Multi-Pollutant Legislative Analysis: Comparison Briefing

U.S. Environmental Protection Agency

Office of Air and Radiation

October 2005

Introduction

This technical support package is part of a comprehensive U.S. Environmental Protection Agency (EPA) analysis of various multi-pollutant proposals. The analysis is based on air quality, health benefits, and power sector modeling and provides projections for each proposal for the years 2010, 2015, and 2020.

EPA has modeled the following multi-pollutant approaches:

1. Clean Air Planning Act (Carper, S.843 in 108th)
2. Clean Power Act (Jeffords, S.150 in 109th)
3. Clear Skies Act of 2005 (Inhofe, S.131 in 109th)
4. Clear Skies Act of 2003 (Inhofe/Voinovich at the Administration's request, S.485 in 108th)
5. Clear Skies Manager's Mark (of S.131 in 109th)
6. Clean Air Interstate Rule, Clean Air Mercury Rule, and the Clean Air Visibility Rule

Key Elements of Analysis

Baseline

- EPA analyzed all proposals relative to a common baseline, to allow for comparison of the incremental impacts of each proposal over time.
  - For the economic modeling of the utility industry, the baseline includes Title IV, the NO_x SIP Call, New Source Review settlements, State-specific rules, and/or agreements that were finalized by mid-2004.
  - For air quality modeling, the baseline also includes the Tier II, Heavy Duty Diesel, and Non-Road Diesel Rules.

Short-Term Feasibility Constraint

Sensitivity Analyses

- Natural gas prices
- Electric demand
- Feasibility constraints
- Incremental cost impacts of specific provisions in the different proposals

Provisions with Offline Analyses

- EPA conducted a number of offline analyses to evaluate the effects of certain provisions that could not be more comprehensively evaluated in the time available.
  - Opt-ins
  - Early Reduction Credits
  - Allowance Allocations
  - Other changes to existing Clean Air Act provisions

Modeling Tools

Integrated Planning Model (IPM)

Retail Electricity Pricing Model

Air Quality Modeling*

Benefits Modeling (BENMap)

Greenhouse Gas Offset Models for the Clean Air Planning Act (S.843)**

Interpolation Methods***

*Same PM and ozone modeling platform as EPA used for CAIR.

**CO_2 Mitigation from SGM, EPPA, MERGE, IGEM; Agriculture and Forestry from FASOM, GTM; Non-CO_2 from various EPA Non-CO_2 Models used in EMF-21.

***Air quality and benefits for Clear Skies 2003 (S.485), Clear Skies (Manager's Mark), and the Clean Power Act (S.150) were calculated by interpolation using projected SO_2 and NO_x emissions coupled with the modeling results from Clear Skies (S.131) and the Clean Air Planning Act (S.843). EPA believes that the interpolation technique provides a reasonable assessment of the projected air quality and benefits for the scenarios that were not modeled with air quality and benefits models. Our confidence in this technique is based on an analysis in which we applied the interpolation technique for two scenarios which we also modeled. The results indicate that the interpolation for these scenarios were within 5% of the corresponding modeled values.

Uncertainty in Projections of Costs and Technological Feasibility

There are a number of factors that can lead to uncertainty in cost estimates including:

- Differences in assumptions about key variables such as natural gas prices or electricity demand – EPA has addressed this uncertainty by performing sensitivity analyses on both natural gas prices and electric demand.

- Uncertainty about availability, cost, and performance of control technologies.
  - If technology is not available to meet emission constraints (such as the first phase unit-specific mercury constraints under the Clean Air Planning Act (Carper, S.843), or the first phase CO_2 caps or mercury requirements under the Clean Power Act (Jeffords, S.150)), costs could be significantly higher for those bills.
  - If there are technical innovations (including new technologies or improvements in existing technologies), this could lead to lower costs. This is particularly true in the longer term.

- Unquantified costs of regulation vs. legislation.
  - State-by-State plan development process under CAIR, CAMR, and CAVR and source-specific determinations under CAVR results in additional unquantified costs. These costs are borne by both State regulators and interested parties, such as the power sector and environmental groups, that participate in this process.
  - Uncertainty of litigation under regulation can delay pollution control decision-making, increasing costs in later “rush to compliance”.

Uncertainty in Projections of Benefits

There are a number of factors that can lead to uncertainty in the benefits estimated including*:

- Gaps in scientific knowledge that prevent us from quantifying certain types of benefits.
- Variability in estimated pollution concentrations and response relationships, introduced through differences in study design and statistical modeling.
- Errors in measurement and projection for important variables in analysis such as population growth rates, changes in emissions and pollutant concentrations derived from air quality modeling.

In addition, if projected emission reductions occur more slowly than projected, benefits would be less.

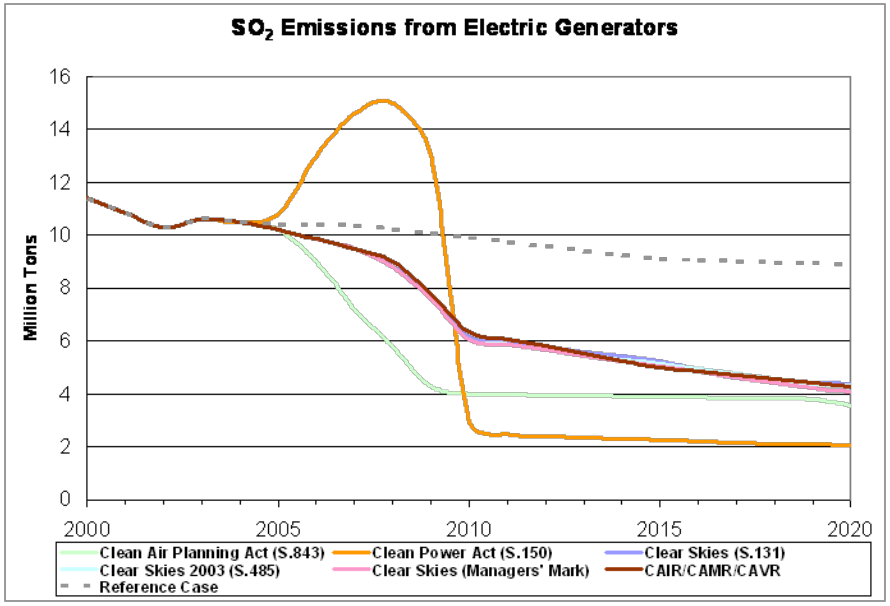
- If litigation results in delaying CAIR, CAMR, or CAVR, benefits would be less. Litigation could result in other changes to timing or control levels that would impact benefits.
- If emission controls cannot be installed quickly enough, or if allowance costs exceed projected prices so that safety valves are triggered, benefits could be less.

