Thoughts on Energy Projections Used in Climate Change Analysis

for

Workshop on Methods to Address Uncertainty in Forecasting Future Values of Key Social, Economic, and Resource Variables

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by

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Observations regarding energy projections and forecasts

- Leading providers of energy projections generally do a better job of characterizing uncertainty and providing meaningful caveats than is suggested in the background note.

- Caveats included both physical or social science studies are not effective in preventing the willful misuse of their contents. This problem, which relates to the actual "wants" and "needs" of policymakers and those seeking to influence the policy process deserves more attention.

- EIA prepares and publicly posts on a regular basis, detailed "post mortem" comparisons of projected and actual values.

- While "point value" energy projections are inevitably wrong, experience suggests that fossil fuel quantities are easier to project than fossil fuel prices. Quantities, not prices, are most relevant to climate concerns.

- Assessment of the track record of energy projections is inherently subjective and in the eye of the beholder.

EIA retrospective review of reference case projections through AEO2012: summary

Variable	Average Absolute Percent Differences	Percent of Projections Over-Estimated
Real Gross Domestic Product (Average Cumulative Growth)*	1.0	42.6
Petroleum		
Imported Refiner Acquisition Cost of Crude Oil (Constant $)	35.2	18.6
Imported Refiner Acquisition Cost of Crude Oil (Nominal $)	34.7	19.7
Total Petroleum Consumption	6.2	66.5
Natural Gas		
Natural Gas Wellhead Prices (Constant $)	30.7	26.1
Natural Gas Wellhead Prices (Nominal $)	30.0	27.1
Total Natural Gas Consumption	7.8	70.2
Coal		
Coal Prices to Electric Generating Plants (Constant $)	18.6	39.9
Coal Prices to Electric Generating Plants (Nominal $)	20.8	43.6
Total Coal Consumption	7.4	60.1
Electricity		
Average Electricity Prices (Constant $)	10.0	37.8
Average Electricity Prices (Nominal $)	12.5	42.6
Total Electricity Sales	4.2	46.3
Total Energy, Carbon and Intensity		
Total Energy Consumption	5.6	79.3

* The basis for GDP comparison is the projection differences in the cumulative average growth rate of real GDP from the first year shown for each AEO. The summary information for projection differences given for GDP growth rates is absolute percentage point differences; for all other *AEO* concepts, the comparison basis is absolute percent differences.

