EPA United States Environmental Protection Agency

Initial Results of Updated Clear Skies Analysis

July 2, 2003

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**

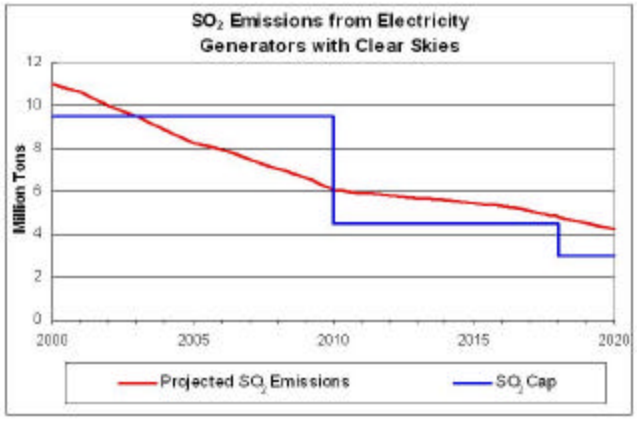
Summary

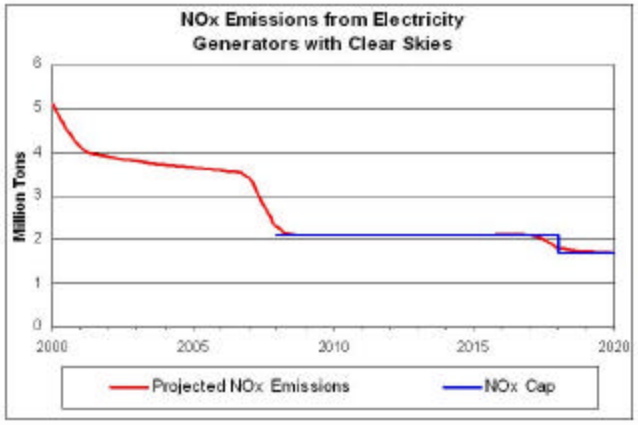
The 2003 analysis reaffirms previous analytical results – Clear Skies provides substantial benefits to the public at a reasonable cost.

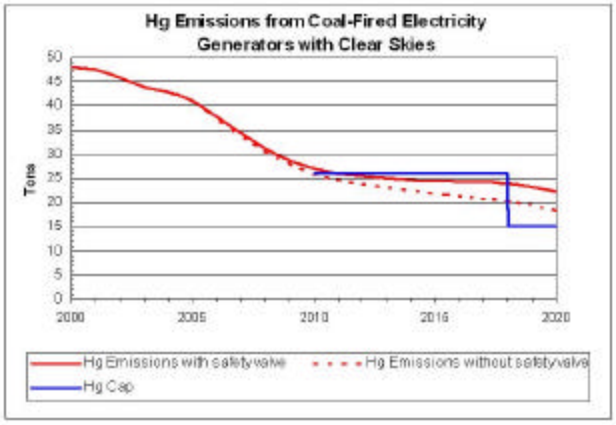
- **Clear Skies delivers approximately $110 billion annually in health benefits by 2020.**
  - An alternative estimate is $21 billion.
    - Many additional benefits are not monetized.
    - Benefits begin right after passage of the Act.
- **Clear Skies yields significant environmental benefits, including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

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.

Clear Skies Safety Valve Provision

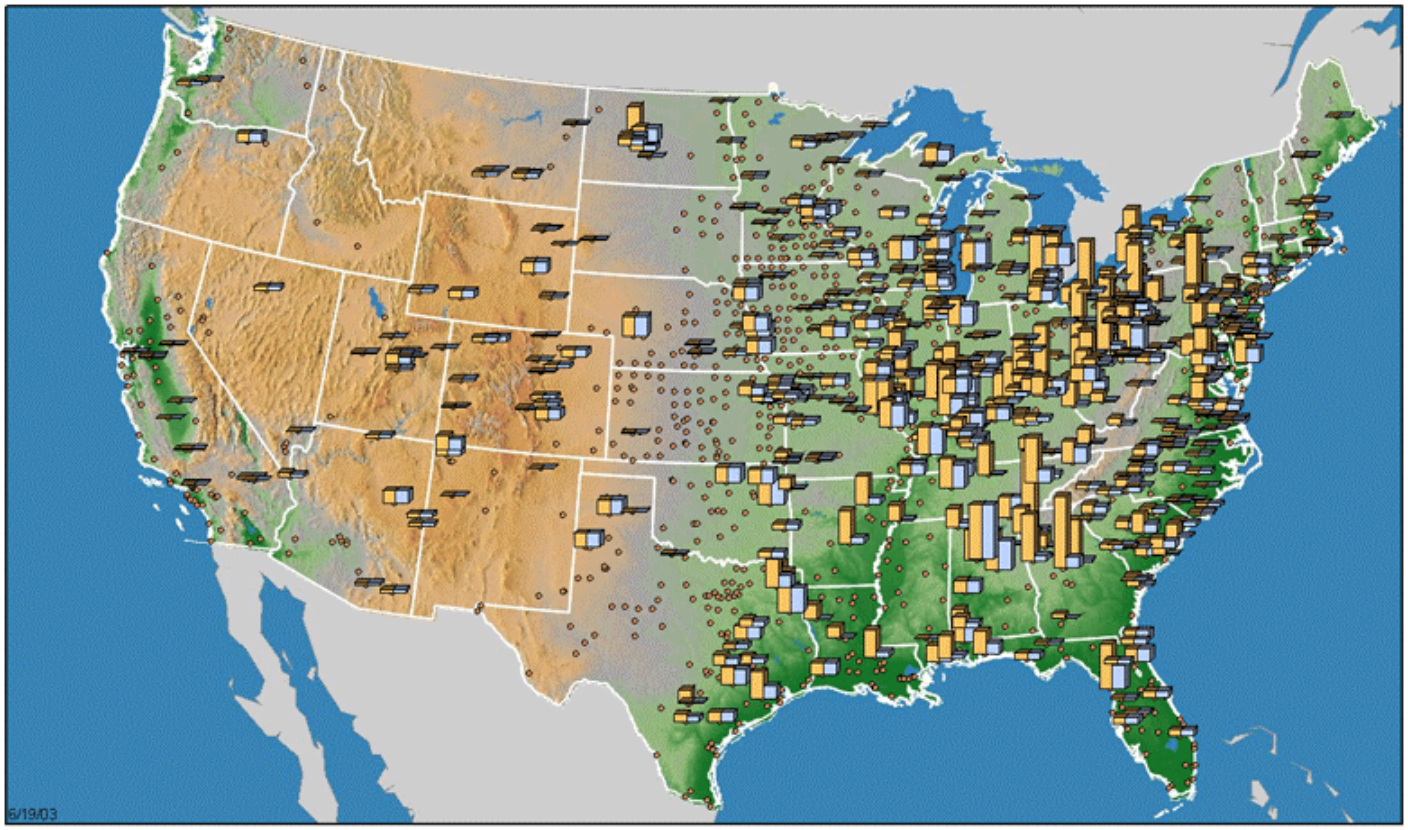
- The Clear Skies Act "safety valve" provisions for NOx, SO2, and mercury limit the amount each affected plant would be required to pay for removing each pollutant (i.e., SO2 and NOx = $4,000/ton and mercury = $35,000/pound).

- The safety valve mechanism ensures the cost of control does not exceed a certain level, but also ensures that emissions reductions are achieved.

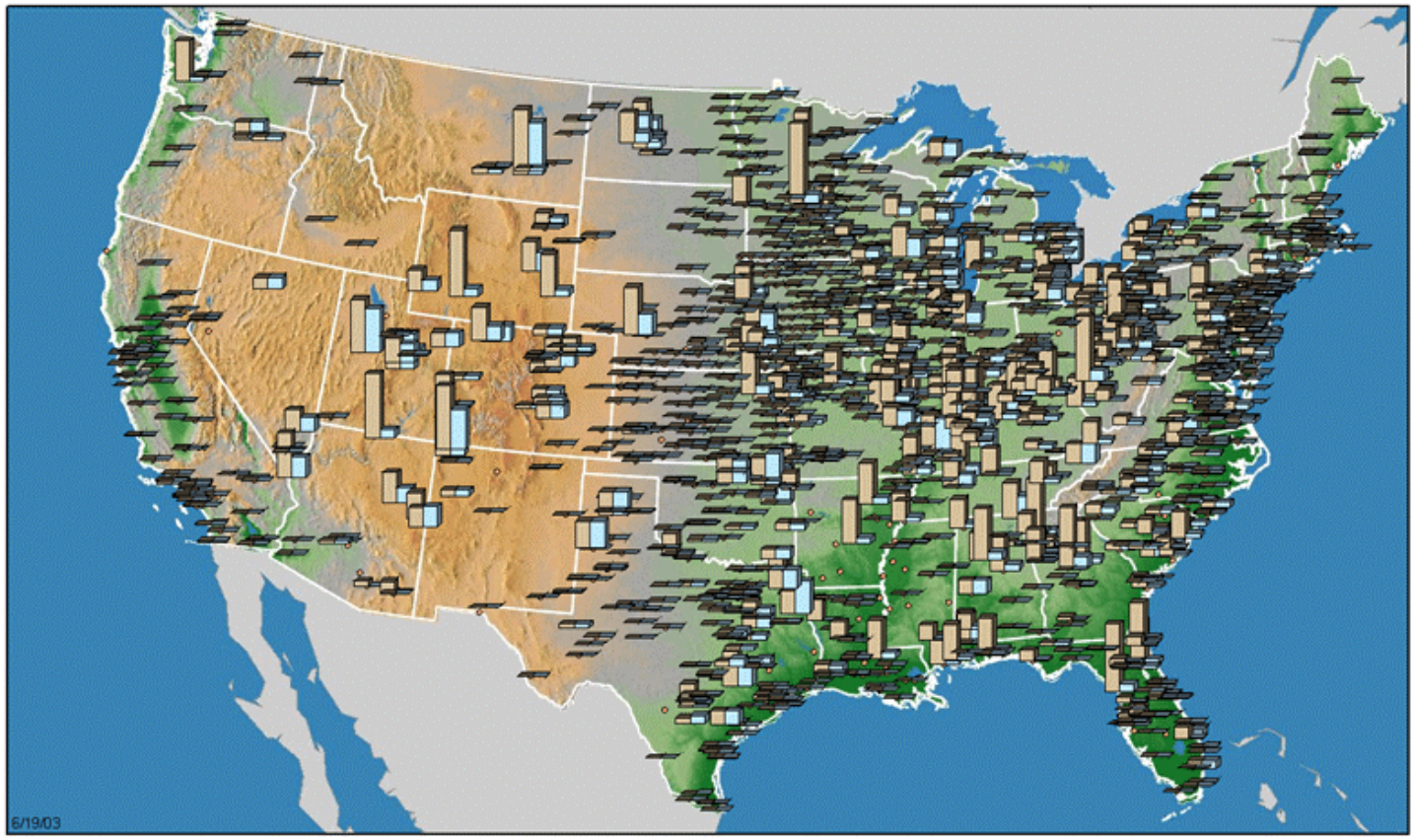
- Under the safety valve mechanism, the price of allowances is capped, meaning that if the allowance price exceeds the "safety-valve," EPA will borrow allowances from the following year auction to make more allowances available at that price. Thus, the future year cap is reduced by the borrowed amount, and the emissions reductions are achieved in that future year.

- Although our current Clear Skies modeling suggests that the mercury safety valve price will be reached, we believe that this is a conservative cost estimate since technology will likely advance and the cost for mercury control will decrease over time.

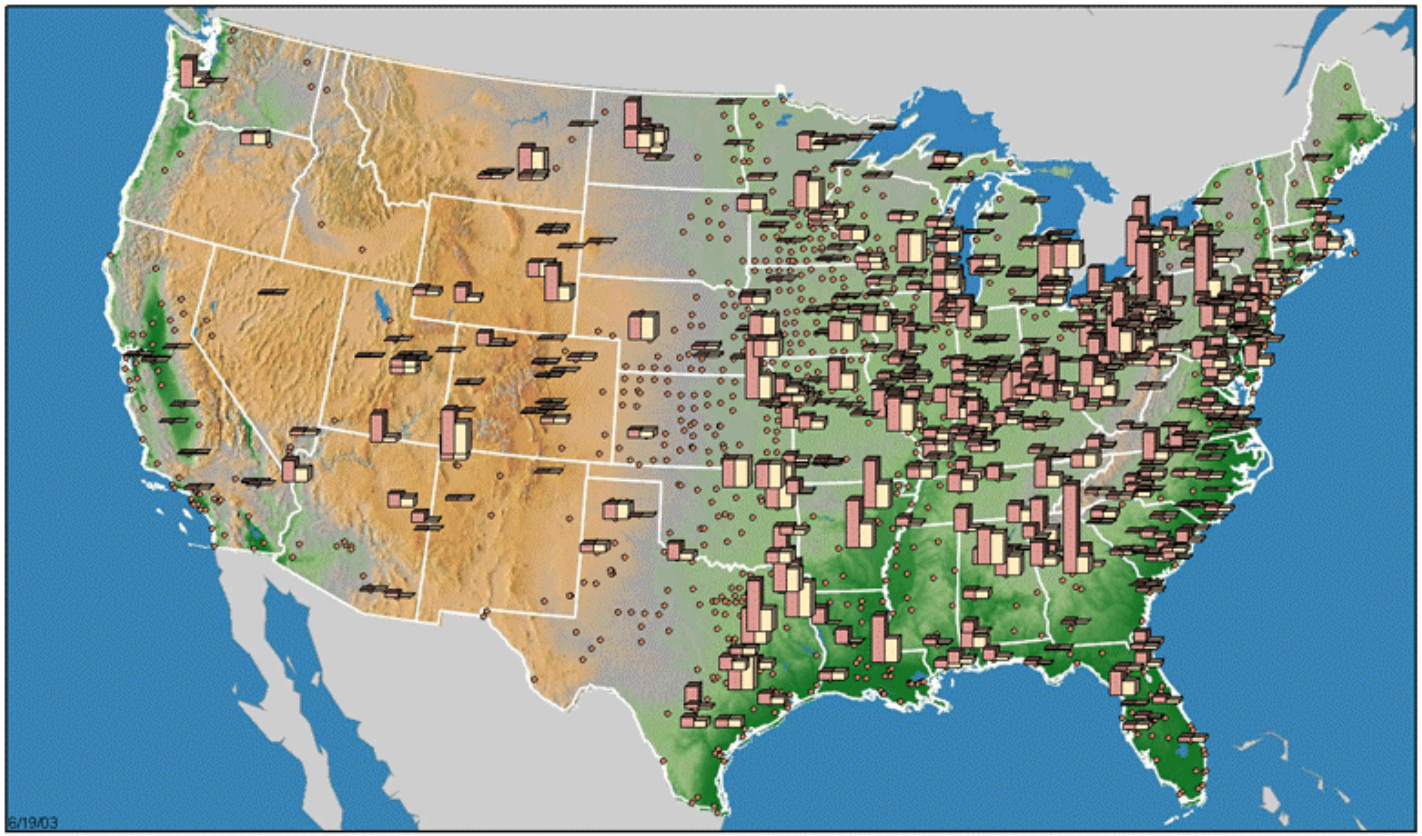
Projected SO_2 Emissions from Power Plants with the Base Case and Clear Skies in 2020