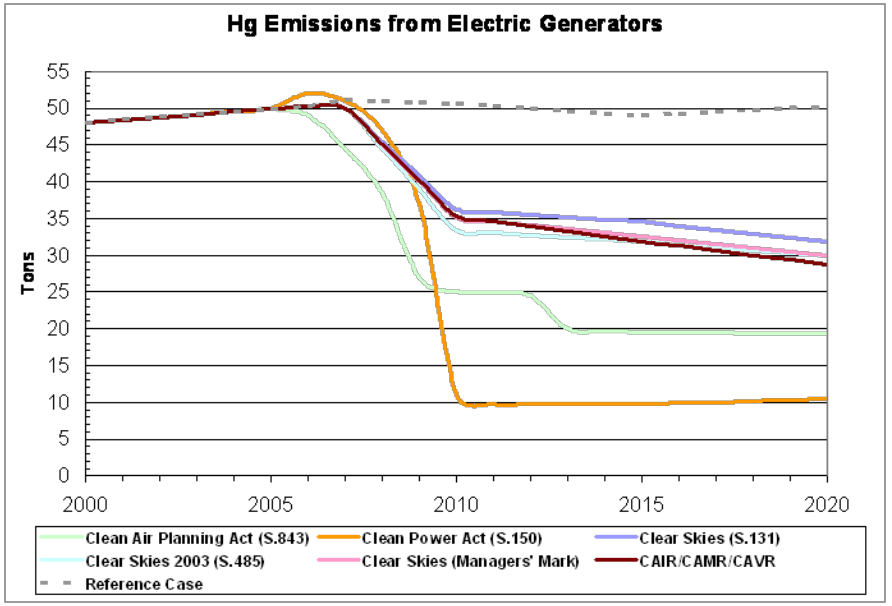
*For a more complete discussion of uncertainties related to benefits estimates for fine particles ($PM_{2.5}$) and Ozone, see "Regulatory Impact Analysis for the Final Clean Air Interstate Rule", EPA-452/R-/05-002, March 2005, U.S. EPA

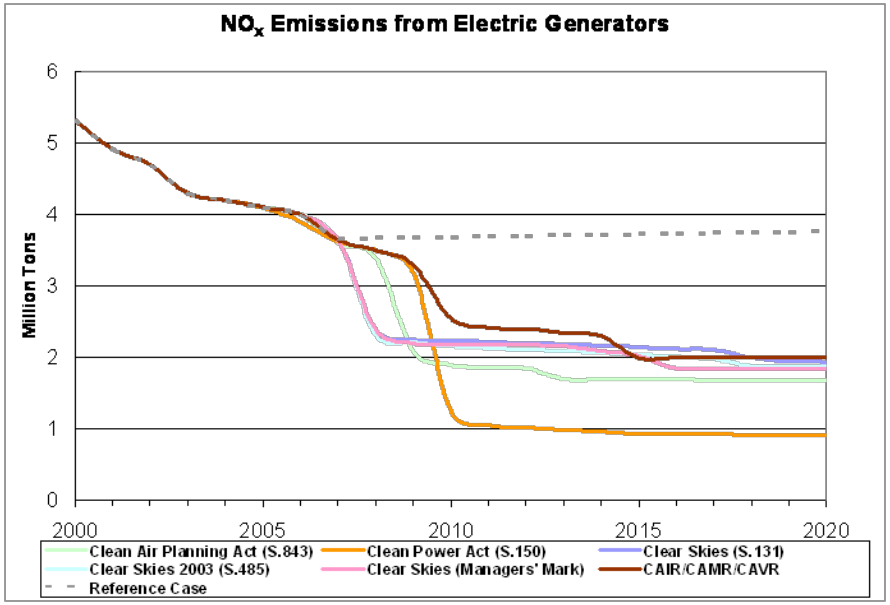
Comparison of Provisions

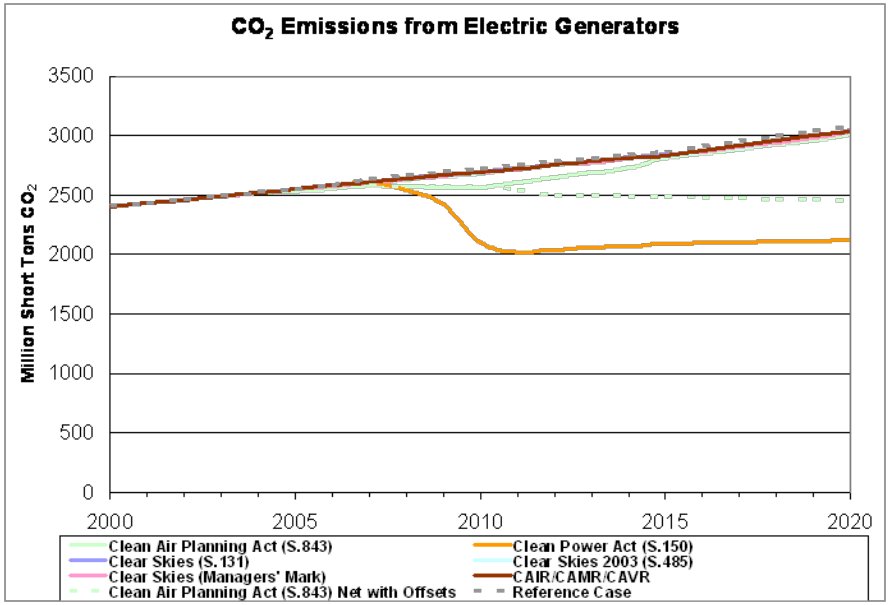
	Clean Air Planning Act (Carper, S.843 in 108th)	Clean Power Act (Jeffords, S.150 in 109th)	Clear Skies Act of 2005 (Inhofe, S.131 in 109th)	Clear Skies Act of 2003 (Inhofe/ Voinovich, S.485 in 108th)	Clear Skies Act of 2005 (Managers' Mark of S.131)	CAIR/CAMR/CAVR
Affected Units	Existing and new electricity generating facilities with a nameplate capacity > 25 MW	Existing and new electricity generating facilities with a nameplate capacity >/= 15 MW	Electricity generating facilities with a nameplate capacity > 25 MW. Exempts most co-gens from mandatory inclusion but allows them to opt-in. For NO_x, new units are included regardless of size, except new gas-fired units serving a generator with capacity </= 25 MW. For Hg, units emitting 50 lbs or less are exempted on an annual basis.	Electricity generating facilities with a nameplate capacity > 25 MW; cogen units selling more than 1/3 of potential output capacity and more than 25 MW to the grid. New units are included regardless of size, except new gas-fired units serving a generator with capacity </= 25 MW exempted for SO_2.	Electricity generating facilities with a nameplate capacity > 25 MW. Exempts most co-gens from mandatory inclusion but allows them to opt-in. New units are included regardless of size, except new gas-fired units serving a generator with capacity </= 25 MW exempted for SO_2 and NO_x. For Hg, units emitting 30 lbs or less are exempted on an annual basis	Existing and new electricity generating facilities with a nameplate capacity > 25 MW; cogen units selling more than 1/3 of potential output capacity and more than 25 MW to the grid. (CAIR: 28 States+DC CAMR: 50 States +DC CAVR: Non-CAIR States)
Emissions Caps	SO_2 2009: 4.5 million tons 2013: 3.5 million tons 2016: 2.25 million tons NO_x 2009: 1.87 million tons 2013: 1.7 million tons CO_2 2009: 2006 emissions* (2.655 billion tons, 656.9 MMTCE) 2013: 2001 emissions* (2.454 billion tons, 607.2 MMTCE) *May be achieved using emissions offsets. Hg 2009: 24 tons 2013: 10 tons Includes Hg unit-specific limit. Birthday provision: Starting in 2020, affected units on which construction commenced before August 17, 1971 must meet performance standards for SO_2 and NO_x.	SO_2 2010: 2.25 million tons (split into West and Non-West: West: 275,000 tons, Non-west: 1.975 million tons) NO_x 2010: 1.51 million tons CO_2 2010: 2.050 billion tons (507.2 MMTCE) Hg 2010: 5 tons No Hg trading. Hg unit-specific emissions limitation of no greater than 2.48 grams per 1,000 MWh in 2009. Birthday provision: Facilities subject to BACT limits after January 1, 2014 or 40 years after commencement of generation, whichever comes later.	SO_2 2010: 4.5 million tons 2018: 3.0 million tons NO_x 2008: 2.2 million tons 2018: 1.8 million tons CO_2 Not covered Hg 2010: 34 tons 2018: 15 tons	SO_2 2010: 4.5 million tons 2018: 3.0 million tons NO_x 2008: 2.1 million tons 2018: 1.7 million tons CO_2 Not covered Hg 2010: 26 tons 2018: 15 tons	SO_2 2010: 4.5 million tons 2016: 3.0 million tons NO_x 2008: 2.2 million tons 2016: 1.8 million tons CO_2 Not covered Hg 2010: 34 tons 2016: 15 tons	SO_2 (CAIR) 2010: 3.6 million tons 2015: 2.5 million tons NO_x - Annual (CAIR) 2009: 1.5 million tons 2015: 1.3 million tons NO_x - Ozone Season (CAIR) 2009: 0.6 million tons 2015: 0.5 million tons CO_2 Not covered Hg (CAMR) 2010: 38 tons 2018: 15 tons CAVR: BART for individual units

