EPA United States Environmental Protection Agency

Clear Skies Technical Briefing

STAPPA/ALAPCO

July 30, 2003

Caps and Timing for the Electric Power Sector under the Clear Skies Act

What Has Changed Since the 2002 Analysis?

- **Updated current and future year emission files**
  - New electric generation unit (EGU) controls (e.g., Centralia power plant)
  - New state programs (e.g., North Carolina state law)
  - New federal control programs (e.g., Nonroad Diesel)
  - Updated current year emissions inventory from 1996 to 2001
- **Updated IPM modeling with EPA and EIA assumptions**
- **Updated air quality model (new version of REMSAD)**
- **Updated benefits and air quality modeling approaches**
- **Oklahoma and Kansas now in the Western NOx Zone**

Summary

The 2003 analysis reaffirms previous analytical results – Clear Skies provides substantial benefits to the public at a reasonable cost.

- **Clear Skies delivers approximately $110 billion annually in health benefits by 2020.**
  - An alternative estimate is $21 billion.
    - Many additional benefits are not monetized.
    - Benefits begin right after passage of the Act.

- **Clear Skies yields significant environmental benefits, including important reductions in sulfur, nitrogen, and mercury deposition. Annual monetized benefits of visibility are $3 billion by 2020.**

- **With Clear Skies, by 2020, 35 counties (home to approximately 12 million people) would be brought into attainment with the fine particle standard, leaving only 8 eastern counties in non-attainment. Clear Skies would also bring 3 counties (home to approximately 6 million people) into attainment with the 8-hour ozone standard, and remaining counties closer to attainment.**

- **Clear Skies is projected to cost $6.3 billion annually in 2020 ($1999) and prices of electricity, coal, and natural gas only increase a small amount. Varying key assumptions increases costs by less than 10%.**
  - Technological improvements in emission controls could reduce overall cost of compliance.

Changes to EPA's Economic Modeling

- **Updated EPA 2003 IPM Base Case (Base Case):** The 2003 Base Case includes Title IV, the NOx SIP Call, NSR settlements, and state-specific caps in Connecticut, Massachusetts, Missouri, New Hampshire, North Carolina, Texas, and Wisconsin all finalized before March 2003.

- **Updated EPA 2003 IPM Modeling Assumptions:** EPA has recently enhanced IPM to better reflect the power sector and incorporate the best available information.

  - Some modeling assumptions used in IPM have been updated from the 2000 version used to model the Clear Skies Act of 2002. A summary of these changes are listed on the following slide.

  - The revised assumptions were used in IPM runs completed for analysis of the 2003 reintroduced Clear Skies Act.

Background on IPM

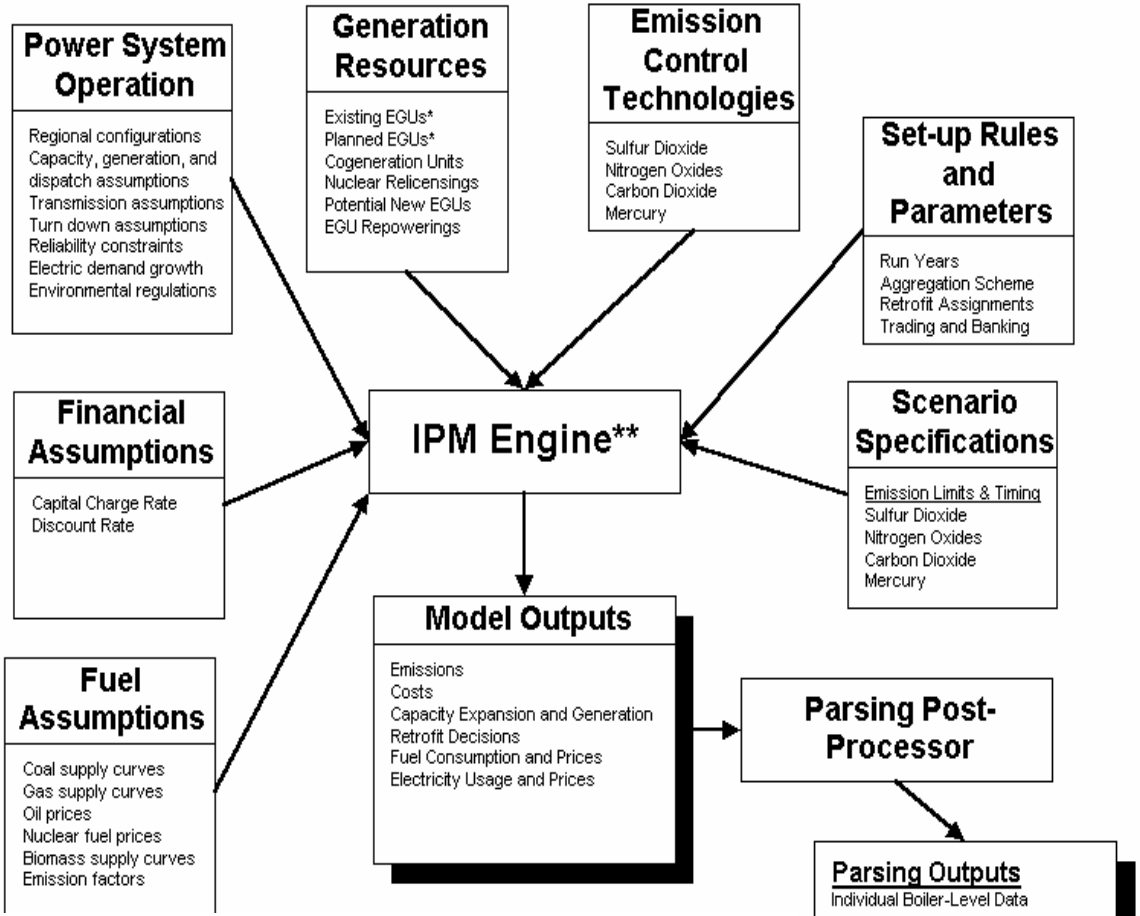
What is IPM?

- The Integrated Planning Model (IPM) is a long-term capacity expansion and production costing model for analyzing the electric power sector.
- **It is a multi-regional, deterministic, dynamic linear programming model.**
- IPM finds the least-cost solution to meeting electricity demand subject to environmental, transmission, fuel, reserve margin, and other system operating constraints.

Objective: Constructs Most Economical Way for a Specified Set of Electric Generation Units to Operate to Meet Load Demand Subject to Constraints.

- IPM Can Analyze a Single Power Company's Operations, or the Entire Grid. It Can Look at a Day of Operation, or Over 30 Years.
- IPM's Uses Have Grown: Capacity Planning, Load Management, Environmental Compliance, Pollution Control and Grid Management Strategies.
- EPA Uses IPM to Analyze National and Regional Approaches to Emissions Control from 2005 to 2020.
- All assumptions, inputs, and run results for EPA's applications of IPM are extensively documented and available at *www.epa.gov/airmarkets/epa-ipm*.

Modeling and Data Structure for EPA's Base Case



Notes:

*Information on existing and planned electric generating units (EGUs) is contained in the National Energy Data System (NEEDS) data base developed for EPA by ICF Consulting, Inc. Planned EGUs are those which were under construction or had obtained financing at the time that EPA's Base Case 2003 was finalized.

**IPM Engine is the model structure described in Chapter 2 of the IPM documentation.

Updates to EPA's Economic Modeling Assumptions

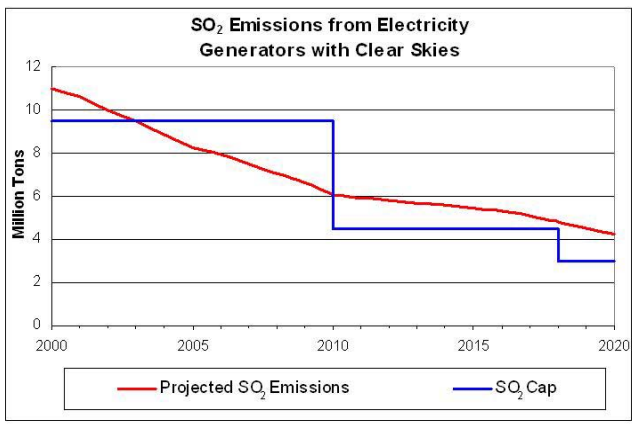
Assumption	Change
Cost, performance, emission, and removal rate assumptions for new conventional units and existing nuclear units	Revised to ensure consistency with AEO 2003.
Renewable energy programs and renewable portfolio standards	Updated information largely based on AEO 2003.
Fuel oil assumptions	Incorporation consistent with AEO 2003.
Coal supply curves	Revised to incorporate the coal productivity, labor productivity, and transportation escalators used in AEO 2003.
Existing generation capacity – planned/committed units	159 GW of new capacity by 2005 was added to the model based on information in the RDI database and AEO 2003 inventory.
Inventory of installed SO_2 and NOx controls	Updated inventory of installed SO_2 and NOx controls based on information reported by utilities, vendors, state regulatory agencies, and regional EPA offices.
Updated baseline for state controls	Added state-specific caps in Massachusetts, New Hampshire, North Carolina, Texas, and Wisconsin.
Mercury emissions modification factors (EMFs)	• Mercury EMFs were revised based on latest technical data; the major changes were the SCR+FGD assumptions: – For bituminous coal, the removal rate was changed from 95% to 90%. – For subbituminous coal, smaller (25-85%) removal rates for SCR +FGD are now used. • Also modeled with EIA assumptions.
Annual electricity demand growth	• Annual electricity demand growth rate was changed from 1.2% to 1.55%. • Also modeled with EIA assumptions.
Natural gas supply prices	• Revisions were based on the latest version of ICF's North American Natural Gas Analysis System (NANGAS) model. The impact is an approximate 15% increase in gas prices in the model output, relative to Clear Skies 2002 model output. • Also modeled with EIA assumptions.
Activated carbon injection (ACI) cost and performance data	ACI removal was changed from 80% to 90%, based on the latest full-scale test data. (EIA also uses 90% removal.)
Title IV allowance bank	Updated Title IV bank assumptions based on most current data from ICF, Inc. Private Practice projections.

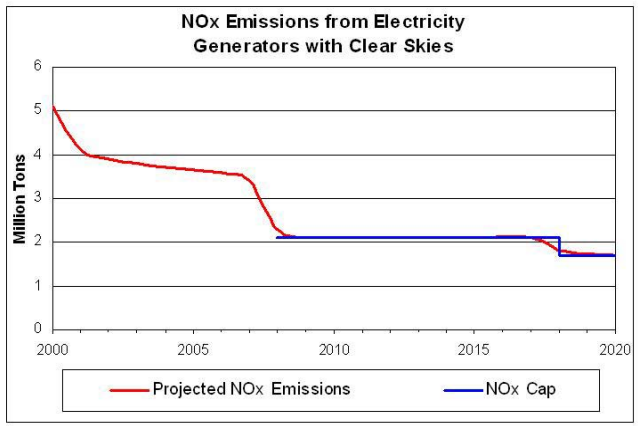
State Multi-Pollutant Regulations Incorporated into Base Case

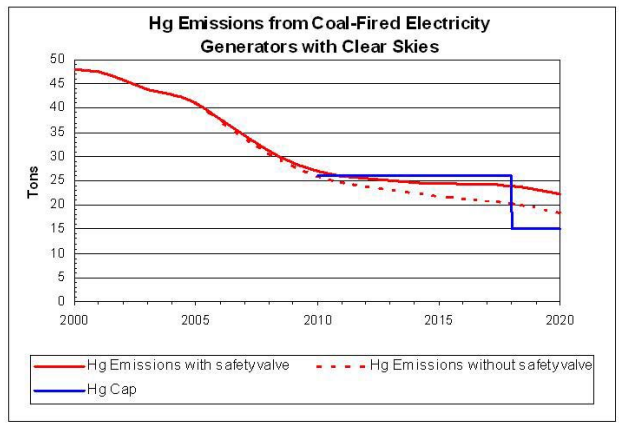
State	Bill	Emission Type	Emission Specifications
Connecticut	Exec. Order 19	NOx	Winter (October-April) Emission rate of 0.15 lb/mmBtu for fossil units > 15 MW
		SO2	Emission rate of 0.33 lb/mmBtu for fossil units > 15 MW. Title IV allowances/ERC's can be used until 2005, then all units must meet limit.
Massachusetts	310 CMR 7.29	NOx	Emission rate of 1.5 lb/MWh for the 6 grandfathered units in state
		SO2	Emission rate of 3.0 lb/MWh for the 6 grandfathered units in state
		Hg	Included in bill but limits not yet decided
		CO2	Emission rate of 1,800 lb/MWh for the 6 grandfathered units in state
Missouri	Title 10, Div 10, Ch 6.350	NOx	Summer season cap of 43,950 tons on all units > 25 MW
New Hampshire	HB 284	NOx	Cap of 3,644 tons on all existing fossil steam units
		SO2	Cap of 7,289 tons on all existing fossil steam units
		Hg	No HG state emission cap on existing fossil steam units1
		CO2	Cap of 5,425,866 tons on all existing fossil steam units2
North Carolina	Clean Smokestacks Act	NOx	Cap of 56,000 tons on 14 coal-fired units belonging to Duke Power and CP&L >25MW
		SO2	Cap of 205,000 tons on 14 coal-fired units belonging to Duke Power and CP&L >25MW by 2009 and 130,000 tons by 2013 [Title IV allowances allocated to North Carolina units that exceed the State's cap will be retired from the federal program in IPM]
Texas	Senate Bill 7	NOx - East	50% reduction from 1997 baseline for all grandfathered fossil > 25MW [all of Texas traversed by or east of Rt 35]
	Senate Bill 7	NOx - West	50% reduction from 1997 baseline for all grandfathered fossil > 25MW [all of Texas not in East region or El Paso county]
	Senate Bill 7	NOx - El Paso	50% reduction from 1997 baseline for all grandfathered fossil > 25MW [El Paso county]
	Senate Bill 7	SO2 - East	25% reduction from 1997 baseline for all grandfathered fossil > 25MW [all of Texas traversed by or east of Rt 35]
	Senate Bill 7	SO2 - West	25% reduction from 1997 baseline for all grandfathered fossil > 25MW [all of Texas not in East region or El Paso county]
	Senate Bill 7	SO2 - El Paso	25% reduction from 1997 baseline for all grandfathered fossil > 25MW [El Paso county]
	Ch. 117	NOx - Houston	Cap of 4,710 tons applied to all fossil units
	Ch. 117	NOx - Dallas/Fort Worth	Cap of 2,164 tons applied to all fossil units
	Ch. 117	NOx - East/Central	Cap of 123,530 tons applied to all fossil units
Wisconsin *WEPCO owns 5 coal and 3 natural gas facilities affected by agreement*	Cooperative agreement between WEPCO and DNR, Wisconsin Dept of Natural Resources (PUB-AM-316 2001)	SO2	System-wide emission limit of .70 lb/mmBtu in 2007 and .45 lb/mmBtu in 2012
		NOx	System-wide emission limit of .25 lb/mmBtu in 2007 and .15 lb/mmBtu in 2012
		Hg	10% reduction from '98-'00 levels by 2007 and 50% reduction by 20123

Projected Emissions from Electric Generating Units

- The Clear Skies Act will result in significant over-compliance in the early years, particularly for SO_2, because sources are allowed to bank excess emissions reductions and use them later. The use of these banked allowances for compliance in the later years of the program (e.g., 2020) results in SO_2 and mercury emissions initially above the second phase cap, gradually declining to the cap level.
- Based on current technological capabilities, the cost of mercury removal is expected to reach the safety valve price ($35,000/lb) by 2010. However, technological improvements could decrease the cost of mercury control over time and cause prices to remain below safety valve levels. EPA saw scrubber costs drop and performance improve during the 1990s when the power sector faced regulatory controls for SO_2. There is no significant change in projected SO_2 and NOx emissions when Clear Skies is modeled without the safety valve.



