



ICAC Annual Meeting

Developments in Air Emissions Trading Markets

April 30, 2009

John Blaney

Outline

- Overview
- Market Trends
- ICF Expected Case Results
- Key Sensitivity Cases Results

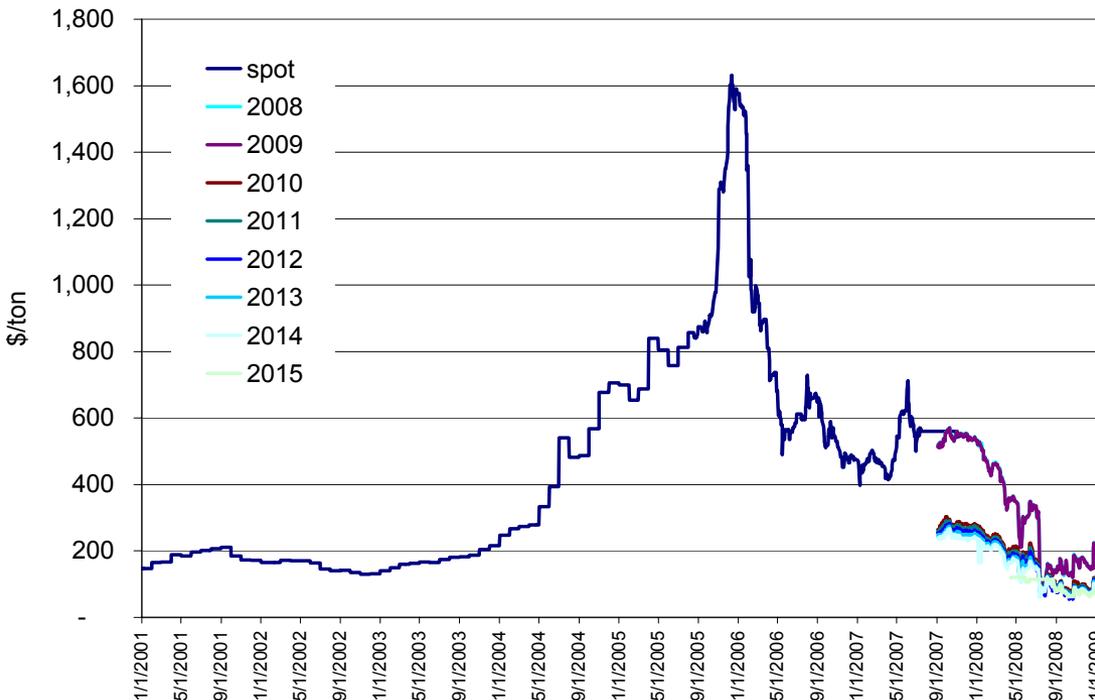
Overview

Back to the Drawing Board – Air Regulations Now Less Certain than One Year Ago

- Going into 2008, generators were well along the path to preparing for the implementation of CAIR (NO_x in 2009 and SO₂ in 2010) and CAMR.
- By the end of 2008, CAIR and CAMR had both been vacated by the U.S. Court of Appeals for the District of Columbia Circuit.
- At the end of 2008, the court remanded CAIR back to the U.S. Environmental Protection Agency (EPA) for revision rather than vacating it, but only to maintain temporary environmental benefits while EPA revises the rule.
- EPA is required under the Clean Air Act to move ahead with the reinvention of CAIR consistent with the court's July decision. Given the findings of that decision, it is difficult to see how EPA will be able to offer a cap and trade solution for SO₂ and NO_x without a legislative fix.
- EPA must also move ahead with regulation of Hg to replace CAMR.

