comprehensive energy projection with a time horizon similar to that of *AEO2009*. Other organizations, however, address one or more aspects of the U.S. energy market. The most recent projection from IHSGI, 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 *AEO2009* projections.

Economic Growth

Projections of the average annual real GDP growth rate for the United States from 2007 through 2010 range from 0.2 percent to 3.1 percent (Table 15). Real GDP grows at an annual rate of 0.6 percent in the *AEO2009* reference case over the period, significantly lower than the projections made by the Office of Management and Budget (OMB), the Bureau of Labor Statistics (BLS), and the Social Security Administration (SSA)—although not all of those projections have been updated to take account of the current economic downturn. The *AEO2009* projection is slightly lower than the projection by IHSGI and slightly higher than the projection by the Interindustry Forecasting Project at the University of Maryland (INFORUM). In March 2009, the consensus Blue Chip projection was for 2.2-percent average annual growth from 2007 to 2010.

The range of GDP growth rates is narrower for the period from 2010 to 2015, with projections ranging from 2.1 to 3.8 percent per year. The average annual GDP growth of 3.2 percent in the *AEO2009* reference case from 2010 to 2015 is mid-range, with the Congressional Budget Office (CBO) projecting a stronger recovery from the recession. CBO projects average annual GDP growth of 3.8 percent, IHSGI projects growth of 3.1 percent, and the INFORUM, SSA, and International Energy Agency (IEA) projections all project growth that is below the *AEO2009* reference case projection.

There are few public or private projections of GDP growth for the United States that extend to 2030. The *AEO2009* reference case projects 2.5-percent average annual GDP growth from 2007 to 2030, consistent with the trend in expected labor force and productivity growth. IHSGI projects GDP growth from 2007 to 2030 at 2.4 percent, and INFORUM expects lower GDP growth at 2.2 percent over the same period. INFORUM also projects lower growth in productivity and the labor force.

Table 15. Projections of annual average economic growth rates, 2007-2030

Projection	Average annual percentage growth rates			
	2007-2010	2010-2015	2015-2020	2020-2030
AEO2008 (reference case)	2.5	2.7	2.4	2.4
AEO2009 (reference case)	0.6	3.2	2.6	2.6
IHSGI (November 2008)	0.7	3.1	2.8	2.5
OMB (June 2008)	2.9	2.9	NA	NA
CBO (January 2009)	0.2	3.8	2.3	NA
INFORUM (December 2008)	0.4	2.8	2.3	2.3
SSA (May 2008)	2.6	2.4	2.3	2.1
BLS (November 2007)	3.1	2.4	NA	NA
IEA (November 2008)	NA	2.1	NA	2.1
Blue Chip Consensus (March 2009)	2.2	2.8	2.7	NA

NA = not available.

World Oil Prices

Comparisons of the *AEO2009* cases with other oil price projections are shown in Table 16. In the *AEO2009* reference case, world oil prices rise from current levels to approximately $80 per barrel in 2010 and $110 per barrel in 2015. After 2015, prices increase to $130 per barrel in 2030. This price trend is higher than shown in the *AEO2008* reference case and, generally, more consistent with the *AEO2008* high oil price case.

Market volatility and different assumptions about the future of the world economy are reflected in the range of price projections for both the short term and the long term. The projections trend in different directions, with one group, the Institute of Energy Economics and the Rational Use of Energy at the University of Stuttgart (IER), showing prices stabilizing at around $70 per barrel by 2020 and remaining relatively constant through 2030 and another group, Energy Ventures Analysis, Inc. (EVA), showing prices rising steadily over the entire course of the projection period. Excluding the *AEO2009* reference case, the other projections range from $47 per barrel

Table 16. Projections of world oil prices, 2010-2030 (2007 dollars per barrel)

Projection	2010	2015	2020	2025	2030
AEO2008 (reference case)	75.97	61.41	61.26	66.17	72.29
AEO2008 (high price case)	81.08	92.77	104.74	112.10	121.75
AEO2009 (reference case)	80.16	110.49	115.45	121.94	130.43
DB	47.43	72.20	66.09	68.27	70.31
IHSGI	101.99	97.60	75.18	71.33	68.14
IEA (reference)	100.00	100.00	110.00	116.00	122.00
IER	65.24	67.03	70.21	72.37	74.61
EVA	57.09	74.61	95.33	105.25	116.21
SEER	54.82	98.40	89.88	82.10	75.00

to $102 per barrel in 2010, a span of $55 per barrel, and from $68 per barrel to $122 per barrel in 2030, a span of $54 per barrel. The wide range of the projections reflects the recent volatility of crude oil prices and the uncertainty inherent in the projections. The range of the other projections is encompassed in the range of the *AEO2009* low and high oil price cases, from $50 per barrel to $200 per barrel in 2030.

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 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 2008*, where prices are expressed as the IEA crude oil import price.

Total Energy Consumption

Both the *AEO2009* reference case and IHSGI projections show total energy consumption growing by 0.5 percent per year from 2007 to 2030. Given different totals for 2007, total energy consumption in 2030 in the IHSGI projection is about 1 quadrillion Btu lower than in the reference case. Growth rates by sector, however, differ between the two sets of projections (Table 17).