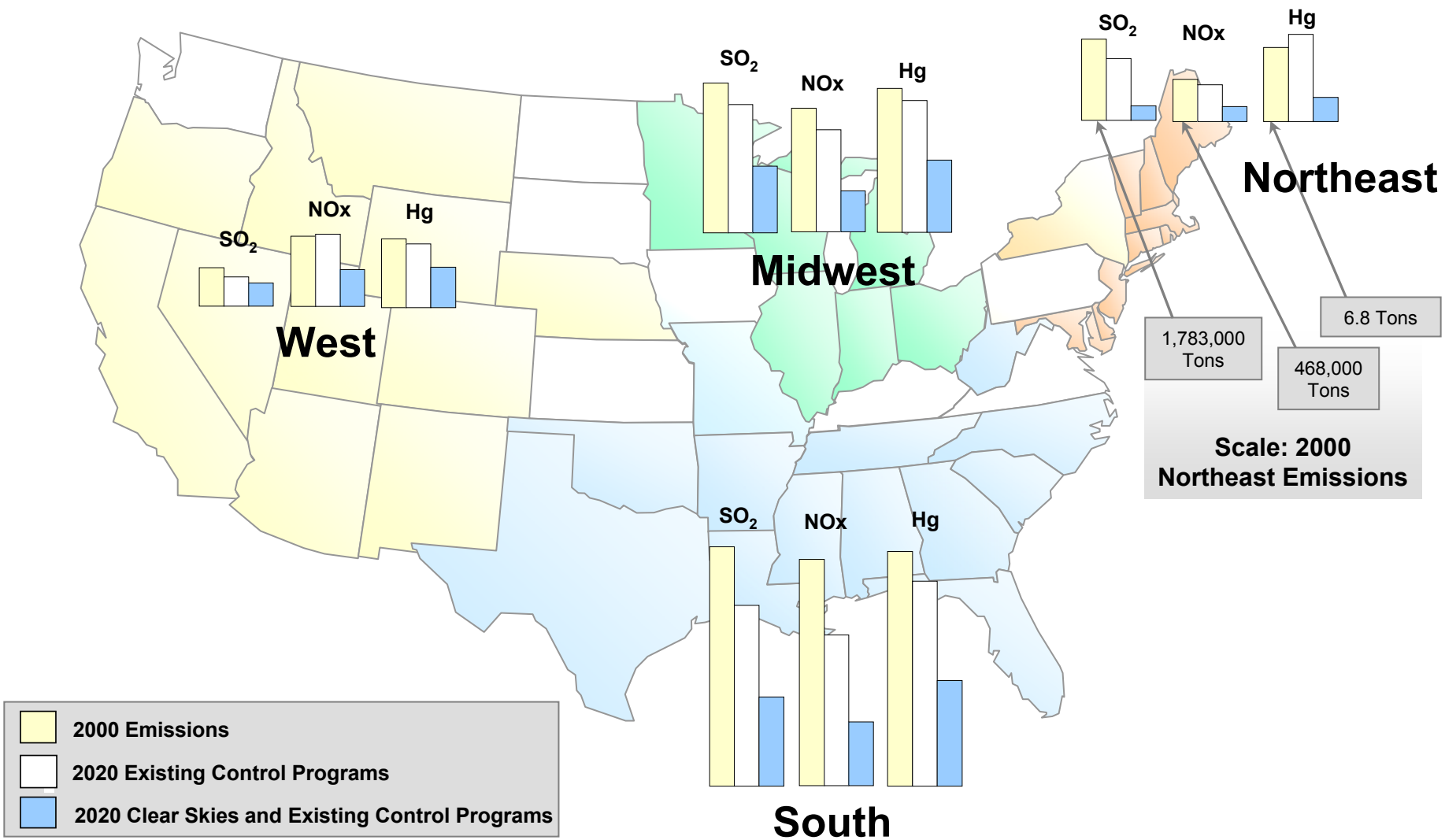




Note: Projected emissions data for SO_2, NOx and mercury are from IPM.

Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

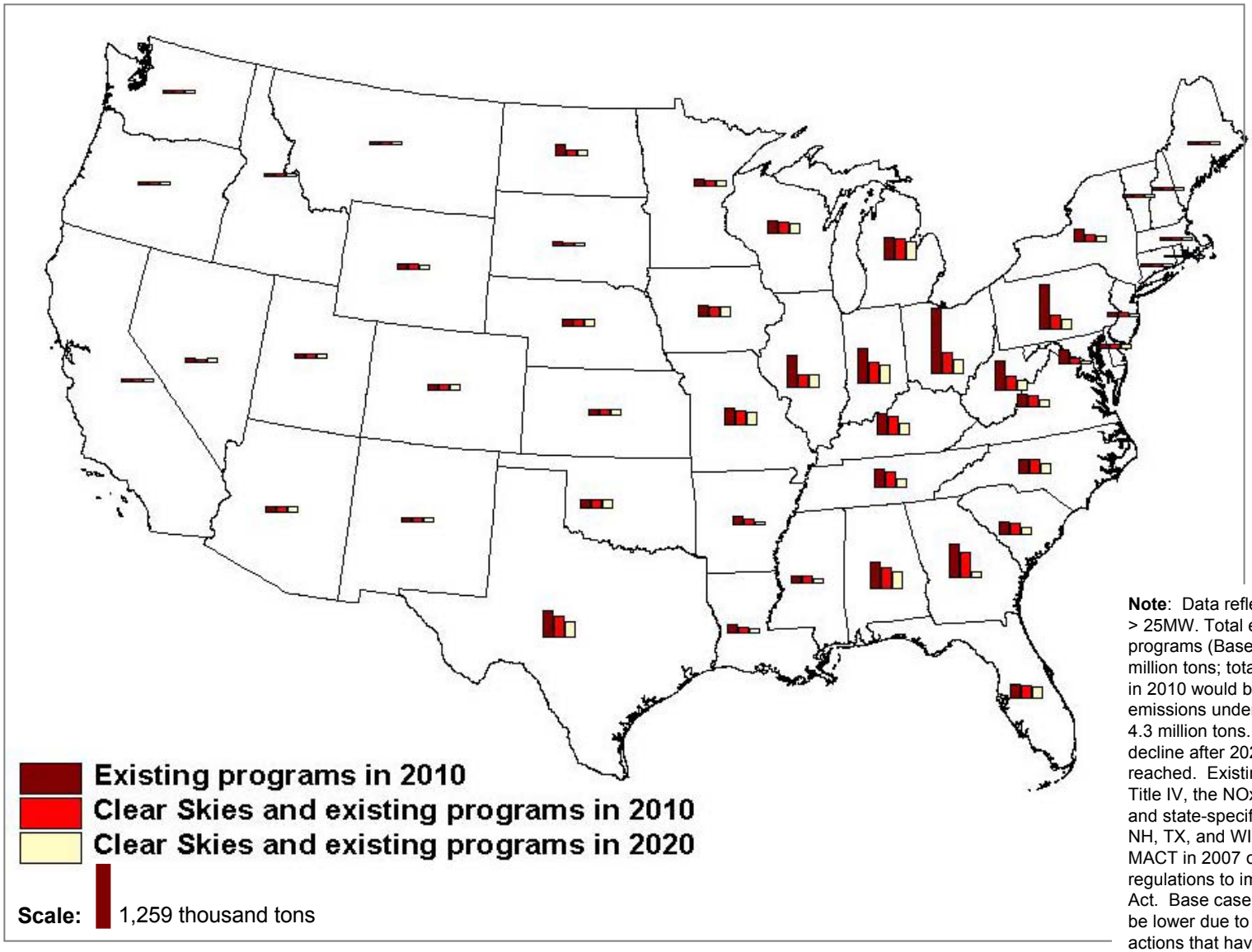
Power Industry Emissions: Current, Base Case, & Clear Skies



Alaska & Hawaii are not included in EPA's model of sources connected to the continental U.S. electricity grid.

Note: Existing control programs in IPM include Title IV, the NOx SIP Call, NSR settlements, and state-specific caps in CT, MA, MO, NC, NH, TX, and WI. It does not include mercury MACT in 2007 or any other potential future regulations to implement the current Clean Air Act. Base case emissions in 2020 will likely be lower due to state and federal regulatory actions that have not yet been promulgated.

Power Industry Emissions of Sulfur Dioxide



Note: Data reflect sources > 25MW. Total emissions under existing programs (Base Case) in 2010 would be 9.9 million tons; total emissions under Clear Skies in 2010 would be 6.1 million tons; total emissions under Clear Skies in 2020 would be 4.3 million tons. Emissions will continue to decline after 2020 until the cap level is reached. Existing control programs include Title IV, the NOx SIP Call, NSR settlements, and state-specific caps in CT, MA, MO, NC, NH, TX, and WI. It does not include mercury MACT in 2007 or any other potential future regulations to implement the current Clean Air Act. Base case emissions in 2020 will likely be lower due to state and federal regulatory actions that have not yet been promulgated.

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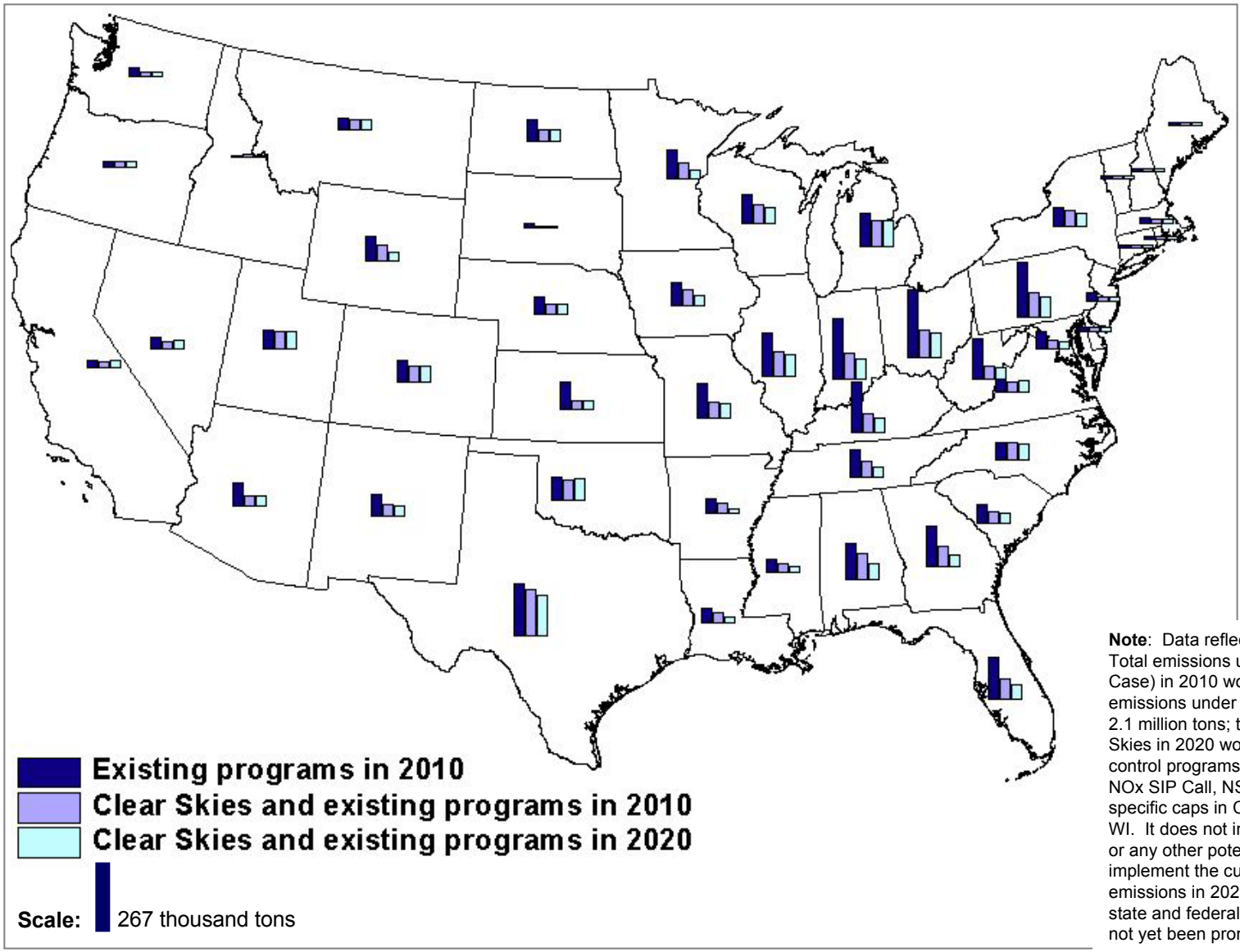
Power Industry Emissions of Nitrogen Oxide



Note: Data reflects power plants > 25MW. Total emissions under existing programs (Base Case) in 2010 would be 3.9 million tons; total emissions under Clear Skies in 2010 would be 2.1 million tons; total emissions under Clear Skies in 2020 would be 1.7 million tons. Existing control programs in IPM include Title IV, the NOx SIP Call, NSR settlements, and state-specific caps in CT, MA, MO, NC, NH, TX, and WI. It does not include mercury MACT in 2007 or any other potential future regulations to implement the current Clean Air Act. Base case emissions in 2020 will likely be lower due to state and federal regulatory actions that have not yet been promulgated.

