Impact on CO$_2$ Price Expectations on Electric Generation Investment in the U.S.

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Outline

• Developing price expectations

• Implications for investment decisions to retrofit existing coal plants to cut $\text{SO}_2$, NOx, and Hg
Waxman-Markey Passed House 219-212 on June 26th: Seeks to Cut CO₂ Emissions Well Below Historic Levels


June 25, 2009

Waxman-Markey, H.R. 2454 (June 22 substitute)
- Emission caps only
- Caps plus all complementary requirements
- Potential range of additional reductions

For a full discussion of underlying methodology, assumptions and references, please see http://www.wri.org/usclimatetargets.
Electric Sector is Major Source of CO₂ Emissions

Electric sector’s share of national total (2006)
• 33% of total GHGs
• 39% of total CO₂

Shares within the electric sector CO₂
• 15% from natural gas ($6/MMBtu)
• 83% from coal ($1.5/MMBtu)
Private NEMS Analysis for PacifiCorp Provides Insights on CO₂ Prices Under Waxman-Markey

• Preliminary NEMS results courtesy of PacifiCorp, a subsidiary of MidAmerican Energy Holdings Company
• NEMS (National Energy Modeling System) used by EIA for AEOs (Annual Energy Outlooks) and policy analyses
• NEMS and AEO 2009 publicly available from EIA
• EPRI applied model to represent Waxman-Markey on behalf of PacifiCorp
  – PacifiCorp assumptions on power plant costs (2008)
  – PacifiCorp/EPRI team set scenarios
Analysis Highlights Critical Role of Offset Availability Assumptions for Waxman-Markey

Offset Availability by Case

Reference Case: 2B tons/yr starting in 2012

Case 1: Plentiful by 2030
Case 2: Scarce
Case 3: Very scarce

Ref WM (max)  Case 1 (2B)  Case 2 (1B)  Case 3 (halfB)
Results Highlight Critical Importance of Offset Availability for CO₂ Price

NEMS CO₂ Price to Meet Abatement Target

- **No offsets at first**
- **Very scarce**
  - .5B by 2030
- **Scarce**
  - 1B by 2030
- **Plentiful**
  - 2B by 2030
- **Offsets plentiful throughout**

Legend:
- Ref WM (max)
- Case 1 (2B)
- Case 2 (1B)
- Case 3 (halfB)
EIA and PacifiCorp-EPRI Results Differ Due to Scenario and Generation Cost Assumptions

Figure 5. Projected Allowance Prices in ACESA Main Cases, 2012-2030
(2007 dollars per metric ton CO₂-equivalent)

Why lower?
New nuclear @ $2,900/kW
New CCS coal @ $3,200/kW
Result is 95GW of nuclear, 69GW of CCS in Basic Case

Source: National Energy Modeling System runs, HR2454CAP.D072909A, HR2454NOBNK.D072909A, HR2454HIOFF.D072909A, HR2454HC.D072909A, HR2454NOINT.D072909A, and HR2454NIBIV.D072909A.
Electric Sector CO₂ Emissions Fall Dramatically When Offsets are Limited
Generation By Fuel Type – Reference Case with Full Offsets

Generation By Fuel Type - Ref WM (max)
Generation By Fuel Type – Offsets Limited to 1B (burns less coal, more gas)

Generation By Fuel Type - Case 2 (1B)
Little Coal Generation Retired in Reference Case (full offsets)

Cumu. Capacity Retirement - Ref WM (max)

- Renewable
- Nuclear
- Conv CT
- Conv CC
- Oil/NG Steam
- Conv Coal

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Massive Retirements of Coal Generation In Case With Limited Offsets

Cumu. Capacity Retirement - Case 2 (1B)
Implications for Electric Sector Decisions
How Much Should a Utility be Willing to Spend to Keep an Existing Coal Unit Running?

- $300 million?
- $200 million?
- $100 million?
- $250 million?
- $350 million?
Framing the Decision to Retrofit SO$_2$, NOx, Hg Controls, or Cooling Towers

• Cost of retrofit highly dependent on plant specifics
  – layout,
  – age, size,
  – boiler type,
  – pre-existing controls,
  – region, etc.

• Retrofit costs may exceed $500/kW

• If don’t retrofit, must close plant

• Question is, will the value of the plant’s continued output exceed cost of its retrofit?
Cash Flows for $500/kW Retrofit of an Existing Coal Unit

What you pay

What you get
What is the Impact of Climate Policy on Existing Coal Generation?

• Cap-and-trade climate policy will impinge on existing coal
• With high price on CO₂:
  – System redispatches gas more
  – New non/low-emitting generation added to stack
  – Customers cut load in response to price increases
• Coal units run less and less
• Cash flows to coal units drop even faster

• But these forces take time
Results Here Contrast Impact of Climate Policy for Two Prototypical Coal Units

- Xcoal-10 (existing coal w. heat rate of 10,000)
- Xcoal-12 (existing coal w. heat rate of 12,000)
- Explore three climate policy cases starting in 2015
  - No policy
  - Stabilization policy ($20/ton, + 3%/year)
  - Aggressive policy ($50/ton, + 3%/year)
- Assume $500/kW retrofit investment
  - Spend $200 in 2010, $300 in 2011
  - Operating parameters remain unchanged after retrofit
Three Bounding CO₂ Price Scenarios Capture Essence of the Uncertainty
Operating Hours Decline Sharply in Aggressive Policy Case
Cash Flows for $500/kW Retrofit – No Policy Case

Annual Cash Flow for No Climate Policy Case

NR-Xcoal-10: IRR = 37.1%
NR-Xcoal-12: IRR = 34.3%
Annual Cash Flow for Stabilization Climate Policy Case

Cash Flow ($/kW-year)

NR-Xcoal-10: IRR = 34.1%
NR-Xcoal-12: IRR = 28.7%
Cash Flows for $500/kW Retrofit – Aggressive Policy Case

Annual Cash Flow for Aggressive Climate Policy Case

NR-Xcoal-10: IRR = 26.7%
NR-Xcoal-12: IRR = 11.8%
Caveats and Insights

• CO₂ price highly uncertain so decision makers should develop contingency strategies

• Key drivers of CO₂ prices becoming clear
  – Ultimate supply of offsets
  – Cost of new nuclear and CCS if offsets “scarce”

• CO₂ price expectations are beginning to change electric sector investment decisions