As shown in Table 16, energy prices in 2030 are higher in *AEO2009* than in the IHSGI projection. IHSGI's world oil price track is closer to the *AEO2009* low oil price case than the reference case. IHSGI's natural gas, coal, and electricity prices all are lower than those in the *AEO2009* reference case, but by a smaller percentage than the difference between the world oil price projections. As a result, IHSGI projects stronger growth in petroleum consumption, a key factor in its higher projections for energy consumption in the residential and industrial sectors. The *AEO2009* reference case includes stronger growth in the commercial and transportation sectors than the IHSGI projection.

In the residential sector, natural gas and electricity use in the IHSGI projection both grow significantly faster than in the *AEO2009* reference case. Factors slowing growth in the *AEO2009* reference case include increased lighting efficiency, a switch to a 10-year average from a 30-year average for heating and cooling degree-days, and a more detailed breakout for televisions, personal computers, and related equipment that better accounts for efficiency changes. In both projections, total housing stock grows by about 1.0 percent per year from 2007 to 2030.

The commercial sector is the least reliant on liquid fuels among the end-use sectors, and the difference in world oil prices between IHSGI and the *AEO2009* has the least impact on projections for commercial energy use. In the *AEO2009* reference case, commercial energy demand is driven by growth in commercial floorspace (divided into 11 building types), as well as by weather, population, and disposable income. Total commercial floorspace grows by 1.3 percent per year in the reference case. IHSGI cites commercial energy use per employee, which grows by 1.0 percent per year, about the same as in *AEO2009*. Consumption growth for both natural gas and electricity is higher in *AEO2009*, despite slightly higher prices. One aspect that could account for this difference is that IHSGI projects a population growth rate slightly below 0.8 percent per year from 2007 to 2030, as compared with 0.9 percent per year in the *AEO2009* reference case. For the industrial sector, IHSGI expects lower energy prices and more rapid growth in output, leading to more rapid increases in consumption of petroleum, natural gas, and electricity, than are projected in *AEO2009*.

Table 17. Projections of energy consumption by sector, 2007 and 2030 (quadrillion Btu)

	2007		2030		Average annual percentage growth, 2007-2030	
Sector	**AEO2009**	**IHSGI**	**AEO2009**	**IHSGI**	**AEO2009**	**IHSGI**
Residential	11.4	10.9	12.4	13.0	0.4	0.8
Commercial	8.5	8.4	10.6	9.9	1.0	0.7
Industrial	25.3	23.0	26.3	25.6	0.2	0.5
Transportation	28.8	28.5	31.9	30.0	0.4	0.2
Electric power	40.7	42.1	48.0	49.9	0.7	0.7
Less: electricity losses	-12.8	-12.8	-15.7	-16.1	—	—
Total primary energy	**101.9**	**100.1**	**113.6**	**112.3**	**0.5**	**0.5**

More than 97 percent of the energy consumed in the transportation sector in 2007 came from liquid fuels. Despite lower world oil prices in the IHSGI projection, the *AEO2009* reference case projects more rapid growth in transportation energy consumption. In both the *AEO2009* and IHSGI projections, an increase in diesel fuel use is offset by a decrease in motor gasoline use; however, the offset is more than 1 quadrillion Btu larger in the IHSGI projection. A more rapid increase in jet fuel consumption is projected by IHSGI, in line with its lower fuel prices.

Electricity

Table 18 provides a summary of the results from the *AEO2009* cases and compares them with other projections. For 2015, electricity sales range from a low of 3,960 billion kilowatthours in the *AEO2009* reference case to a high of 4,475 billion kilowatthours in the projection from IER, which also shows higher sales in the commercial and residential sectors and much higher growth in industrial sales than the *AEO2009* reference case. For 2030, both IHSGI and IER have higher projections for total electricity sales in 2030 than the 4,609 billion kilowatthours in the *AEO2009* reference case. IHSGI and IER also project higher residential and industrial sales in 2030 than the *AEO2009* reference case. IER projects commercial sales that are higher than both IHSGI and the *AEO-2009* reference case.

The *AEO2009* reference case shows declining real electricity prices after 2009 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 *AEO2009* reference case result in an increase in the average electricity price from 9.1 cents per kilowatthour in 2015 to 10.4 cents per kilowatthour in 2030. IER and IHSGI show declining electricity prices between 2015 and 2030. In contrast, EVA shows higher prices than the other projections, with substantial increases between 2015 and 2030.

Total generation and imports of electricity in 2015 are lower in the EVA projections than in the *AEO2009* reference case, IHSGI, and IER projections. U.S. electricity generation in the IER projection (which excludes imports of electricity) is higher than in the other projections. Requirements for generating capacity are based on 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, IER shows higher growth in generating capacity through 2015 than in the other projections.

Although the projections for coal-fired capacity in 2030 are similar (with EVA being somewhat lower than the others), there are significant differences in other capacity types. IHSGI and IER project similar levels of oil- and natural-gas-fired capacity, and both are significantly lower than projected in the *AEO2009* reference case. The EVA and IER projections for nuclear capacity are also much higher than the *AEO2009* and IHSGI projections. Nuclear capacity in 2030 is 113 gigawatts in *AEO2009* and 119 gigawatts in the IHSGI projections, as a result of the incentives included in EPACT2005. EVA and IER project substantially more aggressive nuclear growth, with total nuclear capacity at 166 and 154 gigawatts, respectively, in 2030. The *AEO2009* reference case includes 3.4 gigawatts of uprates for nuclear capacity and 4.4 gigawatts of nuclear plant retirements by 2030 as their operating licenses expire. The 2030 projections for renewable capacity also differ widely among the projections, from EVA's 128 gigawatts to IER's 312 gigawatts.

