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Review of Oil Price Forecasts

*Supplementary Information
Response to PAG Comments*

April 1, 2008

AIRPORT FUTURES

CHARTING A COURSE FOR PDX

INTRODUCTION AND PURPOSE

What is the purpose of this research?

- The purpose of this research is to respond to PAG requests from the meeting of February 19 for additional agencies or institutions that prepare oil price forecasts [other than the Department of Energy (DOE)].
- A second objective was to investigate the performance of DOE oil price forecasts compared with actual oil prices and to test for optimism bias*.

- This review included:
 - Long-term forecasts prepared by DOE, International Energy Agency (IEA), Federal Aviation Administration (FAA), and the World Bank
 - Short-term forecasts prepared by financial investors and commodity traders such as Morgan Stanley, Goldman Sachs, Duetsche Bank, Lehman Brothers, and Barclay's Bank

***Optimism bias** is the demonstrated systematic tendency for people to be over-optimistic about the outcome of planned actions.

KEY FINDINGS

How do DOE forecasts of oil prices compare with actual prices historically?

- The absolute average difference between DOE forecasts and actual oil prices is 20.8% for the period from 1994 through 2005.*
- Note: The absolute average difference ignores whether DOE overestimated or underestimated prices.
- In recent years, DOE forecasts have underestimated actual oil prices and the differences have been larger than 20.8%.
- For example, the price of oil was underestimated by 36.7% in 2005 (based on all the forecasts prepared through 2005).

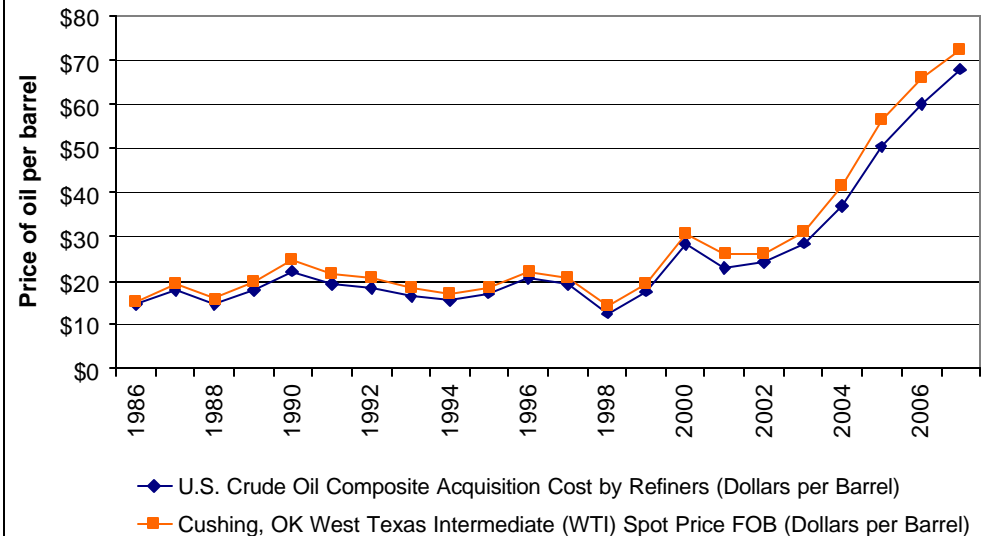
*The National Energy Modeling System (NEMS) was completed in December 1993 and was first used for the DOE energy forecasts in 1994. Therefore, the period from 1994 through 2005 is evaluated because it includes only NEMS generated forecasts.

KEY FINDINGS

Are all oil prices the same?

- West Texas Intermediate (WTI) Crude is typically quoted in news articles and forecast by financial investors and commodity traders.
- The composite cost of oil to refiners is forecast by the DOE and was used in the PDX MP forecasts.
- WTI is about 10% higher, on average, than the refiners cost.

COMPARISON OF HISTORICAL OIL PRICES IN NOMINAL DOLLARS
In nominal or current dollars (not adjusted for inflation)



Source: U.S. Department of Energy, Energy Information Administration, online data.

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This review includes long-term forecasts prepared by DOE, IEA, FAA, and the World Bank and short-term forecasts by financial investors and commodity traders such as Morgan Stanley.

- Table 1 and Figure 1, Review of Oil Price Forecasts in Nominal Dollars
- Table 2 and Figure 2, Review of Oil Price Forecasts in Constant Dollars
- Table 3, Comparison of Historical Oil Prices (WTI is about 10% higher, on average, than the refiners cost.)
- Tables 4 and 5, Oil Price Forecasts: Adjustments to the Parameters, in nominal and constant dollars (The purpose of these tables is to present alternative options to adjust the oil price forecasts used in PDX MP forecasts.)
- Appendix A: Annual Energy Outlook, Retrospective Review: Evaluations of Projections in Past Editions (1982-2006), U.S. Department of Energy

Table 1
REVIEW OF OIL PRICE FORECASTS IN NOMINAL DOLLARS
 In current or nominal dollars per barrel (not adjusted for inflation)