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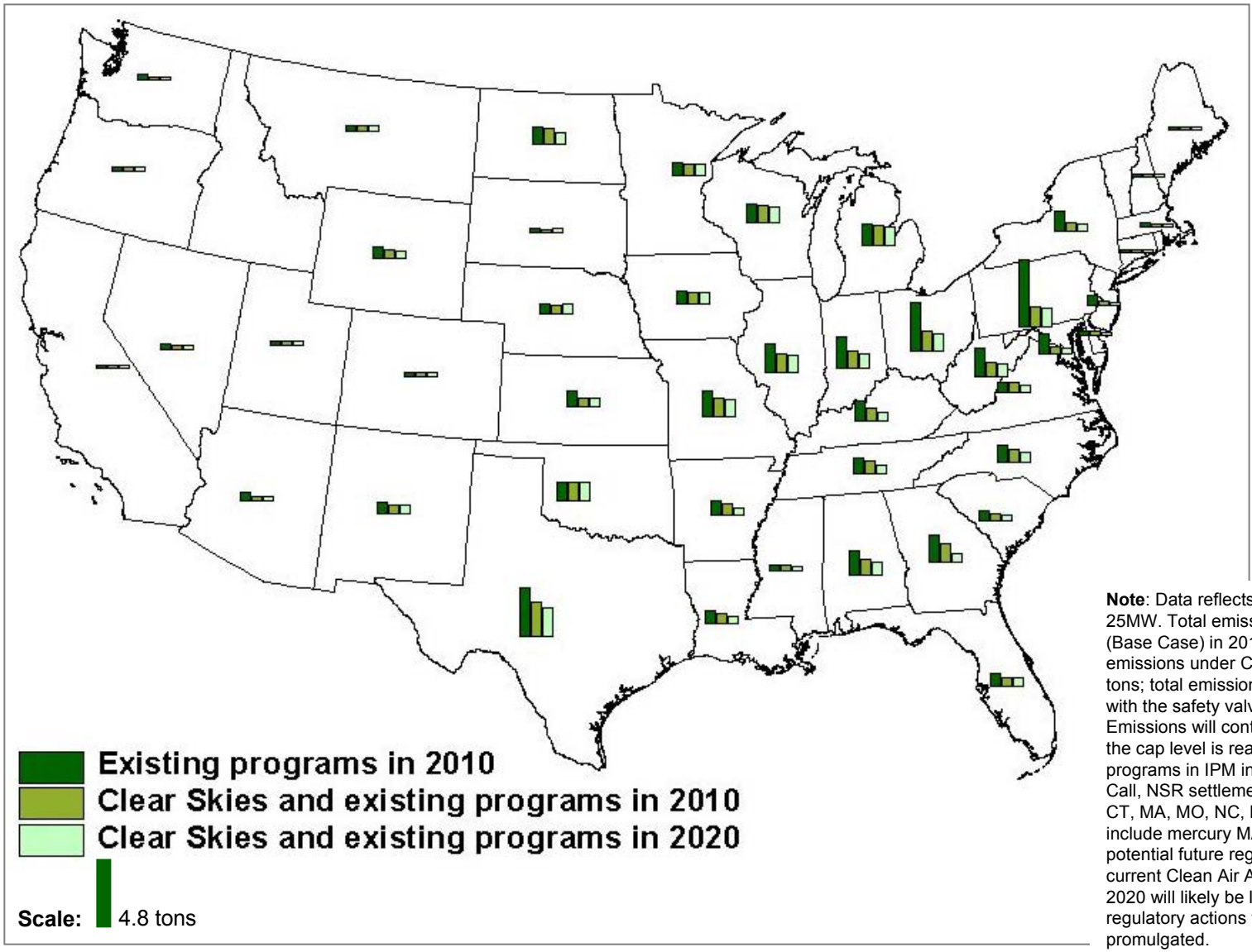
Power Industry Emissions of Mercury



Note: Data reflects coal-fired power plants > 25MW. Total emissions under existing programs (Base Case) in 2010 would be 45 tons; total emissions under Clear Skies in 2010 would be 27 tons; total emissions under Clear Skies in 2020 with the safety valve triggered would be 22 tons. Emissions will continue to decline after 2020 until the cap level is reached. Existing control programs in IPM include Title IV, the NOx SIP Call, NSR settlements, and state-specific caps in CT, MA, MO, NC, NH, TX, and WI. It does not include mercury MACT in 2007 or any other potential future regulations to implement the current Clean Air Act. Base case emissions in 2020 will likely be lower due to state and federal regulatory actions that have not yet been promulgated.

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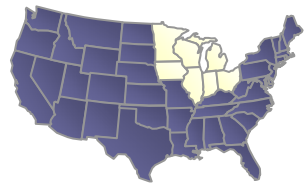
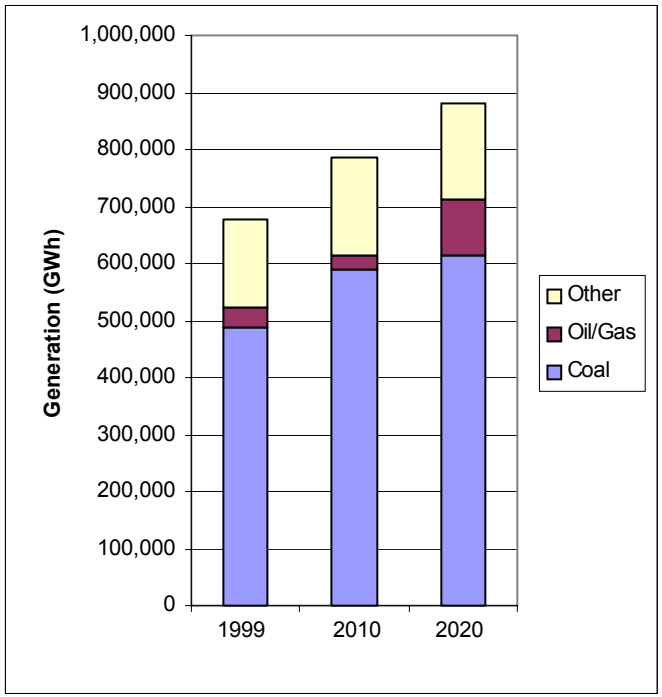
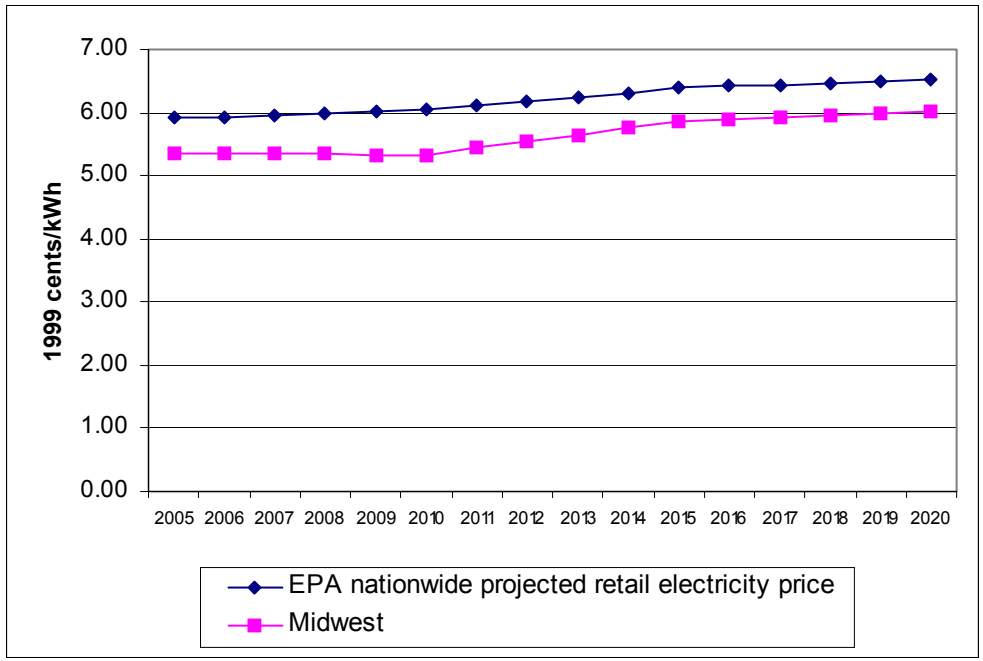
Summary of Projected Impacts in the Midwest



Current Generation Mix and Projected Mix Under Clear Skies



Projected Retail Electricity Prices under Clear Skies (2005 - 2020)



Projected Emissions Rates from Power Generators

Year		SO2	NOx			Hg
		Coal	All	Coal	Gas	Coal
	Units	lbs/MMBtu	lbs/MMBtu	lbs/MMBtu	lbs/MMBtu	lbs/TBtu
2010	Base Case	1.15	0.36	0.37	0.07	4.08
	Clear Skies	0.61	0.19	0.20	0.07	2.59
2020	Base Case	0.92	0.33	0.36	0.05	3.94
	Clear Skies	0.49	0.13	0.14	0.05	2.21

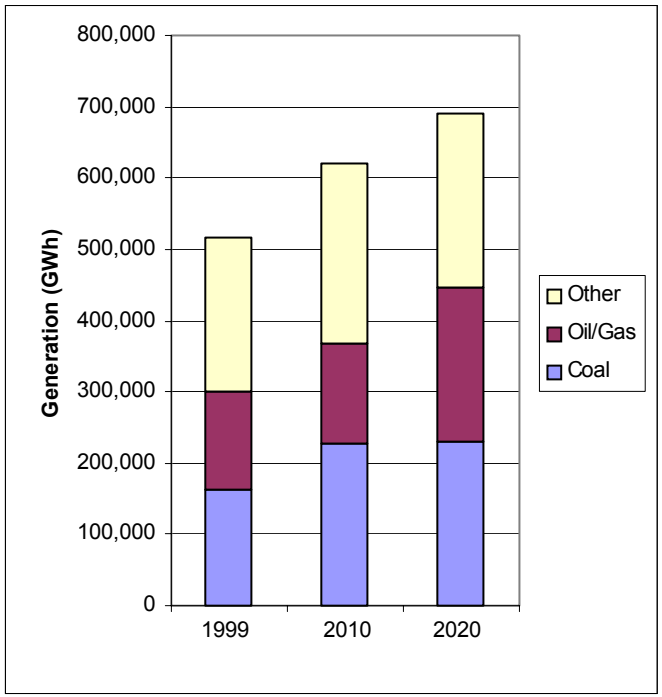
Note: The Midwest includes Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin.

2020 generation projections are EPA estimates using IPM. 1999 generation from EIA, aggregated from state-level data at: www.eia.doe.gov/cneaf/electricity/st_profiles/ (Table 5).

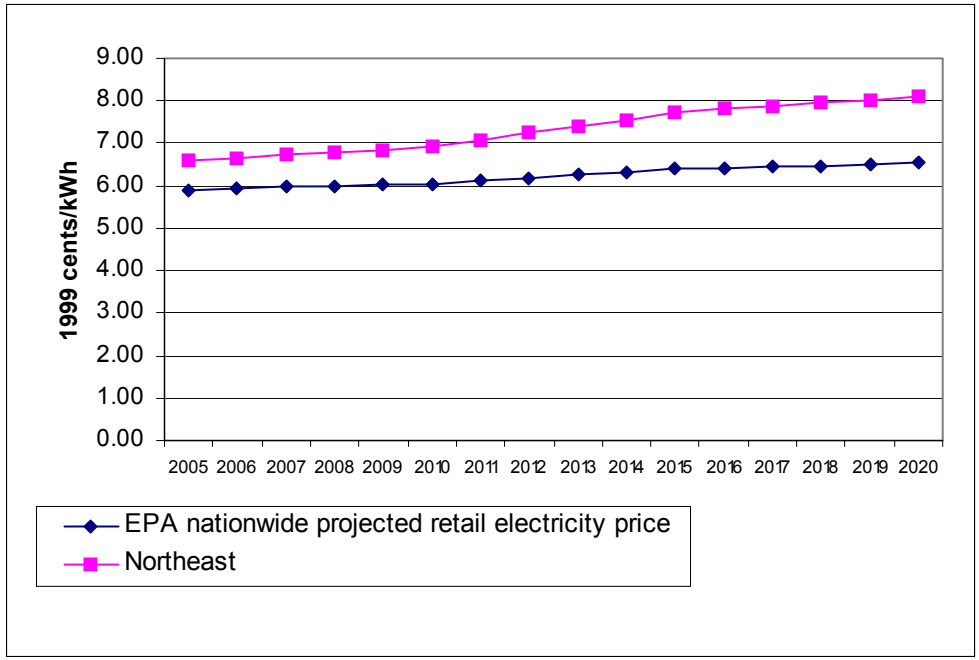
Electricity prices were calculated using the Retail Electricity Price Model (see Section G for a description of the Model).