Environmental regulations are an important factor in the selection of technologies for electricity generation. The *AEO2009* reference case excludes the impact of the EPA's CAIR and CAMR regulations, and because only current laws and regulations as of November 2008 are included, it does not assume any tax on CO_2 emissions. Restrictions on CO_2 emissions could change the mix of technologies used to generate electricity.

Natural Gas

In the *AEO2009* reference case, total natural gas consumption declines in the short run (2008-2011), begins rising in 2014, peaks in 2025, then declines from 2025 to 2030 as consumption for electricity generation falls (Table 19). In the projections from other organizations, IHSGI, EVA, and Altos show steady increases in natural gas consumption (although the Altos projection includes an early decline, similar to that in the *AEO2009* reference case). EVA projects the highest level of consumption in 2030 (29.4 trillion cubic feet), followed by Altos (28.1 trillion cubic feet). In contrast, Deutsche Bank AG (DB), IER, and Strategic Energy and Economic Research, Inc. (SEER) show a peak in consumption around 2015 and a

Table 18. Comparison of electricity projections, 2015 and 2030 (billion kilowatthours, except where noted)

Projection	2007	AEO2009 reference case	Other projections		
			IHSGI	EVA	IER
		2015			
Average end-use price (2007 cents per kilowatthour)	**9.1**	**9.1**	**9.9**	**10.7**	**NA**
Residential	10.6	10.8	11.4	NA	9.6
Commercial	9.6	9.3	10.4	NA	9.6
Industrial	6.4	6.3	6.9	NA	7.4
Total generation plus imports	**4,190**	**4,398**	**4,589**	**4,174**	**4,696**
Coal	2,021	2,121	2,139	1,975	NA
Oil	66	57	54	58	NA
Natural gas [a]	892	815	1,004	889	NA
Nuclear	806	831	838	840	NA
Hydroelectric/other [b]	374	555	537	420	NA
Net imports	31	17	17	21	NA
Electricity sales	**3,747**	**3,960**	**4,138**	**NA**	**4,475**
Residential	1,392	1,423	1,559	NA	1,567
Commercial/other [c]	1,349	1,513	1,508	NA	1,649
Industrial	1,006	1,025	1,071	NA	1,259
Capability, including CHP (gigawatts) [d]	**996**	**1,050**	**1,030**	**1,084**	**1,117**
Coal	315	331	323	331	287
Oil and natural gas	448	458	441	488	510
Nuclear	101	104	105	105	111
Hydroelectric/other	131	157	160	115	208
		2030			
Average end-use price (2007 cents per kilowatthour)	**9.1**	**10.4**	**9.4**	**12.3**	**NA**
Residential	10.6	12.2	10.8	NA	8.6
Commercial	9.6	10.6	10.0	NA	8.6
Industrial	6.4	7.4	6.4	NA	6.5
Total generation plus imports	**4,190**	**5,181**	**5,229**	**4,871**	**5,335**
Coal	2,021	2,415	2,356	2,006	NA
Oil	66	60	40	46	NA
Natural gas [a]	892	1,012	1,035	968	NA
Nuclear	806	907	921	1,324	NA
Hydroelectric/other [b]	374	758	864	535	NA
Net imports	31	28	14	19	NA
Electricity sales	**3,747**	**4,609**	**4,717**	**NA**	**5,064**
Residential	1,392	1,667	1,829	NA	1,891
Commercial/other [c]	1,349	1,865	1,735	NA	1,963
Industrial	1,006	1,077	1,152	NA	1,210
Capability, including CHP (gigawatts) [d]	**996**	**1,227**	**1,102**	**1,171**	**1,224**
Coal	315	360	348	332	349
Oil and natural gas	448	563	403	501	409
Nuclear	101	113	119	166	154
Hydroelectric/other	131	191	232	128	312

[a]Includes 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. [d]EIA capacity is net summer capability, including combined heat and power plants. IHSGI capacity is nameplate, excluding cogeneration plants.

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

Sources: ***2007 and AEO2009:*** AEO2009 National Energy Modeling System, run AEO2009.D120908A. **IHSGI:** IHS Global Insight, Inc., *Global Petroleum Outlook, Fall 2008* (Lexington, MA, November 2008). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (August 2008). **IER:** Institute of Energy Economics and the Rational Use of Energy at the University of Stuttgart, TIAM Global Energy System Model (November 2008).

steady decline thereafter. IER projects the lowest level of consumption in 2030 (21.4 trillion cubic feet), followed by DB (23.8 trillion cubic feet).

There are some notable variations across the projections for natural gas consumption by sector. For the residential sector, only Altos shows a decline in consumption in the later years of the projection, with residential natural gas use in 2030 lower than in 2007. DB projects the greatest increase in residential natural gas consumption, with 2030 consumption 1.3 trillion cubic feet higher than in 2007. *AEO2009* shows the smallest increase, with 2030 consumption 0.2 trillion cubic feet higher than in 2007.