Year	Acquisition Cost by Refiners				West Texas Intermediate Crude								
	Department of Energy (DOE) (a)			2007 International Energy Administration (IEA) (b)	FAA 2008 National Aviation Forecasts (c)	2007 World Bank Commodity Forecasts (d)	Morgan Stanley (e)			Goldman Sachs (f)	Deutsche Bank (g)	Lehman Brothers (h)	Barclay's Bank (i)
	Reference (base case)	High	Low				Base	High	Low				
2008	\$76	\$80	\$74	\$62	\$86	\$84	\$80	\$110	\$65	\$95	\$80	\$84	\$98
2009	\$73	\$81	\$67	\$64	\$79	\$78	\$83	\$112	\$67	\$105	\$75	\$79	--
2010	\$71	\$86	\$61	\$65	\$75	\$73	\$85	\$115	\$70	\$110	--	--	--
2011	\$70	\$92	\$56	\$67	\$74	\$73	\$87	\$117	\$72	--	--	--	--
2012	\$69	\$97	\$52	\$68	\$74	\$68	\$90	\$120	\$75	--	--	--	--
2013	\$67	\$100	\$49	\$70	\$74	\$64	--	--	--	--	--	--	--
2014	\$66	\$102	\$46	\$72	\$73	\$60	--	--	--	--	--	--	--
2015	\$64	\$102	\$44	\$74	\$73	\$53	--	--	--	--	--	--	--
2016	\$62	\$102	\$42	\$75	\$74	\$53	--	--	--	--	--	--	--
2017	\$64	\$105	\$42	\$77	\$75	\$53	--	--	--	--	--	--	--
2018	\$66	\$110	\$44	\$79	\$77	\$54	--	--	--	--	--	--	--
2019	\$68	\$115	\$45	\$81	\$79	\$54	--	--	--	--	--	--	--
2020	\$71	\$121	\$46	\$83	\$80	\$54	--	--	--	--	--	--	--
2021	\$73	\$125	\$48	\$86	\$82	--	--	--	--	--	--	--	--
2022	\$76	\$129	\$49	\$88	\$84	--	--	--	--	--	--	--	--
2023	\$79	\$133	\$50	\$90	\$86	--	--	--	--	--	--	--	--
2024	\$82	\$138	\$51	\$92	\$87	--	--	--	--	--	--	--	--
2025	\$86	\$144	\$53	\$94	\$87	--	--	--	--	--	--	--	--
2026	\$89	\$149	\$55	\$97	--	--	--	--	--	--	--	--	--
2027	\$90	\$151	\$55	\$99	--	--	--	--	--	--	--	--	--
2028	\$94	\$158	\$57	\$102	--	--	--	--	--	--	--	--	--
2029	\$98	\$165	\$59	\$104	--	--	--	--	--	--	--	--	--
2030	\$101	\$171	\$61	\$107	--	--	--	--	--	--	--	--	--

- (a) U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2008* (Revised Early Release), Revised March 2008, Reference case results only and Annual Energy Outlook 2007, high and low cases. High and low 2008 forecasts are not yet available and were calibrated to March 2008 reference based on the 2007 forecasts.
- (b) Organization for Economic Co-operation and Development (OECD), International Energy Administration, *World Energy Outlook 2007, Fact Sheet Oil*, 2007. Forecasts were provided for 2015 and 2030. Values for intermediate years were interpolated.
- (c) U.S. Department of Transportation, Federal Aviation Administration, *FAA Aerospace Forecasts, Fiscal Years 2008-2025*, March 2008. Oil price forecasts are sourced to the Office of Management and Budget.
- (d) The World Bank, Development Prospects Group, *Commodity Prices*, online website. Forecasts were prepared December 20, 2007.
- (e) Bloomberg News, "Morgan Stanley Raises Long-Term Oil Forecast to \$85 (Update 2)", December 3, 2007.
- (f) Market Watch, "New 'Super-Spike' Might Mean \$200 A Barrel Oil, Goldman's Projections Foretell Persistent Turbulence in Energy Prices", March 7, 2008.
- (g) Bloomberg News, "Deutsche bank Raises Oil Price Forecast 6.3% to \$85", January 12, 2008.
- (h) Bloomberg News, "OPEC Should Increase Output to Rebuild Inventories, Lehman Says", January 10, 2008.
- (i) Bloomberg News, "Barclays Raises 2008 Crude Oil Price Forecast by 12% (Update 1)", February 28, 2008.

Figure 1 REVIEW OF OIL PRICE FORECASTS IN NOMINAL DOLLARS

In nominal or current dollars (not adjusted for inflation)