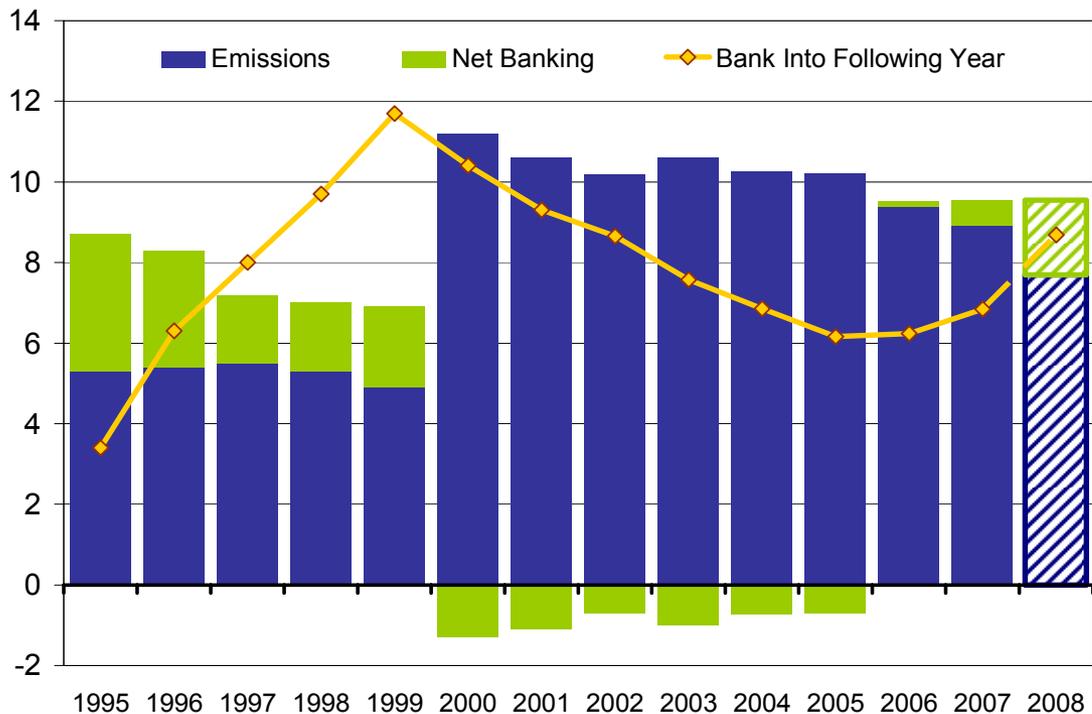
Market Trends

Regulatory Uncertainty Leaves SO₂ Prices Near Historic Lows



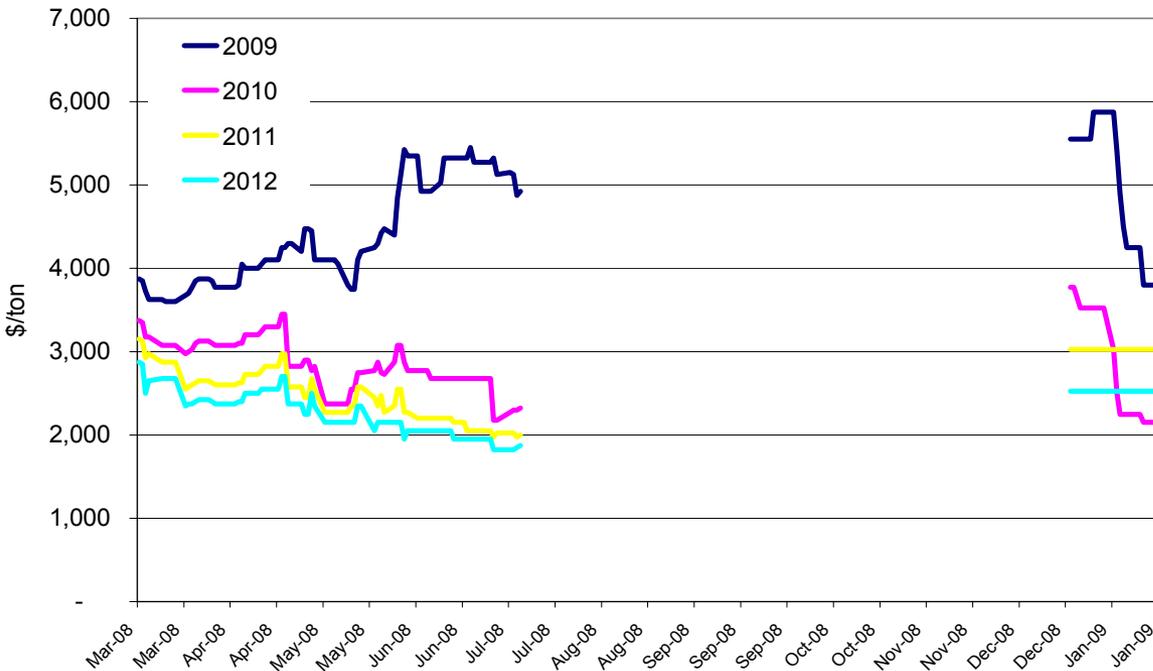
- The future of SO₂ regulation is critical to the value of SO₂ allowances today because of the large allowance bank.
- With over 6 million tons in the bank going into 2008 and over 50 GW of controls scheduled to come online in the coming years, affected units are more than equipped to meet Title IV requirements going forward.
- If banked allowances are not allowed to be used for compliance under a new SO₂ program, they will be worth very little for Title IV compliance alone.
- Expectations about the stringency and timing of future SO₂ regulation, therefore, are the primary drivers of SO₂ allowance prices today.

The SO₂ Allowance Bank Continues to Grow in Lead-up to CAIR



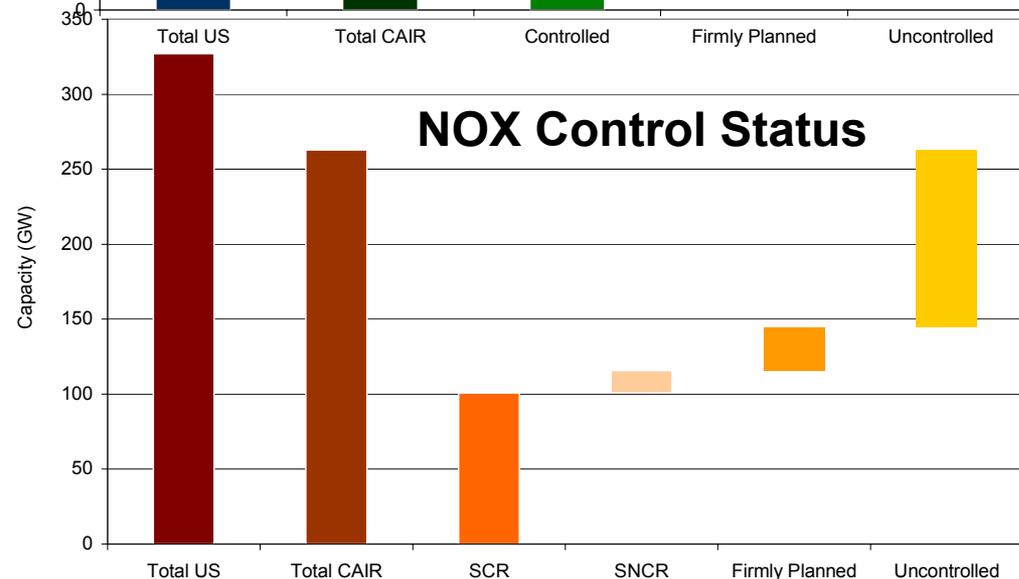
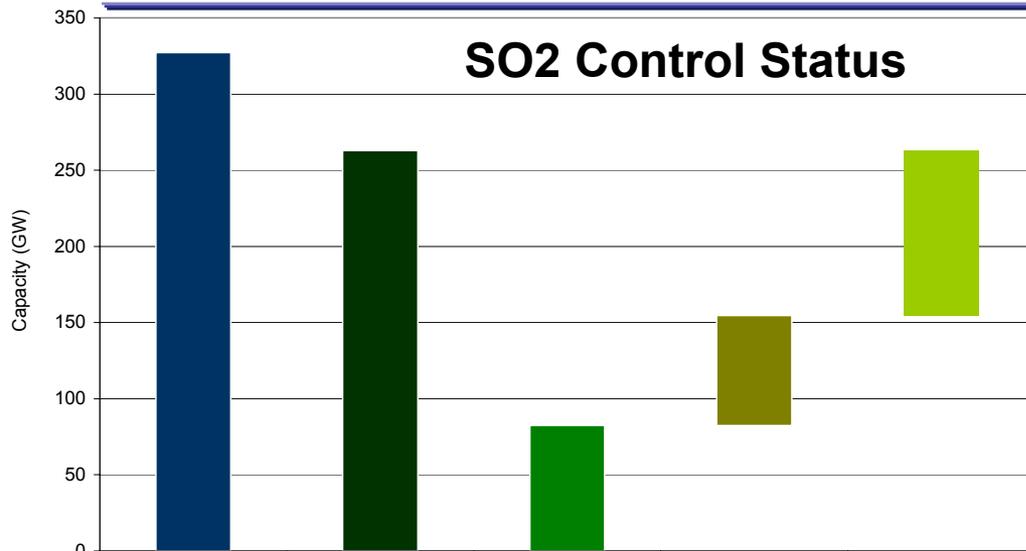
- The SO₂ banked declined each year from 1999 through 2005.
- However, the bank has grown since 2006 in anticipation of CAIR implementation.
- The SO₂ allowance price is a function of the perceived value of these banked and the annually allocated allowances, driven by the expected cost of compliance with CAIR or other future regulations.
- “Cashing in” the bank in any one year would be more than enough to achieve compliance with the cap and would therefore collapse the value of current SO₂ allowances

Annual NO_x Prices Interrupted by Court Ruling



- Annual NO_x allowance prices for the 2009 vintage remained strong leading up to the decision, reflecting concerns over the liquidity of the CAIR annual program.
- When the court vacated CAIR, no existing regulation was left to sustain value in the allowances. After the December decision restoring the CAIR NO_x markets for January 1st, allowance prices immediately resumed trading at their previous levels.
- Since the beginning of the year, however, prices have fallen off, reflecting continuing uncertainty over the future of CAIR.

