



Carbon Dioxide Emissions Costs and Electricity Resource Planning

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Background

- There is increasing acknowledgement of climate change from industry and government and that emissions from fossil fired power plants are a major contributor.
- Federal regulation of CO₂ emissions is now a question of when, not if.
- Significant reductions will be required.
- Imprudent for a utility to evaluate future resource options without fully considering carbon risks.

Uncertainty in Many Resource Planning Assumptions Example: Natural Gas Prices



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How to Make CO₂ Costs *Not* Count In Resource Planning

- 1. Too uncertain! assume that CO₂ costs will be zero throughout 40-60 year operating lives of proposed generating facilities.
- 2. Assume CO₂ costs only as sensitivity analyses not in base case studies.
- 3. Assume only a single CO_2 price trajectory, not a range of possible CO_2 prices.
- 4. At best, only a few non-carbon emitting resources are made available for model to select.
- 5. Avoided costs for energy efficiency don't reflect the cost of CO_2 regulations.
- 6. Assume CO₂ prices do not reflect any increases, over time, of the stringency of regulation.
- 7. Assume delayed adoption or implementation of CO_2 regulations, e.g., not starting until 2015.
- 8. Focus on decreasing carbon intensity (lbs per MWh) instead of reducing overall CO_2 emissions.
- 9. Assume that new units will be grandfathered.

Current Synapse CO₂ Price Forecast

- Developed in the Winter and Spring of 2006.
- Based on several factors including analyses of four bills proposed in Congress prior to 2006 and a proposal from the National Commission on Energy Policy.

Policy proposal	Analysis
McCain Lieberman – S. 139	EIA 2003, MIT 2003, Tellus 2003
McCain Lieberman – SA 2028	EIA 2004, MIT 2003, Tellus 2004
Greenhouse Gas Intensity Targets	EIA 2005, EIA 2006
Jeffords – S. 150	EPA 2005
Carper 4-P – S. 843	EIA 2003, EPA 2005

Factors that Affect Future Carbon Emissions Policy Costs

- "Base case" emissions forecast
- Complimentary policies
- Policy implementation timeline
- Reduction targets
- Program flexibility
- Technological progress
- Emissions co-benefits

The Current Synapse CO₂ Price Forecast



Synapse's Levelized Carbon Price Forecast (2005\$/ton)

ę	Low	Mid	High
	Case	Case	Case
	\$7.80	\$19.10	\$30.50

Examples of the Impact of Current Synapse CO₂ Price Forecast on Costs of Fossil Supply Options

For a new plant online in 2011				
Supercritical Combi		Combined	N.	
	PC	Cycle	IGCC	
Size (MW)	600	600	535	
CO ₂ (Ib/MMBtu)	208	110	200	
Heat Rate (Btu/KWh)	9,369	7,400	9,612	
CO ₂ Low Price (2005\$/ton)	7.8	7.8	7.8	
CO_2 Mid Price (2005\$/ton)	19.1	19.1	19.1	
CO ₂ High Price (2005\$/ton)	30.5	30.5	30.5	
CO ₂ Low Cost per MWh	\$7.60	\$3.17	\$7.50	
CO_2 Mid Cost per MWh	\$18.61	\$7.77	\$18.36	
CO ₂ High Cost per MWh	\$29.72	\$12.41	\$29.32	

Proposed Big Stone II Coal-Fired Generating Unit – 600 MW at an average 88% annual capacity factor

- Low Synapse CO₂ Price Forecast 4,856,000 MWh \cdot \$7.74/MWh = \$37,585,440 per year
- Mid Synapse CO₂ Price Forecast 4,856,000 MWh · \$19.60/MWh = \$95,177,600 per year
- High Synapse CO₂ Price Forecast 4,856,000 MWh \cdot \$30.39/MWh = \$147,573,840 per year

- Proposals in Congress have become much more aggressive since early 2006 - would require greater CO₂ emissions reductions.
- Estimates of the CO₂ allowance prices at which carbon capture and sequestration technologies would become cost-effective.
- State initiatives create pressure for stringent federal regulation e.g. California.

Bills in the 109th Congress



Bills in 110th Congress are more aggressive than the bills used to develop Synapse CO₂ price forecast





 Most aggressive proposal prior to May 2006 was capping emissions at 1990 levels. Most proposals now are looking at reductions of 60-80 percent below 1990 levels.

Utility CO₂ price forecasts do not reflect current bills being discussed in Congress

- FPL
 - Bingaman's 2006 Discussion Draft
 - Carper 2006 (S.2724)
 - Feinstein 2006 Draft
 - McCain-Lieberman 2005
- Duke
 - Bingaman 2006 Draft
- AEP
 - Carper 2003 (S.843)
 - McCain-Lieberman 2003 (S. 139)
- As a result, utility CO₂ price forecasts are too low and do not adequately reflect real risks of CO₂ regulation.

2007 FPL CO₂ price forecast

Comparison of FPL CO₂ Forecast to Synapse Forecast



Duke January 2007 CO₂ price forecast



Estimates of the CO₂ Prices at which CCS technologies would become cost-effective

- \$30/ton 2007 MIT Study, "The Future of Coal – Options for a Carbon-Constrained World"
- \$15-\$75/ton CO₂ net captured Intergovernmental Panel on Climate Change, "Carbon Dioxide Capture and Storage"
- \$45/ton Global Energy Technology Strategy Program, "Carbon Dioxide Capture and Geologic Storage



STATE	GHG REDUCTION GOALS & TIMELINES
AZ	2000 levels by 2020; 50 percent below 2000 levels by 2040
CA	2000 levels by 2010; 10 percent below by 2020; 80 percent below by 2050
CT	1990 levels by 2010; 10 percent below by 2020; 75 percent below by 2050
MA	1990 levels by 2010; 10 percent below by 2020; 75 percent below by 2050
ME	1990 levels by 2010; 10 percent below by 2020; 75 percent below by 2050
NJ	5 percent below 1990 by 2005
NM	2000 by 2012; 10 percent below by 2020; 75 percent below 2050
NY	5 percent below 1990 by 2010
OR	1990 by 2010; 10 percent below by 2020; 75 percent by 2100
RI	1990 by 2010; 10 percent below by 2020; 75 percent by 2050
VT	25 percent below 1990 levels by 2012; 50 percent below 2028; 75 below by 2050
WA (Puget Sound)	1990 by 2010; 10 percent below by 2020; 75 percent by 2100

Source: December 2006 New Mexico Climate Change Advisory Group Report