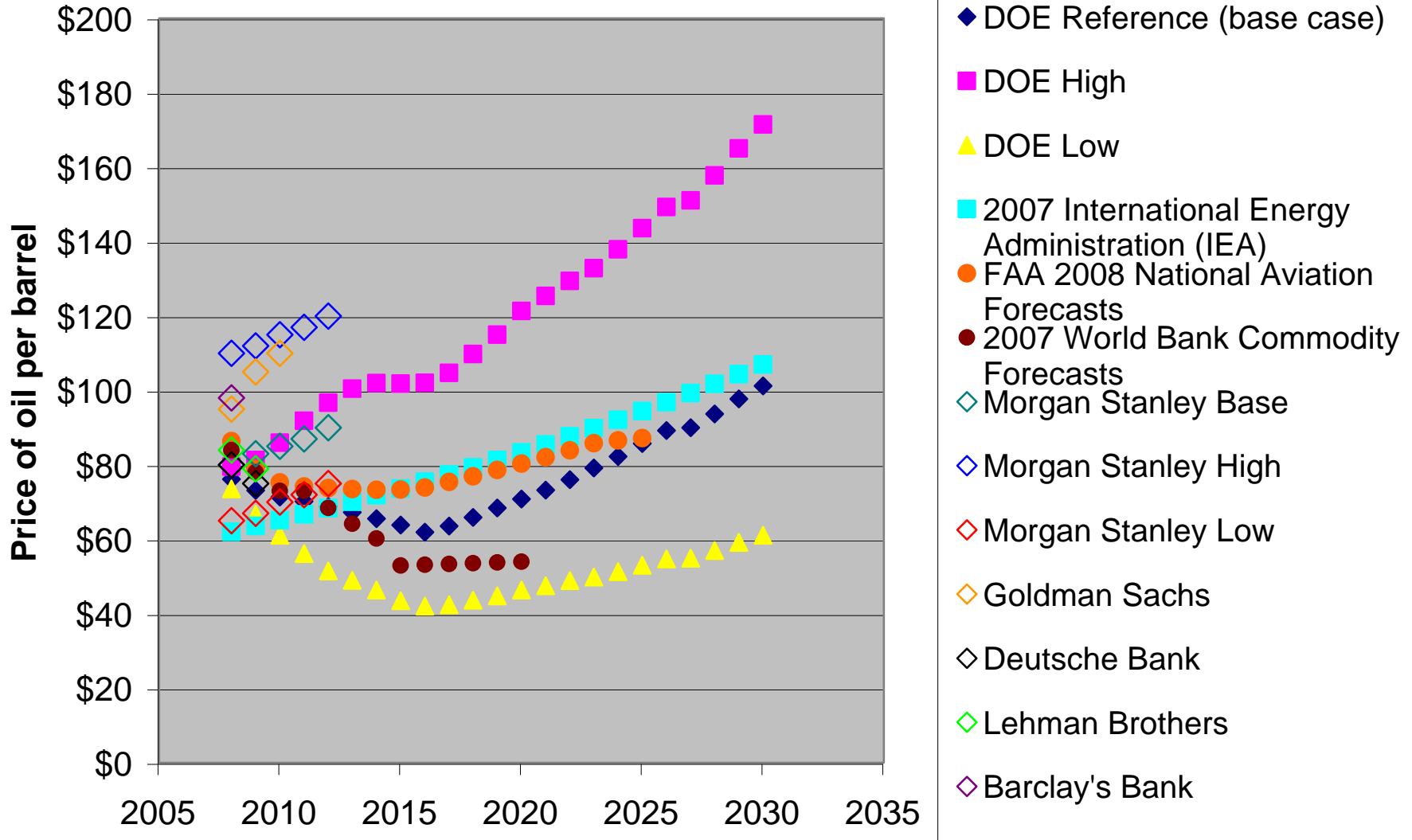


Table 2
REVIEW OF OIL PRICE FORECASTS IN CONSTANT DOLLARS
 In 2006 dollars per barrel (adjusted for inflation)

Year	Acquisition Cost by Refiners						West Texas Intermediate Crude							
	Department of Energy (DOE) (a)			2007 International Energy Administration (IEA) (b)	FAA 2008 National Aviation Forecasts (c)	2007 World Bank Commodity Forecasts (d)	Morgan Stanley (e)			Goldman Sachs (f)	Deutsche Bank (g)	Lehman Brothers (h)	Barclay's Bank (i)	
	Reference (base case)	High	Low				Base	High	Low					
2008	\$73	\$76	\$70	\$59	\$83	\$80	\$76	\$105	\$62	\$91	\$76	\$80	\$94	
2009	\$68	\$76	\$62	\$59	\$74	\$73	\$78	\$105	\$63	\$98	\$70	\$74	--	
2010	\$65	\$78	\$56	\$59	\$69	\$67	\$78	\$105	\$64	\$100	--	--	--	
2011	\$63	\$82	\$50	\$60	\$66	\$65	\$78	\$104	\$64	--	--	--	--	
2012	\$60	\$84	\$45	\$60	\$64	\$60	\$79	\$105	\$65	--	--	--	--	
2013	\$57	\$86	\$42	\$60	\$63	\$55	--	--	--	--	--	--	--	
2014	\$55	\$85	\$39	\$60	\$61	\$50	--	--	--	--	--	--	--	
2015	\$52	\$83	\$35	\$60	\$60	\$43	--	--	--	--	--	--	--	
2016	\$49	\$81	\$34	\$60	\$59	\$42	--	--	--	--	--	--	--	
2017	\$49	\$82	\$33	\$60	\$59	\$42	--	--	--	--	--	--	--	
2018	\$50	\$84	\$33	\$60	\$59	\$41	--	--	--	--	--	--	--	
2019	\$51	\$86	\$33	\$61	\$59	\$40	--	--	--	--	--	--	--	
2020	\$52	\$88	\$34	\$61	\$58	\$39	--	--	--	--	--	--	--	
2021	\$52	\$89	\$34	\$61	\$58	--	--	--	--	--	--	--	--	
2022	\$53	\$90	\$34	\$61	\$58	--	--	--	--	--	--	--	--	
2023	\$54	\$90	\$34	\$61	\$58	--	--	--	--	--	--	--	--	
2024	\$55	\$92	\$34	\$61	\$57	--	--	--	--	--	--	--	--	
2025	\$56	\$93	\$34	\$61	\$57	--	--	--	--	--	--	--	--	
2026	\$57	\$95	\$35	\$61	--	--	--	--	--	--	--	--	--	
2027	\$56	\$94	\$34	\$62	--	--	--	--	--	--	--	--	--	
2028	\$57	\$96	\$35	\$62	--	--	--	--	--	--	--	--	--	
2029	\$58	\$98	\$35	\$62	--	--	--	--	--	--	--	--	--	
2030	\$59	\$99	\$35	\$62	--	--	--	--	--	--	--	--	--	

Note: Nominal oil prices from Table 1 were adjusted to 2006 dollars by Jacobs Consultancy, Inc. using an inflation rate of 2.3%.