Source: EIA, Annual Energy Outlook Retrospective Review Table 1

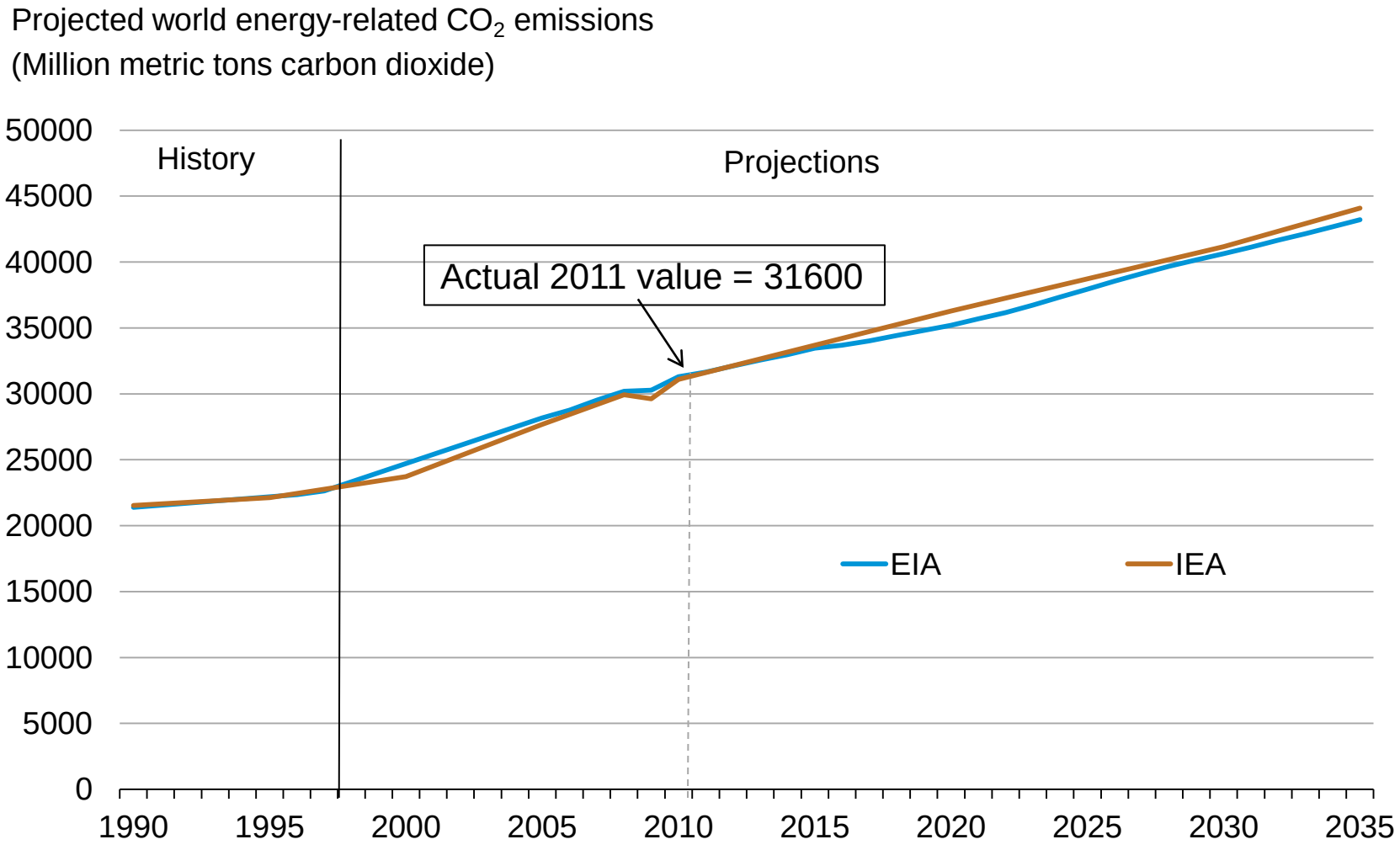
EIA retrospective review of reference case projections through AEO2012: energy related CO_2 emissions

Projected (million metric tons)	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
AEO 1994	5060	5130	5185	5240	5287	5335	5379	5438	5482	5529	5599	5658	5694	5738	5797	5874	5925	5984	
AEO 1995		5137	5174	5188	5262	5309	5361	5394	5441	5489	5551	5621	5680	5727	5775	5841	5889	5944	
AEO 1996			5182	5224	5295	5355	5417	5464	5525	5589	5660	5735	5812	5879	5925	5981	6030	6087	6142
AEO 1997				5295	5381	5491	5586	5658	5715	5781	5863	5934	6009	6106	6184	6236	6268	6316	6365
AEO 1998					5474	5621	5711	5784	5893	5957	6026	6098	6192	6292	6379	6465	6542	6612	6683
AEO 1999						5522	5689	5810	5913	5976	6036	6084	6152	6244	6325	6418	6493	6563	6641
AEO 2000							5573	5692	5777	5865	5971	6078	6172	6262	6345	6420	6480	6551	6610
AEO 2001								5630	5781	5909	6023	6114	6197	6281	6387	6470	6541	6633	6709
AEO 2002									5723	5808	5981	6095	6210	6323	6438	6530	6624	6727	6839
AEO 2003										5633	5749	5856	5954	6095	6232	6360	6475	6602	6719
AEO 2004											5743	5826	5986	6124	6251	6357	6453	6559	6657
AEO 2005												5905	6023	6138	6274	6415	6533	6627	6721
AEO 2006													5967	5978	6080	6182	6281	6365	6440
AEO 2007														5940	5999	6059	6124	6214	6296
AEO 2008															5977	5983	5978	6011	6087
AEO 2009																5849	5699	5746	5803
AEO 2010																	5507	5521	5643
AEO 2011																		5643	5601
AEO 2012																			5632
Actual	5185	5258	5314	5501	5575	5622	5682	5867	5759	5806	5857	5975	5997	5919	6020	5838	5429	5612	5481
Average Absolute Difference	125	125	134	264	235	183	161	258	137	149	158	157	144	220	222	377	797	659	848