Substantial Coal-fired Capacity Remains Uncontrolled



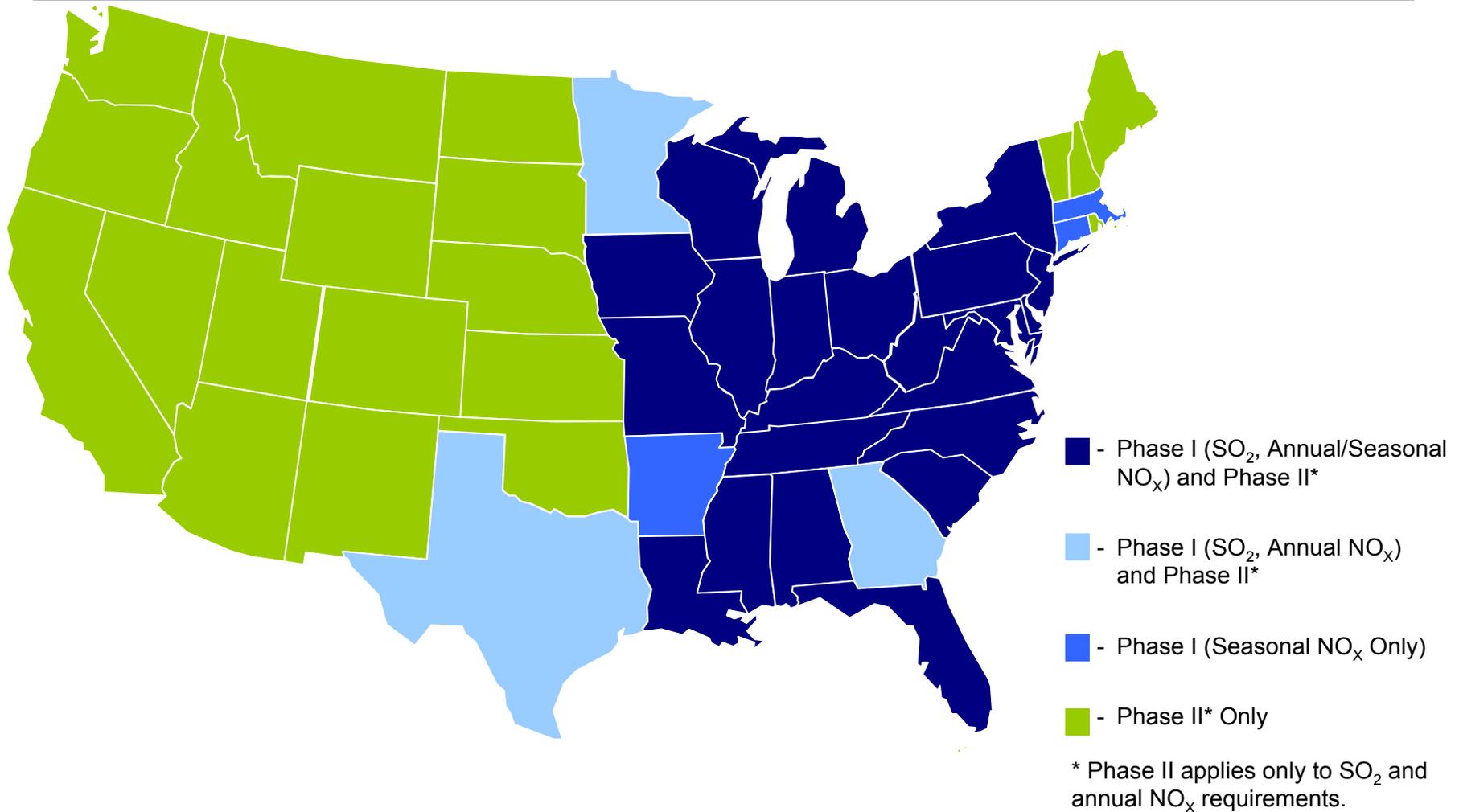
- When a replacement for CAIR is eventually released, roughly 100 GW of coal-fired capacity will remain uncontrolled, both for SO₂ and NO_x.
- Owners of those units will have to determine whether it makes sense to undertake capital-intensive control measures, complicated by likely GHG regulation that could threaten the competitiveness of some of those units.
- **About half of the unscrubbed units are under 250 MW in size and over 40 years of age, meaning that they will face relatively high control costs and may incur additional costs to continue operating into their 50s and 60s.**

Expected Case Results

ICF Expected Case Air Regulatory Assumptions

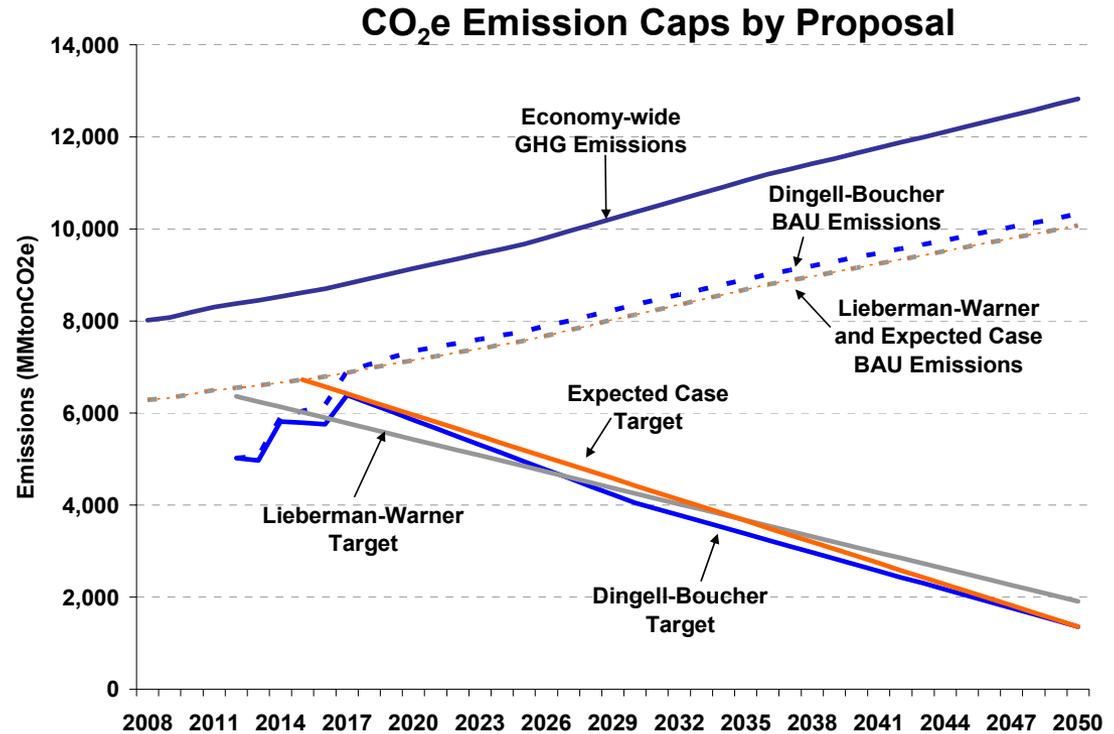
- The ICF Expected Case assumes a program equivalent to CAIR starting as planned in 2009.
- However, instead of Phase II CAIR, ICF assumes a more stringent standards for SO₂ and NO_x consistent with the second phase requirements from Senator Carper's proposed Clean Air Planning Act of 2007 (CAPA) in 2015 and beyond to reflect where new multi-pollutant legislative efforts for SO₂ and NO_x may end up.
- Since the court vacated the Clean Air Mercury Rule (CAMR) on February 8, 2008, the Expected Case adopts a MACT requirement imposed at the unit level nationwide starting in 2013.
- The Expected Case also includes a national climate change regulatory component, described on the next page, that draws on elements from the Lieberman-Warner and Dingell-Boucher proposals.