- (a) U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2008 (Revised Early Release)*, Revised March 2008, Reference case results only and Annual Energy Outlook 2007, high and low cases. High and low 2008 forecasts are not yet available and were calibrated to March 2008 reference based on the 2007 forecasts.
- (b) Organization for Economic Co-operation and Development (OECD), International Energy Administration, *World Energy Outlook 2007, Fact Sheet Oil*, 2007. Forecasts were provided for 2015 and 2030. Intermediate years were interpolated.
- (c) U.S. Department of Transportation, Federal Aviation Administration, *FAA Aerospace Forecasts, Fiscal Years 2008-2025*, March 2008. Oil price forecasts are sourced to the Office of Management and Budget.
- (d) The World Bank, Development Prospects Group, *Commodity Prices*, online website. Forecasts were prepared December 20, 2007.
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- (h) Bloomberg News, "OPEC Should Increase Output to Rebuild Inventories, Lehman Says", January 10, 2008.
- (i) Bloomberg News, "Barclays Raises 2008 Crude Oil Price Forecast by 12% (Update 1)", February 28, 2008.

Figure 2
REVIEW OF OIL PRICE FORECASTS IN CONSTANT DOLLARS

In 2006 dollars (adjusted for inflation)

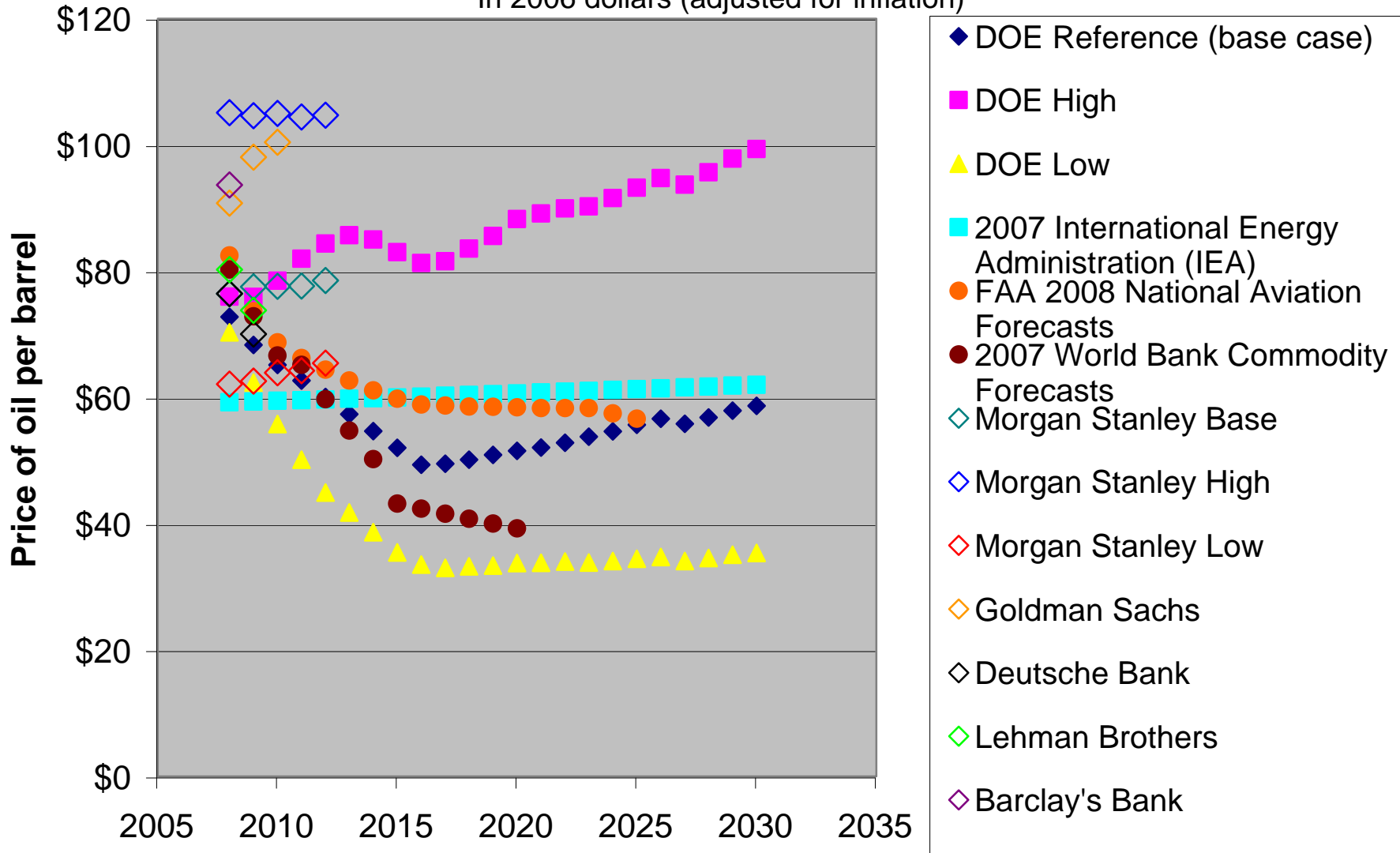


Table 3
COMPARISON OF HISTORICAL OIL PRICES
 In current or nominal dollars (not adjusted for inflation)

	U.S. Crude Oil Composite Acquisition Cost by Refiners (Dollars per Barrel)	Cushing, OK WTI Spot Price FOB (Dollars per Barrel)	Percent difference-- WTI vs. refiners acquisition cost
1986	\$15	\$15	3%
1987	\$18	\$19	7%
1988	\$15	\$16	9%
1989	\$18	\$20	9%
1990	\$22	\$25	10%
1991	\$19	\$22	13%
1992	\$18	\$21	12%
1993	\$16	\$18	12%
1994	\$16	\$17	10%
1995	\$17	\$18	7%
1996	\$21	\$22	7%
1997	\$19	\$21	8%
1998	\$13	\$14	15%
1999	\$18	\$19	10%
2000	\$28	\$30	8%
2001	\$23	\$26	13%
2002	\$24	\$26	9%
2003	\$29	\$31	9%
2004	\$37	\$42	12%
2005	\$50	\$57	13%
2006	\$60	\$66	10%
2007	\$68	\$72	6%

Source: U.S. Department of Energy, Energy Information Administration, online data.