Summary of Projected Impacts in the Northeast

Current Generation Mix and Projected Mix Under Clear Skies



Projected Retail Electricity Prices under Clear Skies (2005 - 2020)



Projected Emissions Rates from Power Generators

Year		SO2	NOx			Hg
		Coal	All	Coal	Gas	Coal
	Units	lbs/MMBtu	lbs/MMBtu	lbs/MMBtu	lbs/MMBtu	lbs/TBtu
2010	Base Case	1.24	0.24	0.32	0.06	7.56
	Clear Skies	0.47	0.12	0.16	0.06	2.37
2020	Base Case	1.17	0.21	0.32	0.05	6.88
	Clear Skies	0.29	0.09	0.12	0.05	2.03

Note: The Northeast includes Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont.

2020 generation projections are EPA estimates using IPM. 1999 generation data from EIA, aggregated from state-level data at: www.eia.doe.gov/cneaf/electricity/st_profiles/ (Table 5).

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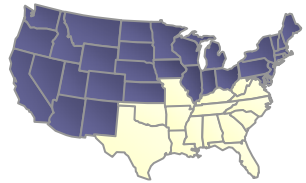
Summary of Projected Impacts in the South



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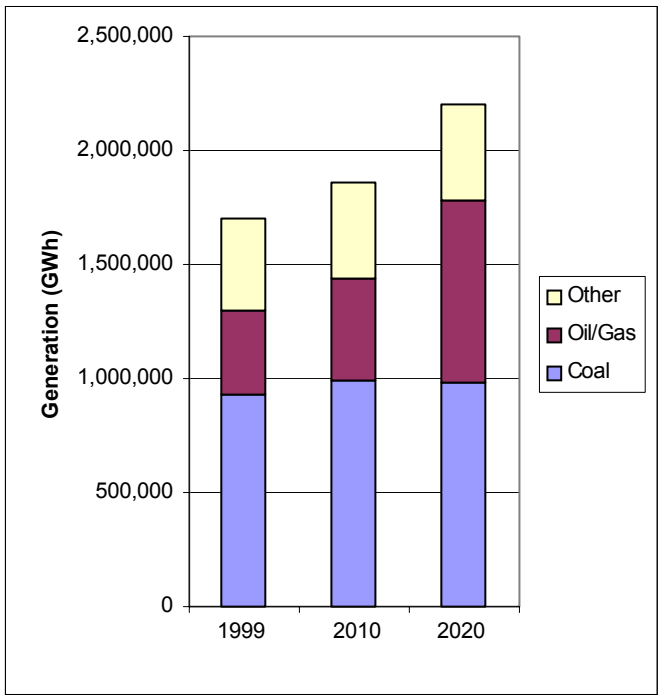
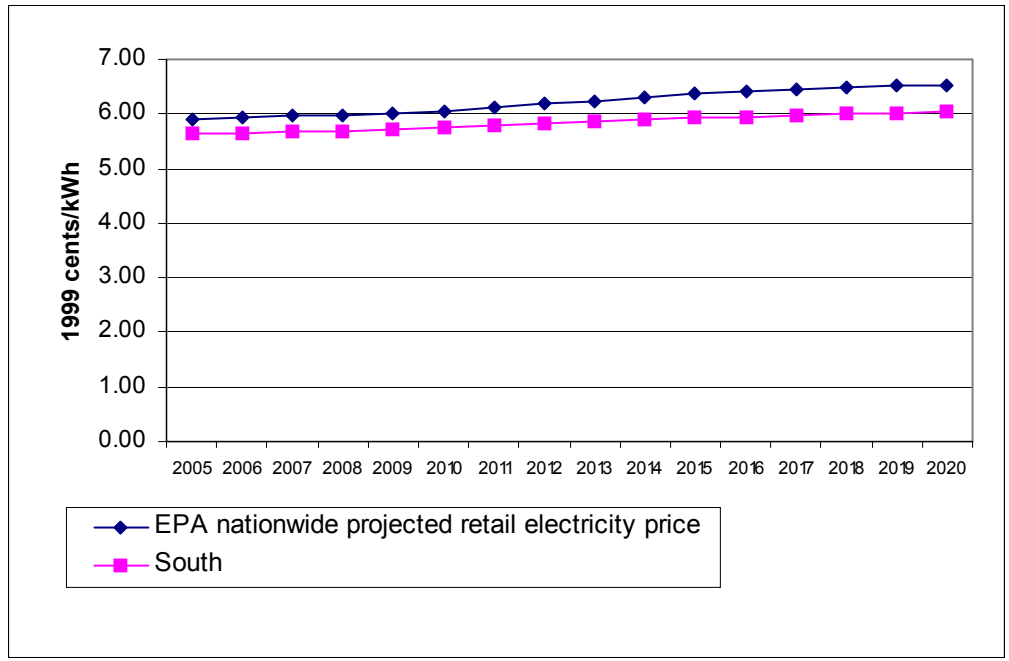


Projected Retail Electricity Prices under Clear Skies (2005 - 2020)



Projected Emissions Rates from Power Generators

Year		SO2	NOx			Hg
		Coal	All	Coal	Gas	Coal
	Units	lbs/MMBtu	lbs/MMBtu	lbs/MMBtu	lbs/MMBtu	lbs/TBtu
2010	Base Case	0.87	0.25	0.31	0.06	3.79
	Clear Skies	0.68	0.14	0.17	0.05	2.64
2020	Base Case	0.77	0.21	0.30	0.04	3.66
	Clear Skies	0.40	0.09	0.12	0.04	1.97

Note: The South includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia and West Virginia.

2020 generation projections are EPA estimates using IPM. 1999 generation from EIA, aggregated from state-level data at: www.eia.doe.gov/cneaf/electricity/st_profiles/ (Table 5).

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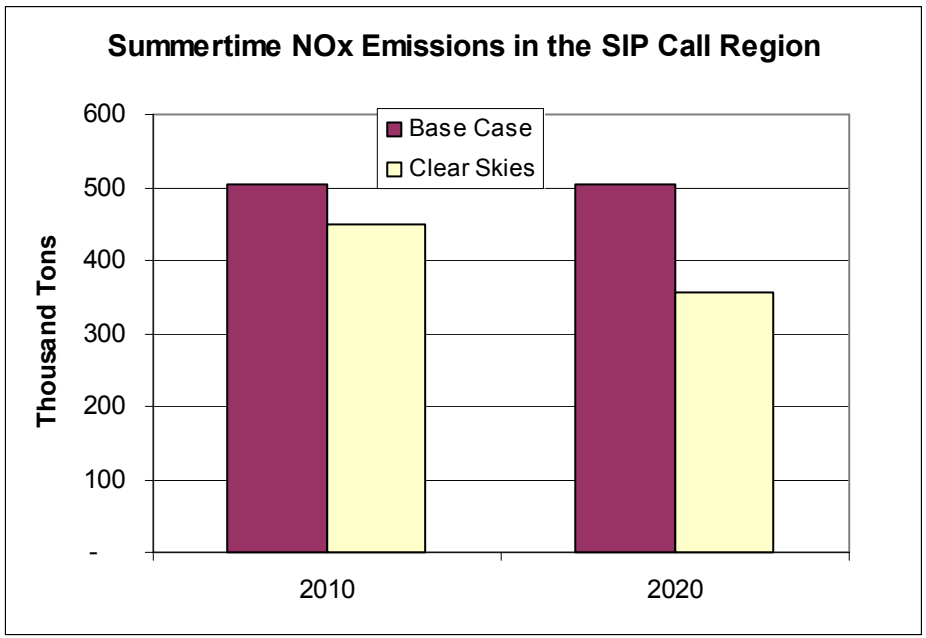
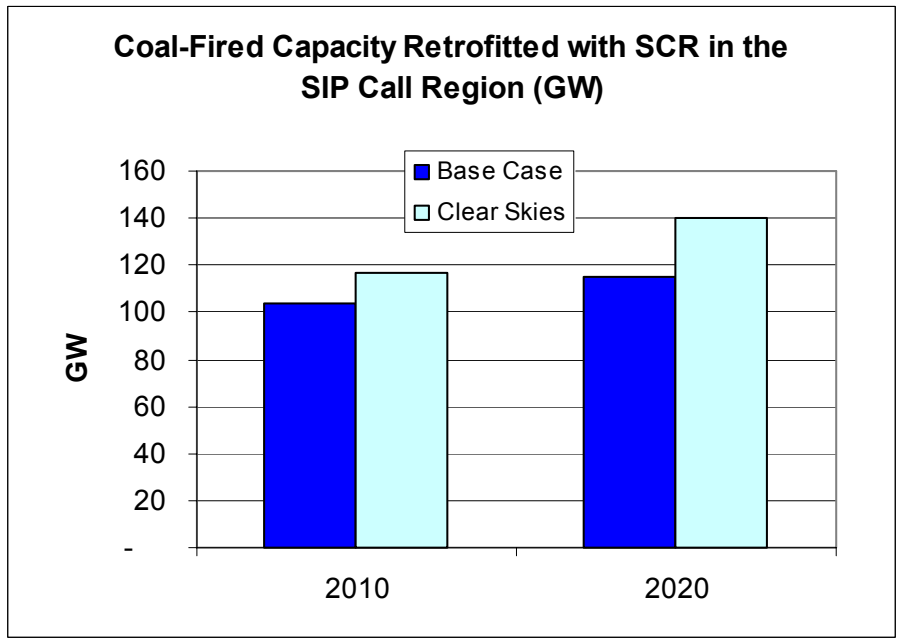
Impact of Clear Skies on the NOx SIP Call Region

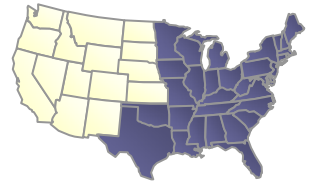
- Summertime NOx emissions in the SIP Call region with Clear Skies are significantly lower than the emissions predicted under the NOx SIP Call. The additional reductions with Clear Skies come from the approximately 25 GW of additional SCR retrofits by 2020.





Note: The NOx SIP Call Region includes nineteen Eastern States and DC. Summertime NOx emissions occur between May 1 and September 30. Georgia is not currently part of the SIP Call program; however, EPA is drafting regulations that would include Georgia in the SIP Call Region by 2007 and a significant number of utilities in Georgia are installing controls to comply with potential future requirements. For these reasons, EPA has included Georgia in the SIP Call region modeled under the Base Case. This does not materially change the trends.

Summary of Projected Impacts in the West



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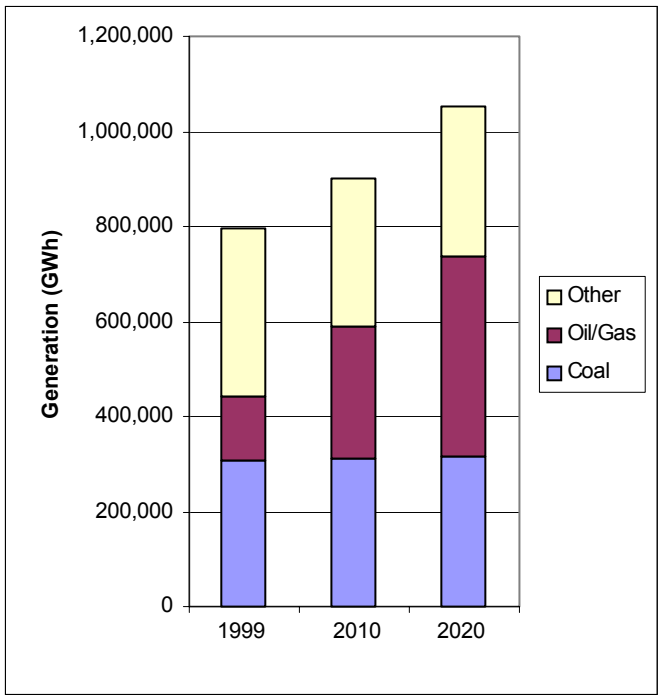
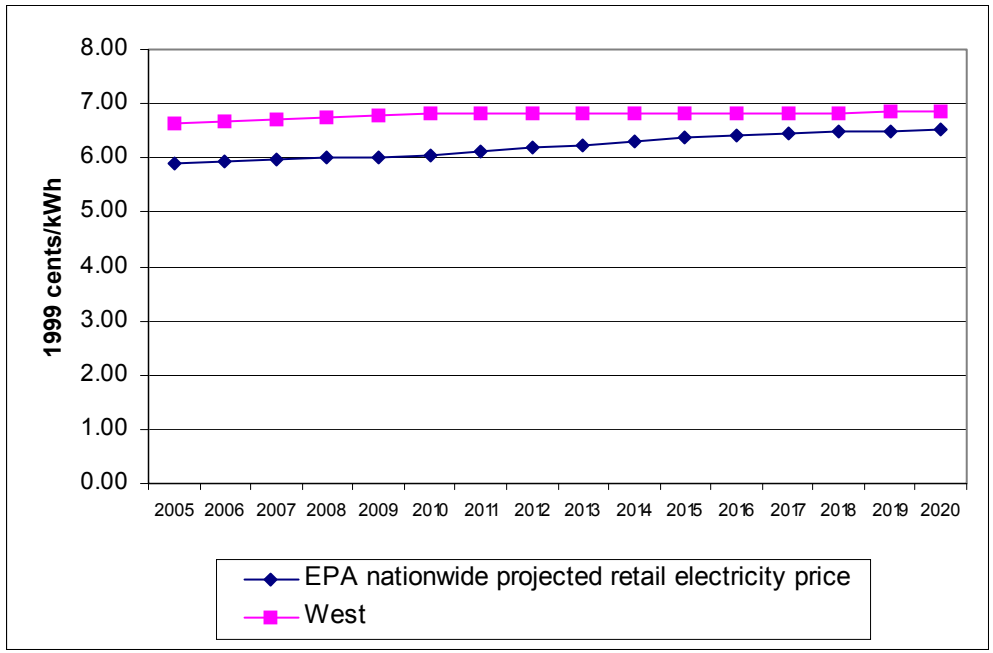


Projected Retail Electricity Prices under Clear Skies (2005 - 2020)



Projected Emissions Rates from Power Generators

Year		SO2	NOx			Hg
		Coal	All	Coal	Gas	Coal
	Units	lbs/MMBtu	lbs/MMBtu	lbs/MMBtu	lbs/MMBtu	lbs/TBtu
2010	Base Case	0.40	0.29	0.45	0.03	3.48
	Clear Skies	0.32	0.16	0.24	0.03	2.50
2020	Base Case	0.38	0.25	0.45	0.03	3.48
	Clear Skies	0.32	0.13	0.22	0.03	2.26

Note: The West includes Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington and Wyoming.