For natural gas use in the commercial sector there is significant variation among the projections. Most show consumption increasing over the projection period, with the notable exceptions of DB and IER. As a result, there is a significant range among the projections for 2030, with Altos showing an increase of 0.7 trillion cubic feet from 2007 (slightly higher than the

Table 19. Comparison of natural gas projections, 2015, 2025, and 2030 (trillion cubic feet, except where noted)

Projection	2007	AEO2009 reference case	Other projections					
			IHSGI	EVA	DB	IER	SEER	Altos
					2015			
Dry gas production [a]	**19.30**	**20.31**	**21.93**	**20.35**	**21.96**	**15.64**	**22.13**	**20.40**
Net imports	**3.79**	**2.36**	**3.01**	**3.74**	**5.02**	**10.75**	**3.55**	**5.54**
Pipeline	3.06	1.11	1.41	1.98	2.83	5.01	1.80	1.34
LNG	0.73	1.25	1.60	1.76	2.19	5.74	1.75	4.20
Consumption	**23.05**	**22.77**	**24.92**	**25.56**	**26.21**	**26.39**	**25.68**	**22.55 [b]**
Residential	4.72	4.87	5.08	5.07	5.22	5.28	4.91	4.22
Commercial	3.01	3.16	3.14	3.08	3.34	2.28	3.27	2.87
Industrial [c]	6.63	6.80	6.97	7.38	7.26	5.35	6.58	6.30 [d]
Electricity generators [e]	6.87	6.04	7.63	8.05	8.38	8.83	9.03	9.15
Other [f]	1.81	1.90	2.11	1.98	2.01	4.65	1.89	NA
Lower 48 wellhead price (2007 dollars per thousand cubic feet) [g]								
	6.39	**6.27**	**8.73**	**6.16**	**7.80**	7.38	**6.85**	**7.47**
End-use prices (2007 dollars per thousand cubic feet)								
Residential	13.05	12.32	14.49	NA	NA	12.58	12.76	NA
Commercial	11.30	10.86	13.06	NA	NA	11.28	11.23	NA
Industrial [h]	7.73	7.21	10.67	NA	NA	9.86	8.15	NA
Electricity generators	7.22	6.90	9.40	NA	NA	8.16	7.74	NA
					2025			
Dry gas production [a]	**19.30**	**23.22**	**22.07**	**18.75**	**19.75**	**14.51**	**21.32**	**18.80**
Net imports	**3.79**	**1.35**	**3.51**	**8.50**	**5.36**	**7.76**	**3.24**	**9.50**
Pipeline	3.06	0.15	0.91	2.91	1.83	2.02	0.56	0.30
LNG	0.73	1.20	2.60	5.58	3.53	5.74	2.68	9.20
Consumption	**23.05**	**24.67**	**25.56**	**27.41**	**24.83**	**22.27**	**24.56**	**26.06 [b]**
Residential	4.72	4.99	5.31	5.31	5.76	5.40	4.95	4.10
Commercial	3.01	3.36	3.18	3.14	2.73	2.23	3.50	3.09
Industrial [c]	6.63	6.76	7.36	8.16	5.92	4.28	6.64	6.60 [d]
Electricity generators [e]	6.87	7.38	7.55	8.69	8.59	5.47	7.49	12.27
Other [f]	1.81	2.19	2.17	2.11	1.82	4.88	1.99	NA
Lower 48 wellhead price (2007 dollars per thousand cubic feet) [g]								
	6.39	**7.33**	**7.47**	**7.20**	**9.45**	**8.17**	**7.25**	**9.21**
End-use prices (2007 dollars per thousand cubic feet)								
Residential	13.05	13.43	13.02	NA	NA	13.37	13.35	NA
Commercial	11.30	12.07	11.63	NA	NA	12.07	11.56	NA
Industrial [h]	7.73	8.22	9.35	NA	NA	10.77	8.55	NA
Electricity generators	7.22	7.95	8.10	NA	NA	8.95	8.06	NA

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

AEO2009 projection) and DB showing a decrease of 0.7 trillion cubic feet.

The range of projections for natural gas consumption in the industrial sector is similar to that for the commercial sector. Only DB and IER show declines from 2007 to 2030. Whereas EVA shows an increase of 2.0 trillion cubic feet, IER shows a decrease of 3.2 trillion cubic feet.

Natural gas consumption in the electricity generation sector grows steadily from 2007 to 2015 in all the projections, with the exception of a projected decline in the *AEO2009* reference case from 6.9 trillion cubic feet in 2007 to 6.0 trillion cubic feet in 2015. IHSGI, EVA, DB, and Altos show greater reliance on natural gas for electricity generation than the *AEO2009* projection. The largest increase from 2007 to 2030 is projected by Altos (5.3 trillion cubic feet), followed by EVA (3.1 trillion cubic feet). *AEO2009* shows an initial decline, followed by an increase and then another decline in the later years of the projection, but is within the range of the other projections.