Projected Emissions from Electric Generating Units

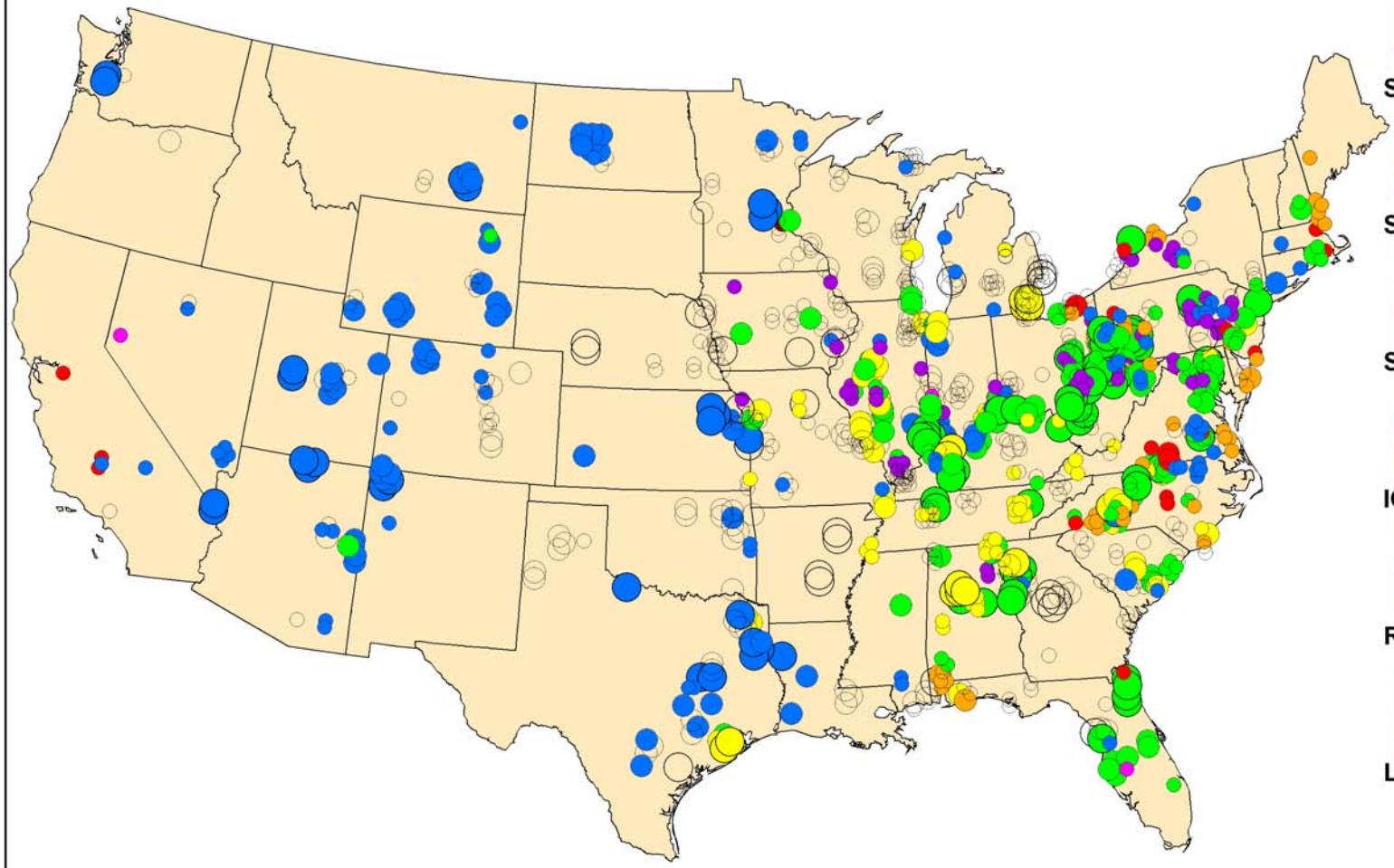








Projected Pollution Controls at Coal Fired Units After CAIR, CAMR, and CAVR in 2010



SCR Only
- <300 MW
- 300 MW to 600 MW
- >=600 MW

SCR/Scrubber
- <300 MW
- 300 MW to 600 MW
- >=600 MW

SNCR Only
- <300 MW
- 300 MW to 600 MW
- >=600 MW

SNCR/Scrubber
- <300 MW
- 300 MW to 600 MW
- >=600 MW

Scrubber Only
- <300 MW
- 300 MW to 600 MW
- >=600 MW

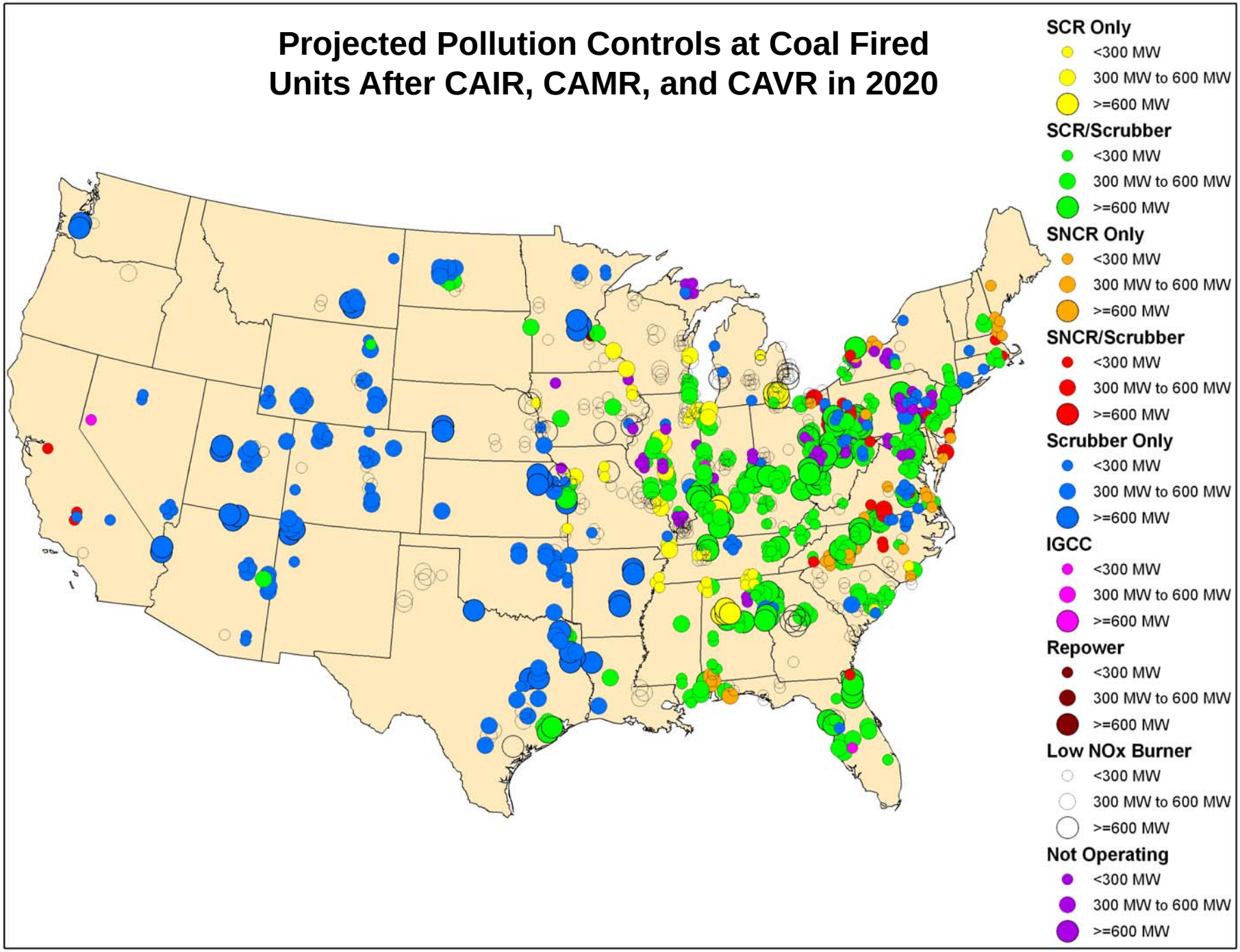
IGCC
- <300 MW
- 300 MW to 600 MW
- >=600 MW