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



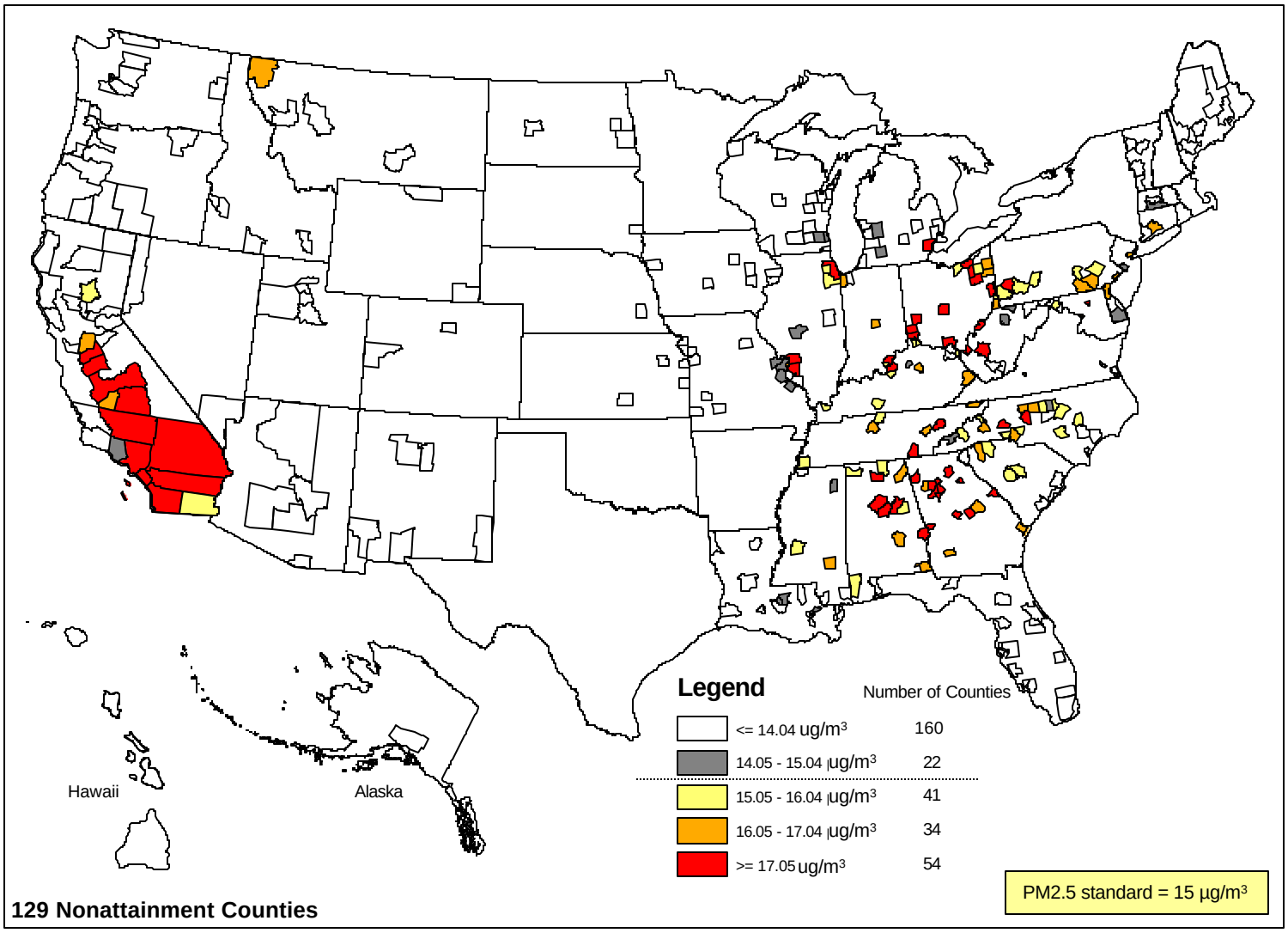
Projected Mercury Emissions from Power Plants with the Base Case and Clear Skies in 2020



Changes to EPA's Air Quality Modeling

- Updated ambient design values used to calculate attainment to 1999-2001 ambient data.
- New current year baseline inventory (2001).
- New Base Case and Clear Skies inventories to reflect revised IPM Base Case and Clear Skies runs.
- New version of REMSAD:
  - Updates and corrections to the dry deposition code and the secondary organic aerosol (SOA) code
  - Updates to mercury chemistry
- Improved method in which modeled percent reduction for **each** of the $PM_{2.5}$ species was applied to the ambient measurements (instead of using total $PM_{2.5}$).
- Built proposed Nonroad Diesel controls into the Base Case.

Current Attainment with the Fine Particle ($PM_{2.5}$) Standard

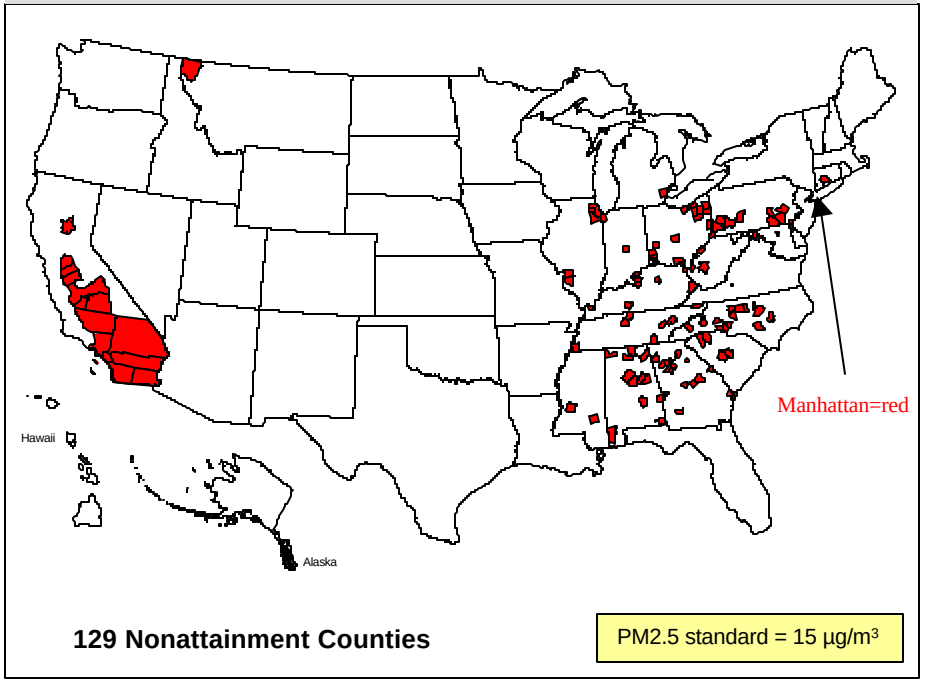


- **There are 129 counties nationwide (114 counties in the East) that exceed the annual fine particle standard of 15 µ/m³.**
- **65 million people (43 million people in the East) live in counties that would not meet this standard.**

Note: Based on 1999-2001 monitoring data of counties with monitors that have three years of complete data.

Clear Skies with Other Air Programs Would Substantially Improve Fine Particle Attainment over the Next Two Decades

Counties Exceeding the Annual Fine Particle Standard in 2001

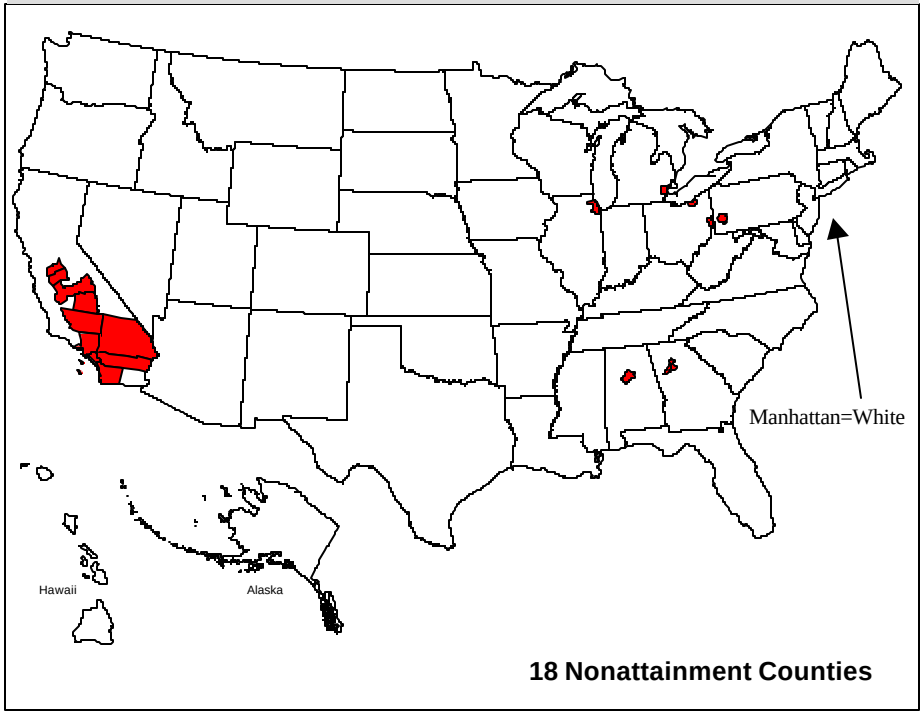


- **There are 129 counties nationwide (114 counties in the East) that are currently estimated to exceed the annual fine particle standard of 15 µ/m^3.**
  - **65 million people (43 million people in the East) currently live in counties that would not meet the standard**.

Most counties would be brought into attainment with the $PM_{2.5}$ standard by 2020:

- **Clear Skies and existing programs will bring 111 counties (home to approximately 32 million people) into attainment with the fine particle standard (compared to current conditions).**

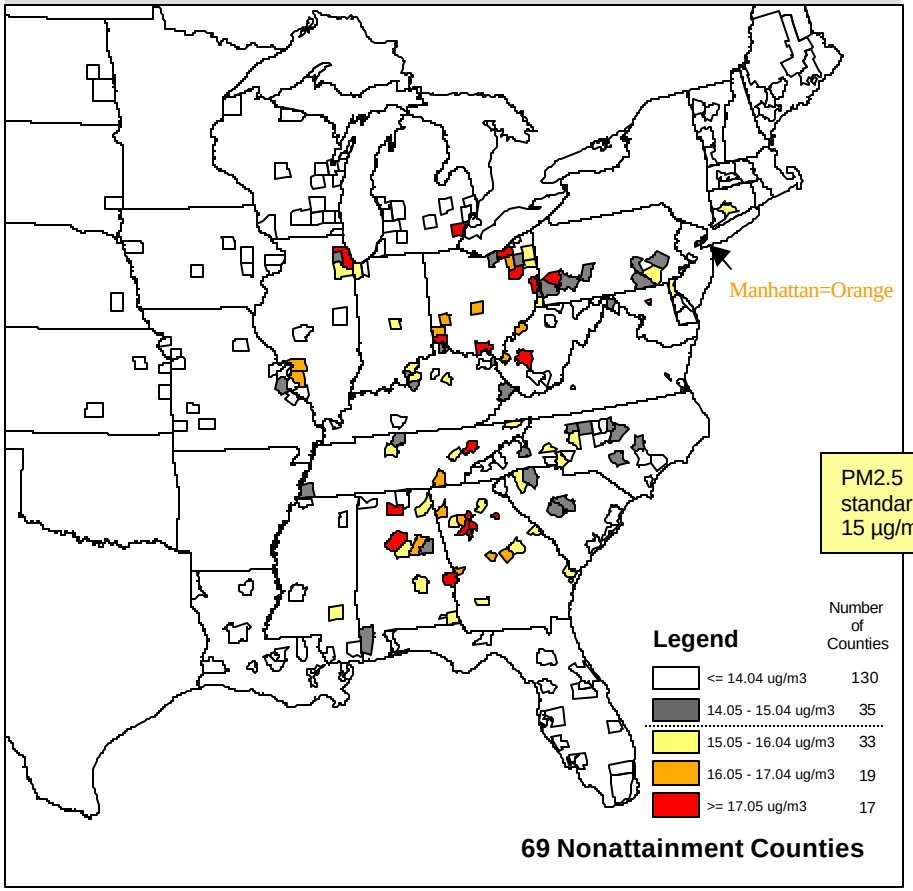
Remaining Counties Likely to Exceed the Annual Fine Particle Standard with Clear Skies and the Base Case in 2020



Notes: Based on 1999-2001 data of counties with monitors that have three years of complete data. Additional federal and state programs must bring all counties into attainment by 2016 at the latest. The methodology used to predict nonattainment status in the West is different than that used for the East.