2020 generation projections are EPA estimates using IPM. 1999 generation from EIA, aggregated from state-level data at: www.eia.doe.gov/cneaf/electricity/st_profiles/ (Table 5).

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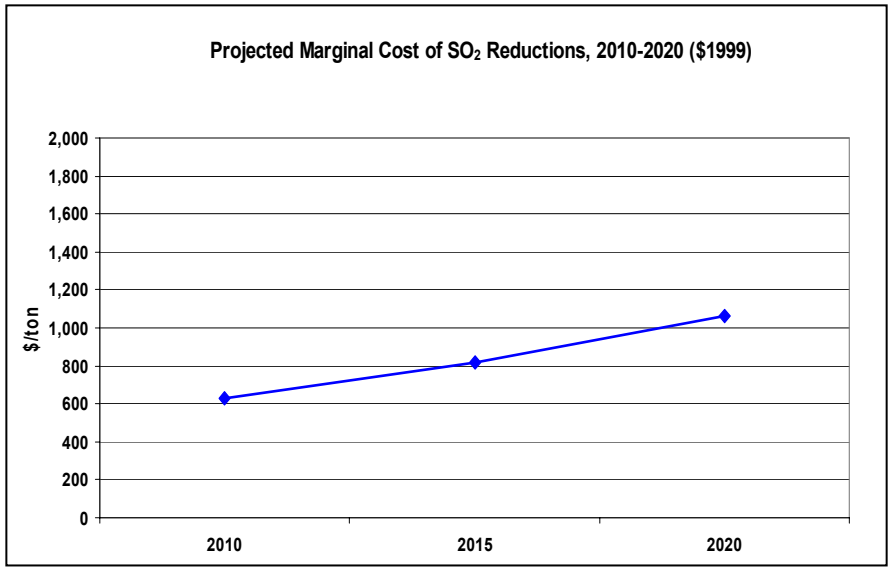
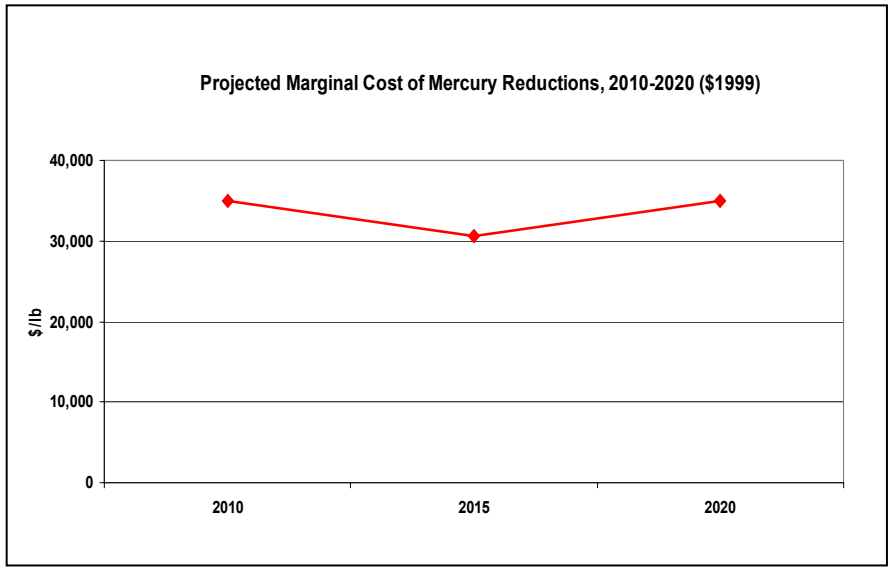
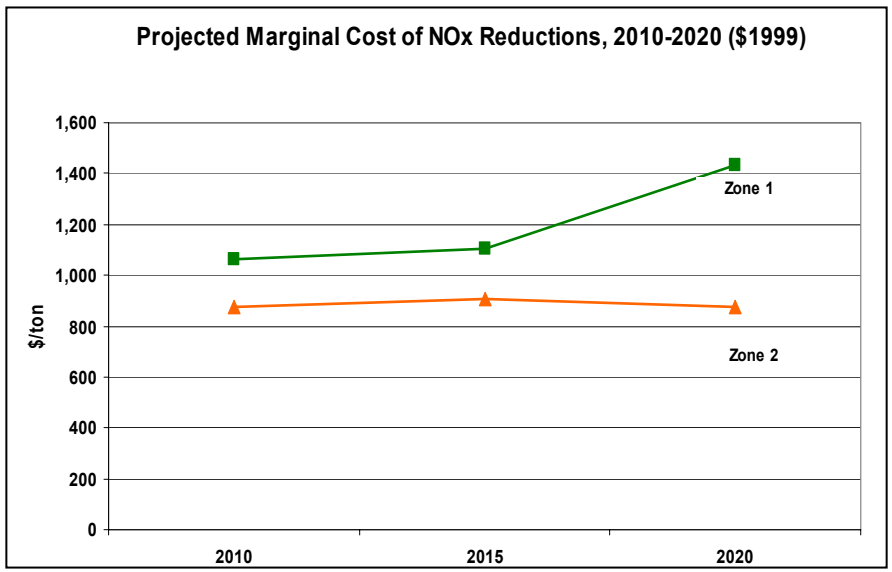
Projected Allowance Prices with Clear Skies







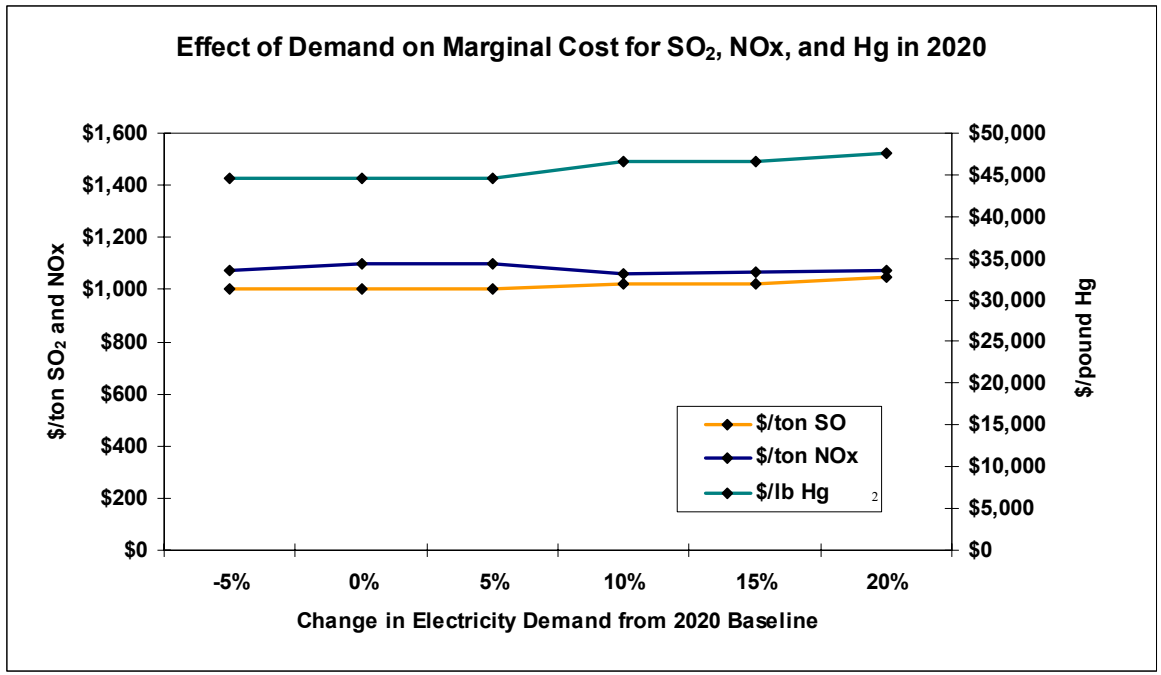
Note: The dollar value is the projected allowance price, representing the marginal cost (i.e., the cost of reducing the last ton) of emissions reductions. Marginal costs are based on modeling using IPM.

Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

Varying Electricity Growth Rates

- The effects of increased demand on allowance prices is quite modest, due to the use of low-emitting gas units for most of the increase in generation (though there is some increase in capacity factors for coal units, leading to pressure on SO_2 and Hg prices).

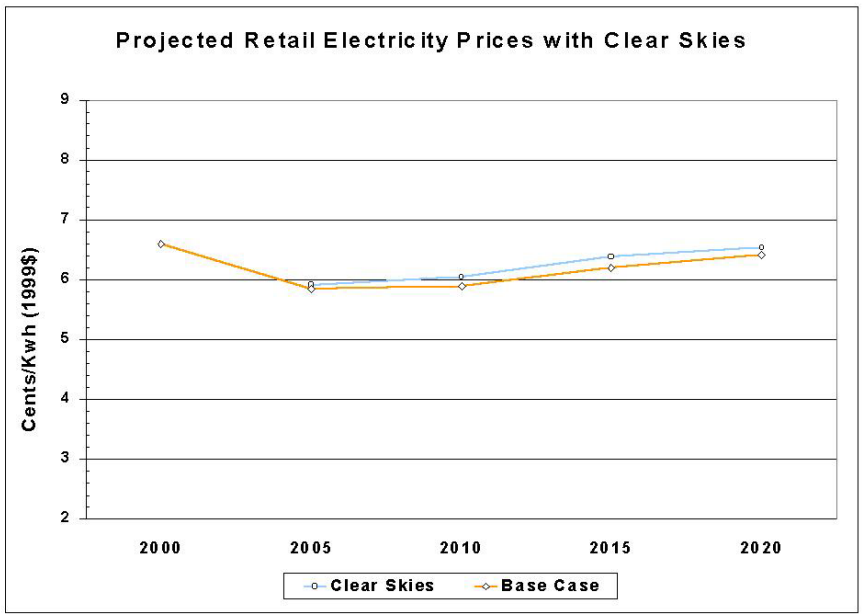
- Both SO_2 and Hg prices increase steadily at higher electricity demand levels in 2020, with the Hg price rising by 6.7% when demand is 20% higher. The price of NOx, however, drops at one point, reflecting interaction of Hg and NOx control strategies; as demand increases (and meeting the Hg cap becomes more difficult), the use of SCR+FGD is justified by the SO_2 and Hg prices, resulting in NOx co-benefits that permit a slight easing in the NOx price.

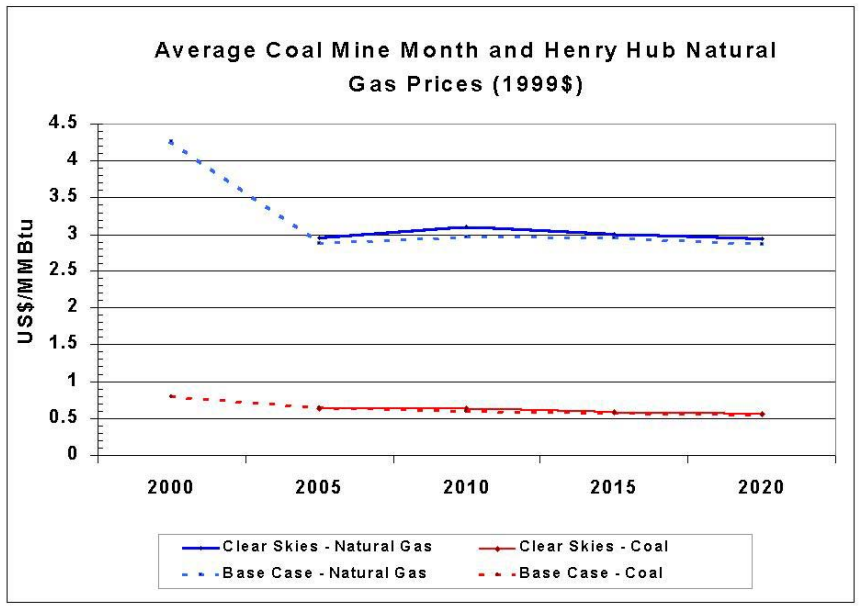


Note: In contrast, in 2010, increased demand leads to higher SO_2 and NOx prices, with the Hg allowance price dropping with the co-benefits. This effect on Hg reverses itself with 20% higher demand. Analysis uses the Technology Retrofit and Updating Model (see Section H for a description). To measure the pure impact of increasing growth, as opposed to the safety valve effect, a Clear Skies Case without the safety valve was used. Analysis of changes in IPM modeling assumptions can be found in Section D.

Impact on Electricity Prices and Fuel Prices

- Retail electricity prices are expected to gradually decline from today's levels but then rise over time with Clear Skies. (Prices are expected to drop initially due to the increase of excess generation capacity; in 2010 prices would begin to increase due to new capacity requirements, which lead to higher capital costs and greater natural gas use, and higher retail prices passed onto consumers.)
- Clear Skies will have a small effect on national electricity, coal, and natural gas prices.
- The impact on coal-fired capacity is small.