Sources of natural gas supply also vary among the projections. In all the projections, U.S. pipeline imports in 2030 are lower than in 2007, although IER projects an initial increase in net pipeline imports from 2007 to 2015. The size of the decline in pipeline imports is similar in the *AEO2009*, IHSGI, SEER, and Altos projections, whereas DB shows a smaller but steady decrease. The IER projection for 2030 is similar to the DB projection, although there are differences between the two in the years from 2007 to 2025. EVA shows an initial decline in natural gas pipeline imports, followed by a recovery and a

Table 19. Comparison of natural gas projections, 2015, 2025, and 2030 (continued)
(trillion cubic feet, except where noted)

Projection	2007	AEO2009 reference case	Other projections					
			IHSGI	EVA	DB	IER	SEER	Altos
		2030						
Dry gas production [a]	**19.30**	**23.60**	**22.33**	**18.49**	**18.70**	**13.76**	**20.44**	**17.70**
Net imports	**3.79**	**0.66**	**3.56**	**9.17**	**5.39**	7.64	**3.74**	**11.01**
Pipeline	3.06	-0.18	0.51	2.49	1.83	1.97	0.32	0.01
LNG	0.73	0.85	3.05	6.68	3.56	5.68	3.42	11.00
Consumption	**23.05**	**24.36**	**25.87**	**29.41**	**23.81**	**21.41**	**24.18**	**28.13 [b]**
Residential	4.72	4.93	5.39	5.43	6.06	5.60	4.92	4.63
Commercial	3.01	3.44	3.23	3.17	2.35	2.50	3.66	3.69
Industrial [c]	6.63	6.85	7.32	8.60	5.09	3.42	6.62	7.61 [d]
Electricity generators [e]	6.87	6.93	7.75	9.94	8.59	4.36	6.98	12.20
Other [f]	1.81	2.21	2.19	2.27	1.73	5.52	1.99	NA
Lower 48 wellhead price (2007 dollars per thousand cubic feet) [g]								
	6.39	**8.40**	**7.61**	**7.78**	**9.94**	**8.88**	**7.28**	**10.13**
End-use prices (2007 dollars per thousand cubic feet)								
Residential	13.05	14.71	13.06	NA	NA	14.08	13.48	NA
Commercial	11.30	13.32	11.70	NA	NA	12.78	11.56	NA
Industrial [h]	7.73	9.33	9.47	NA	NA	11.48	8.57	NA
Electricity generators	7.22	8.94	8.23	NA	NA	9.66	8.31	NA

NA = not available.

[a]Does not include supplemental fuels. [b]Does not include natural gas use as fuel for lease and plants, pipelines, or natural gas vehicles. [c]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. [d]Includes lease and plant fuel. [e]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. [f]With the exception of IHSGI and IER, includes lease, plant, and pipeline fuel and fuel consumed in natural gas vehicles. IHSGI includes lease and plant fuel with industrial consumption. IER includes agricultural and non-energy use in other consumption. [g]2007 wellhead natural gas prices for EVA and DB are $6.68 and $6.91 per thousand cubic feet, respectively. [h]The 2007 industrial natural gas prices for IHSGI and SEER are $8.56 and $7.59 per thousand cubic feet, respectively.

Sources: **2007 and *AEO2009*:** AEO2009 National Energy Modeling System, run AEO2009.D120908A. **IHSGI:** IHS Global Insight, Inc., *2008 U.S. Energy Outlook* (September 2008). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (January 2009). **DB:** Deutsche Bank AG estimates (September 2008). **IER:** Institute of Energy Economics and the Rational Use of Energy at the University of Stuttgart, TIAM Global Energy System Model (November 2008). **SEER:** Strategic Energy and Economic Research, Inc., "SEER Balanced Portfolio, $45 per ton Carbon Tax 2015" (April 2008). **Altos:** Altos World Gas Trade Model (October 2008).

subsequent decline, with total pipeline imports in 2030 at the highest level among all the projections but still 0.6 trillion cubic feet below the 2007 level.

Net LNG imports in the *AEO2009* reference case are considerably lower than in any of the other projections, at less than 1.0 trillion cubic feet in 2030. EVA and IER are far more optimistic about the potential for increased LNG imports, with 2030 levels near 6 trillion cubic feet. Altos projects the highest level of LNG imports, at 11.0 trillion cubic feet in 2030, and IHSGI, DB, and SEER project more modest increases.

U.S. domestic natural gas production increases through 2015 in all the projections except IER's. SEER shows the highest production levels in 2015, at 22.1 trillion cubic feet. After 2015, only IHSGI and *AEO2009* show domestic production continuing to increase through 2030. The domestic production share of total natural gas supply in the *AEO2009* reference case increases steadily, to more than 95 percent in 2030, as compared with the DB projection, which shows the domestic share consistent at around 80 percent. The other projections show declines in domestic natural gas production from 2015 to 2030. IER has the lowest level in 2030, at 13.8 trillion cubic feet. In the EVA, IER, and Altos projections, domestic production represents a much smaller share of total natural gas supply in 2030, at less than 70 percent.

Natural gas wellhead prices in the United States, which were $6.39 per thousand cubic feet in 2007, increase steadily in all the projections, with some exceptions in 2015. Altos, IER, and DB project higher average prices in 2030 than *AEO2009*. IHSGI, EVA, and SEER project lower prices than *AEO2009*. SEER and Altos also include lower domestic production levels than the other projections. The highest wellhead price in 2030 is projected by Altos, at $10.13 per thousand cubic feet. The lowest is projected by SEER, at $7.28 per thousand cubic feet.

The price margins for delivered natural gas (the difference between delivered and wellhead prices) can vary significantly from year to year. In 2007, margins in the end-use sectors were notably higher than the historical average. In the *AEO2009* reference case, margins in the electricity generation and industrial sectors generally decline over the projection period, whereas margins in the residential and commercial sectors generally rise, because fixed costs are spread over lower per-customer volumes as consumption is reduced by efficiency improvements.