Clear Skies Achieves Early Benefits by Bringing More Areas into Attainment with the $PM_{2.5}$ Standard in 2010

Remaining Counties Likely to Exceed the Annual Fine Particle Standard under the Base Case in 2010



$PM_{2.5}$ attainment status in 2010 base case:

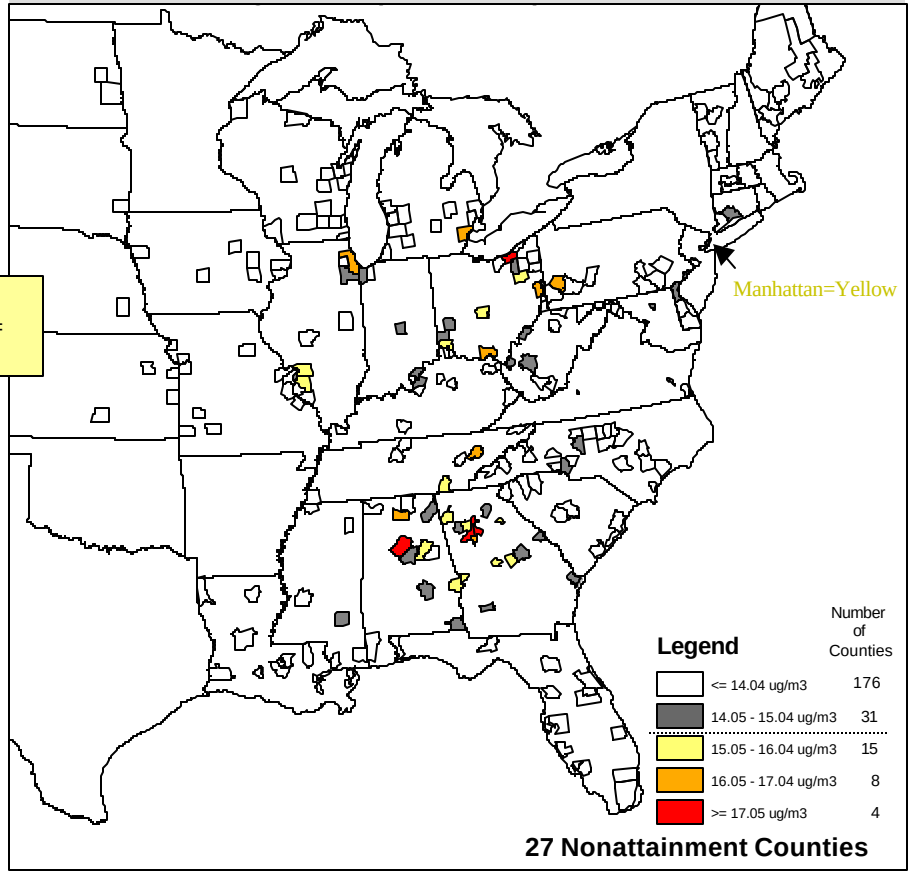
- **Existing programs will bring 45 eastern counties (home to approximately 10 million people) into attainment with the fine particle standard (compared to current conditions).**

$PM_{2.5}$ attainment status in 2010 Clear Skies case:

- **Clear Skies would bring 42 additional eastern counties (home to approximately 14 million people) into attainment with the fine particle standard (as compared to the Base Case).**

Remaining Counties Likely to Exceed the Annual Fine Particle Standard with Clear Skies and the Base Case in 2010

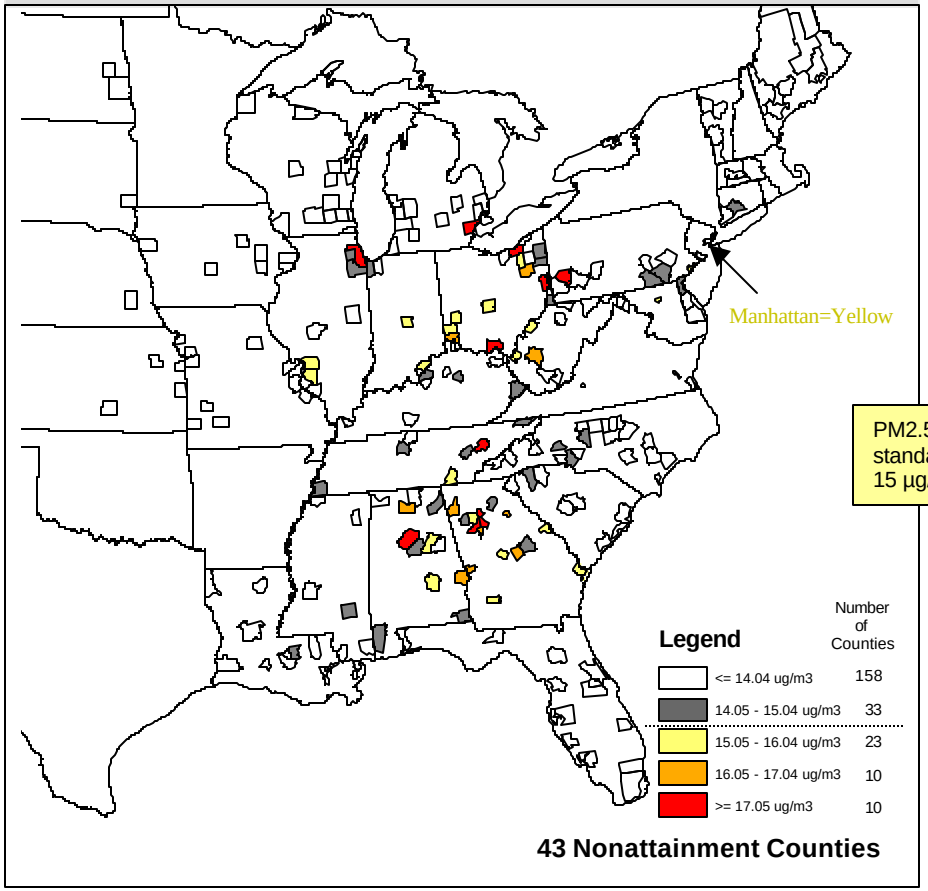
PM2.5 standard = 15 µg/m³



Notes: Based on 1999-2001 data of counties with monitors that have three years of complete data. Additional federal and state programs must bring all counties into attainment by 2016 at the latest. Clear Skies is not expected to bring additional counties into attainment for 2020 in the West. Therefore, the western region is not presented here.

Clear Skies Would Bring More Areas into Attainment with the $PM_{2.5}$ Standard in 2020

Remaining Counties Likely to Exceed the Annual Fine Particle Standard under the Base Case in 2020



$PM_{2.5}$ attainment status in 2020 base case:

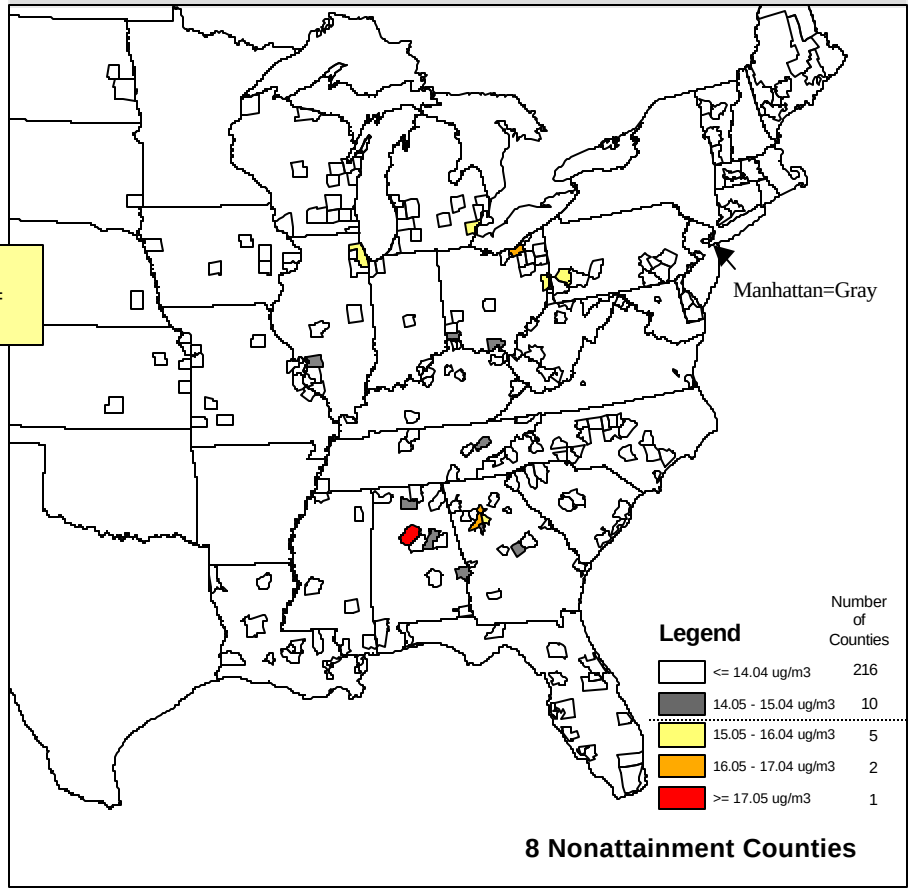
- **Existing programs will bring 71 eastern counties (home to approximately 18 million people) into attainment with the fine particle standard (compared to current conditions).**

$PM_{2.5}$ attainment status in 2020 Clear Skies Case:

- **Clear Skies would bring 35 additional eastern counties (home to approximately 12 million people) into attainment with the fine particle standard (as compared to the Base Case).**

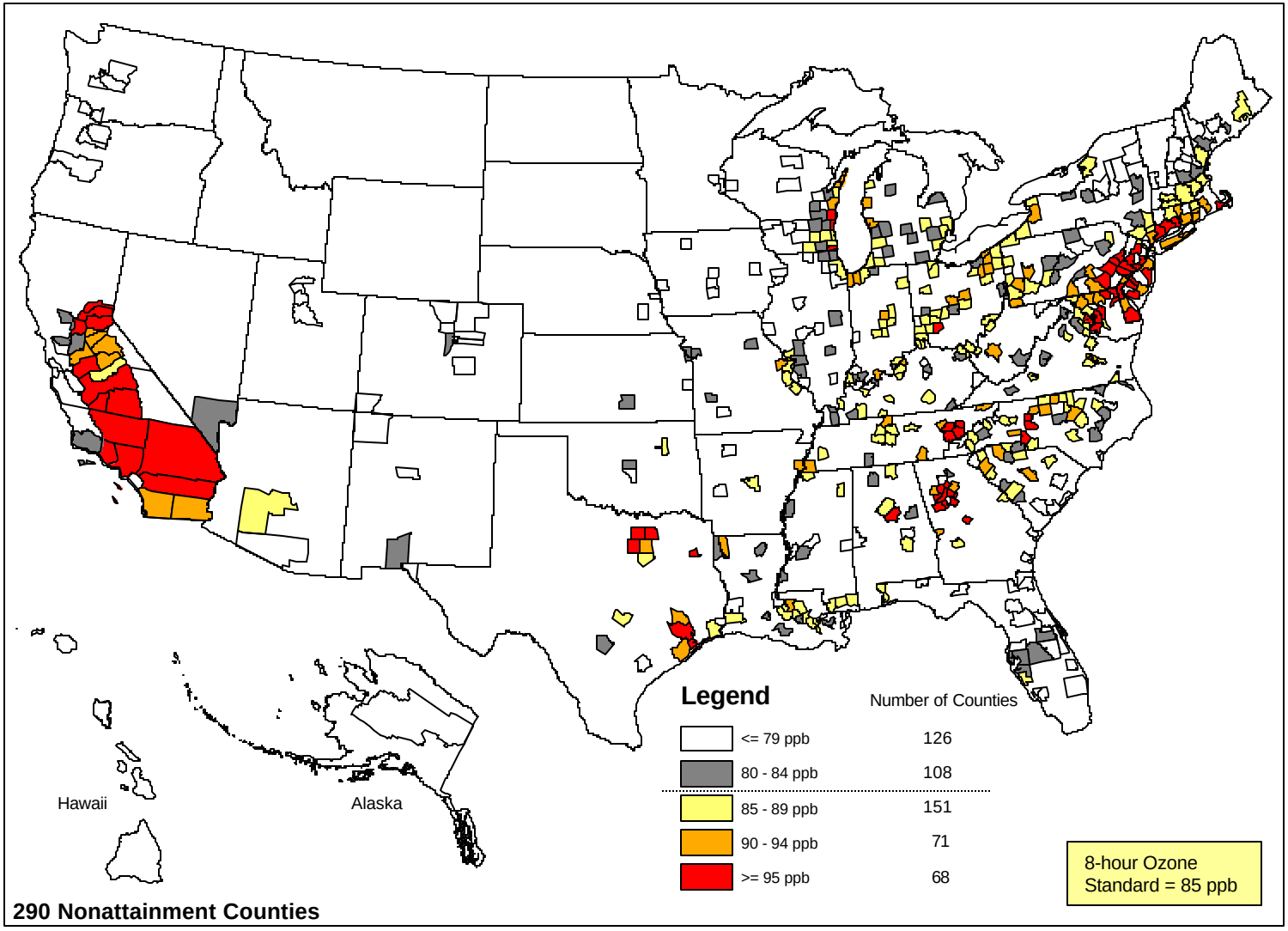
Remaining Counties Likely to Exceed the Annual Fine Particle Standard with Clear Skies and the Base Case in 2020

PM2.5 standard = 15 µg/m³



Notes: Based on 1999-2001 data of counties with monitors that have three years of complete data. Additional federal and state programs must bring all counties into attainment by 2016 at the latest. Clear Skies is not expected to bring additional counties into attainment for 2020 in the West. Therefore, the western region is not presented here.

Current Attainment in the US with the 8-hour Ozone Standard

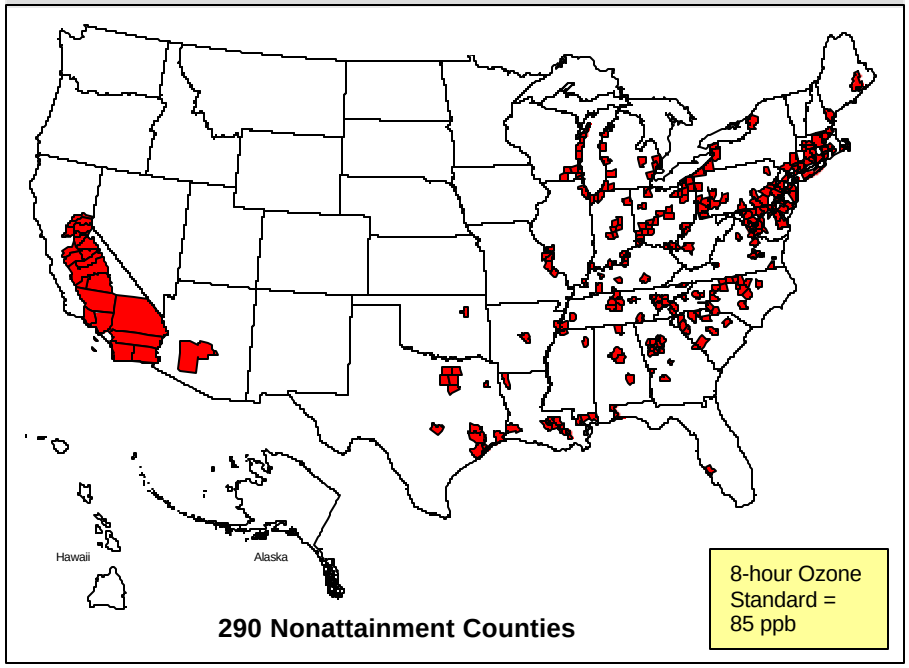


- **There are 290 counties nationwide (268 counties in the East) that exceed the 8-hour ozone standard.**
- **111 million people (87 million people in the East) live in counties that would not meet this standard.**

Note: Based on 1999-2001 monitoring data of counties with monitors that have three years of complete data.