Table 4

OIL PRICE FORECASTS IN NOMINAL DOLLARS: OPTIONS TO ADJUST THE MODEL PARAMETERS

In current or nominal dollars per barrel (not adjusted for inflation)

Year	Option 1: DOE			Option 2: IEA	Option 3: Morgan Stanley		
	Shifted up 20.8% to reflect average percent difference--forecast vs. actual*			Shifted up 27% to reflect average percent difference--forecast vs. actual	Morgan Stanley projections from 2008-2012; annual growth in DOE projections from 2013-2030		
	Department of Energy (DOE)			2007 International Energy Administration (IEA)	Morgan Stanley		
	Reference (base case)	High	Low		Base	High	Low
2008	\$92	\$96	\$89	\$79	\$80	\$110	\$65
2009	\$88	\$98	\$81	\$81	\$83	\$112	\$67
2010	\$86	\$104	\$74	\$83	\$85	\$115	\$70
2011	\$85	\$111	\$68	\$85	\$87	\$117	\$72
2012	\$83	\$117	\$62	\$87	\$90	\$120	\$75
2013	\$81	\$121	\$59	\$89	\$88	\$125	\$71
2014	\$79	\$123	\$56	\$91	\$86	\$127	\$68
2015	\$77	\$123	\$53	\$94	\$83	\$126	\$63
2016	\$75	\$123	\$51	\$96	\$81	\$127	\$61
2017	\$77	\$127	\$51	\$98	\$83	\$130	\$62
2018	\$80	\$133	\$53	\$101	\$86	\$136	\$64
2019	\$83	\$139	\$54	\$103	\$89	\$143	\$65
2020	\$86	\$147	\$56	\$106	\$93	\$151	\$68
2021	\$88	\$151	\$57	\$109	\$96	\$156	\$69
2022	\$92	\$156	\$59	\$111	\$99	\$161	\$71
2023	\$96	\$161	\$60	\$114	\$104	\$165	\$73
2024	\$99	\$167	\$62	\$117	\$108	\$171	\$75
2025	\$104	\$173	\$64	\$120	\$112	\$178	\$77
2026	\$108	\$180	\$66	\$123	\$117	\$185	\$80
2027	\$109	\$182	\$66	\$126	\$118	\$187	\$80
2028	\$113	\$191	\$69	\$129	\$123	\$196	\$83
2029	\$118	\$199	\$72	\$133	\$128	\$205	\$86
2030	\$122	\$207	\$74	\$136	\$132	\$213	\$89
Average annual percent growth							
2006-2030	2.27%	4.54%	0.14%	2.51%			
2008-2030					2.31%	3.04%	1.43%

*Reflects National Energy Modeling System (NEMS) Annual Energy Outlooks (AEO) only. The National Energy Modeling System (NEMS) was completed in December 1993 and was first used for the DOE energy forecasts in 1994. Therefore, the period from 1994 through 2005 is evaluated because it includes only NEMS generated forecasts.

Table 5
OIL PRICE FORECASTS IN CONSTANT DOLLARS: OPTIONS TO ADJUST THE MODEL PARAMETERS
 In 2006 dollars per barrel (adjusted for inflation)

Year	Option 1: DOE			Option 2: IEA	Option 3: Morgan Stanley		
	Shifted up 20.8% to reflect average percent difference--forecast vs. actual*			Shifted up 27% to reflect average percent difference--forecast vs. actual	Morgan Stanley projections from 2008-2012; annual growth in DOE projections from 2013-2030		
	Department of Energy (DOE) (a)			2007 International Energy Administration (IEA) (b)	Morgan Stanley (e)		
	Reference (base case)	High	Low		Base	High	Low
2008	\$88	\$92	\$85	\$75	\$76	\$105	\$62
2009	\$83	\$92	\$75	\$75	\$78	\$105	\$63
2010	\$79	\$95	\$67	\$76	\$78	\$105	\$64
2011	\$76	\$99	\$61	\$76	\$78	\$104	\$64
2012	\$73	\$102	\$54	\$76	\$79	\$105	\$65
2013	\$69	\$104	\$50	\$76	\$75	\$106	\$61
2014	\$66	\$103	\$47	\$76	\$71	\$105	\$56
2015	\$63	\$100	\$43	\$76	\$68	\$103	\$52
2016	\$60	\$98	\$41	\$76	\$65	\$101	\$49
2017	\$60	\$99	\$40	\$77	\$65	\$101	\$48
2018	\$61	\$101	\$40	\$77	\$66	\$104	\$48
2019	\$62	\$103	\$40	\$77	\$67	\$106	\$49
2020	\$62	\$107	\$41	\$77	\$67	\$110	\$49
2021	\$63	\$108	\$41	\$77	\$68	\$111	\$49
2022	\$64	\$109	\$41	\$77	\$69	\$112	\$50
2023	\$65	\$109	\$41	\$78	\$70	\$112	\$49
2024	\$66	\$111	\$41	\$78	\$71	\$114	\$50
2025	\$67	\$113	\$42	\$78	\$73	\$116	\$50
2026	\$68	\$114	\$42	\$78	\$74	\$118	\$51
2027	\$67	\$113	\$41	\$78	\$73	\$116	\$50
2028	\$69	\$116	\$42	\$78	\$74	\$119	\$50
2029	\$70	\$118	\$42	\$79	\$76	\$121	\$51
2030	\$71	\$120	\$43	\$79	\$77	\$123	\$52
Average annual percent growth							
2006-2030	-0.03%	2.19%	-2.11%	0.20%			
2008-2030					0.01%	0.73%	-0.85%