End-use prices in the IHSGI projection imply declining margins in all end-use sectors. The IER projections imply constant margins in all sectors except the industrial sector. In the SEER projection, margins remain relatively steady in the residential and industrial sectors through 2030. The industrial sector margins in the SEER projection are approximately $0.40 per thousand cubic feet higher than those in the *AEO2009* projection from 2015 to 2030, and those in the IER projection are about $1.65 per thousand cubic feet higher than in *AEO2009*. Margins in the electricity generation sector are similar in the *AEO2009* and IHSGI projections, and both are lower than in the IER and SEER projections.

Liquid Fuels

In the *AEO2009* reference case, the world oil price is $111 per barrel in 2015 and rises to $130 per barrel in 2030 (see Table 16). In the DB projection, real crude oil prices are $72 per barrel in 2015, $68 per barrel in 2025, and $70 per barrel in 2030. Not surprisingly, domestic crude oil production is lower and total net imports are higher in the DB projections than in *AEO2009* (Table 20).

A major difference between the *AEO2009* reference case and all but one of the other projections—IHSGI, DB, IER, Purvin and Gertz, Inc. (P&G), and IEA—is that the other projections assume less domestic crude oil production and a gradual decline in production in future years. The IER projection for oil production is particularly pessimistic in comparison with *AEO2009*. In general, the more pessimistic outlook in the other projections results in higher levels of total net imports and greater dependence on imports to meet supply needs. The one exception is EVA, which includes higher domestic crude oil production in 2015 than projected in the *AEO2009* reference case; however, EVA's projections for crude oil and natural gas liquids (NGL) production in 2025 and 2030 are lower than in *AEO2009*.

The *AEO2009* reference case is also the most bullish with respect to NGL production, with the exception of IHSGI. Both IER and DB show lower NGL production than *AEO2009*, with IER being much lower. The difference can be explained, at least in part, by lower projections of natural gas production in the DB and IER cases. Both projections show a steady decline in natural gas production after 2020 (earlier in the IER case), whereas *AEO2009* shows a slow but steady increase through 2030. The highest projection for U.S.

Table 20. Comparison of liquids projections, 2015, 2025, and 2030 (million barrels per day, except where noted)

Projection	2007	AEO2009 reference case	Other projections					
			IHSGI	EVA	DB	IER	P&G	IEA
					2015			
Crude oil and NGL production	**6.85**	**7.61**	**6.60**	**8.15**	**6.74**	**5.08**	**NA**	**6.80**
Crude oil	5.07	5.72	4.56	6.39	5.04	4.29	4.36	NA
Natural gas liquids	1.78	1.89	2.02	1.76	1.70	0.78	NA	NA
Total net imports	**12.09**	**9.74**	**12.11**	**NA**	**11.38**	**12.97**	**11.48**	**NA**
Crude oil	10.00	8.10	11.10	NA	NA	NA	11.68	NA
Petroleum products	2.09	1.64	1.02	NA	NA	NA	-0.20	NA
Petroleum demand	**20.65**	**20.16**	**21.07**	**NA**	**19.69**	**18.05**	**18.28**	**18.75**
Motor gasoline	9.29	8.97	9.09	NA	9.01	7.57	8.99	NA
Jet fuel	1.63	1.52	1.72	NA	1.52	1.99	1.59	NA
Distillate fuel	4.20	4.46	4.55	NA	4.00	3.49	4.23	NA
Residual fuel	0.72	0.69	0.69	NA	0.60	0.64	0.51	NA
Other	4.82	4.52	5.02	NA	4.56	4.36	2.96	NA
Net import share of petroleum demand (percent)	**59**	**49**	**57**	**NA**	**58**	**72**	**63**	**NA**
					2025			
Crude oil and NGL production	**6.85**	**9.14**	**5.74**	**7.05**	**5.28**	**3.80**	NA	**NA**
Crude oil	5.07	7.21	3.71	5.61	4.01	3.07	3.24	NA
Natural gas liquids	1.78	1.93	2.03	1.44	1.27	0.73	NA	NA
Total net imports	**12.09**	**8.01**	**12.61**	**NA**	**13.88**	**15.58**	**12.51**	**NA**
Crude oil	10.00	6.66	12.06	NA	NA	NA	12.37	NA
Petroleum products	2.09	1.35	0.56	NA	NA	NA	0.14	NA
Petroleum demand	**20.65**	**20.76**	**21.77**	**NA**	**21.05**	**19.37**	**18.15**	**NA**
Motor gasoline	9.29	8.15	8.12	NA	9.59	7.89	7.82	NA
Jet fuel	1.62	1.81	2.04	NA	1.62	2.28	1.78	NA
Distillate fuel	4.20	4.91	5.61	NA	4.36	4.00	4.92	NA
Residual fuel	0.72	0.71	0.65	NA	0.63	0.74	0.42	NA
Other	4.82	5.18	5.35	NA	4.85	4.46	3.22	NA
Net import share of petroleum demand (percent)	**59**	**40**	**58**	**NA**	**66**	**80**	**63**	**NA**
					2030			
Crude oil and NGL production	**6.85**	**9.29**	**5.36**	**6.28**	**4.78**	**3.15**	**NA**	**6.50**
Crude oil	5.07	7.37	3.30	4.97	3.63	2.45	2.84	NA
Natural gas liquids	1.78	1.92	2.06	1.31	1.15	0.70	NA	NA
Total net imports	**12.09**	**8.35**	**13.49**	**NA**	**14.99**	**16.53**	**12.80**	**NA**
Crude oil	10.00	6.95	12.46	NA	NA	NA	12.66	NA
Petroleum products	2.09	1.40	1.02	NA	NA	NA	0.15	NA
Petroleum demand	**20.65**	**21.67**	**22.27**	**NA**	**21.69**	**19.69**	**18.15**	**18.41**
Motor gasoline	9.29	8.04	7.65	NA	9.83	8.10	7.45	NA
Jet fuel	1.62	1.99	2.21	NA	1.66	2.17	1.85	NA
Distillate fuel	4.20	5.42	6.26	NA	4.58	4.29	5.14	NA
Residual fuel	0.72	0.72	0.64	NA	0.65	0.79	0.40	NA
Other	4.82	5.50	5.51	NA	4.97	4.34	3.30	NA
Net import share of petroleum demand (percent)	**59**	**41**	**61**	**NA**	**69**	**84**	**71**	**NA**