Repower
- <300 MW
- 300 MW to 600 MW
- >=600 MW

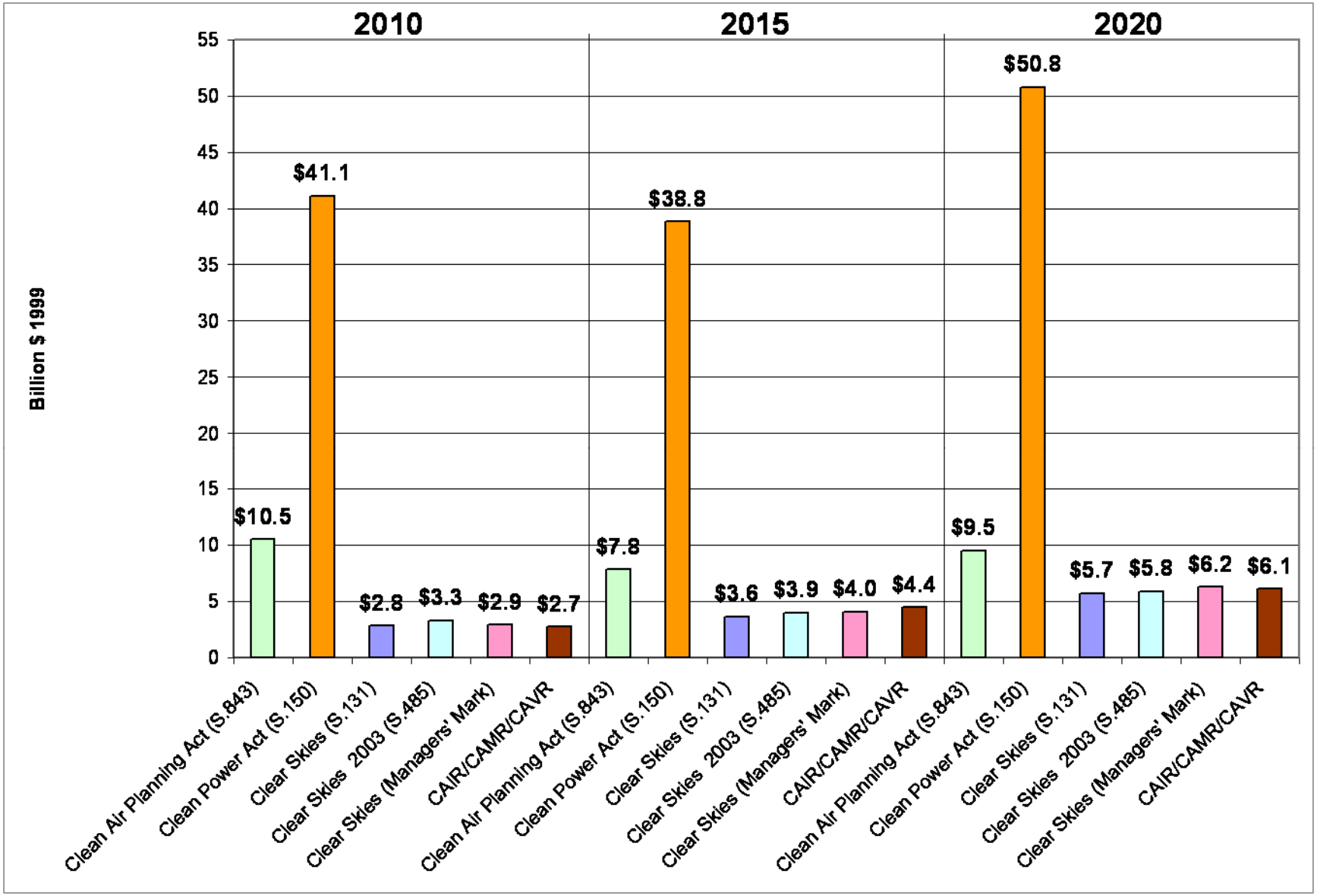
Low NOx Burner
- <300 MW
- 300 MW to 600 MW
- >=600 MW

Not Operating
- <300 MW
- 300 MW to 600 MW
- >=600 MW

Projected Pollution Controls at Coal Fired Units After CAIR, CAMR, and CAVR in 2020



Projected Annual Costs



Note: Allowance transfer costs are not included in these estimates.

Air Quality Impacts: Areas Projected to Exceed NAAQS Absent Additional Local Controls

Nonattainment Areas for $PM_{2.5}$*				
	Designated Nonattainment Areas (Based on 2001- 2003 Ambient Data)	2010	2015	2020
Clean Air Planning Act (S.843)	39	11	12**	14**
Clean Power Act (S.150)	39	9	10**	11**
Clear Skies (S.131)	39	20	18	18
Clear Skies 2003 (S.485)	39	20	17	17
Clear Skies (Manager's Mark)	39	20	17	16
CAIR/CAMR/CAVR	39	21	17	16

Nonattainment Areas for 8-Hour Ozone*				
	Designated Nonattainment Areas (Based on 2001- 2003 Ambient Data)	2010	2015	2020
Clean Air Planning Act (S.843)	126	20	11	10
Clean Power Act (S.150)	126	16	11	10
Clear Skies (S.131)	126	22	11	10
Clear Skies 2003 (S.485)	126	22	11	10
Clear Skies (Manager's Mark)	126	22	11	10
CAIR/CAMR/CAVR	126	22	11	10

*Does not account for disbenefits associated with initial increase in emissions prior to 2010 under the Clean Power Act (S.150) and benefits associated with early reductions under Clear Skies (S.131) and Clear Skies (Managers' Mark). Ozone in the West was not modeled as part of this analysis. Future year ozone nonattainment in the West is based on modeling that was performed for the Nonroad Engine Rule. Results for the Clean Power Act (S.150), Clear Skies 2003 (S.485), and Clear Skies (Managers' Mark) were calculated based on interpolation using results from other scenarios modeled with air quality models.

**The increase in $PM_{2.5}$ nonattainment areas from 2010 to 2015 and 2020 is primarily due to growth in emissions of SO_2 and directly emitted $PM_{2.5}$ from industrial and unaffected smaller Electric Generating Unit (EGU) sources. There are no increases in other emissions from these sources.