Clear Skies with Other Air Programs Would Substantially Improve Ozone Attainment over the Next Two Decades

Counties Exceeding the 8-hour Ozone Standard in 2001



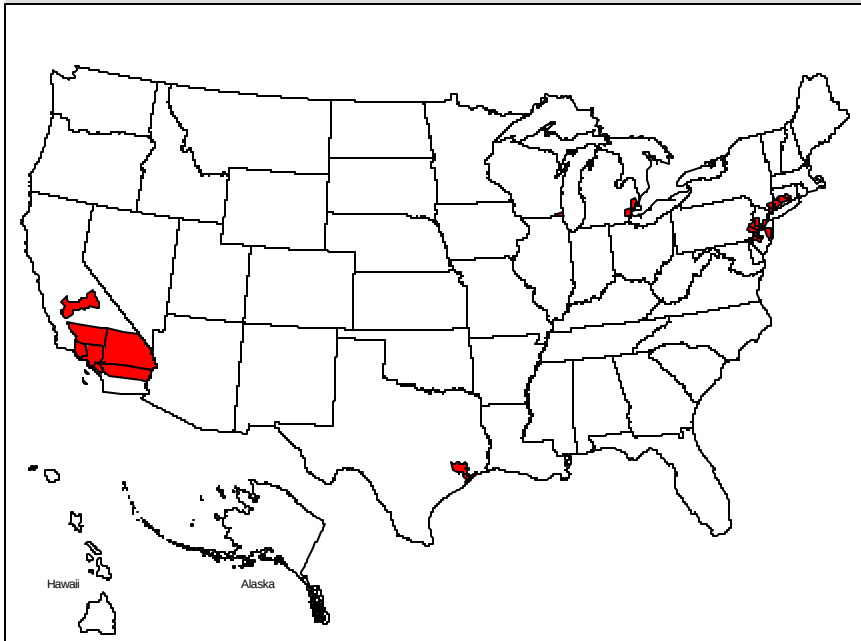
290 Nonattainment Counties

- **There are 290 counties nationwide (268 counties in the East) currently estimated to exceed the 8-hour ozone standard.**
  - **111 million people (87 million people in the East) currently live in counties with projected ozone concentrations greater than the 8-hour ozone standard of 85 ppb.**

Most counties would be brought into attainment with the ozone standard by 2020 :

- **Clear Skies and existing programs (primarily the NOx SIP Call and vehicle rules, including the proposed non-road rule) will bring 263 counties (home to approximately 77 million people) into attainment with the 8-hour ozone standard (compared to current conditions).**

Remaining Counties Likely to Exceed the 8-hour Ozone Standard with Clear Skies and the Base Case in 2020

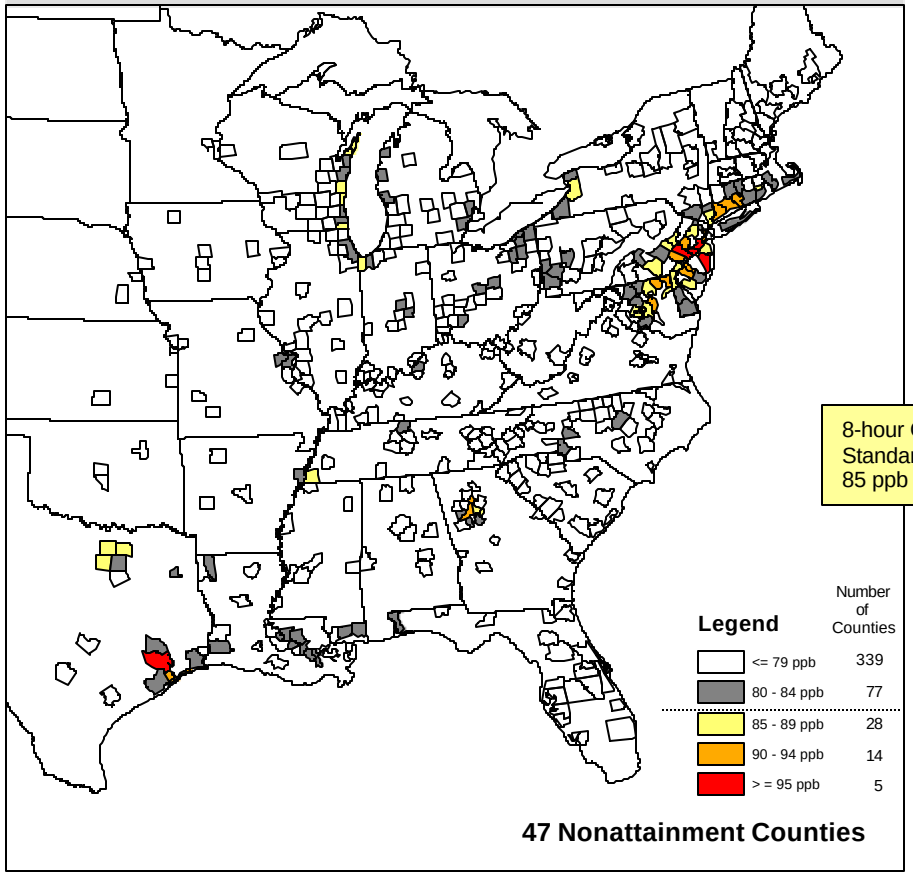


27 Nonattainment Counties

Notes: Based on 1999-2001 data of counties with monitors that have three years of complete data. Additional federal and state programs must bring all counties into attainment between 2007 and 2021. The methodology used to predict nonattainment status in the West is different than that used for the East.

Clear Skies Achieves Early Benefits by Bringing More Areas into Attainment with the 8-hour Ozone Standard in 2010

Remaining Counties Likely to Exceed the 8-hour Ozone Standard under Base Case in 2010



Ozone attainment status in 2010 base case:

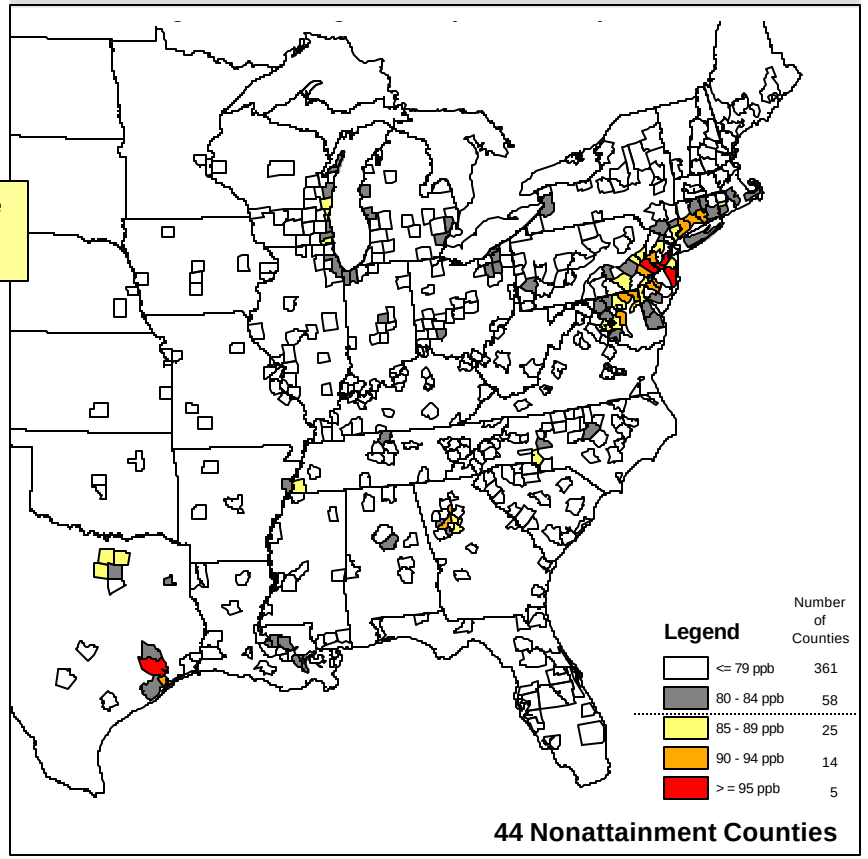
- **Existing programs (primarily the NOx SIP Call and vehicle rules) will bring 221 additional eastern counties (home to approximately 61 million people) into attainment with the 8-hour ozone standard (compared to current conditions).**

Ozone attainment status in 2010 Clear Skies case:

- **The NOx SIP Call will bring many Eastern counties into attainment with the 8-hour ozone standard.**
- **With Clear Skies, as compared to the Base Case, the number of counties out of attainment with the 8-hour ozone standard decreases from 47 to 44 (approximately 1 million more people living in counties in attainment).**

8-hour Ozone Standard = 85 ppb

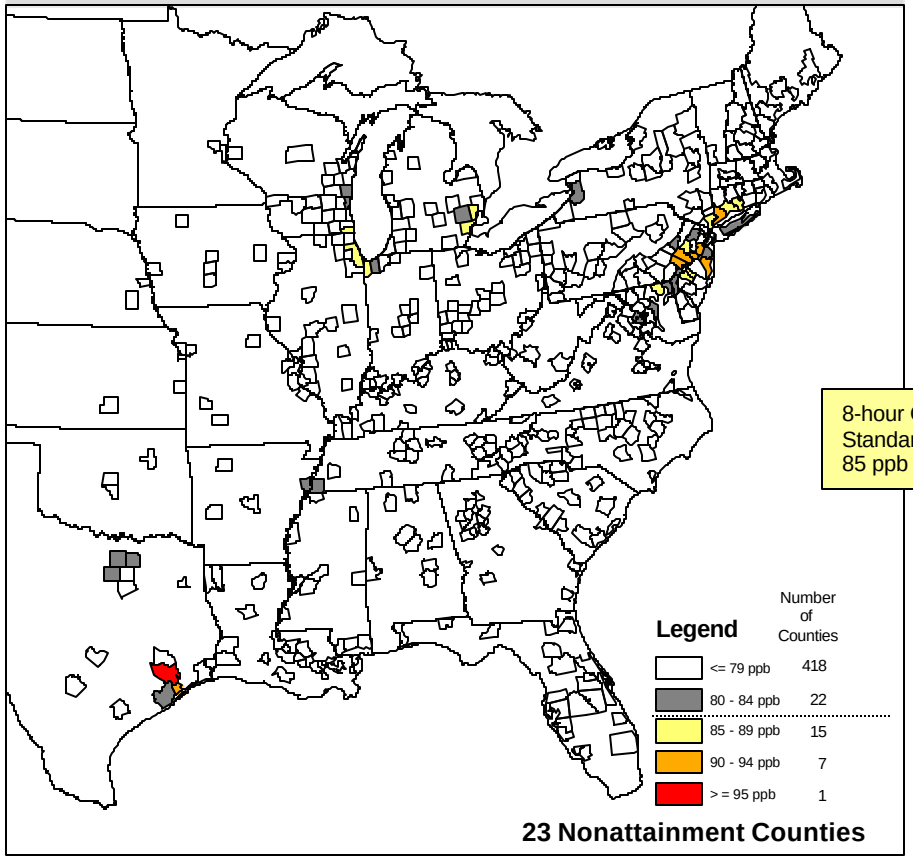
Remaining Counties Likely to Exceed the 8-hour Ozone Standard with Clear Skies and the Base Case in 2010



Notes: Based on 1999-2001 data of counties with monitors that have three years of complete data. Additional federal and state programs must bring all counties into attainment between 2007 and 2021. Clear Skies is not expected to bring additional counties into attainment for 2010 in the West. Therefore, the western region is not presented here.

Clear Skies Would Bring More Areas into Attainment with the 8-hour Ozone Standard in 2020

Remaining Counties Likely to Exceed the 8-hour Ozone Standard under Base Case in 2020



Ozone attainment status in 2020 base case:

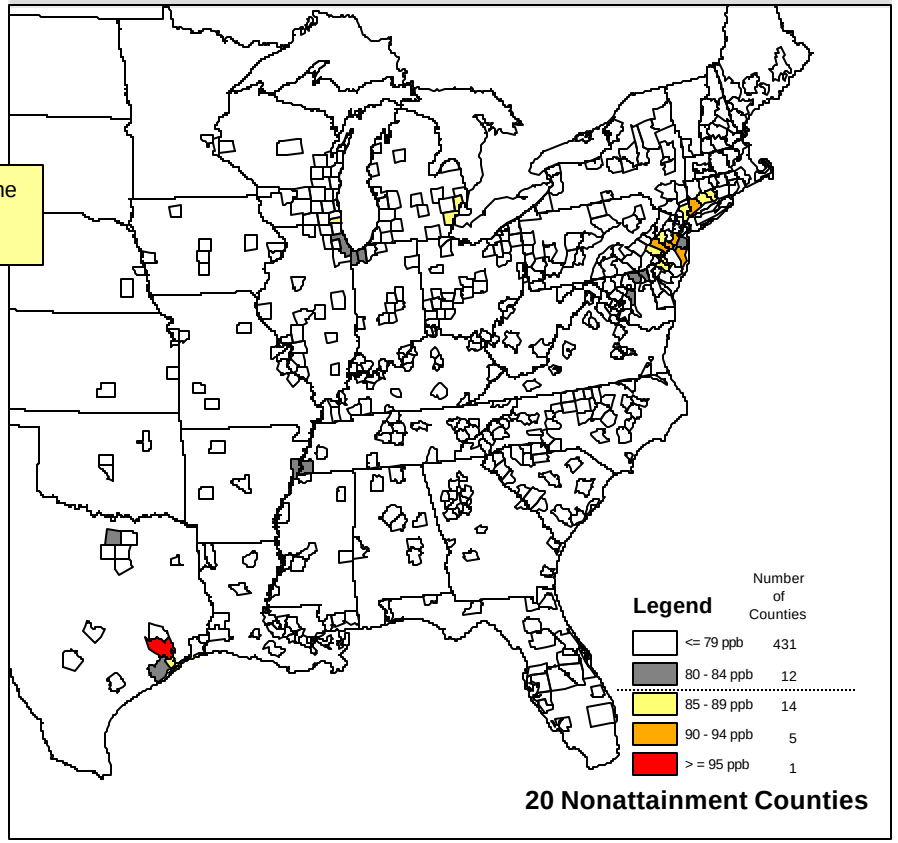
- **Existing programs (primarily the NOx SIP Call and vehicle rules, including the proposed non-road rule) will bring 245 eastern counties (home to approximately 65 million people) into attainment with the 8-hour ozone standard (compared to current conditions).**

Ozone attainment status in 2020 Clear Skies case:

- **The NOx SIP Call will bring many Eastern counties into attainment with the 8-hour ozone standard.**
- **Clear Skies would bring 3 additional counties (home to approximately 6 million people) into attainment with the 8-hour ozone standard (as compared to the Base Case).**

8-hour Ozone Standard = 85 ppb

Remaining Counties Likely to Exceed the 8-hour Ozone Standard with Clear Skies and the Base Case in 2020



Notes: Based on 1999-2001 data of counties with monitors that have three years of complete data. Additional federal and state programs must bring all counties into attainment between 2007 and 2021. Clear Skies is not expected to bring additional counties into attainment for 2020 in the West. Therefore, the western region is not presented here.