NA = Not available.

Sources: ***2007 and AEO2009:*** AEO2008 National Energy Modeling System, run AEO2009.D120908A. **IHSGI:** IHS Global Insight, Inc., *Global Petroleum Outlook, Fall 2008* (Lexington, MA, November 2008). **EVA:** Energy Ventures Analysis, Inc., *FUELCAST: Long-Term Outlook* (January 2009). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on November 4, 2008. **IER:** Institute of Energy Economics and the Rational Use of Energy at the University of Stuttgart, e-mail from Markus Blesl on December 1, 2008. **P&G:** Purvin and Gertz, Inc., *2008 Global Petroleum Market Outlook* (February 2009). **IEA:** International Energy Agency, *World Energy Outlook 2008* (Paris, France, November 2008).

NGL production is by IHSGI, consistent with its outlook for a significant increase in natural gas production through 2015, to a level higher than the *AEO2009* projection for 2015. *AEO2009* projects more natural gas production in 2025 and 2030 than in the IHSGI projection, however, suggesting that IHSGI assumes higher yields of NGL from the production of natural gas.

With the exception of IEA and P&G, liquids demand is similar in all the projections. The IEA petroleum demand projection is lower than the others, possibly reflecting IEA's assumptions of generally higher prices for oil and petroleum products, which depress demand and create an incentive for more use of alternative fuels and improvements in fuel efficiency. The IEA projection also includes more pessimistic assumptions about U.S. (and worldwide) economic growth. Although P&G projects a lower oil price than the *AEO2009* reference case, the lower GDP growth rate in the P&G projection leads to significantly lower demand in all categories in the later years of the projections.

Both the DB and IER cases show increasing demand for motor gasoline in the long term. In the *AEO2009* reference case, motor gasoline demand declines as a result of new CAFE standards and a steady increase in ethanol supply throughout the projection. Demand for gasoline also falls in the IHSGI projection, in large part because of its optimistic projection for ethanol consumption, at 2.02 million barrels per day (31 billion gallons per year) of ethanol in 2030.

Demand for distillate fuel increases throughout all the projections, presumably because of rapid growth in freight and ship movement, leading to increased consumption of diesel fuel, during the economic recovery. Jet fuel demand also increases from 2015 to 2030 in all the projections except IER.

Coal

The outlook for coal markets varies considerably across the projections compared in Table 21. Differences in assumptions about expectations for and implementation of legislation aimed at reducing GHG emissions can lead to significantly different projections for coal production, consumption, and prices. In addition, different assumptions about world oil prices, natural gas prices, and economic growth can contribute to variation across the projections.

In the *AEO2009* reference case, total U.S. coal consumption increases to 1,363 million tons (26.6 quadrillion Btu) in 2030. Total coal consumption also increases in the IEA projection, to 25.1 quadrillion Btu in 2030, which is closer to the *AEO2009* projection than are any of the others. Total coal consumption decreases from 2007 levels to 991 million tons and 21.4 quadrillion Btu in 2030 in the IER and DB projections, respectively. IHSGI projects relatively constant total coal consumption over the projection period, with a slight overall increase from 2007 levels to 1,150 million tons in 2030.

In the *AEO2009* projection, coal production increases to 1,248 milliion tons (25.1 quadrillion Btu) in 2025 and 1,341 million tons (26.9 quadrillion Btu) in 2030. Similar increases are projected by IEA and Hill and Associates (WM), to 27.3 quadrillion Btu in 2030 and 1,361 million tons in 2025, respectively. Coal production falls slightly from 2007 levels in the IER projection, to 1,035 million tons in 2030. In the IHSGI projection, production remains relatively constant, increasing slightly to 1,158 million tons in 2030.

With the exception of IER and WM, the other projections show net U.S. coal exports as flat or decreasing. In the *AEO2009* reference case, the United States becomes a net importer of coal, with coal exports declining to 44 million tons and imports increasing to 53 million tons in 2030. The IHSGI and IER projections show net U.S. exports in 2030 at 9 million tons and 44 million tons, respectively, with IER's projection of 72 million tons of coal exports in 2030 the highest among all the projections.

Minemouth coal prices in 2030 are higher than in 2007 in all the projections except IHSGI. *AEO2009* shows the minemouth price increasing to $28.45 per ton ($1.42 per million Btu) in 2025 and $29.10 per ton ($1.46 per million Btu) in 2030, compared with $34.43 per ton ($1.66 per million Btu) in 2030 projected by IER and $32.26 per ton ($1.62 per million Btu) in 2025 projected by WM. In the IHSGI projection, the minemouth coal price falls to $21.63 per ton ($1.05 per million Btu) in 2030.