Annual Monetary Health Benefits of Reducing Fine Particles and Ozone

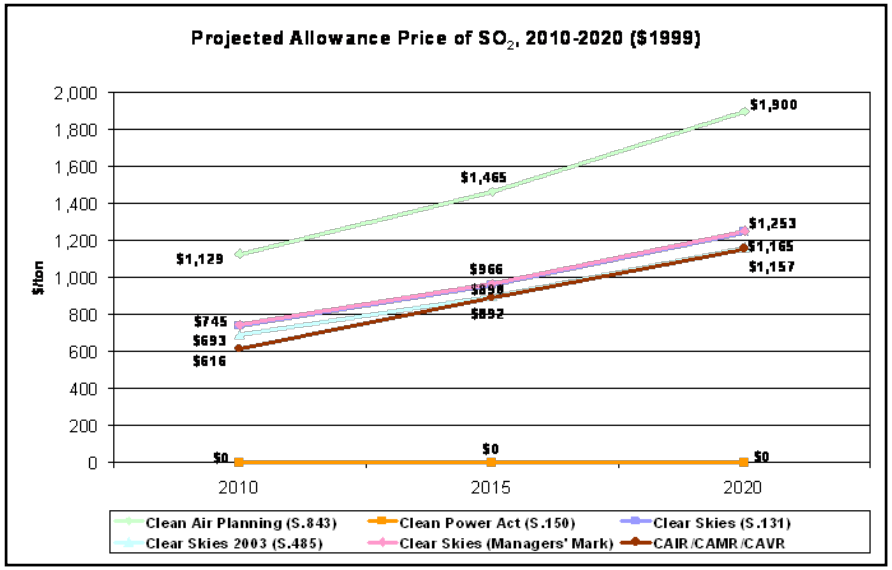
Projected Quantified Annual Health Benefits (Billion $ 1999)*			
	2010	2015	2020
Clean Air Planning Act (S.843)	$109 - 128	$117 – 137	$137 – 161
Clean Power Act (S.150)	$139 - 162	$156 – 183	$180 – 211
Clear Skies (S.131)	$66 – 78	$84 – 99	$114 – 134
Clear Skies 2003 (S.485)	$68 – 80	$88 – 102	$118 – 138
Clear Skies (Managers' Mark)	$68 – 79	$89 – 104	$122 – 143
CAIR/CAMR/CAVR	$62 – 73	$91 – 106	$120 - 140

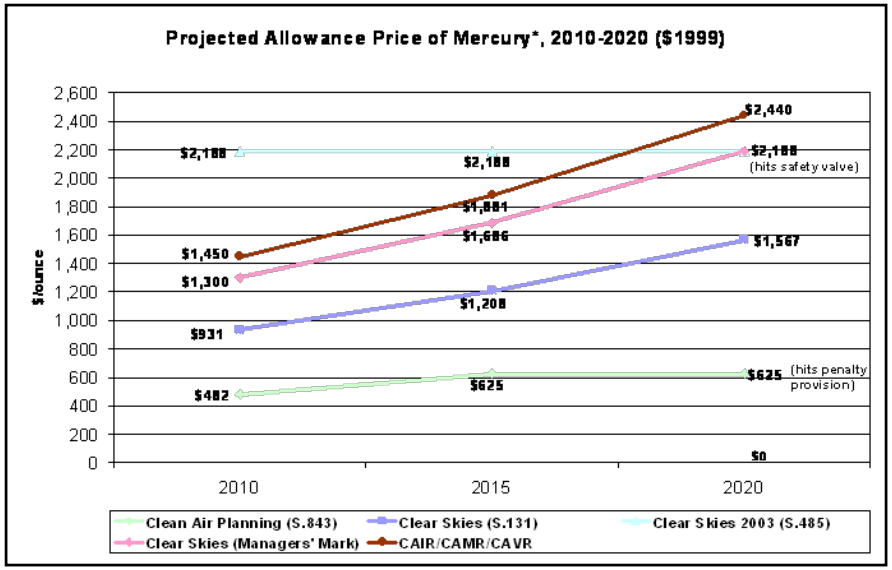
- The monetized benefits estimated for CAIR/CAMR/CAVR are from reductions in ozone and fine particle concentrations resulting from lower SO_2 and NO_x emissions. EPA is not estimating the benefits from the Hg and CO_2 reductions that also occur.
- Fine particle concentration reductions provide the vast majority of the monetized benefits. From past analysis that has been done of SO_2 and NO_x reductions, it is clear that each ton of SO_2 reduction that occurs to lower fine particle emissions provides more benefits than the NO_x reductions that occur to lower fine particles in the same area. Therefore, we believe that the total monetized benefits of a ton of SO_2 reduction are significantly higher than a ton of NO_x reduction.

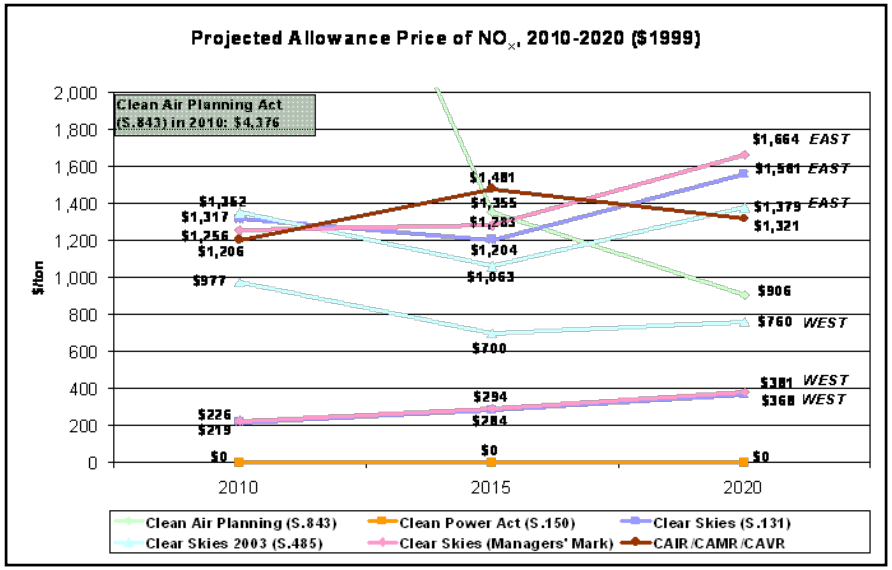
There are unquantified benefits that are relatively greater for proposals with larger emissions reductions, including improvements in visibility in parks and recreational areas and in residential areas, decreases in ozone-related damage to agriculture, decreases in sulfur and nitrogen (reduced acidification of surface waters, damage to forest ecosystems and soils, and coastal eutrophication), decreases in mercury deposition, and reduction in risks associated with climate change.