Projected vs. Actual (percent difference)	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
AEO 1994	-2.4	-2.4	-2.4	-4.8	-5.2	-5.1	-5.3	-7.3	-4.8	-4.8	-4.4	-5.3	-5.0	-3.1	-3.7	0.6	9.1	6.6	
AEO 1995		-2.3	-2.6	-5.7	-5.6	-5.6	-5.7	-8.1	-5.5	-5.5	-5.2	-5.9	-5.3	-3.2	-4.1	0.1	8.5	5.9	
AEO 1996			-2.5	-5.0	-5.0	-4.8	-4.7	-6.9	-4.1	-3.7	-3.4	-4.0	-3.1	-0.7	-1.6	2.5	11.1	8.5	12.1
AEO 1997				-3.7	-3.5	-2.3	-1.7	-3.6	-0.8	-0.4	0.1	-0.7	0.2	3.2	2.7	6.8	15.5	12.5	16.1
AEO 1998					-1.8	0.0	0.5	-1.4	2.3	2.6	2.9	2.1	3.3	6.3	6.0	10.7	20.5	17.8	21.9
AEO 1999						-1.8	0.1	-1.0	2.7	2.9	3.1	1.8	2.6	5.5	5.1	9.9	19.6	16.9	21.2
AEO 2000							-1.9	-3.0	0.3	1.0	1.9	1.7	2.9	5.8	5.4	10.0	19.3	16.7	20.6
AEO 2001								-4.0	0.4	1.8	2.8	2.3	3.3	6.1	6.1	10.8	20.5	18.2	22.4
AEO 2002									-0.6	0.0	2.1	2.0	3.5	6.8	6.9	11.9	22.0	19.9	24.8
AEO 2003										-3.0	-1.8	-2.0	-0.7	3.0	3.5	8.9	19.3	17.6	22.6
AEO 2004											-1.9	-2.5	-0.2	3.5	3.8	8.9	18.9	16.9	21.5
AEO 2005												-1.2	0.4	3.7	4.2	9.9	20.3	18.1	22.6
AEO 2006													-0.5	1.0	1.0	5.9	15.7	13.4	17.5
AEO 2007														0.4	-0.3	3.8	12.8	10.7	14.9
AEO 2008															-0.7	2.5	10.1	7.1	11.1
AEO 2009																0.2	5.0	2.4	5.9
AEO 2010																	1.4	-1.6	3.0
AEO 2011																		0.6	2.2
AEO 2012																			2.7
Average Absolute Percent Difference	2.4	2.4	2.5	4.8	4.2	3.3	2.8	4.4	2.4	2.6	2.7	2.6	2.4	3.7	3.7	6.5	14.7	11.7	15.5