Changes to EPA's Health Benefits Modeling

- **Used proposed Nonroad Rule methods.**
- **Population exposure**.
  - Ambient PM monitored data adjusted using REMSAD results (instead of using REMSAD results directly)
- **Demographic data.**
  - 2000 Census data (instead of 1990 data)
  - Improved future population projections
- **Health effects incidence/prevalence data.**
  - Updated baseline incidence/prevalence for health endpoints
- **Concentration-Response functions.**
  - Non-fatal heart attacks, school loss days added
  - New epidemiological studies for certain endpoints (hospital admissions, ER visits for asthma)
- **Valuation of changes in health outcome.**
  - New valuation for alternative estimate

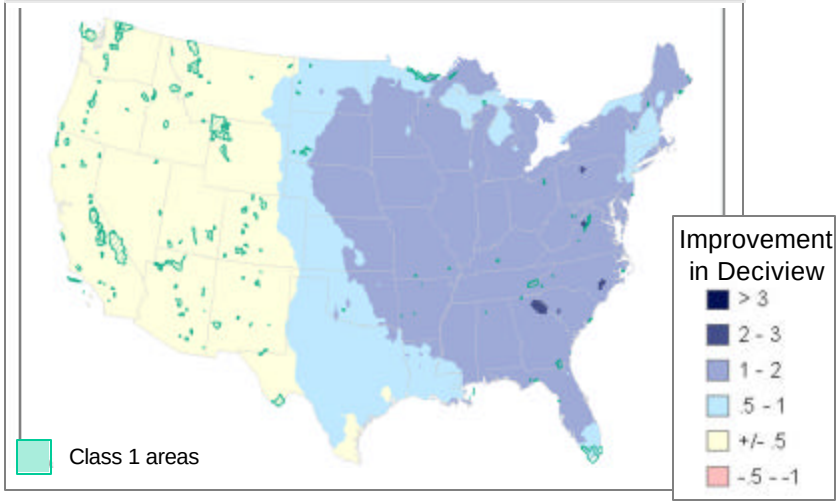
Summary of Human Health and Environmental Benefits of Reducing Fine Particles ($PM_{2.5}$) and Ozone[1] with Clear Skies

- Quantifiable health benefits would total approximately **$110 billion annually in 2020**.
  - An alternative estimate is $21 billion.[2]
- Each year, by 2020, Americans would experience:
  - 14,100 fewer premature deaths;
    - An alternative estimate projects 8,400 fewer premature deaths.[2]
  - 8,800 fewer cases of chronic bronchitis;
  - 23,000 fewer non-fatal heart attacks;
  - 30,000 fewer hospitalizations/emergency room visits for cardiovascular & respiratory symptoms;
    - Included in this total are 15,000 fewer hospital and emergency room visits for asthma.
  - 12.5 million fewer days with respiratory illnesses and symptoms, including work loss days (1.6 million), restricted activity days (10.3 million), and school absences (200,000).
    - Included in this total are hundreds of thousands fewer respiratory symptoms and illnesses for asthmatics, including approximately 180,000 fewer asthma attacks.
- Reductions in fine particles ($PM_{2.5}$) and ozone would result in substantial **early** benefits, including 7,900 fewer premature deaths and **$54 billion annually in 2010**.
  - An alternative estimate projects 4,700 fewer premature deaths and $10 billion annually in health benefits.[2]
- In 2020, annual visibility benefits would be $3 billion in selected National Parks and Wilderness areas.
- Additional significant health and environmental benefits (e.g., reduced human exposure to mercury and fewer acidified lakes) are expected, but cannot currently be quantified and/or monetized.

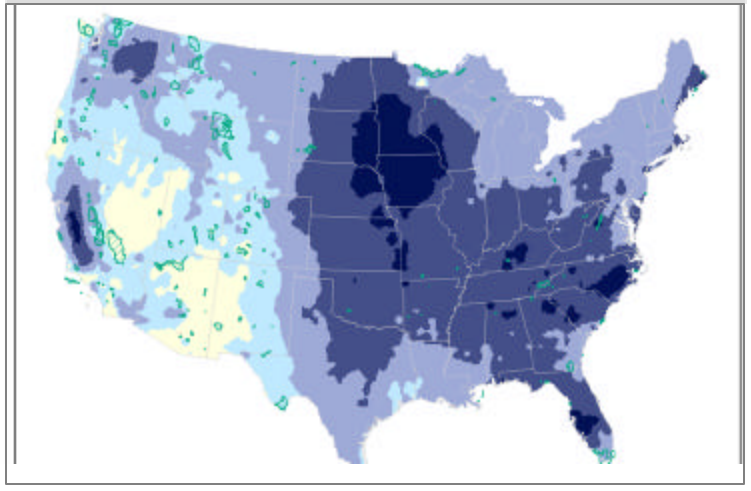
1. Ozone benefits were calculated for the eastern U.S. and areas of the West where significant ozone changes are expected. Total national ozone benefits may be slightly higher than reflected here.
2. The two sets of estimates reflect alternative assumptions regarding the effects of airborne particles on public health. The base estimate relies on estimates of the potential cumulative effect of long-term exposure to particles, while the alternative estimate presumes that PM effects are limited to those that accumulate over much shorter time periods. The alternatives also use different approaches to value health effects damages. (It is of note that, based on recent preliminary findings from the Health Effects Institute, the magnitude of mortality from short-term exposure (alternative estimates) and hospital/ER admissions estimates (both estimates) may be overstated.) The key assumptions, uncertainties, and valuation methodologies underlying the approaches used to produce these results are detailed in *Technical Addendum: Methodologies for Benefit Analysis of the Clear Skies Act, 2003* that will be released on the Clear Skies website shortly.

Visibility Improvements in 2020 with Clear Skies

Projected Changes in Visibility with Clear Skies compared to the Base Case in 2020



Projected Changes in Visibility with Clear Skies and Base Case in 2020 compared to 2001



- Clear Skies would improve visibility over much of the eastern U.S. 1-2 deciviews beyond the Base Case. [1]
  - In the southeastern U.S., this translates into an improvement in visual range of approximately 2-4 miles.
- Clear Skies along with existing programs would improve visibility in a large portion of the East and Midwest 2-3 deciviews (approximately 5-9 miles in those areas) from current levels.
  - Visibility in some areas would improve more than 3 deciviews.
- Western skies currently have much better visibility than the East. The Western Regional Air Partnership agreement is honored.
  - This allows growth in the West without degrading visibility.

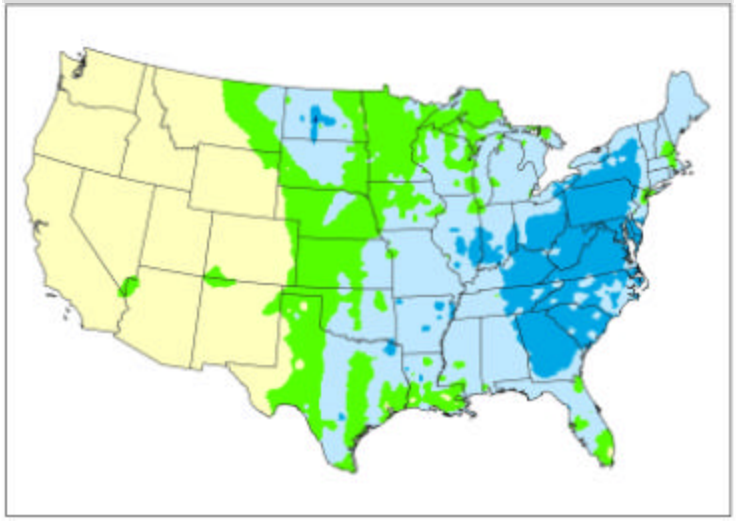
Monetized Visibility Benefits

- In 2020, annual visibility benefits would be **$3 billion** in selected National Parks and Wilderness Areas. In 2010, early benefits would be **$1 billion**.
- This assessment projects benefits due to improvements in impaired visibility in National Parks and Wilderness areas in many areas in the Southeast, Southwest, and California.
- This estimate does not include the value of improving visibility in residential areas, or of improving visibility at Parks and Wilderness Areas in other areas of the country (such as the Northeast).

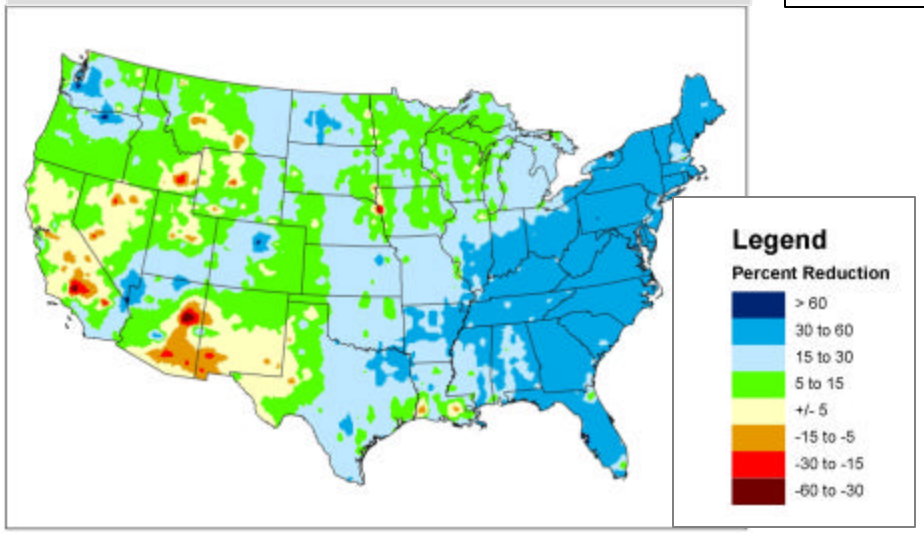
[1]This analysis calculated changes in air quality and in visibility, measured in terms of deciviews, a standard measure of relative visibility change; a one or two deciview change translates to a noticeable change in visibility for most individuals. The improvement in visual range in miles associated with each change in deciview depends on the absolute visibilitv.

Sulfur Deposition Improvements in 2020 with Clear Skies

Projected Changes in Sulfur Deposition with Clear Skies compared to the Base Case in 2020

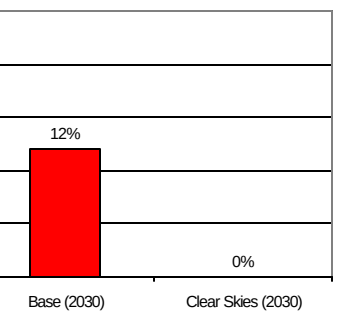


Projected Changes in Sulfur Deposition with Clear Skies and Base Case in 2020 compared to 2001



- Clear Skies would reduce sulfur deposition up to 60% beyond Base Case in some of the most acid-sensitive regions of the country, including the Appalachian Mountains, southern Blue Ridge, and southeastern U.S.
- Together with existing programs, Clear Skies would reduce sulfur deposition 30-60% across the most of the eastern U.S. and several sensitive areas of the West.

Projected Improvements in Adirondack Lakes



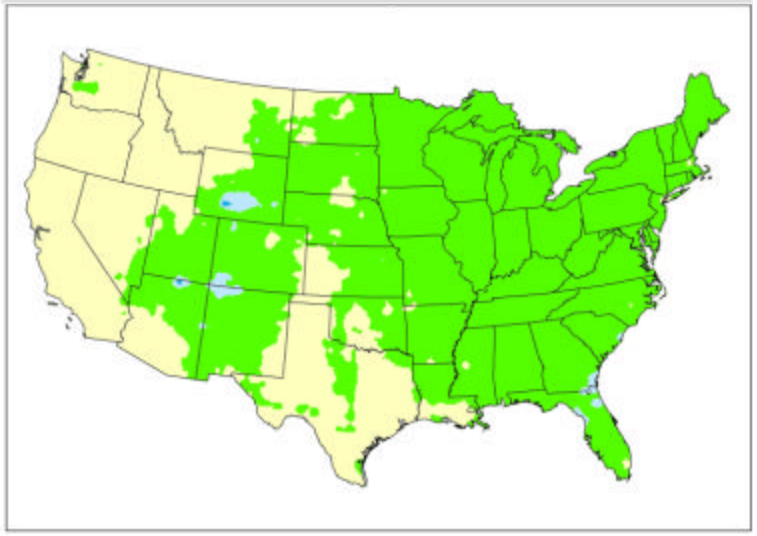
- Clear Skies would eliminate chronic acidity in Adirondack region lakes by 2030, and only 1% of lakes would remain chronically acidic in the Northeast region.

- Clear Skies would benefit acid-sensitive ecosystems in the Southeast, by slowing the deterioration of stream health expected under the Base Case.