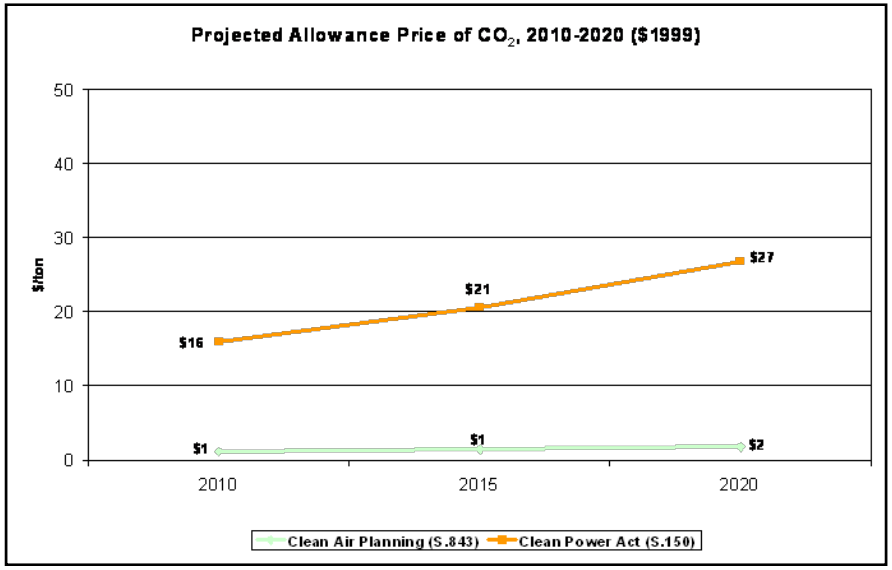
*****Does not account for disbenefits associated with initial increase in emissions prior to 2010 under the Clean Power Act (S.150) and benefits associated with early reductions under Clear Skies (S.131) and Clear Skies (Managers' Mark). Results for the Clean Power Act (S.150), Clear Skies 2003 (S.485), and Clear Skies (Managers' Mark) were calculated based on interpolation using results from other scenarios modeled with air quality models.

Projected Allowance Prices



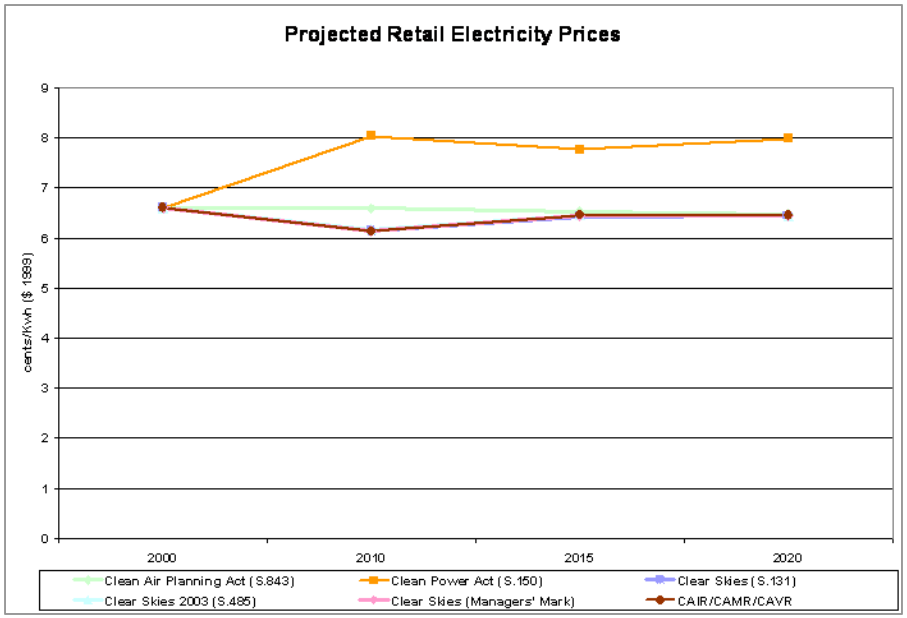


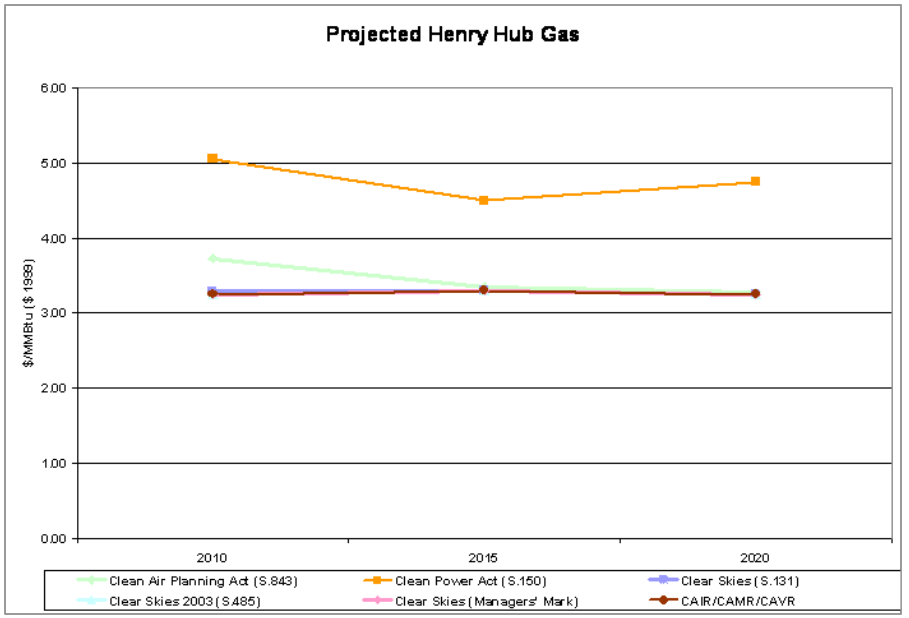




*The Clean Power Act (S.150) does not permit allowance trading for mercury. CO_2 and mercury control costs under the Clean Power Act collapse SO_2 and NO_x trading markets and govern all three pollutants.