Note: Retail prices from 2000 are from AEO2003. Prices for the period 2005 and after were calculated using the Retail Electricity Price Model (see Section G for a description of the Model).

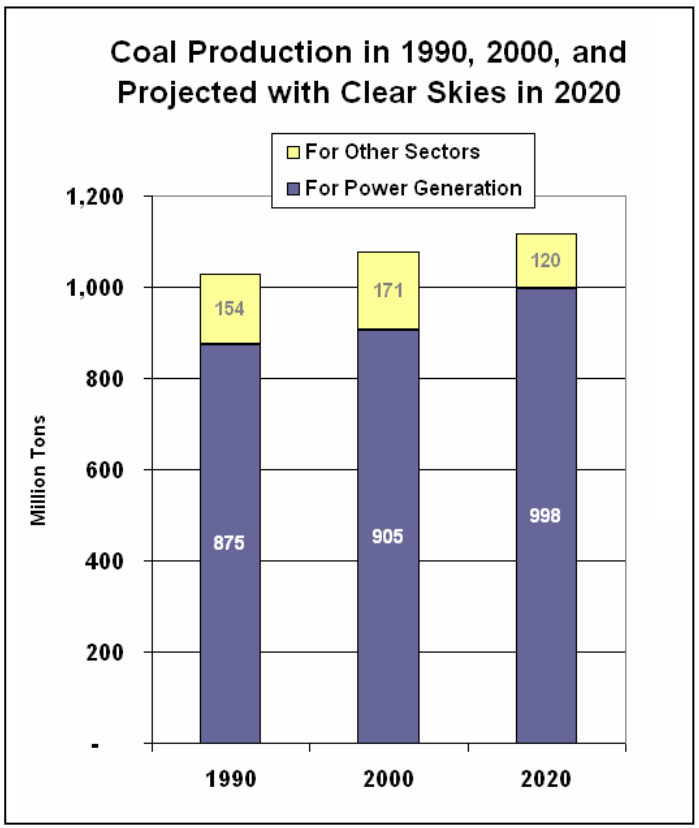
The coal price represents an average minemouth price across all twelve grades of coal in the model mined in 39 supply regions. The natural gas price is the Henry Hub price. Fuel prices for 2005 to 2020 are EPA's projections from IPM.

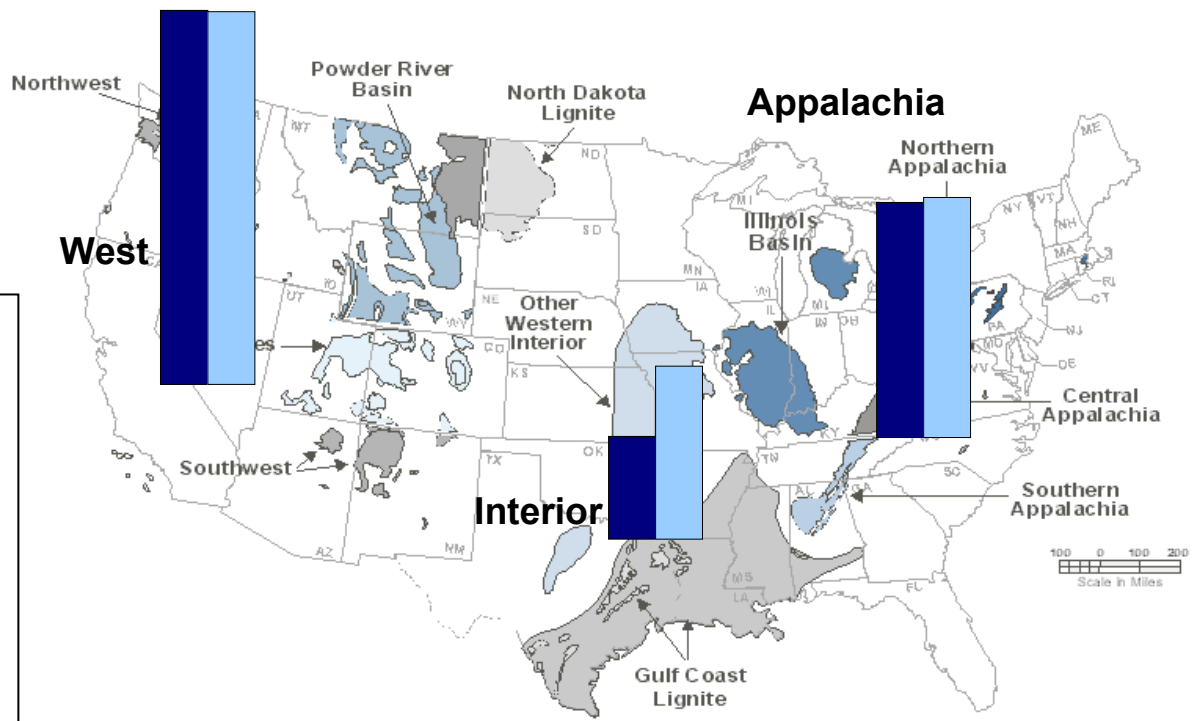
Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

Coal Production for Electricity Generation in 1990 and 2000 and Projected Production with Clear Skies in 2020

Coal Production for the Power Sector

- 2000 Actual
- 2020, Clear Skies





Scale: Appalachia 2000 = 299 million tons

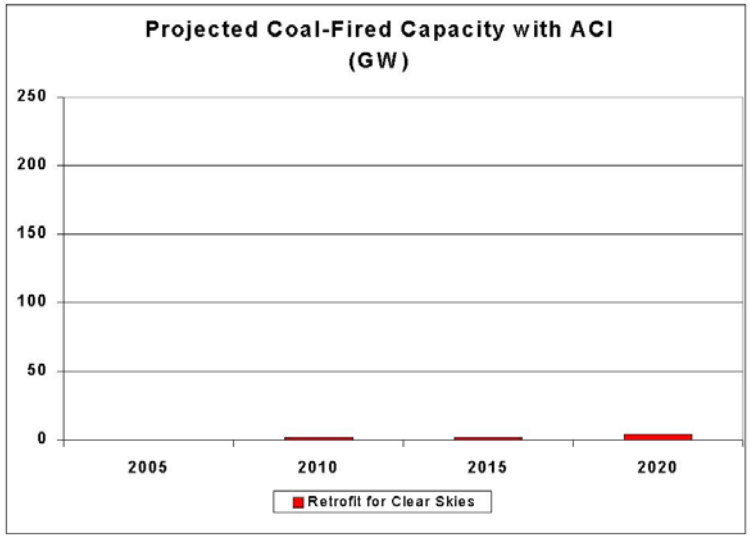
Notes: 2020 national coal production projections are EPA estimates from IPM. 1990 data is from the Coal Industry Annual 1994, Table 4 (DOE/EIA-0584 (2000)). 2000 data is from the Coal Industry Annual 2000, Table 4 and Table 63 (DOE/EIA-0584 (2000)), January, 2002. 2020 production for the power generation sector is derived from the Integrated Planning Model. 2020 production for other sectors is derived from the National Energy Modeling System.

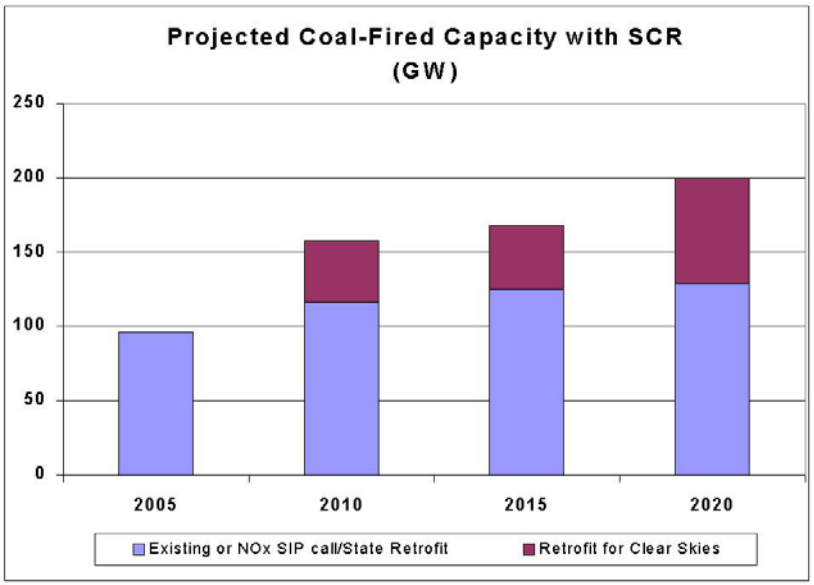
In 1990, EIA did not report the coal produced for power generators. From 1998-2000, 85% of coal produced was for the power generation sector. For an estimate of coal produced for the power generation sector in 1990, EPA assumed the same percentage (85%).

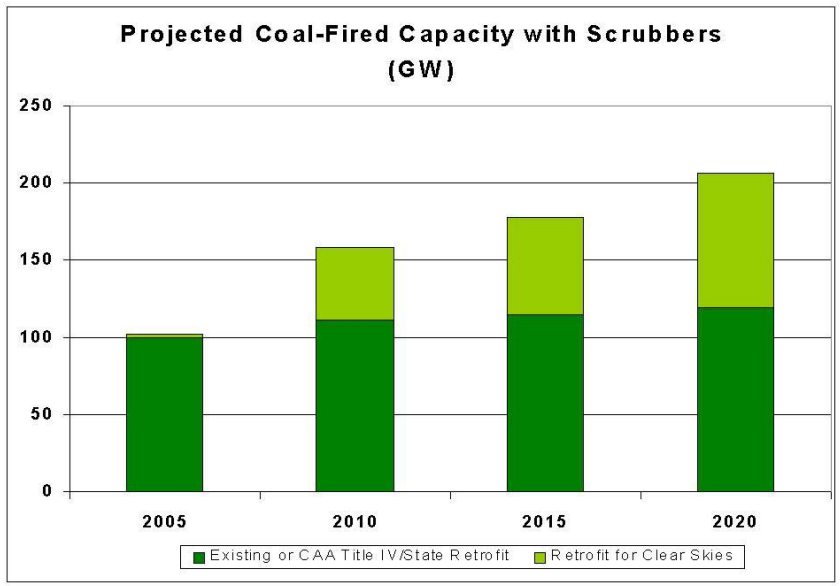
Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

Projected Coal Capacity with Further Emissions Controls

- In 2020 with Clear Skies, 81% of all coal-fired capacity is projected to have one or more of the following: selective catalytic reduction (SCR) for NOx, flue gas desulfization (scrubbers) for SO_2, and/or activated carbon injection (ACI) for mercury. Of this capacity, 34% is due to Clear Skies. There will be about 300 GW of coal-fired units in 2020.
- Graphics show cumulative capacity with existing controls, controls projected to be retrofitted under the NOx SIP call, NSR settlements and state enacted programs, CAA Title IV, and controls projected to be retrofitted with Clear Skies.

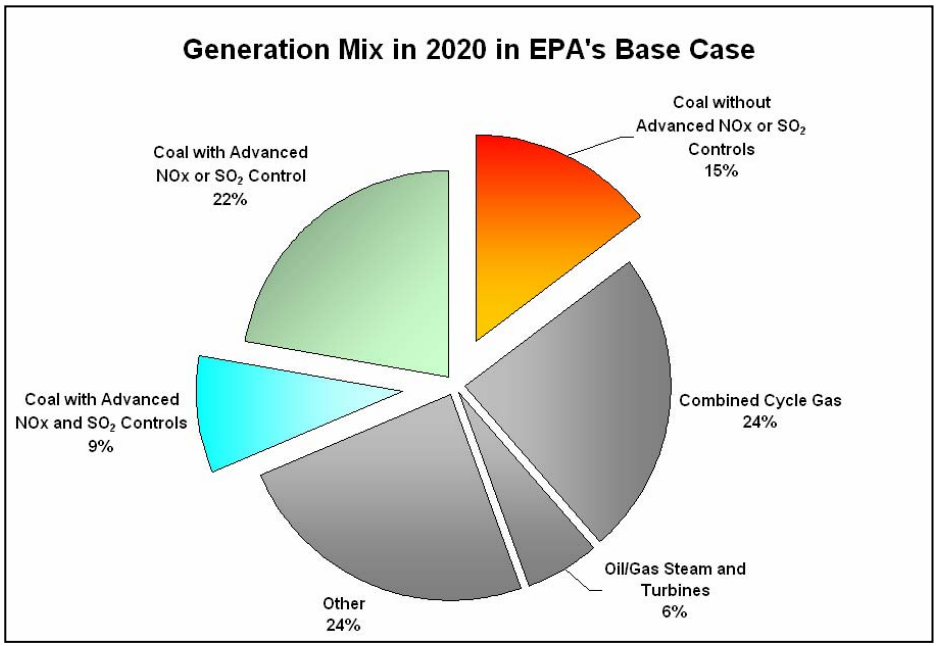


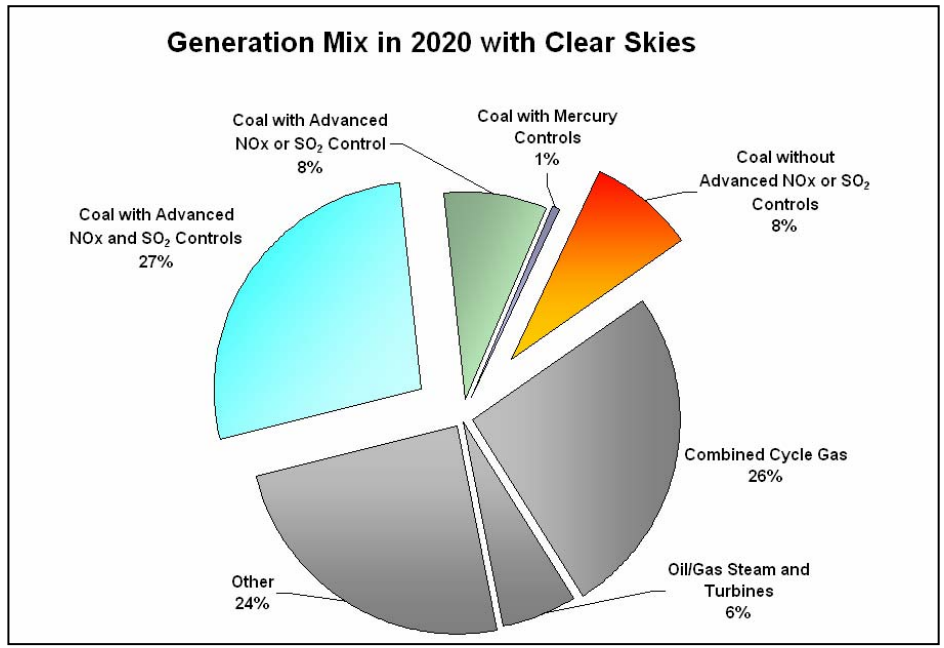




Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

Projected Generation Mix in 2020





Note: Projections are from EPA's modeling using IPM. Coal units with SO_2 and/or NOx controls includes units with advanced post-combustion SO_2 and/or NOx controls (scrubbers for SO_2 removal and SCR or SNCR for NOx removal). Coal units without SO_2 and/or NOx controls could include PM and/or NOx combustion controls. The base case in IPM includes Title IV, the NOx SIP Call, NSR settlements, and state-specific caps in CT, MA, MO, NC, NH, TX, and WI. The "Other" category includes generation from nuclear, hydro, solar, wind, geothermal, biomass, landfill gas, and fuel cells. Control technology percentages are approximations. SO_2 controls include a very small amount of IGCC.

Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

Units Repowering and Uneconomic to Maintain Due to Clear Skies

- The IPM model can determine that specific generating units are uneconomic to maintain, based on their fuel, operating and fixed costs, and whether they are needed to meet both demand and reliability reserve requirements.
- In practice, units projected as uneconomic to maintain may be "mothballed“, actually retired, or kept in service to ensure transmission reliability in certain parts of the grid. Our modeling is unable to distinguish between these potential outcomes.
- “Repowering” converts units to combined-cycle natural gas or IGCC.

COAL

- Relative to the Base Case, Clear Skies modeling is projecting that about 5.2 GW of coal-fired capacity will no longer be economic to maintain and that over 100 MW will repower to natural gas.
  - 54 units at 30 different coal plants are projected to be uneconomic as a result of Clear Skies.
  - Most of these units are a part of larger plants which include multiple units that are expected to keep generating. Only four plants are projected to have all of their units uneconomic to maintain, and only one of these is larger than 110 MW.
  - The uneconomic units are not concentrated in one or two states – the state with the most uneconomic capacity has only 19% of the total.
  - Units < 100 MW are 45% of the uneconomic coal unit capacity and 88% of the units.

Coal Units (GW)	Uneconomic	Repowering
Base Case	1.0	0.0
Clear Skies	6.2	0.1

Note: All uneconomic determinations take place in 2005, repowerings to natural gas in 2010

Units Repowering and Uneconomic to Maintain Due to Clear Skies

OIL/GAS STEAM

- Clear Skies is expected to result in slightly less oil/gas steam units which are uneconomic to maintain and about the same level of repowering relative to the base case.

Oil / Gas Steam Units	Uneconomic		Repowering			
(Cumulative GW)	2005	2010	2005	2010	2015	2020
Base Case	30.7	30.7	0.0	2.1	4.1	4.1
Clear Skies	29.1	29.1	0.0	2.3	3.8	4.1

EFFECT OF OVERBUILD

- The uneconomic coal plants are a consequence of the overbuild of new gas-fired combined cycle plants since 2000. A sensitivity analysis run assuming optimal capacity builds from the year 2000 (rather than the overbuild) projects no coal capacity as uneconomic to maintain.
- Without the current overbuild, significantly fewer oil/gas steam units are uneconomic to maintain and many of those originally deemed uneconomic in 2005 would be repowered in 2010.

Sensitivity w/o overbuild	Uneconomic		Repowering			
(Cumulative GW)	2005	2010	2005	2010	2015	2020
Oil / Gas Steam Units	0.9	2.1	0.0	17.1	20.7	20.7
Coal Units	0.0	0.0	0.0	0.1	0.0	0.0

Projected Retrofits By State in 2010 and 2020

	Incremental Coal Capacity Retrofitted by 2010 (MW)			Incremental Coal Capacity Retrofitted by 2020 (MW)		
	SCR	Scrubber	ACI	SCR	Scrubber	ACI
Alabama	0	1,400	0	1,100	2,500	0
Arizona	3,700	0	0	3,900	0	0
Arkansas	1,300	1,300	0	3,700	3,700	0
California	0	0	0	0	0	0
Colorado	1,100	0	0	1,100	0	0
Connecticut	0	0	0	0	0	0
Delaware	0	0	0	0	0	0
District Of Columbia	0	0	0	0	0	0
Florida	5,500	1,400	0	7,300	1,400	0
Georgia	0	3,800	0	0	11,900	0
Idaho	0	0	0	0	0	0
Illinois	3,000	7,600	0	2,700	7,700	0
Indiana	4,100	3,400	0	6,100	5,600	0
Iowa	700	0	0	3,300	0	600
Kansas	3,900	0	0	3,900	0	0
Kentucky	1,400	1,300	0	2,900	4,500	0
Louisiana	500	500	0	2,200	2,200	0
Maine	0	0	0	0	0	0
Maryland	0	2,100	0	600	3,200	0
Massachusetts	0	0	0	0	0	0
Michigan	0	0	0	200	1,900	0
Minnesota	600	0	0	4,000	0	0
Mississippi	900	0	0	2,200	1,600	0
Missouri	2,200	0	0	2,400	1,100	0
Montana	1,400	0	0	1,400	0	0
Nebraska	700	0	0	700	0	0
Nevada	100	0	0	100	0	0
New Hampshire	0	0	0	0	0	0
New Jersey	0	0	1,200	200	400	1,200
New Mexico	1,700	0	0	1,700	0	0
New York	400	400	0	900	800	0
North Carolina	700	900	200	1,300	500	200
North Dakota	1,000	1,000	0	1,000	1,000	900
Ohio	4,900	9,600	0	3,700	12,800	0
Oklahoma	0	0	0	0	0	0
Oregon	0	0	0	0	0	0
Pennsylvania	600	5,900	200	1,300	8,800	200
Rhode Island	0	0	0	0	0	0
South Carolina	0	0	0	300	1,200	0
South Dakota	0	0	0	400	0	0
Tennessee	0	900	0	1,000	3,100	0
Texas	0	2,300	600	800	4,100	600
Utah	0	0	0	0	0	0
Vermont	0	0	0	0	0	0
Virginia	0	1,100	0	200	2,200	0
Washington	1,300	0	0	1,300	0	0
West Virginia	1,600	5,300	0	400	7,700	0
Wisconsin	300	0	0	700	0	1,200
Wyoming	4,100	0	0	4,100	0	0
Grand Total	**47,700**	**50,200**	**2,200**	**69,100**	**89,900**	**4,900**

Notes:

Table includes retrofits in response to Clear Skies only. This data is a slight over-estimate of retrofits due to IPM modeling limitations. The base case in IPM includes Title IV, the NOx SIP Call, NSR settlements, and state-specific caps in CT, MA, MO, NC, NH, TX, and WI. It does not include mercury MACT in 2007 or any other potential future regulations to implement the current Clean Air Act. Column entitled SCR (Selective Catalytic Reduction) may include a small amount of SNCR (Selective Non-catalytic Reduction) retrofitted capacity for certain states. ACI = Activated Carbon Injection

Projected Retail Electricity Prices under Clear Skies

- In 2000, the national average retail electricity price was 6.6 cents/kWh or 66.0 mills/kWh.

Retail Electricity Prices under Clear Skies

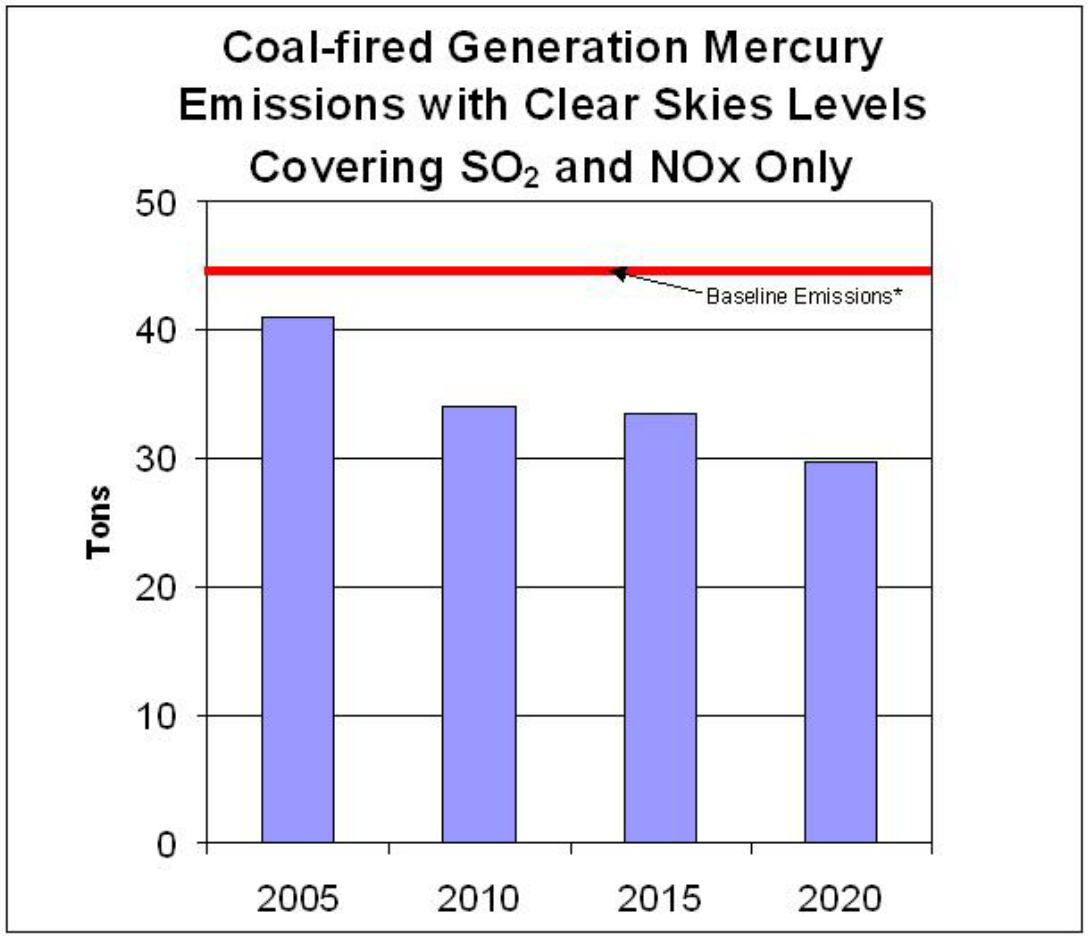
Power Region	*Main States Included*	RETAIL PRICES (Mills Per Kwh - 1999$)									Percentage Price Change			
			Basecase				Clear Skies							
		2000	2005	2010	2015	2020	2005	2010	2015	2020	2005	2010	2015	2020
ECAR	OH, MI, IN, KY, WV, PA	57.4	50.9	51.2	55.0	56.6	52.1	53.7	58.5	58.9	2.4%	5.0%	6.4%	4.0%
ERCOT	TX	65.1	48.5	54.4	64.5	66.3	49.4	55.7	64.9	66.7	2.1%	2.3%	0.6%	0.7%
MAAC	PA, NJ, MD, DC, DE	80.4	54.7	58.5	67.5	74.1	56.6	60.9	70.4	75.7	3.3%	4.1%	4.2%	2.1%
MAIN	IL, MR, WI	61.2	53.3	53.0	57.2	62.6	54.3	55.1	60.9	64.4	1.9%	4.0%	6.5%	2.9%
MAPP	MN, IA, SD, ND, NE	57.4	56.0	54.5	50.9	49.0	56.1	55.3	52.1	50.7	0.2%	1.4%	2.3%	3.5%
NY	NY	104.3	76.8	80.4	87.9	90.8	78.8	82.2	90.0	91.2	2.6%	2.3%	2.4%	0.4%
NE	VT, NH, ME, MA, CT, RI	89.9	70.5	71.8	77.8	84.1	71.3	73.1	79.8	84.6	1.1%	1.8%	2.7%	0.5%
FRCC	FL	67.9	71.9	71.1	70.2	68.6	72.2	72.3	71.0	69.8	0.4%	1.7%	1.2%	1.8%
STV	VA, NC, SC, GA, AL, MS, TN, AR, LA	59.3	56.9	55.8	54.7	54.7	57.3	56.6	55.6	56.2	0.7%	1.4%	1.7%	2.8%
SPP	KS, OK, MR	59.3	51.3	51.7	53.0	56.4	51.7	53.7	54.7	57.6	0.8%	4.0%	3.3%	2.2%
PNW	WA, OR, ID	45.9	48.9	50.2	49.1	48.6	49.2	50.8	49.4	49.0	0.5%	1.2%	0.5%	0.9%
RM	MT, WY, CO, UT, NM, AZ, NV, ID	64.1	61.7	62.9	64.4	65.5	62.1	64.5	65.4	66.3	0.6%	2.6%	1.6%	1.1%
CALI	CA	94.7	93.4	96.0	97.0	97.5	93.7	96.7	97.4	97.9	0.3%	0.7%	0.4%	0.4%
NATIONAL	Contiguous Lower 48 States	66.0	58.5	59.5	62.2	63.9	59.3	61.1	63.9	65.2	1.3%	2.6%	2.8%	2.0%

Note:
A mill is one tenth of a cent.

Information on the North American Electric Reliability Council (NERC) is available at http:// www.nerc.com.