ICF Expected Case SO₂ and NO_x Two-Phase Implementation



ICF Expected Case CO₂ Regulation

- The Expected Case CO₂ component assumes a cap & trade program starting at the projected emission level in 2015 and declines to the cap proposed in the Dingell-Boucher discussion draft, roughly 80% below 2005 levels by 2050.
- The Expected Case allows domestic offsets of 22%, equivalent Dingell-Boucher.



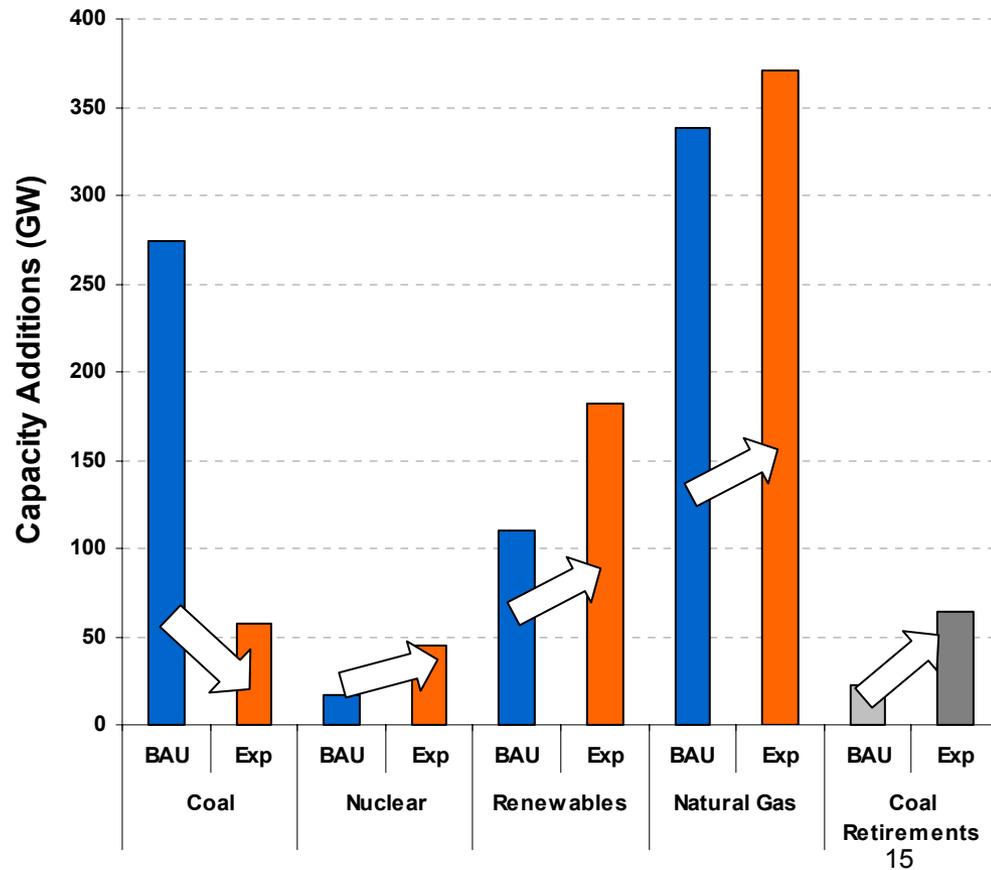
ICF Expected Case Air Regulatory Assumptions

| | SO ₂ Program | NO _x Program | | Mercury Program | CO ₂ Program |
|-----------------------------|---|---|---|---|--|
| Phase I (2009/2010-2014) | <p>25 States + DC</p> <p>2010</p> <p>Cap consistent with retirement ratio: 2:1</p> <p>Existing Title IV for unaffected states</p> | <p>25 States + DC</p> <p>Annual</p> <p>1.522 MMtons</p> | <p>25 States + DC</p> <p>Ozone Season</p> <p>0.568 MMtons</p> | <p>Federal MACT in 2013: 90% inlet Hg removal</p> <p>States with existing rules proceed as planned, so long as they meet minimum requirement as defined by federal MACT</p> | <p>Cap and Trade in 2015: Cap starts at 2015 projected levels in 2015 and declines to Dingell-Boucher 2050 cap of roughly 80% below 2005 levels by 2050</p> <p>Offsets permitted up to 11% of cap for domestic and 11% for international sources</p> <p>Same sectoral coverage as Lieberman-Warner</p> |
| Phase II (2015+) | <p>National</p> <p>2 MMtons</p> | <p>25 CAIR States + DC</p> <p>Ozone Season</p> <p>0.485</p> <p>National Annual</p> <p>1.62 MMtons</p> | | | |