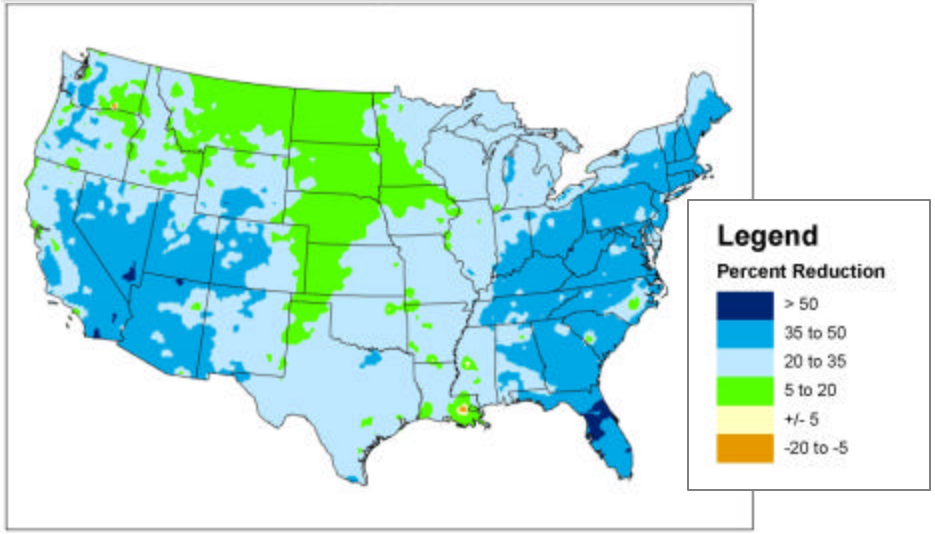
Note: Sulfur deposition in the West is generally low. The large percentage increases correspond to relatively small changes in actual deposition from expected increases in emissions primarily from sources not affected by Clear Skies (e.g., metals processing, petroleum refining, chemical and fertilizer manufacturing). A few power plants are expected to increase emissions slightly under existing programs.

Nitrogen Deposition Improvements with Clear Skies in 2020

Projected Changes in Nitrogen Deposition with Clear Skies compared to the Base Case in 2020



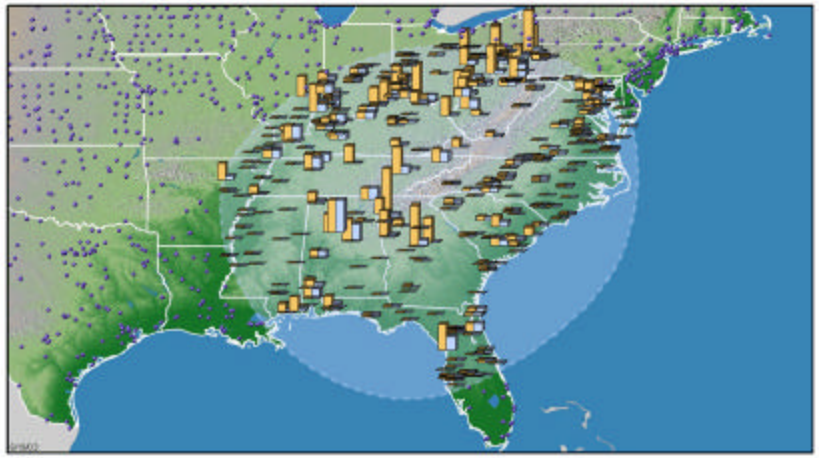
Projected Changes in Nitrogen Deposition with Clear Skies and Base Case in 2020 compared to 2001



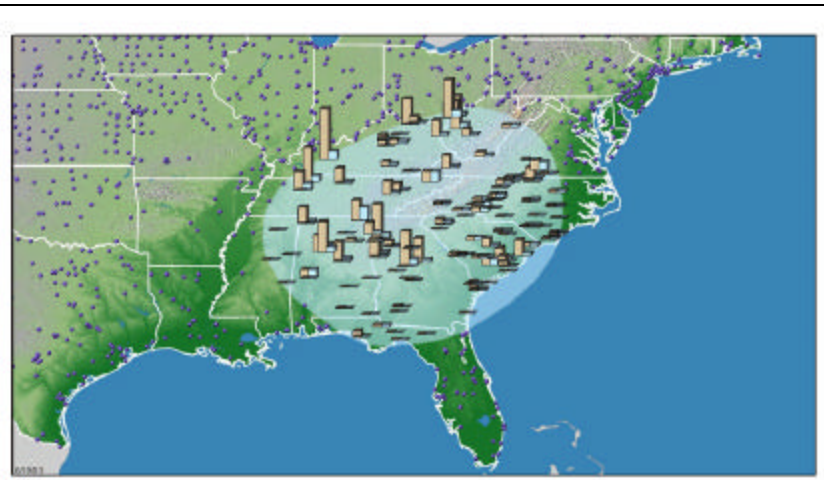
- Clear Skies would reduce nitrogen deposition up to 20% beyond the Base Case across much of the country.
- Clear Skies along with existing programs would reduce nitrogen deposition across much of the country by 20 to 50 percent.

Note: The increases in nitrogen deposition at locations in Louisiana and Washington state occur under the Base Case and with Clear Skies and are the result of increases in emissions from manufacturing and refining sources.

Airshed for the Southern Blue Ridge Mountains



Projected SO_2 Emissions from Existing Power Generation Sources in the Southern Blue Ridge Airshed (2020)

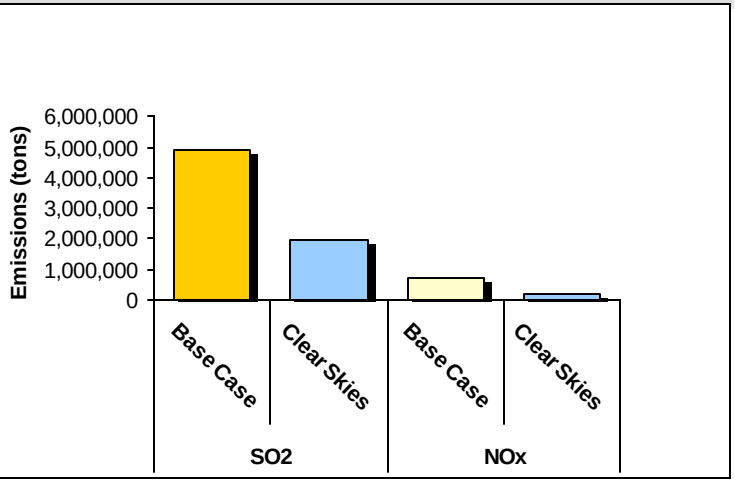


Projected NO_x Emissions from Existing Power Generation Sources in the Southern Blue Ridge Airshed (2020)

Note: An "airshed" depicts a modeled approximation of a large proportion of sources contributing to air quality in a particular receptor region.

- This page shows regional airshed maps that were developed for the Southern Blue Ridge Mountains (which includes Great Smoky Mountain National Park).
- Multiple emission sources in numerous states contribute to air quality degradation and acid deposition in the Southern Blue Ridge region.
- In 2020, emissions from power plants in the Southern Blue Ridge region are projected to be substantially lower with Clear Skies than under the Base Case:
  - SO_2 emissions are projected to decrease 61%;
  - NOx emissions are projected to decrease 68%.

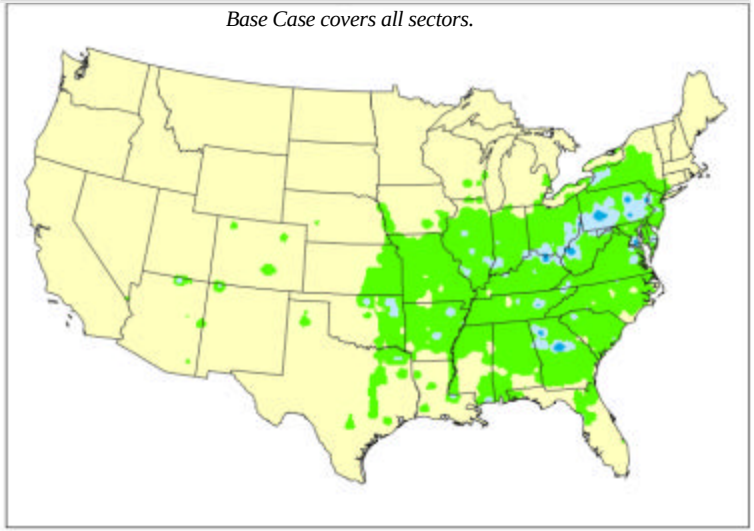
SO_2 and NOx Emissions in the Airsheds (2020)



Mercury Deposition Improvements in 2020 with Clear Skies

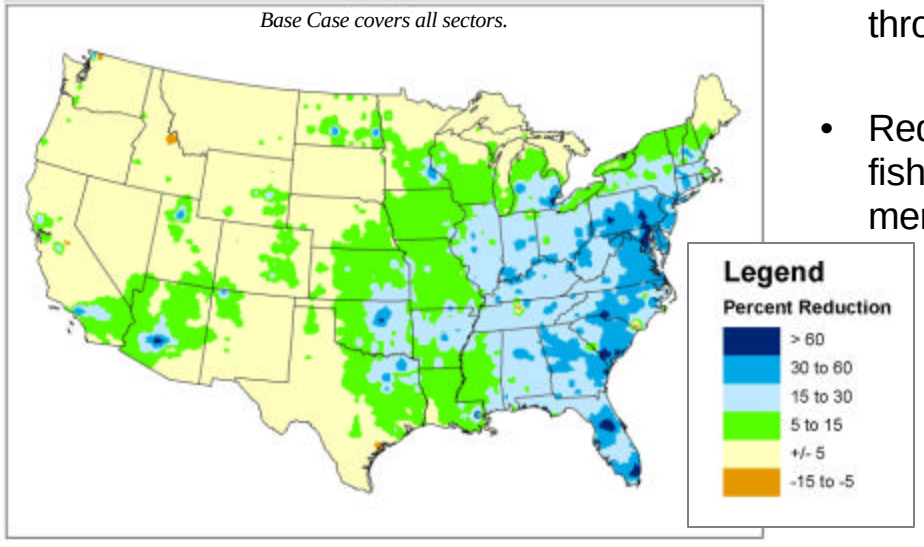
Projected Changes in Mercury Deposition with Clear Skies compared to Base Case in 2020

Base Case covers all sectors.



Projected Changes in Mercury Deposition with Clear Skies and Base Case in 2020 compared to 2001

Base Case covers all sectors.



- Eating contaminated fish is the primary route of exposure to mercury. Developing fetuses are most at risk for neurological harm due to mercury.
- As shown in the top map, considering Clear Skies without the safety valve, Clear Skies could potentially reduce mercury deposition 5-15%* beyond the Base Case across much of the East.
  - In some areas mercury deposition would be reduced up to 60%.
- As shown in the bottom map, together with existing programs, Clear Skies would contribute to a 15-60%* reduction in mercury deposition from current levels throughout the East and Midwest.
- Reductions are expected to occur in many places where fish advisories are in effect due to elevated levels of mercury.

***** These results are based on modeling the Clear Skies mercury cap without triggering the safety valve (see page 5 for a description of the safety valve). Note: The increases in mercury deposition in the bottom map occur under the Base Case and with Clear Skies and are the result of increases in emissions from sources other than power plants that are not affected by Clear Skies.

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.

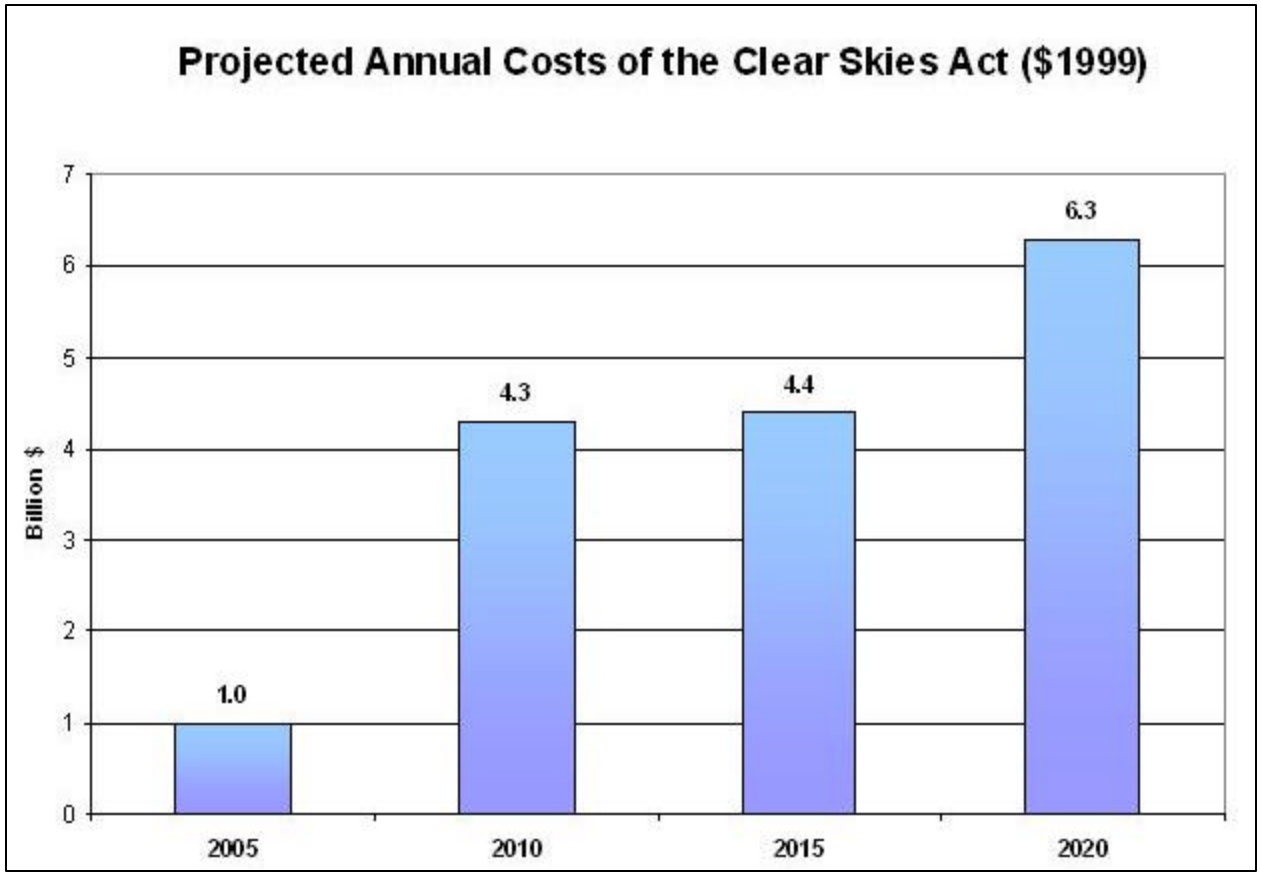
  – Some modeling assumptions used in IPM have been updated from the 2000 version used to model the Clear Skies Act of 2002. A summary of these changes are listed on the following slide.