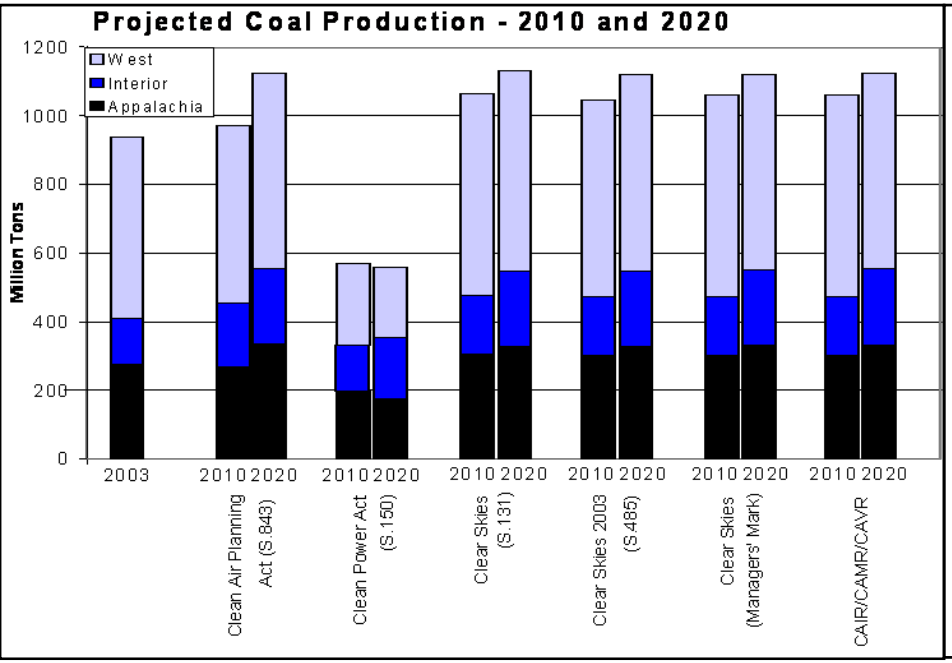
Electricity and Natural Gas Prices

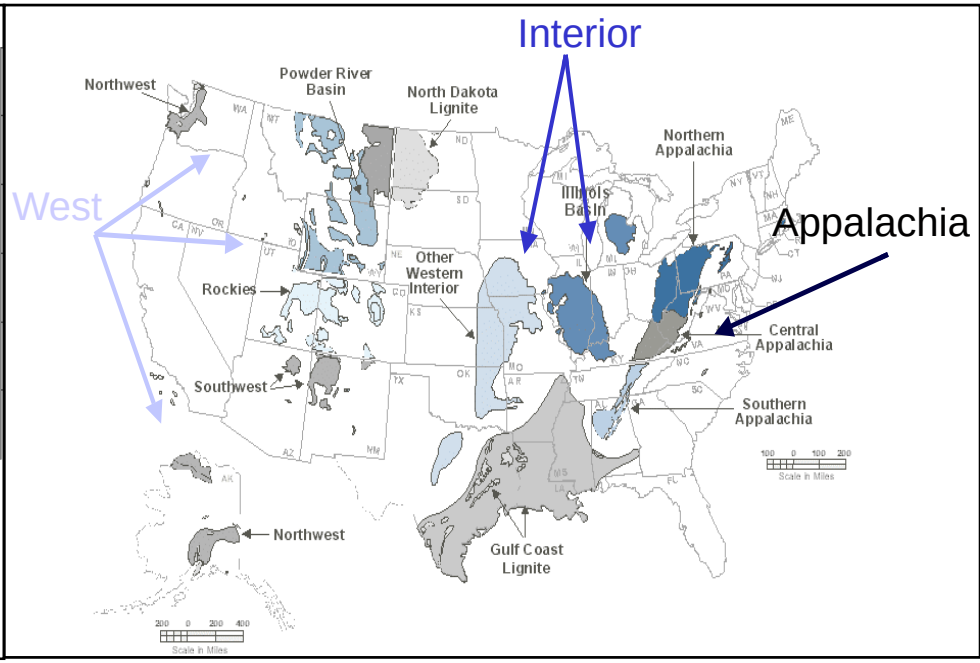




Coal Production

- With the exception of the Clean Power Act (S.150), total coal production is projected to increase under all bills relative to 2003 levels.
- Under Clear Skies 2003 (S.485), Clear Skies (S.131), Clear Skies (Managers' Mark), and CAIR/CAMR/CAVR, coal production is projected to increase over all three regions relative to 2003.
- Under the Clean Air Planning Act (S.843), both Appalachian and Western coal production are projected to decline very slightly from 2003 levels in 2010, but rise relative to 2003 levels by 2020.
- Under the Clean Power Act (S.150), Interior coal production is projected to be at 2003 levels in 2010, increasing in 2020. Both Western and Appalachian coal production are projected to decline relative to 2003 levels.

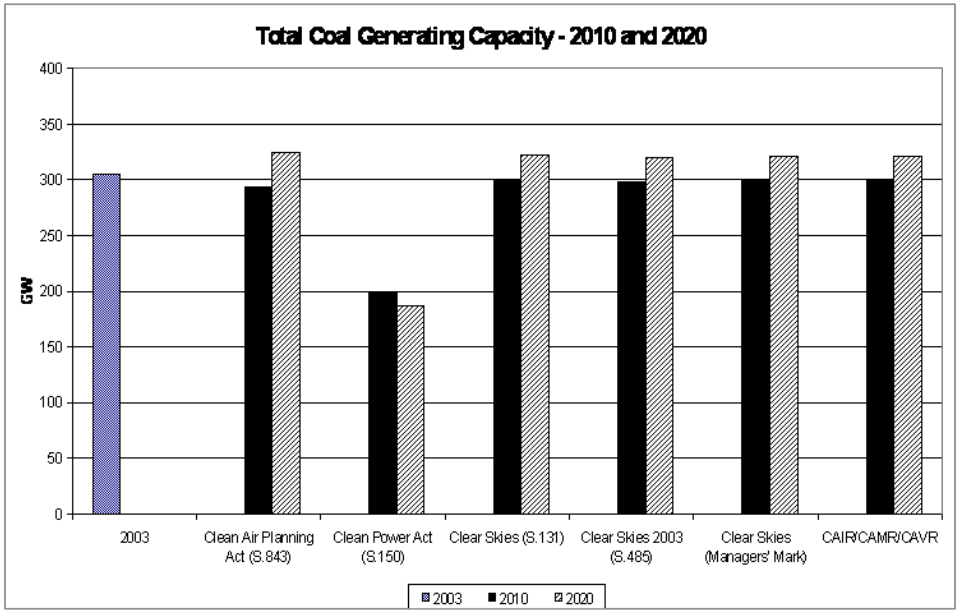


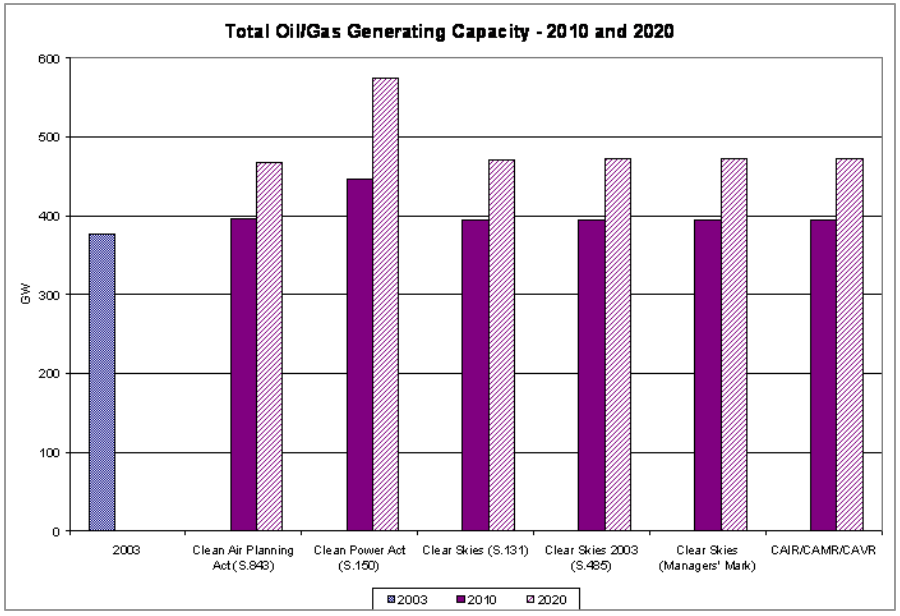


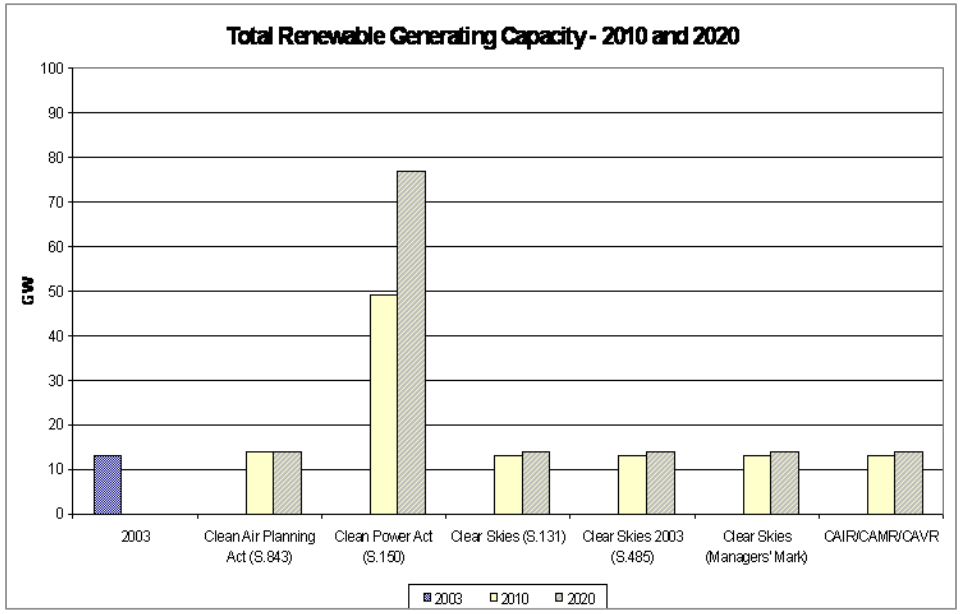
Generating Capacity

- Coal capacity drops to less than 2/3 of current levels under the Clean Power Act (S.150); in all other bills coal capacity increases slightly by 2020.
- Under the Clean Power Act (S.150), combined cycle and renewable generation become more economical, and increase significantly relative to 2003 levels.
- By 2020, combined cycle capacity increases under the remaining bills by about 70 MW, and renewable generation increases only slightly.