Coal Additions Give Way to New Natural Gas, Renewable, and Nuclear Builds

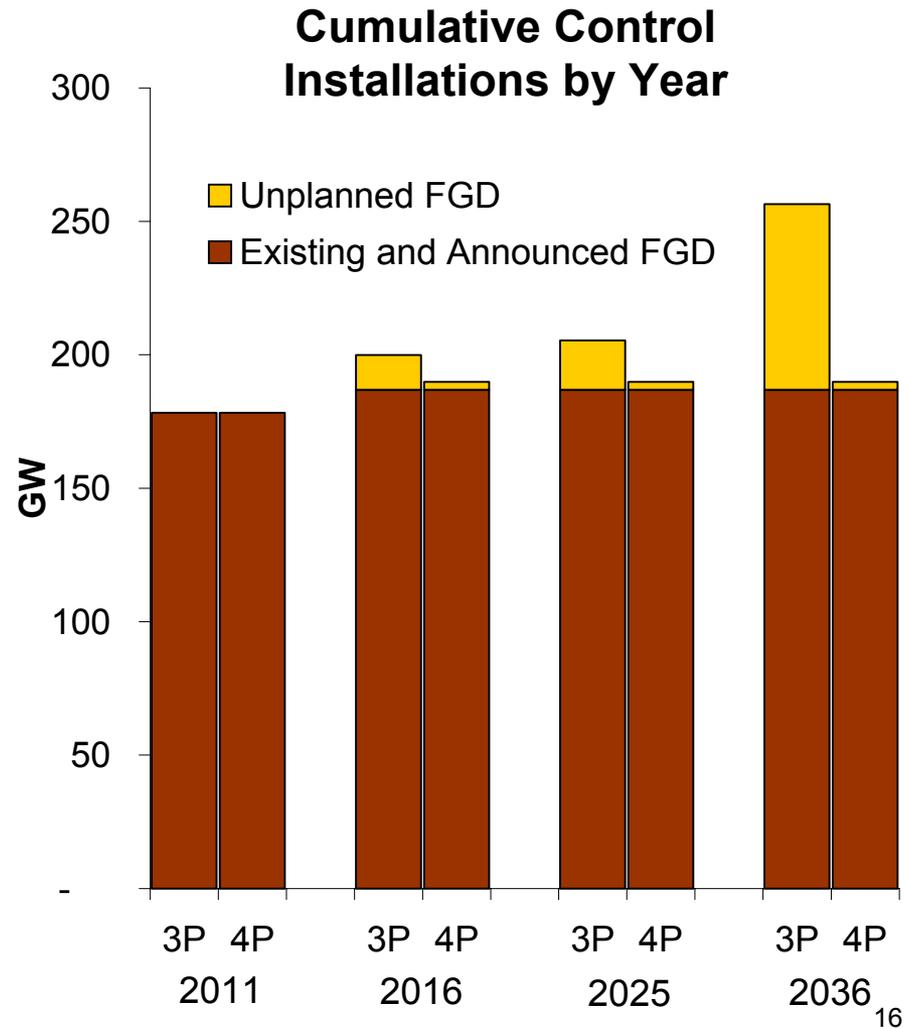
- The prospect of the carbon price reaching \$48/ton in 2030, and higher levels in subsequent years, leads the system to meet new capacity needs through lower-carbon forms of generation including natural gas, renewables and nuclear plants.
 - Coal additions in the Expected Case are all equipped with capture and sequester 90% of their carbon.
- Nuclear and renewable additions increase in the Expected Case to offset the displace coal-fired additions and retirements of existing coal capacity.
 - Gas-fired capacity additions also increase, primarily in the near-term before new nuclear and coal with capture options are available.
 - In the long-term, however, even gas-fired generation emits at a rate too high to meet the reduction needs in the power sector.

Breakdown of New Build by Capacity Type in Expected Case versus BAU
(Cumulative Capacity Additions Achieved by 2036)

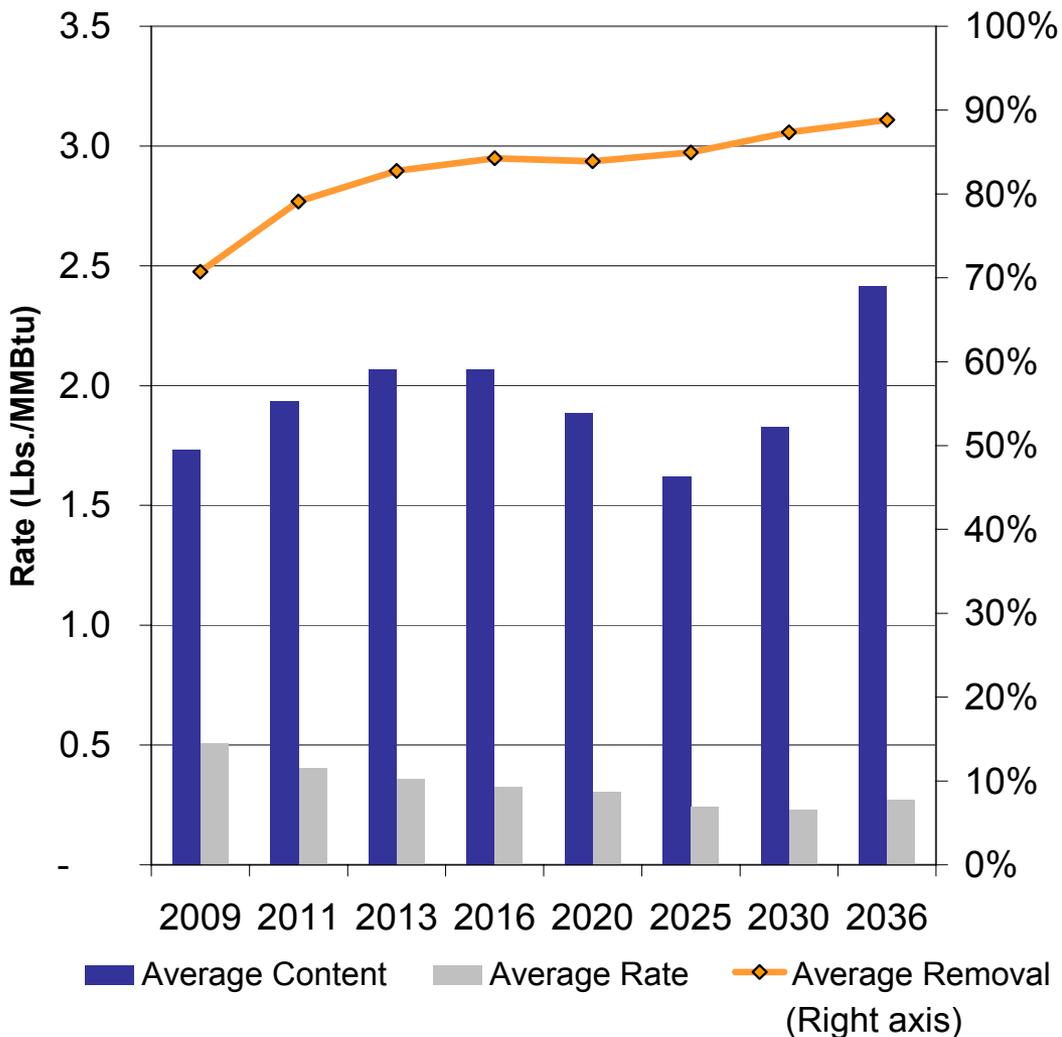


Existing and Planned SO₂ Controls Nearly Sufficient for Compliance in Expected Case

- 163 GW, or 54% of total coal-fired capacity in the U.S., are scheduled to be controlled for SO₂ by 2016.
- As shown in the chart, only a small number of incremental controls are projected to be required in the Expected Case to comply with the SO₂ cap while maintaining coal-fired generation at projected high levels.
- An additional 3 GW of incremental controls are projected in the first years after the CO₂ cap-and-trade program begins in 2015. Under the burden of carbon prices, coal-fired power plants will be forced to reduce generation, and therefore emit less SO₂, relieving the pressure of SO₂ compliance.
 - No additional controls will be installed after 2016.
- Over 90 GW of incremental controls will be required by 2039 in the absence of a climate program.
 - New controls will be installed over the years to comply with SO₂ emission requirements while meeting the increasing electricity demand.