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

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.

Projected Annual Costs of the Clear Skies Act



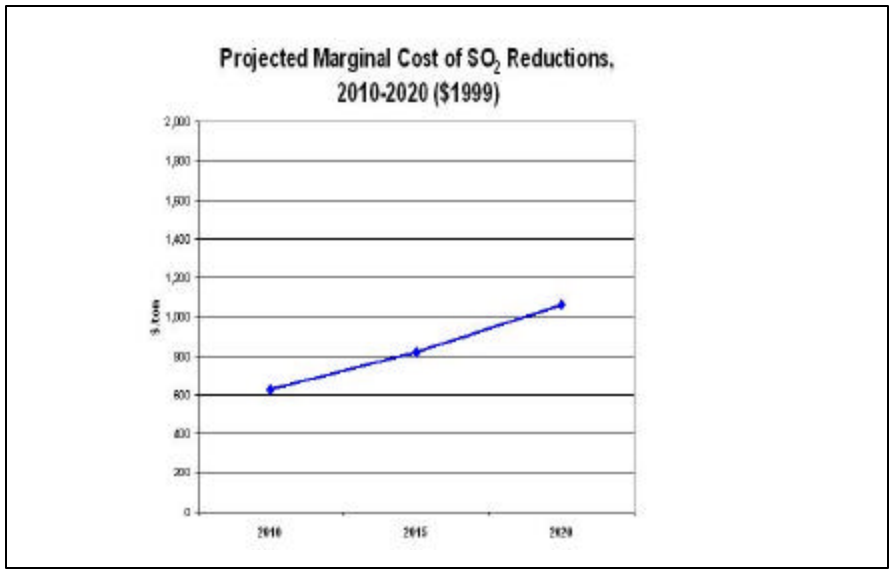
- Total annual costs of the Clear Skies Act are projected to be $6.3 billion ($1999) in 2020.
- The net present value (NPV) of the difference in costs between Clear Skies and the EPA Base Case is $52.5 billion ($1999) for the period between 2005 and 2025.
- The 2003 analysis projects annual costs slightly lower than projected by the 2002 analysis.

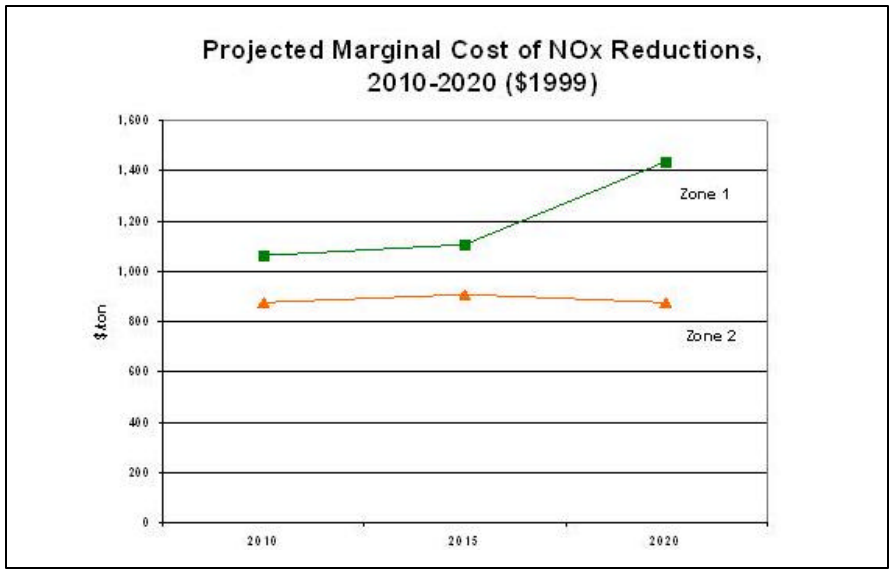
Note: Cost projections are based on modeling using IPM and are based on best available engineering estimates. These projections show the costs to power generators over and above the costs they will incur to meet statutory and regulatory requirements that are already in effect. The projections do not include costs associated with the purchase of allowances from the auction. Nor do the projections consider future technological changes that could lower compliance costs or electric demand response that would lower costs through reduced power generation. In the absence of Clear Skies legislation, there are existing statutory provisions that will, in the future, require EPA and states to impose additional requirements (and thus additional costs) on power generators between now and 2020 (e.g., states will be required to meet the PM2.5 and ozone NAAQS). When compared to existing Clean Air Act requirements, Clear Skies may actually result in cost savings because a cap-and-trade approach is more efficient than existing regulatory programs. When the Acid Rain Program was implemented using a cap-and-trade program, compliance costs to achieve the mandated reductions were significantly lower than predicted as sources took advantage of the flexibility provided by a cap and trade program.

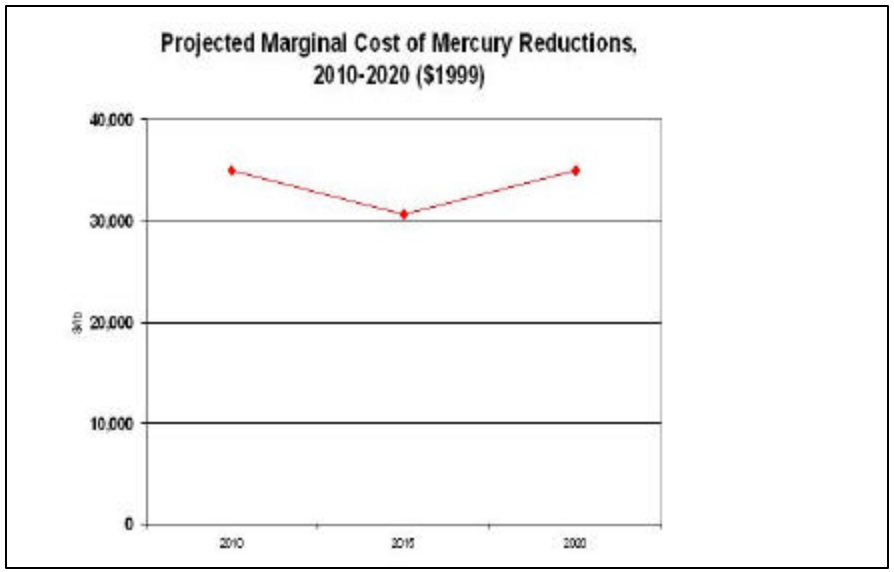
Note: EPA's net present value calculation is based on annual costs from IPM and cover the years 2005-2025. See chapter 7, table 7.1 of the IPM documentation for more information on the discount rates used for various plant types. (www.epa.gov/airmarkets/epa-ipm/index.html#documentation).

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

Projected Allowance Prices with Clear Skies





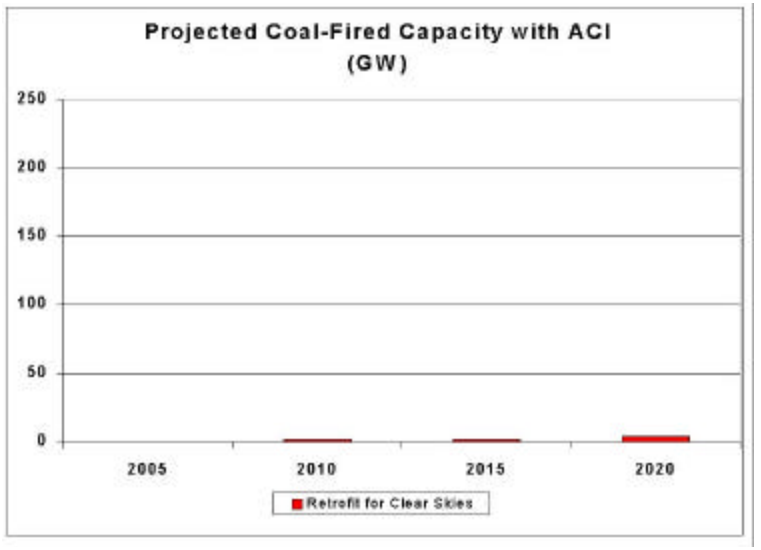


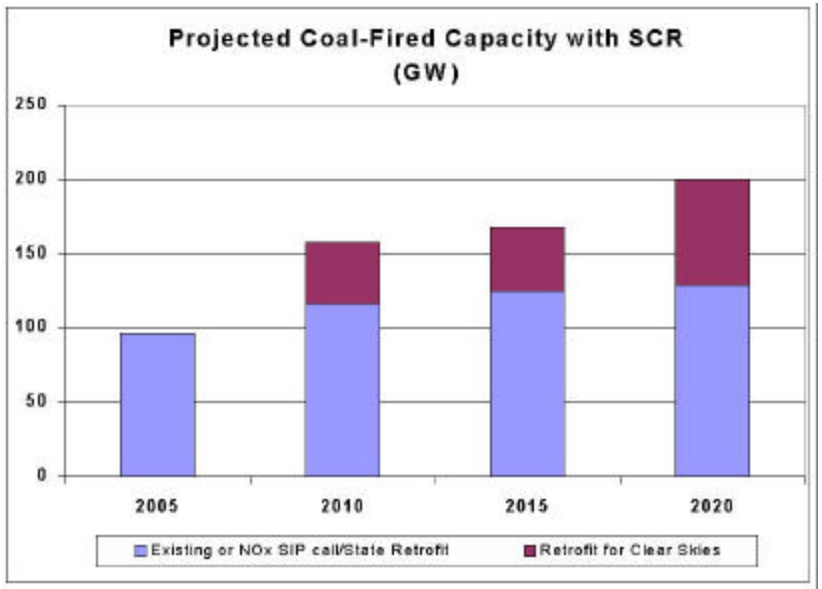
Note: The dollar value is the projected allowance price, representing the marginal cost (i.e., the cost of reducing the last ton) of emissions reductions. Marginal costs are based on modeling using IPM.

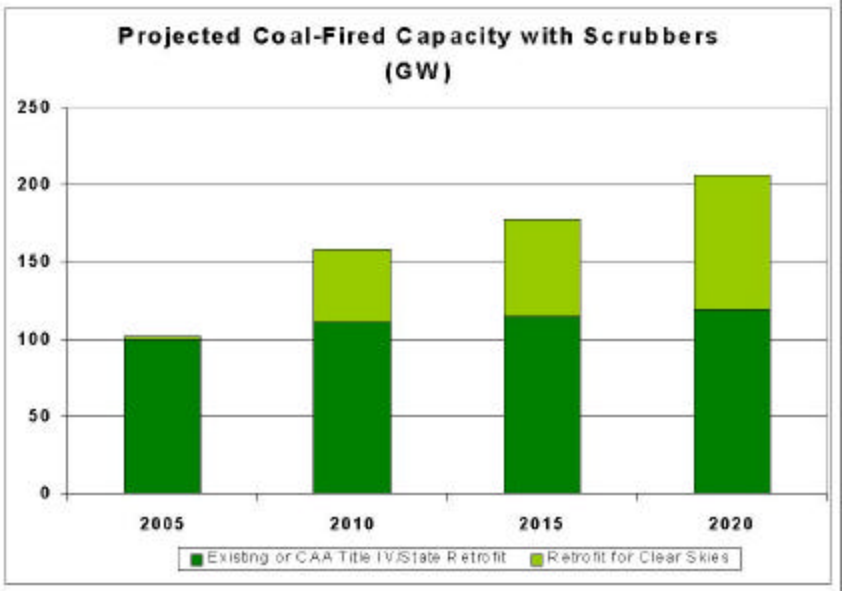
Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

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.