Table 21. Comparison of coal projections, 2015, 2025, and 2030 (million short tons, except where noted)

Projection	2007	AEO2009 reference case	Other projections				
			IHSGI	DB	IER	IEA	WM
			2015				
Production	**1,147**	**1,206**	**1,167**	**NA**	**896**	**24.8** [a]	**1,225** [b]
Consumption by sector							
Electric power	1,046	1,096	1,069	NA	752	NA	NA
Coke plants	23	20	22	NA	37	NA	NA
Coal-to-liquids	0	17	NA	NA	28	NA	NA
Other industrial/buildings	60	60	59	NA	73	NA	NA
Total	**1,129**	**1,192**	**1,150**	**23.0** [a]	**890**	**23.0** [a]	**NA**
Net coal exports	**25**	**28**	**17**	**NA**	**6**	**NA**	**16**
Exports	59	65	57	NA	33	NA	37
Imports	34	38	40	NA	27	NA	22
Minemouth price							
(2007 dollars per short ton)	25.82	28.71	23.79 [c]	NA	34.43 [d]	NA	32.27 [d]
(2007 dollars per million Btu)	1.27	1.42	1.15	NA	1.66 [d]	NA	1.61 [d]
Average delivered price to electricity generators							
(2007 dollars per short ton)	35.45	38.47	37.47 [c]	NA	42.30 [d]	NA	49.24 [d]
(2007 dollars per million Btu)	1.78	1.94	1.81	NA	2.04 [d]	NA	2.51 [d]
			2025				
Production	**1,147**	**1,248**	**1,158**	**NA**	**1,046**	**NA**	**1,361** [a]
Consumption by sector							
Electric power	1,046	1,126	1,071	NA	815	NA	NA
Coke plants	23	18	20	NA	38	NA	NA
Coal-to-liquids	0	48	NA	NA	53	NA	NA
Other industrial/buildings	60	59	56	NA	85	NA	NA
Total	**1,129**	**1,252**	**1,147**	**21.9** [a]	**991**	**25.0** [a]	**NA**
Net coal exports	**25**	**8**	**10**	**NA**	**56**	**NA**	**33**
Exports	59	53	48	NA	72	NA	52
Imports	34	45	38	NA	16	NA	18
Minemouth price							
(2007 dollars per short ton)	25.82	28.45	22.21 [c]	NA	34.43 [d]	NA	32.26 [d]
(2007 dollars per million Btu)	1.27	1.42	1.07	NA	1.66 [d]	NA	1.62 [d]
Average delivered price to electricity generators							
(2007 dollars per short ton)	35.45	38.83	35.40 [c]	NA	42.30 [d]	NA	50.17 [d]
(2007 dollars per million Btu)	1.78	1.96	1.71	NA	2.04 [d]	NA	2.52 [d]

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

Table 21. Comparison of coal projections, 2015, 2025, and 2030 (continued)
(million short tons, except where noted)

Projection	2007	AEO2009 reference case	Other projections				
			IHSGI	DB	IER	IEA	WM
		2030					
Production	**1,147**	**1,341**	**1,158**	**NA**	**1,035**	**27.3** [a]	**NA**
Consumption by sector							
Electric power	1,046	1,215	1,077	NA	797	NA	NA
Coke plants	23	18	20	NA	37	NA	NA
Coal-to-liquids	0	70	NA	NA	69	NA	NA
Other industrial/buildings	60	60	53	NA	88	NA	NA
Total	**1,129**	**1,363**	**1,150**	**21.4** [a]	**991**	**25.1** [a]	**NA**
Net coal exports	**25**	**-10**	**9**	**NA**	**44**	**NA**	**NA**
Exports	59	44	46	NA	72	NA	NA
Imports	34	53	38	NA	27	NA	NA
Minemouth price							
(2007 dollars per short ton)	25.82	29.10	21.63 [c]	NA	34.43 [d]	NA	NA
(2007 dollars per million Btu)	1.27	1.46	1.05	NA	1.66 [d]	NA	NA
Average delivered price to electricity generators							
(2007 dollars per short ton)	35.45	40.61	34.90 [c]	NA	42.30 [d]	NA	NA
(2007 dollars per million Btu)	1.78	2.04	1.69	NA	2.04 [d]	NA	NA

Btu = British thermal unit. NA = Not available.
[a]Reported in quadrillion Btu.
[b]Reported in thermal thousand tons; does not include petroleum coke or waste coal.
[c]Imputed, using heat conversion factor implied by U.S. steam coal consumption figures for the electricity sector.
[d]Converted to 2007 dollars, using the *AEO2009* GDP inflator.
Sources: ***2007 and AEO2009:*** AEO2009 National Energy Modeling System, run AEO2009.D120908A. **IHSGI:** IHS Global Insight, Inc., *2008 U.S. Energy Outlook* (September 2008). **DB:** Deutsche Bank AG, e-mail from Adam Sieminski on November 4, 2008. **IER:** Institute of Energy Economics and the Rational Use of Energy at the University of Stuttgart, TIAM Global Energy System Model (November 2008). **IEA:** International Energy Agency, *World Energy Outlook 2008* (Paris, France, November 2008).**WM:** Hill and Associates, a Wood Mackenzie Company, *Fall 2008 Long Term Outlook Base Case* and *2008 International Coal Trade Base Case*.