Note: Nominal oil prices from Table 1 were adjusted to 2006 dollars by Jacobs Consultancy, Inc. using an inflation rate of 2.3%.

*Reflects National Energy Modeling System (NEMS) Annual Energy Outlooks (AEO) only. The National Energy Modeling System (NEMS) was completed in December 1993 and was first used for the DOE energy forecasts in 1994. Therefore, the period from 1994 through 2005 is evaluated because it includes only NEMS generated forecasts.

DOE DEFINITION OF TERMS

- **West Texas Intermediate (WTI - Cushing):** A crude stream produced in Texas and southern Oklahoma which serves as a reference or "marker" for pricing a number of other crude streams and which is traded in the **domestic spot market** at Cushing, Oklahoma.
- **Spot price:** The price for a one-time open market transaction for immediate delivery of a specific quantity of product at a specific location where the commodity is purchased "on the spot" at current market rates.
- **Refiner acquisition cost of crude oil:** The cost of crude oil, including transportation and other fees paid by the refiner. The composite cost is the weighted average of domestic and imported crude oil costs. *Note:* The refiner acquisition cost does not include the cost of crude oil purchased for the Strategic Petroleum Reserve (SPR).

Appendix A

Annual Energy Outlook, Retrospective Review: Evaluations of Projections in Past Editions (1982-2006)

U.S. Department of Energy, Energy Information Administration

Page 1 of 4

Report #: DOE/EIA-0640(2006)

Release Date: March 2007

Next release date: February 2008

Annual Energy Outlook Retrospective Review

Table 4. World Oil Prices, Actual vs. Forecasts

(current dollars per barrel)

Annual Energy Outlook report	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
AEO 1982	29.66	34.82	41.43	48.04	53.75	59.06																
AEO 1983	28.99	29.39	32.67	39.32	46.07	53.22					101.59											
AEO 1984	29.07	29.39	30.97	33.96	37.23	40.82					73.87											
AEO 1985	27.00	25.86	24.83	26.05	29.69	33.75	36.96	40.54	42.89	46.92	49.65											
AEO 1986		14.57	15.87	17.30	18.86	20.64	22.25	25.37	29.75	34.85	39.91	44.86	49.71	54.30	58.99	64.42						
AEO 1987			18.11	17.30	18.91	19.93	20.90	21.77	23.99	27.50	32.03					57.72						
AEO 1989*				14.70	14.93	16.33	17.75	19.15	21.68	25.21	28.91	33.29	37.81	42.47	46.36	49.98						
AEO 1990					17.70	17.49					26.58					46.17						69.08
AEO 1991						22.00	24.77	25.59	26.45	27.34	28.37	29.44	30.54	32.03	34.28	36.89	39.84	43.34	47.08	50.99	55.23	
AEO 1992							19.03	20.06	20.65	22.27	24.20	26.31	28.66	31.17	33.96	36.96	39.90	42.96	46.05	49.18	52.53	
AEO 1993								18.86	20.25	21.24	22.45	23.68	25.02	26.71	28.64	31.02	33.48	36.27	38.90	41.21	43.63	
AEO 1994									17.06	17.21	18.24	19.43	20.64	22.12	23.76	25.52	27.51	29.67	31.86	34.00	36.05	
AEO 1995										15.24	17.27	18.23	19.26	20.39	21.59	22.97	24.33	25.79	27.27	28.82	30.38	
AEO 1996											17.16	17.74	18.59	19.72	20.97	22.34	23.81	25.26	26.72	28.22	29.87	
AEO 1997												19.99	19.42	19.55	20.07	20.59	21.68	22.71	23.75	24.78	25.87	
AEO 1998													18.54	18.79	19.87	20.95	21.79	22.53	23.46	24.34	25.27	
AEO 1999														12.50	13.64	14.67	16.35	17.87	19.64	21.14	22.59	
AEO 2000															17.35	21.80	20.99	21.52	22.05	22.62	23.23	
AEO 2001																28.21	24.86	22.82	22.36	23.04	23.65	
AEO 2002																	22.99	21.99	24.00	24.86	25.66	
AEO 2003																		23.65	26.92	25.70	25.40	
AEO 2004																			27.65	24.54	24.45	
AEO 2005																					35.74	35.40
AEO 2006																						50.97
Actual	26.99	14.00	18.13	14.56	18.08	21.76	18.70	18.20	16.14	15.51	17.14	20.64	18.53	12.04	17.26	27.70	22.00	23.71	27.71	35.90	48.85	
Average Absolute Difference (All AEOs)	1.7	12.8	9.9	13.5	12.4	12.5	5.2	6.3	9.2	11.0	19.8	6.8	8.3	15.2	11.6	11.7	5.7	5.7	6.2	9.8	18.4	

NOTE: The average absolute percent difference is the simple mean of the absolute values of the percentage difference between the reference case projection and the actual value.