Source: EIA, Annual Energy Outlook Retrospective Review Table 21

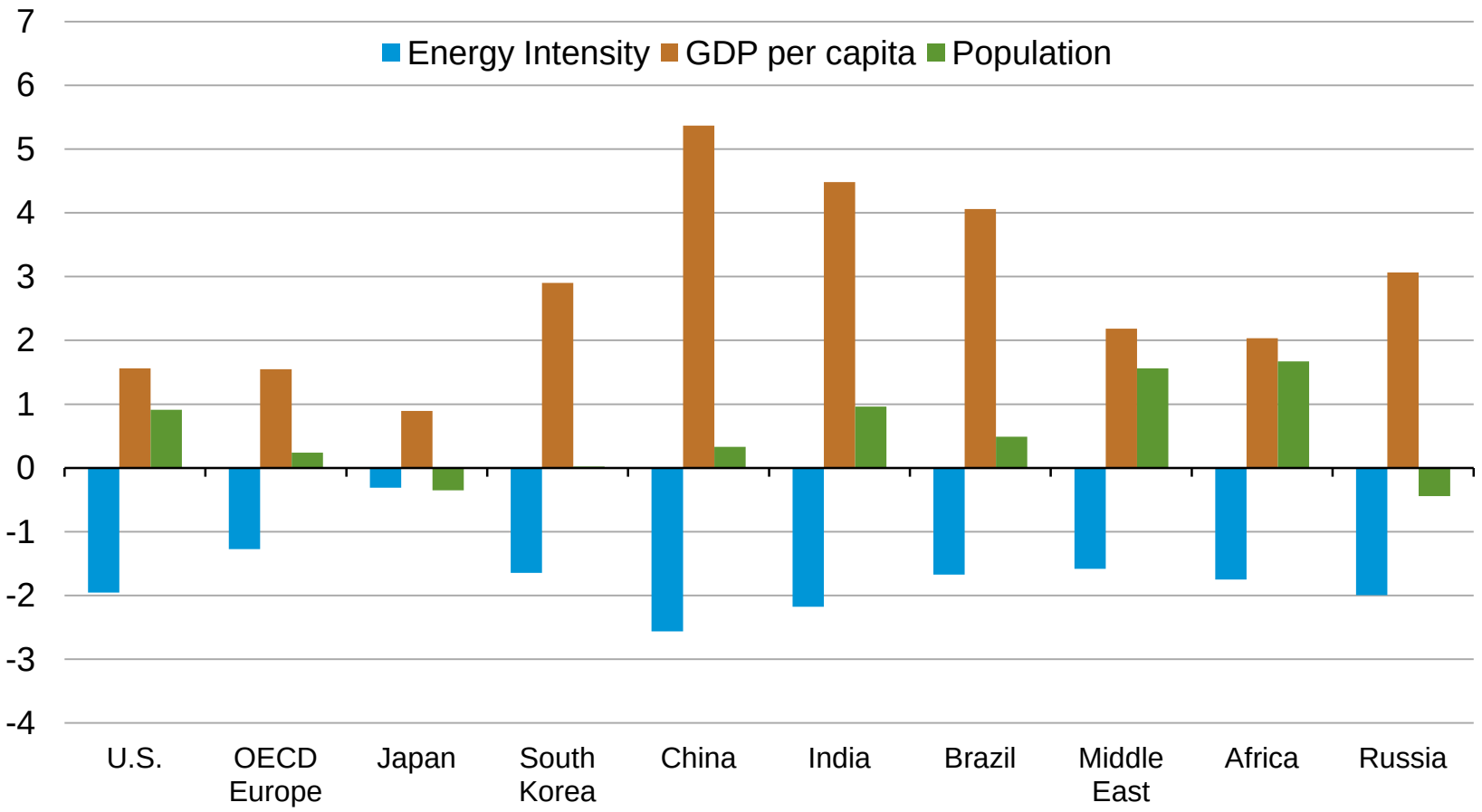
Global projections of energy-related CO_2 emissions: *EIA International Energy Outlook 2000* and *IEA World Energy Outlook 2000*



Source: EIA, International Energy Outlook 2000 and IEA, World Energy Outlook 2000

Growth in income and population drive rising energy use; energy intensity improvements moderate increases in energy demand

average annual change (2008-2035)
percent per year



Source: EIA, International Energy Outlook 2011

Observations regarding climate and energy analysis

- Experts tend to revel in the uncertainties and complexities within their own field while ignoring other key uncertainties, as illustrated by the experience of the Intergovernmental Panel on Climate Change (IPCC).
- Policy makers objectives and their wants & needs for expert information are often quite different than the objectives and information needs that experts would hold if they were in the role of policy makers.
- Experts in all fields face a huge challenge in providing information regarding uncertainty within the constraint of an extremely narrow band width for communicating with policy makers and the public. The challenge is not unique to energy projections or forecasts.
- Improved probabilistic assessments may be more attainable on the hard science side of climate analysis than in energy projections. The premise in the background note that probabilistic energy projections are a particularly high-value target is debatable.
- Work by Weitzman and others suggest that many of the uncertainties of greatest interest in the climate analysis involve issues that are extremely difficult to assess

For more information

U.S. Energy Information Administration home page | www.eia.gov

Annual Energy Outlook | www.eia.gov/forecasts/aeo

Short-Term Energy Outlook | www.eia.gov/forecasts/steo

International Energy Outlook | www.eia.gov/forecasts/ieo

Today In Energy | www.eia.gov/todayinenergy

Monthly Energy Review | www.eia.gov/totalenergy/data/monthly

Annual Energy Review | www.eia.gov/totalenergy/data/annual