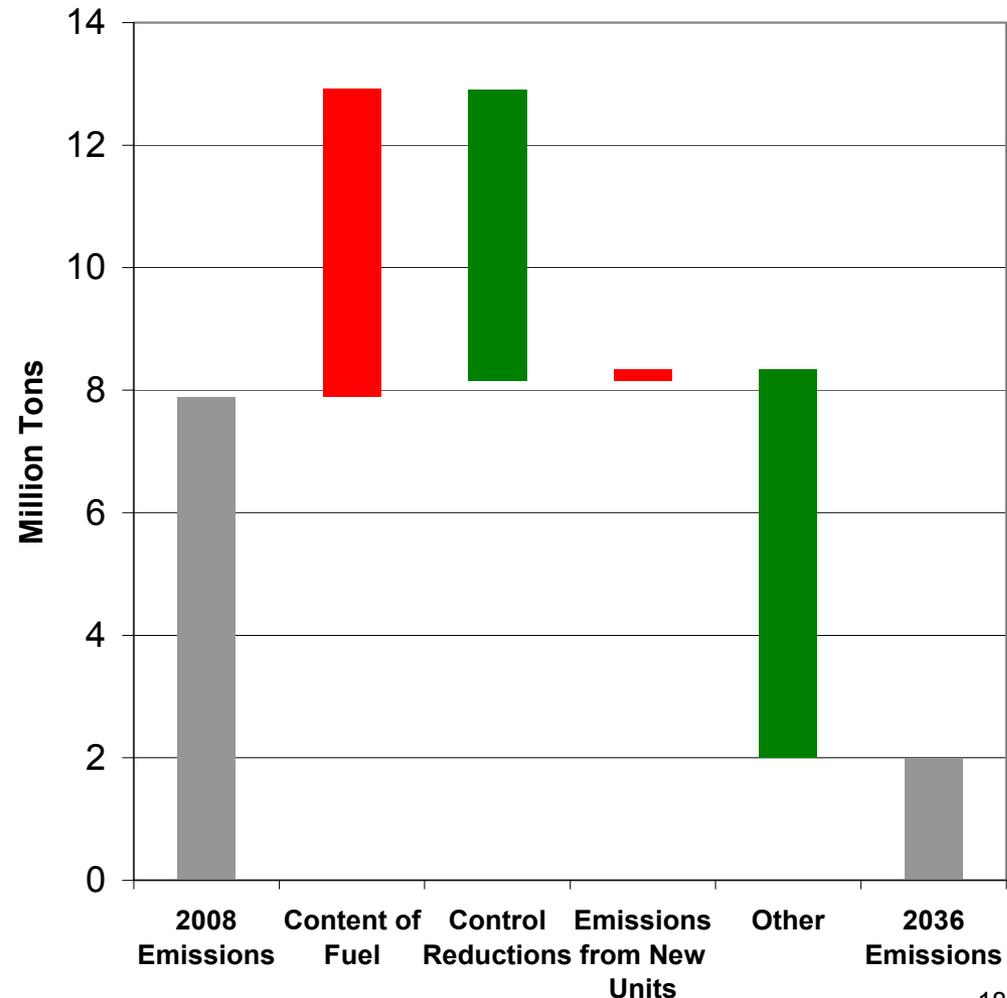
SO₂ Compliance will Require Nearly 90% Removal by 2036, System-Wide



- Achieving emission reductions through control rather than coal choice allows units to select from a broader range of coals and still achieve significant reductions.
- The chart compares the average SO₂ content of the coals burned to the average emission rate of affected sources.
 - The line shows the average percent reduction from fuel input across the system.
- By 2036, the system must achieve nearly 90% reduction, on average, from fuel input, driving control decisions over time.
- If affected sources were to burn coals with an average content of 1 Lb/MMBtu rather than the contents projected in the chart, they would need to achieve 73% removal.
 - Such a choice would require fewer incremental controls than projected in the Expected Case, but would certainly drive up prices for low sulfur coals and impact system costs.

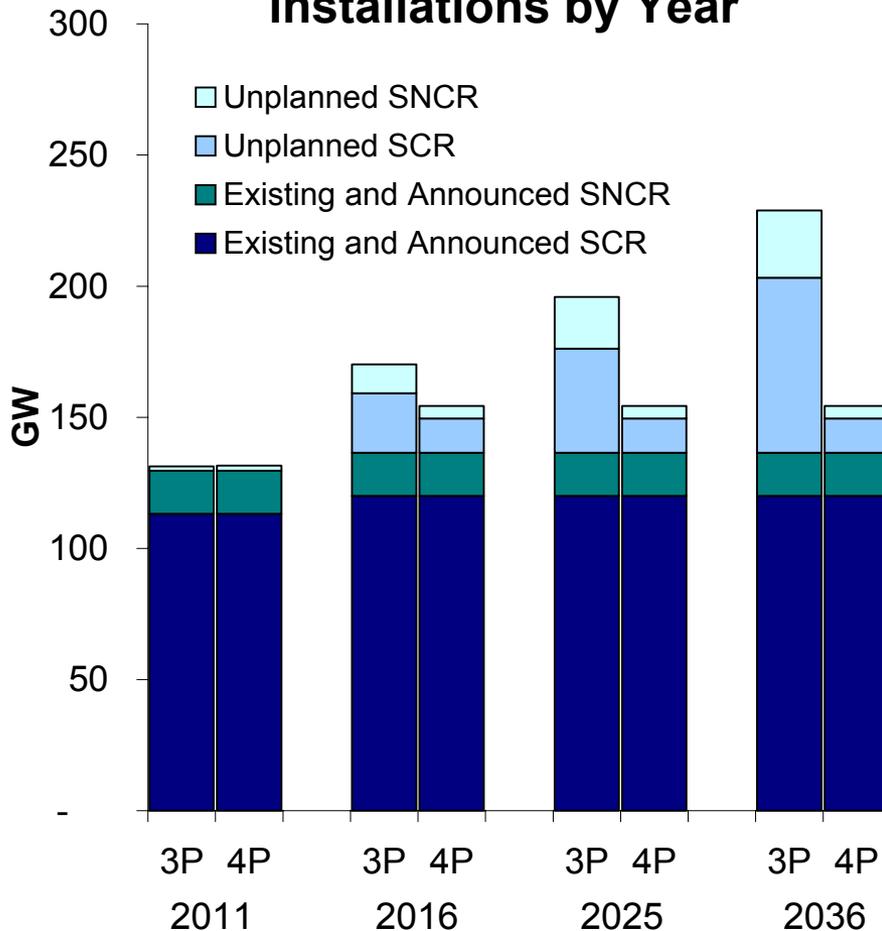
New Controls Contribute to 75% Reduction in SO₂ Emissions by 2036

- The chart at right shows the components that transition emissions of affected units from 2008 levels to the CAPA required levels by 2036.
 - Red bars signify an increase in emissions (or emission potential).
 - Green bars signify a reduction.
- As units control, many shift to less expensive higher sulfur coals, increasing the potential for SO₂ emissions.
- Reductions from controls installed after 2008, however, compensate for that potential.
- Unit retirements and lower capacity factors at coal-fired units, both controlled and uncontrolled for SO₂, in response to the CO₂ program and other fuel-choice adjustments (“Other”) contribute more than 50% of the needed reduction.