Note: EPA did not model the birthday provisions of the Clean Power Act (S.150) or the Clean Air Planning Act (S.843) for units <100MW.

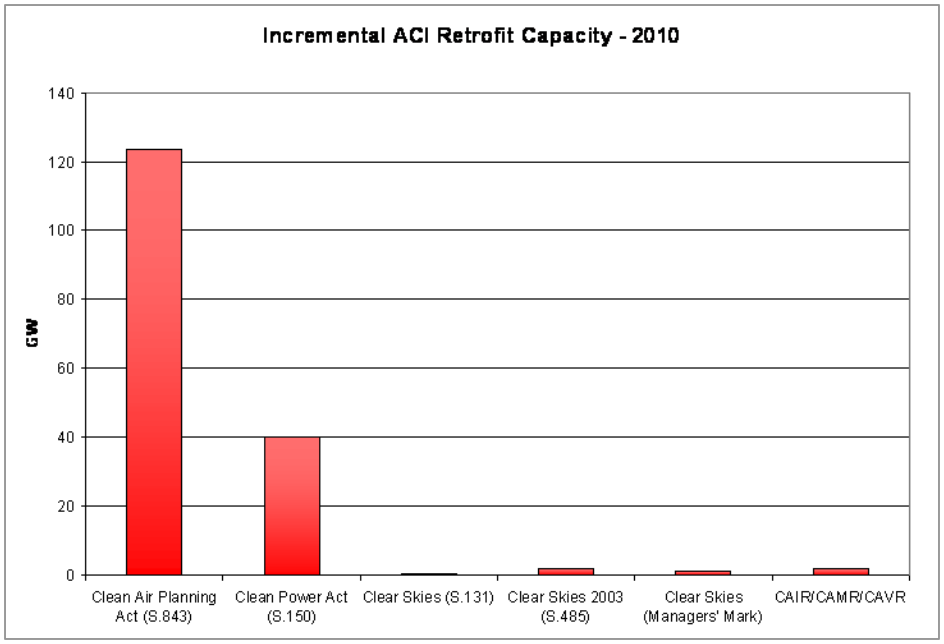


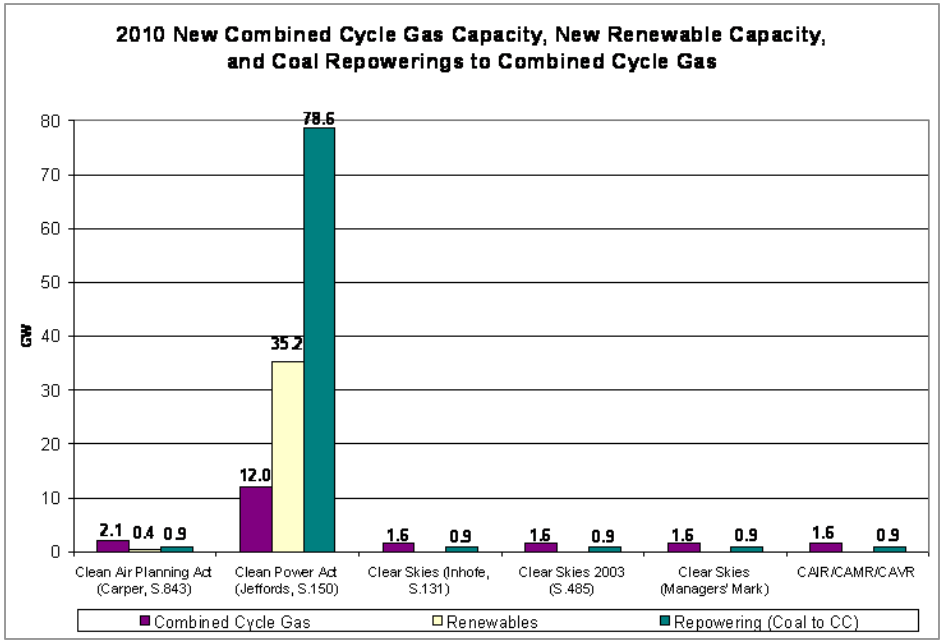




Technical Feasibility of Installing Controls by 2010

- EPA modeling places limits the combined amount of selective catalytic reduction (SCR) and flue gas desulfurization (scrubbers) that can be installed by 2010. This constraint is binding in all bills, such that the cost of each bill is higher in 2010 than it would be if such a constraint were not in place.
- Certain other responses to the emissions constraints in the bill, such as installation of mercury controls and the building of new natural gas capacity, would also likely be limited to some degree in practice due to resource constraints.
- EPA modeling does not place limits on these responses, and EPA believes that projected activated carbon injection (ACI) installations and additional natural gas capacity for the Clean Air Planning Act (S.843) and the Clean Power Act (S.150) exceed what is feasible by 2010.





- While activated carbon controls do not require a significant amount of boilermakers, engineering and project management resources may present bottlenecks in 2010.
- Installation of significant combined cycle capacity in 2010 would present boilermaker, project management and engineering challenges.

Unique Provisions, Off-line Analyses, and Allocations

- EPA conducted off-line analyses of unique provisions in the bills that could not be analyzed within IPM.

Proposal	Unique Provisions Analyzed by EPA	Summary of Allocation Provisions
Clean Air Planning Act (S.843)	Carbon offsets – number of offsets required, total costs Allocations – distribution, total value	Relies on Title IV allocations for SO_2; uses updating, output-based allocations for NO_x, Hg, and CO_2.
Clean Power Act (S.150)	Allocations – distribution; cost of allowance purchases to power sector	Primarily "auction-like" provision with allowances distributed to households, impacted sectors, and set-aside for renewable energy and efficiency projects.
Clear Skies (S.131)	Early reduction credits – estimated early reductions and additional allowances awarded Allocations – distribution, total value Opt-ins – number of sources potentially eligible to opt-in and their emissions Transitional areas – number of eligible non-attainment areas	Relies on Title IV allocations for SO_2; uses historic heat input for NO_x and Hg, with fuel adjustment factors for NO_x and coal adjustment factors for Hg.
Clear Skies 2003 (S.485)	Allocations – distribution; cost of allowance purchases to power sector	Increasing percentage of allowances auctioned each year. For SO_2, allocations tied to Title IV; for NO_x and Hg, allocations based on historic heat input, adjusting for coal type for Hg.
Clear Skies (Managers' Mark)	Early reduction credits – estimated early reductions and additional allowances awarded Allocations – distribution, total value Opt-ins – number of sources potentially eligible to opt-in and their emissions Transitional areas – number of eligible non-attainment areas	Relies on Title IV allocations for SO_2; uses historic heat input for NO_x and Hg, with fuel adjustment factors for NO_x and coal adjustment factors for Hg.

To Learn More…

Additional materials can be found on EPA's website:

http://www.epa.gov/airmarkets/mp

- More detailed briefings of each multi-pollutant approach
- Technical support documents
- Air quality, benefits, and power sector modeling files