Appendix A
Annual Energy Outlook, Retrospective Review: Evaluations of Projections in Past Editions (1982-2006)
 U.S. Department of Energy, Energy Information Administration
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Report #: DOE/EIA-0640(2006)
 Release Date: March 2007
 Next release date: February 2008

Annual Energy Outlook Retrospective Review

Table 4. World Oil Prices, Actual vs. Forecasts

(percent difference)

Annual Energy Outlook report	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
AEO 1982	9.9	148.7	128.5	229.9	197.3	171.4																
AEO 1983	7.4	110.0	80.2	170.0	154.8	144.6					492.7											
AEO 1984	7.7	110.0	70.8	133.2	105.9	87.6					331.0											
AEO 1985	0.0	84.7	36.9	78.9	64.2	55.1	97.7	122.7	165.8	202.5	189.6											
AEO 1986		4.1	-12.5	18.8	4.3	-5.2	19.0	39.4	84.3	124.7	132.9	117.3	168.3	351.0	241.7	132.5						
AEO 1987			-0.1	18.8	4.6	-8.4	11.8	19.6	48.7	77.3	86.9					108.4						
AEO 1989*				1.0	-17.4	-24.9	-5.1	5.2	34.3	62.5	68.7	61.3	104.1	252.7	168.6	80.4						
AEO 1990					-2.1	-19.6					55.1					66.7						41.4
AEO 1991						1.1	32.4	40.6	63.9	76.3	65.5	42.6	64.8	166.0	98.6	33.2	81.1	82.8	69.9	42.0	13.1	
AEO 1992							1.8	10.2	28.0	43.6	41.2	27.5	54.7	158.9	96.7	33.4	81.4	81.2	66.2	37.0	7.5	
AEO 1993								3.6	25.5	36.9	31.0	14.7	35.0	121.8	65.9	12.0	52.2	53.0	40.4	14.8	-10.7	
AEO 1994									5.7	10.9	6.4	-5.9	11.4	83.7	37.7	-7.9	25.0	25.1	15.0	-5.3	-26.2	
AEO 1995										-1.8	0.8	-11.7	4.0	69.4	25.1	-17.1	10.6	8.8	-1.6	-19.7	-37.8	
AEO 1996											0.1	-14.0	0.3	63.8	21.5	-19.3	8.2	6.5	-3.6	-21.4	-38.8	
AEO 1997												-3.1	4.8	62.4	16.3	-25.7	-1.5	-4.2	-14.3	-31.0	-47.0	
AEO 1998													0.0	56.1	15.1	-24.4	-1.0	-5.0	-15.3	-32.2	-48.3	
AEO 1999														3.8	-21.0	-47.0	-25.7	-24.6	-29.1	-41.1	-53.8	
AEO 2000															0.5	-21.3	-4.6	-9.2	-20.4	-37.0	-52.5	
AEO 2001																1.8	13.0	-3.7	-19.3	-35.8	-51.6	
AEO 2002																	4.5	-7.3	-13.4	-30.8	-47.5	
AEO 2003																		-0.3	-2.9	-28.4	-48.0	
AEO 2004																			-0.2	-31.7	-49.9	
AEO 2005																				-0.4	-27.5	
AEO 2006																						4.3
Average Absolute Percent Difference (All AEOs)	6.3	91.5	54.8	93.0	68.8	57.5	28.0	34.5	57.0	70.7	115.5	33.1	44.7	126.3	67.4	42.1	25.7	24.0	22.3	27.2	37.6	

* There is no report titled *Annual Energy Outlook 1988* due to a change in the naming convention of the AEOs.

Sources: Forecasts: *Annual Energy Outlook*, Mid-Price or Reference Case Projections, Various Editions.

Historical Data: Energy Information Administration, Annual Energy Review 2005, DOE/EIA-0384(2005) (Washington, DC, July 2006), Table 5.21.

NOTE: The average absolute percent difference is the simple mean of the absolute values of the percentage difference between the reference case projection and the actual value.

Appendix A
Annual Energy Outlook, Retrospective Review: Evaluations of Projections in Past Editions (1982-2006)
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Report #: DOE/EIA-0640(2006)
 Release Date: March 2007
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Annual Energy Outlook Retrospective Review