GHG Regulation Reduces Incentives for NO_x Controls

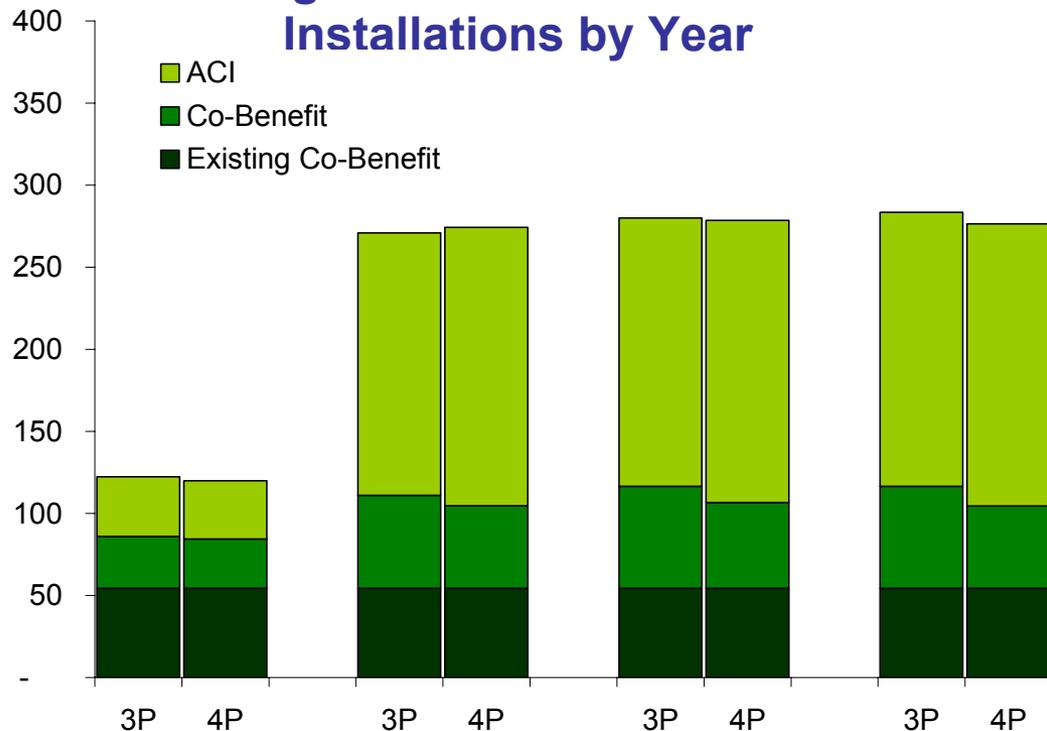
Cumulative Control Installations by Year



- By the start of the CAIR NO_x Phase I programs in 2009, over 100 GW of SCR controls on coal-fired units are expected to be in place, in addition to 15 GW of SNCR.
- Despite nearly 40% of the coal-fired capacity in the U.S. being controlled for NO_x (not accounting for combustion controls), additional controls are projected to be required to comply with the NO_x annual program.
- In the 3P Case, over 90 GW of new controls are installed on coal-fired facilities by 2039, with the majority of incremental controls coming in the form of SCRs.
 - The SCR contributes not only to NO_x reduction but also to Hg reduction, when paired with a scrubber burning bituminous coals. Therefore the SCR installations are encouraged under a Hg MACT program.
- In the 4P Case, no new NO_x controls are added after 2015. The reductions required to comply with the annual cap are achieved instead through dispatch changes at existing facilities and reduced additions of new coal capacity.
 - With the CO₂ allowance price rising through 2039, units choose to forego further control installations, realizing that such investments would not pay off at lower capacity factors.

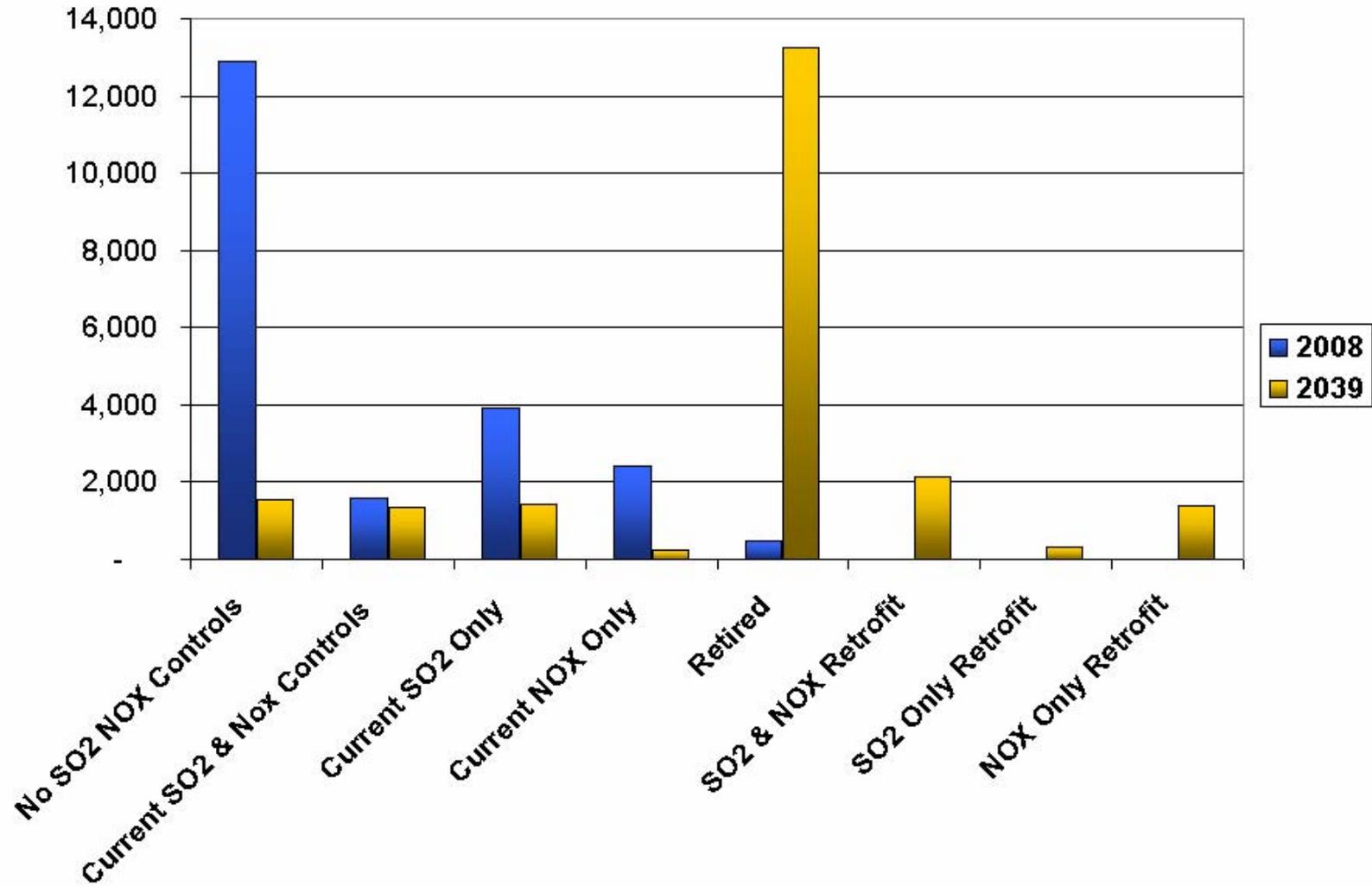
Over 250 MW of Coal-Fired Capacity Controlled in Response to Hg MACT

Hg Cumulative Control Installations by Year



- Additions of ACI controls peak at 134 GW in 2013 when the MACT program starts, about five times as many installations as in 2011 in response to the state-specific programs. Few new ACI controls are added after 2013.
- Despite the reduction in coal-fired generation in response to the CO₂ cap, total Hg control installations in 2013 are very similar in the two cases. In the 4P Case, units install controls in 2013 in response to the MACT to continue operating until the CO₂ price begins to erode their competitive positions in 2030 and beyond.
- 10 GW of coal-fired units retire in 2013 in response to the federal MACT.