2000 national average electricity retail price: EIA at http://www.eia.doe.gov/cneaf/electricity/page/fact_sheets/retailprice.html.
2005 - 2020 projections: from the “Retail Electricity Price Model” (see section G for a description of the Model.)

Co-benefits Emissions



*Baseline mercury emissions are projected to decline from 48 tons in 1999 to 45 tons in 2004 after implementation of Title IV and the NOx SIP call.

- In 2010, mercury emissions are projected to be reduced to 34 tons based on the mercury emission reductions that will occur from the emission controls plants will install to meet the SO_2 and NOx caps.
- In 2010, an additional 1 GW of scrubbers and 3 GW of SCR is projected with Clear Skies to comply with the mercury cap; these retrofits are not projected under a policy scenario that covers SO_2 and NOx only.

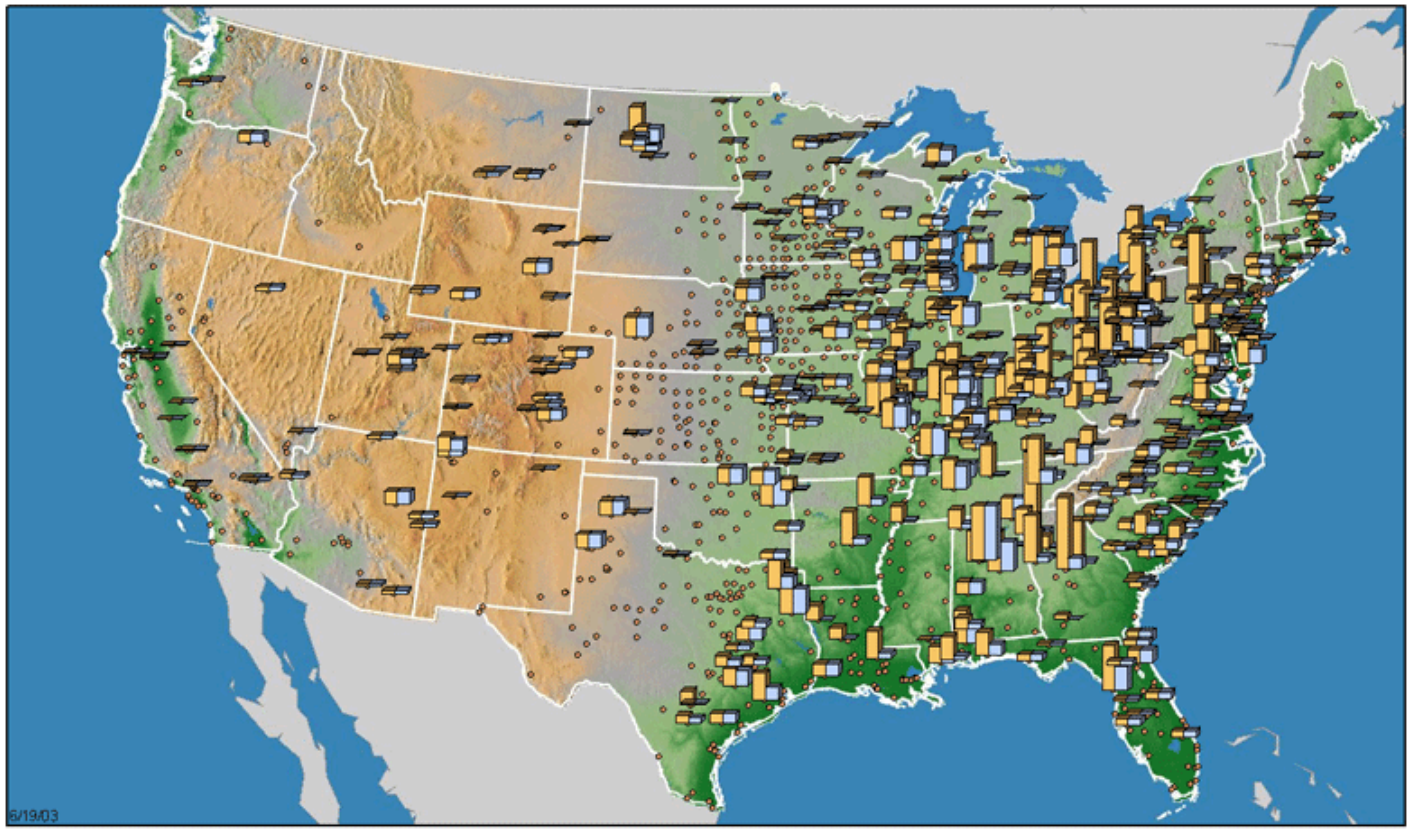
Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

Notes on EPA's Analysis Using a "Base Case"

- The information presented in this analysis reflects EPA's modeling of the Clear Skies Act of 2003.
  - EPA has updated this information to reflect modifications:
    - Changes included in the Clear Skies Act of 2003.
    - Revisions to the Base Case to reflect newly promulgated rules at the state and federal level since the initial analysis was undertaken.
- This analysis compares new programs to a Base Case (Existing Control Programs), which is typical when calculating costs and benefits of Agency rulemakings.
  - The Base Case reflects implementation of current control programs only:
    - Does not include yet-to-be developed regulations such as those to implement the National Ambient Air Quality Standards.
  - The EPA 2003 Base Case for power sector modeling includes:
    - Title IV, the NOx SIP Call, NSR settlements, and state-specific caps in Connecticut, Massachusetts, Missouri, New Hampshire, North Carolina, Texas, and Wisconsin all finalized before March 2003.
  - For air quality modeling, the Base Case also includes the federal and state control programs in the EPA 2003 IPM Base Case, as well as the Tier II, Heavy Duty Diesel, and Non-Road Diesel rules.

Back-up Slides

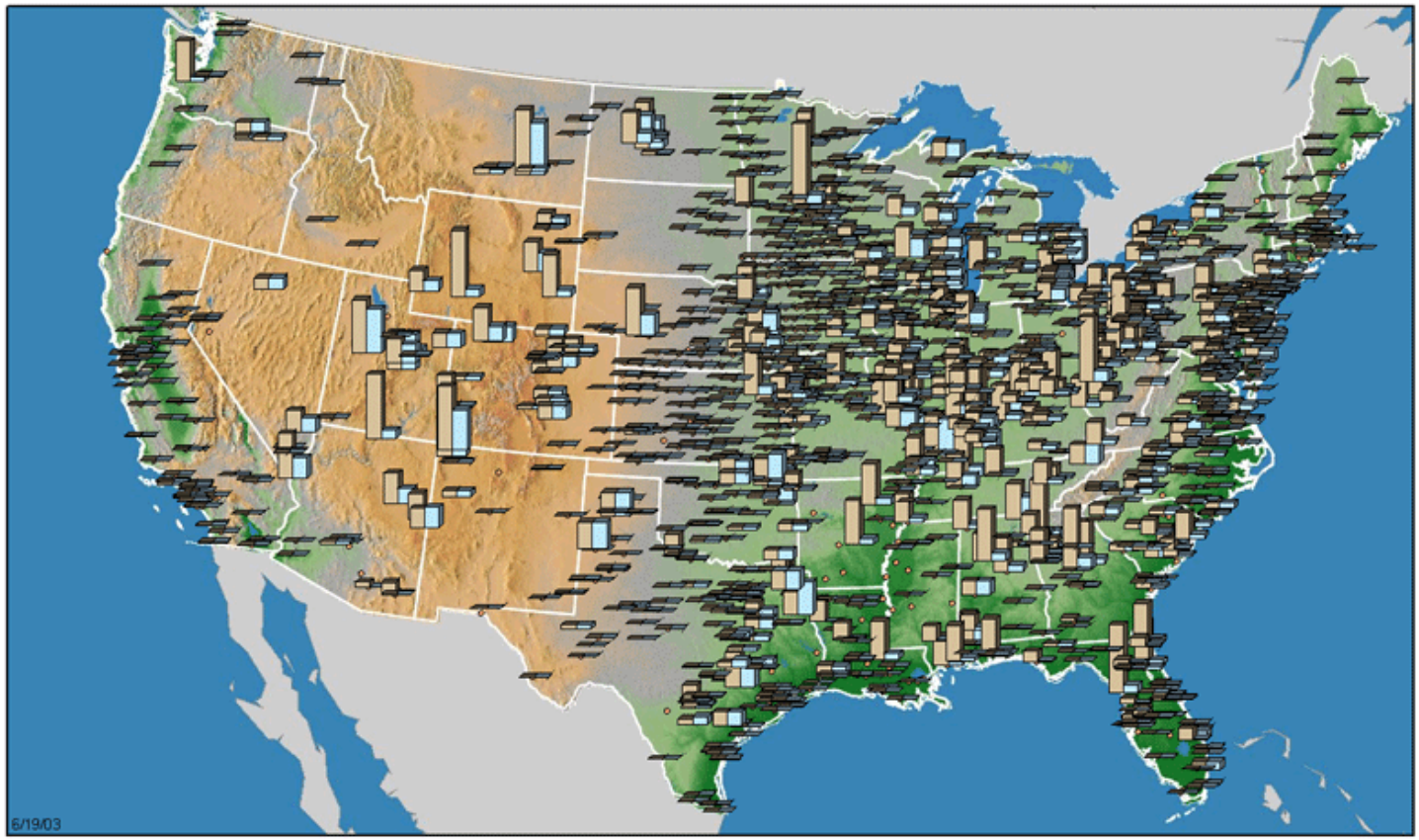
Projected SO_2 Emissions from Power Plants with the Base Case and Clear Skies in 2020



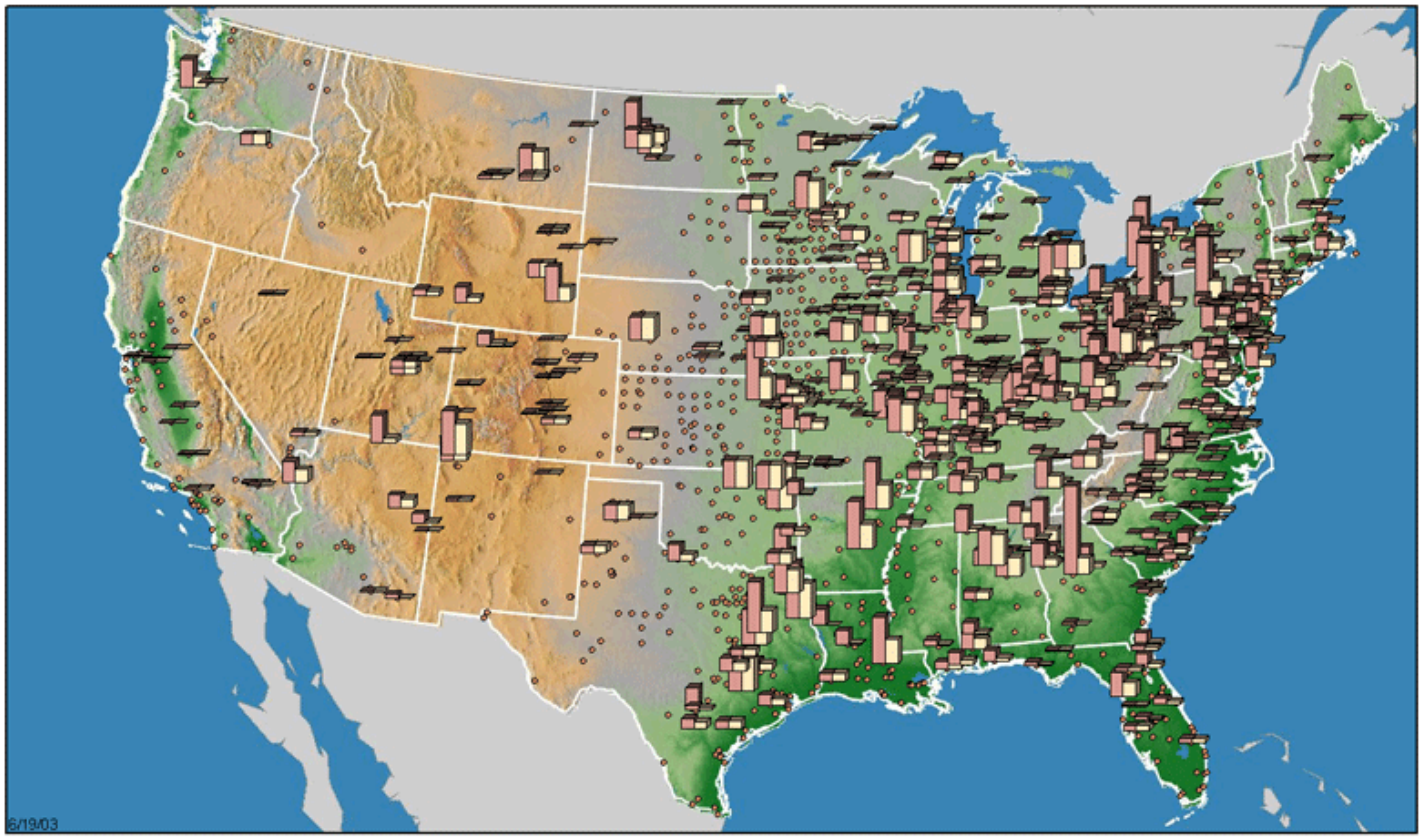
Projected SO_2 Emissions from Power Plants With the Base Case and Clear Skies (2020)

75,000 tons
Base Case Power Plant SO_2
Clear Skies Power Plant SO_2
Fossil Power Plants with Negligible SO_2 Emissions

Projected NOx Emissions from Power Plants with the Base Case and Clear Skies in 2020



Projected Mercury Emissions from Power Plants with the Base Case and Clear Skies in 2020



Projected Mercury Emissions from Coal-Fired Power Plants With the Base Case and Clear Skies (2020)

0.38 tons
Base Case Power Plant Hg
Clear Skies Power Plant Hg
Other Fossil Power Plants (Non-coal)