Table 4. World Oil Prices, Actual vs. Forecasts

Annual Energy Outlook report	(absolute forecasting errors, current dollars per barrel)																				Average Absolute Error (All Years)		
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		2005	
AEO 1982	2.67	20.82	23.30	33.48	35.67	37.30																	25.54
AEO 1983	2.00	15.39	14.54	24.76	27.99	31.46					84.45												28.65
AEO 1984	2.08	15.39	12.84	19.40	19.15	19.06					56.73												20.66
AEO 1985	0.01	11.86	6.70	11.49	11.61	11.99	18.26	22.34	26.75	31.41	32.51												16.81
AEO 1986		0.57	2.26	2.74	0.78	1.12	3.55	7.17	13.61	19.34	22.77	24.22	31.18	42.26	41.73	36.72							16.67
AEO 1987			0.02	2.74	0.83	1.83	2.20	3.57	7.85	11.99	14.89					30.02							7.59
AEO 1989*				0.14	3.15	5.43	0.95	0.95	5.54	9.70	11.77	12.65	19.28	30.43	29.10	22.28							11.64
AEO 1990					0.38	4.27					9.44					18.47						20.23	10.56
AEO 1991						0.24	6.07	7.39	10.31	11.83	11.23	8.80	12.01	19.99	17.02	9.19	17.84	19.63	19.37	15.09	6.38		12.02
AEO 1992							0.33	1.86	4.51	6.76	7.06	5.67	10.13	19.13	16.70	9.26	17.90	19.25	18.34	13.28	3.68		10.26
AEO 1993								0.66	4.11	5.73	5.31	3.04	6.49	14.67	11.38	3.32	11.48	12.56	11.19	5.31	5.22		7.18
AEO 1994									0.92	1.70	1.10	1.21	2.11	10.08	6.50	2.18	5.51	5.96	4.15	1.90	12.80		4.32
AEO 1995										0.27	0.13	2.41	0.73	8.35	4.33	4.73	2.33	2.08	0.44	7.08	18.47		4.28
AEO 1996											0.02	2.90	0.06	7.68	3.71	5.36	1.81	1.55	0.99	7.68	18.98		4.61
AEO 1997												0.65	0.89	7.51	2.81	7.11	0.32	1.00	3.96	11.12	22.98		5.84
AEO 1998													0.01	6.75	2.61	6.75	0.21	1.18	4.25	11.56	23.58		6.32
AEO 1999														0.46	3.62	13.03	5.65	5.84	8.07	14.76	26.26		9.71
AEO 2000															0.09	5.90	1.01	2.19	5.66	13.28	25.62		7.68
AEO 2001																0.51	2.86	0.89	5.35	12.86	25.20		7.94
AEO 2002																	0.99	1.72	3.71	11.04	23.19		8.13
AEO 2003																		0.06	0.79	10.20	23.45		8.63
AEO 2004																			0.06	11.36	24.40		11.94
AEO 2005																					0.16	13.45	6.81
AEO 2006																						2.12	2.12

39%

Average Absolute Error (All AEOs)

10.71

NOTE: The average absolute percent difference is the simple mean of the absolute values of the percentage difference between the reference case projection and the actual value.

Appendix A

Annual Energy Outlook, Retrospective Review: Evaluations of Projections in Past Editions (1982-2006)

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Report #: DOE/EIA-0640(2006)

Release Date: March 2007

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Annual Energy Outlook Retrospective Review

Table 4. World Oil Prices, Actual vs. Forecasts

(absolute percent error)

Annual Energy Outlook report	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average Absolute Percent Error (All Years)	
AEO 1982	9.9	148.7	128.5	229.9	197.3	171.4																	147.6
AEO 1983	7.4	110.0	80.2	170.0	154.8	144.6					492.7												165.7
AEO 1984	7.7	110.0	70.8	133.2	105.9	87.6					331.0												120.9
AEO 1985	0.0	84.7	36.9	78.9	64.2	55.1	97.7	122.7	165.8	202.5	189.6												99.8
AEO 1986		4.1	12.5	18.8	4.3	5.2	19.0	39.4	84.3	124.7	132.9	117.3	168.3	351.0	241.7	132.5							97.1
AEO 1987			0.1	18.8	4.6	8.4	11.8	19.6	48.7	77.3	86.9				108.4								38.4
AEO 1989*				1.0	17.4	24.9	5.1	5.2	34.3	62.5	68.7	61.3	104.1	252.7	168.6	80.4							68.2
AEO 1990					2.1	19.6					55.1					66.7						41.4	37.0
AEO 1991						1.1	32.4	40.6	63.9	76.3	65.5	42.6	64.8	166.0	98.6	33.2	81.1	82.8	69.9	42.0	13.1		60.9
AEO 1992							1.8	10.2	28.0	43.6	41.2	27.5	54.7	158.9	96.7	33.4	81.4	81.2	66.2	37.0	7.5		51.3
AEO 1993								3.6	25.5	36.9	31.0	14.7	35.0	121.8	65.9	12.0	52.2	53.0	40.4	14.8	10.7		37.0
AEO 1994									5.7	10.9	6.4	5.9	11.4	83.7	37.7	7.9	25.0	25.1	15.0	5.3	26.2		20.5
AEO 1995										1.8	0.8	11.7	4.0	69.4	25.1	17.1	10.6	8.8	1.6	19.7	37.8		17.3
AEO 1996											0.1	14.0	0.3	63.8	21.5	19.3	8.2	6.5	3.6	21.4	38.8		18.0
AEO 1997												3.1	4.8	62.4	16.3	25.7	1.5	4.2	14.3	31.0	47.0		21.0
AEO 1998													0.0	56.1	15.1	24.4	1.0	5.0	15.3	32.2	48.3		21.9
AEO 1999														3.8	21.0	47.0	25.7	24.6	29.1	41.1	53.8		30.8
AEO 2000															0.5	21.3	4.6	9.2	20.4	37.0	52.5		20.8
AEO 2001																1.8	13.0	3.7	19.3	35.8	51.6		20.9
AEO 2002																	4.5	7.3	13.4	30.8	47.5		20.7
AEO 2003																		0.3	2.9	28.4	48.0		19.9
AEO 2004																			0.2	31.7	49.9		27.3
AEO 2005																				0.4	27.5		14.0
AEO 2006																					4.3		4.3
Average Absolute Percent Error (All Years, All AEOs)																68.4	65.5	62.4	59.3	56.4	54.1		52.9

NEMS AEOs Only	20.8
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Pre-NEMS AEOs	77.0
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* There is no report titled *Annual Energy Outlook 1988* due to a change in the naming convention of the AEOs.

NEMS = National Energy Modeling System

AEO = Annual Energy Outlook (annual energy reports)

NOTE: The average absolute percent difference is the simple mean of the absolute values of the percentage difference between the reference case projection and the actual value.