Prospects for Small Coal-Fired Units



Key Sensitivity Cases Results

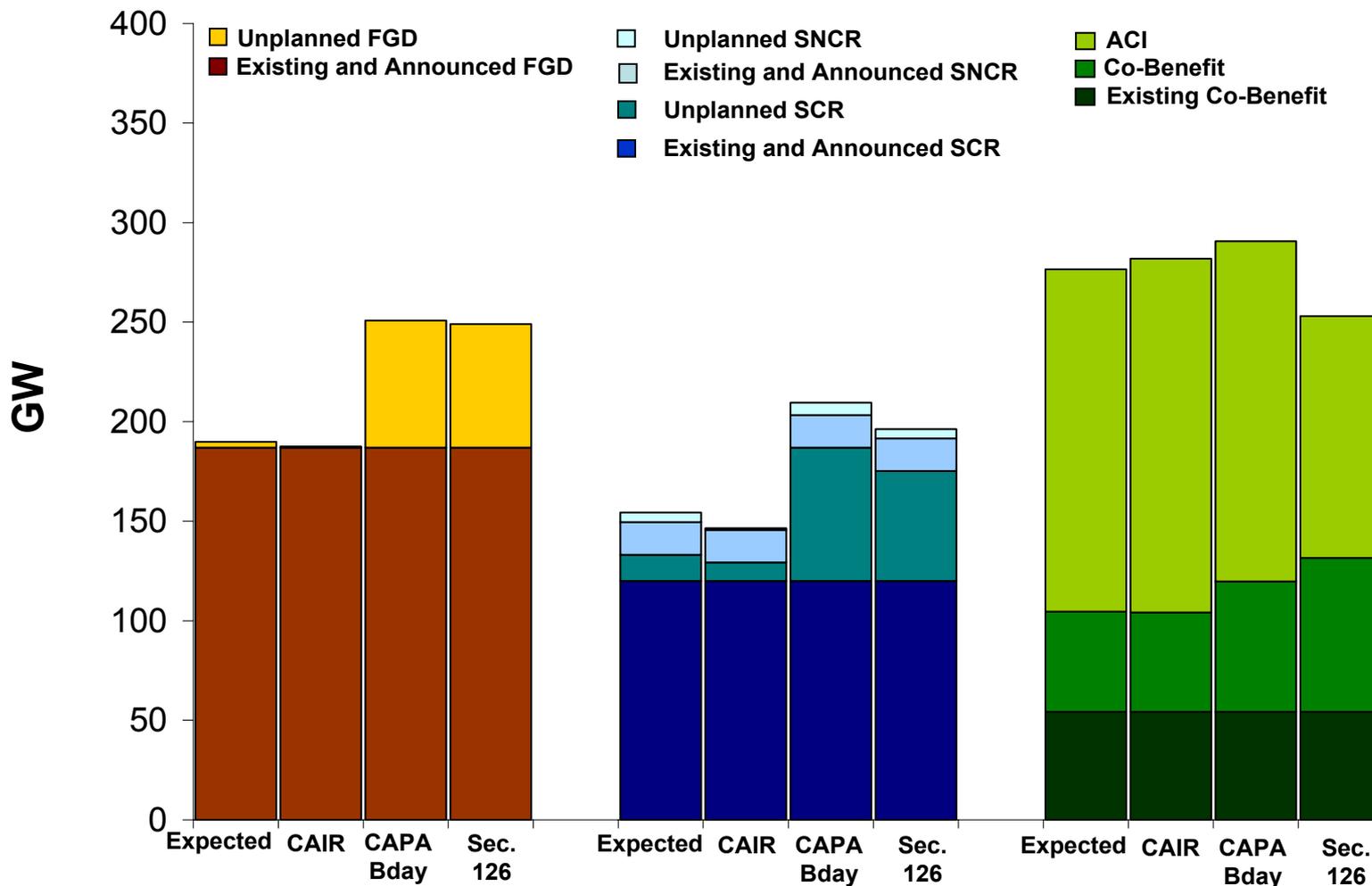
3-Pollutant Air Regulatory Scenarios

Post-CAIR SO₂ and NO_x Scenarios

- The Expected Case projects that a hybrid program of “CAIR Phase I” and “CAPA Phase II” would replace the vacated CAIR SO₂ and NO_x annual program while the CAIR NO_x ozone program would remain in place. Since the future of CAIR still remains uncertain, ICF analyzed alternative SO₂ and NO_x scenarios to assess the potential impacts of various regulation possibilities on SO₂ and NO_x allowance prices.
- *The **CAIR Scenario*** applies CAIR policies on SO₂ and NO_x annual programs testing the possibility that a cap and trade regulation that addresses concerns of the court but has the same reduction requirements as CAIR would be adopted as a final replacement to CAIR.
- *The **CAPA Birthday Scenario*** adopts the CAPA requirement that each affected unit that has been in operation 40 or more years beginning January 1, 2020, and on each January 1 thereafter, and that operates for more than 500 hours per calendar year would have to emit no more than 2 lbs./MWh SO₂ and 1 lb./MWh NO_x.
- *The **Section 126 Scenario*** assumes that no CAIR-substitute is adopted and that successful Section 126 petitions by upwind states would drive control requirements. This scenario assumes that the same limits as required in the CAPA Birthday scenario are adopted in 2013 in the CAIR region.
- The results of these scenarios will be presented relative to the 4P Expected Case.

Air Regulatory Scenarios

Cumulative Control Installations by 2039



CO₂ Threatens to Strand Billions of Dollars in Control Investments

- Higher CO₂ prices discourage coal and other fossil generation and therefore tend to drive down allowance prices for other pollutants.
 - Since CO₂ prices in the Lieberman-Warner Case and the Dingell-Boucher Case are higher than in the Expected Case, SO₂ and NO_x prices in both cases are lower than in the Expected Case.
- As shown in the chart at right, climate regulation has the potential to make billions of dollars of controls in the 3P Case not cost effective anymore, especially those capital-intensive controls such as FGD and SCR.
 - Expenditures on ACI do not change significantly across cases. Since those controls are required for coal-fired units to continue to operate under the assumed Federal MACT, units will spend the relatively small amount of capital to control with ACI in 2013 even in the face of lower dispatch and even retirement 10 or 20 years later.
- Climate regulation is therefore critical to consider in making control decisions as the revision of air regulations remain uncertain in the foreseeable future.

Cumulative Control Investments to 2039