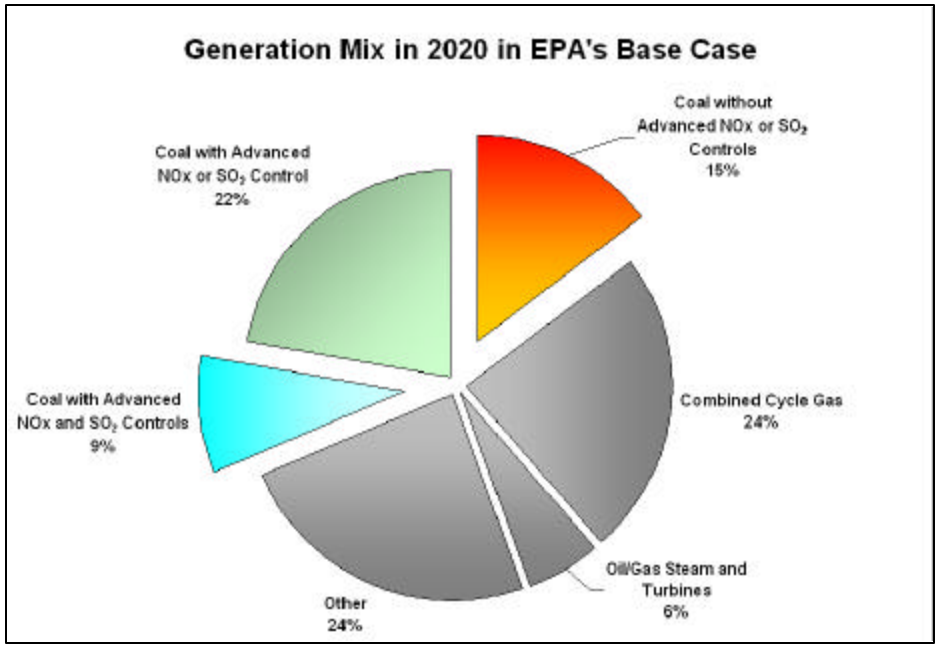


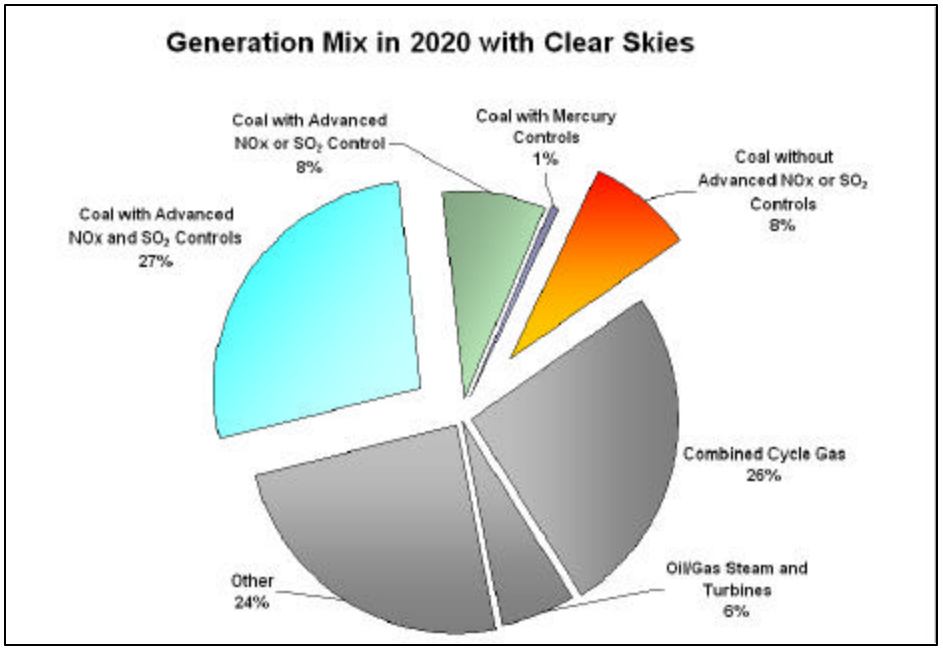




Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

Projected Generation Mix in 2020





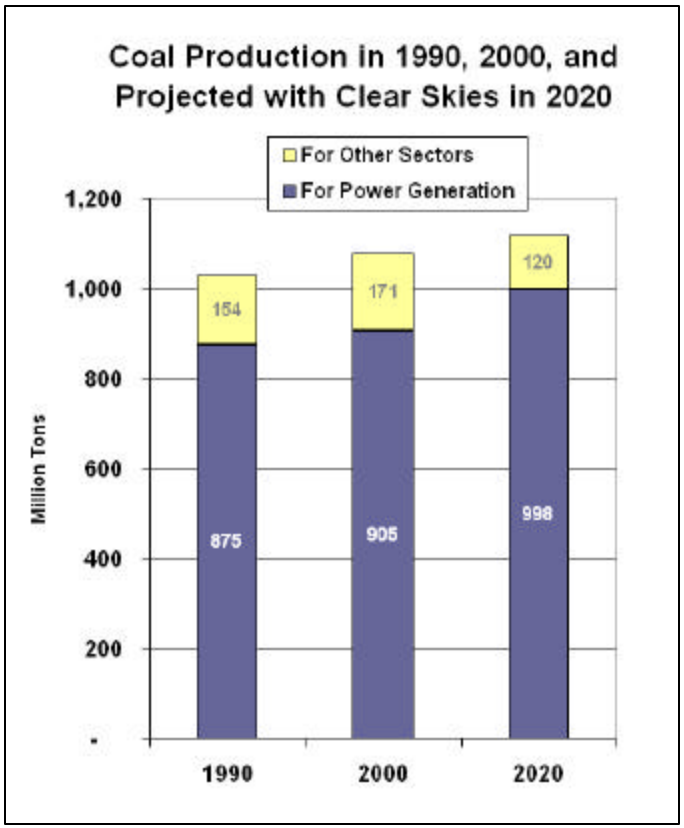
Note: Projections are from EPA's modeling using IPM. Coal units with SO_2 and/or NOx controls includes units with advanced post-combustion SO_2 and/or NOx controls (scrubbers for SO_2 removal and SCR or SNCR for NOx removal). Coal units without SO_2 and/or NOx controls could include PM and/or NOx combustion 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.

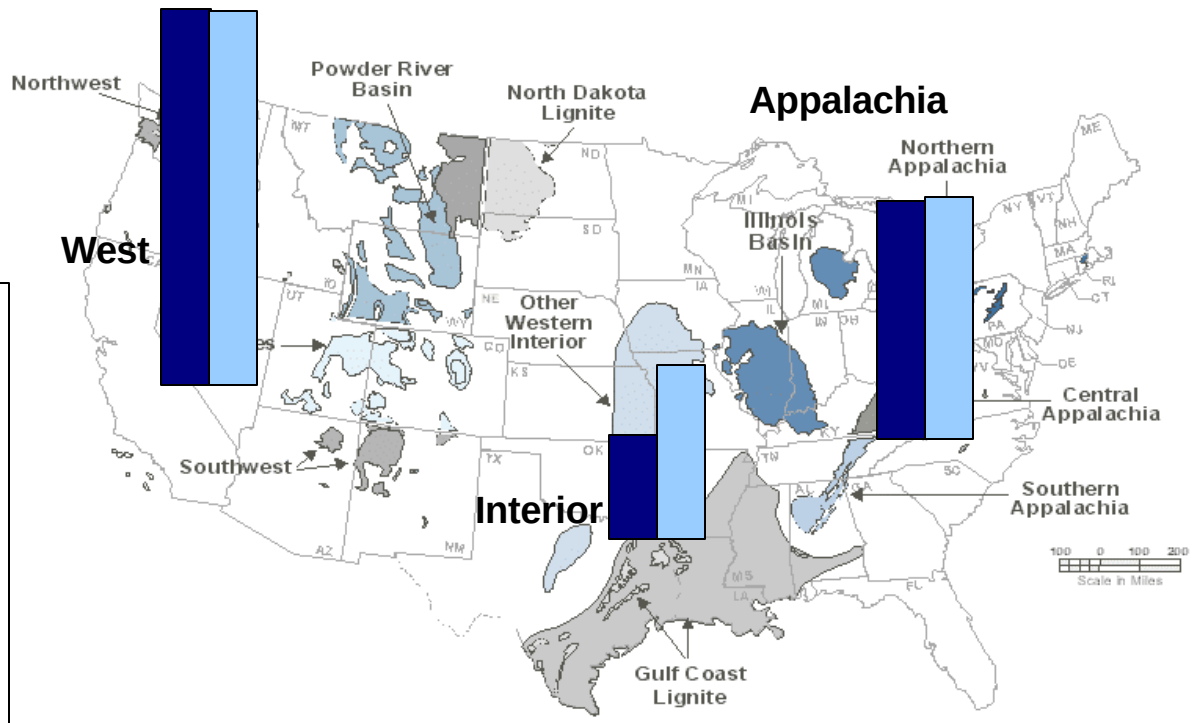
Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

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

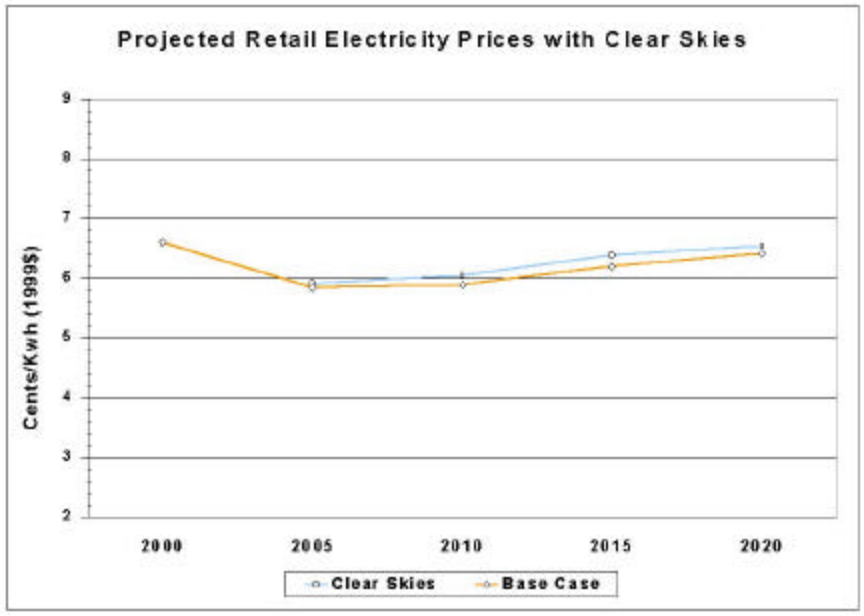
Notes: 2020 national coal production projections are EPA estimates from IPM. 1990 data is from the Coal Industry Annual 1994, Table 4 (DOE/EIA-0584 (2000)). 2000 data is from the Coal Industry Annual 2000, Table 4 and Table 63 (DOE/EIA-0584 (2000)), January, 2002. 2020 production for the power generation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

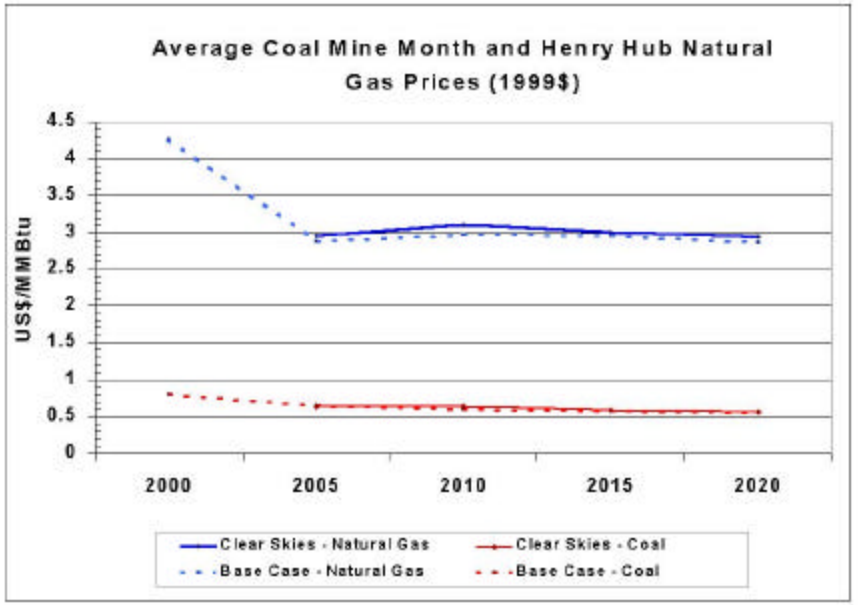
In 1990, EIA did not report the coal produced for power generators. From 1998-2000, 85% of coal produced was for the power generation sector. For an estimate of coal produced for the power generation sector in 1990, EPA assumed the same percentage (85%).

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

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.





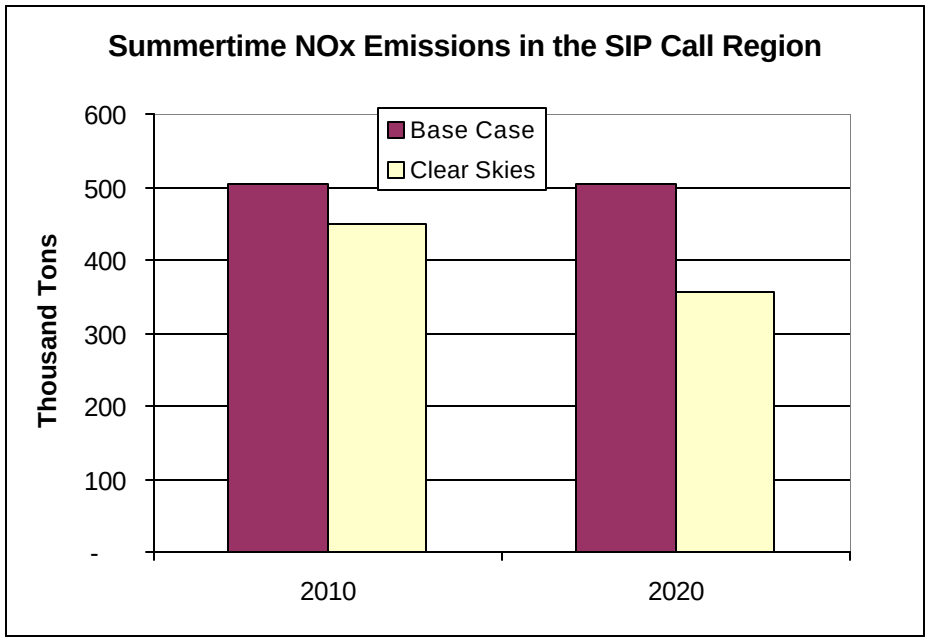
Note: Retail prices from 2000 are from AEO2003. Prices for the period 2005 and after were calculated using the Retail Electricity Price Model (see Section G for a description of the Model).

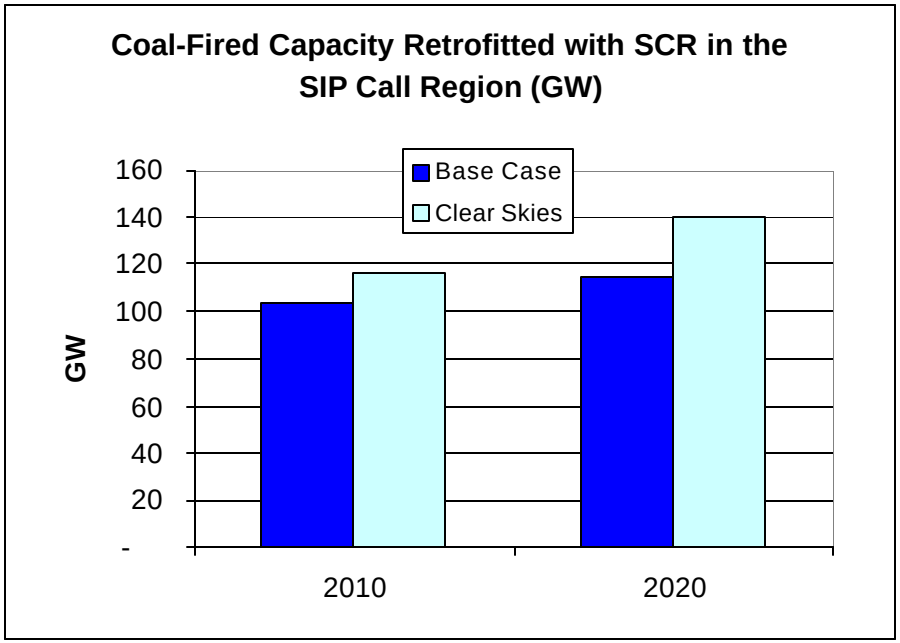
The coal price represents an average minemouth price across all twelve grades of coal in the model mined in 39 supply regions. The natural gas price is the Henry Hub price. Fuel prices for 2005 to 2020 are EPA's projections from IPM.

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

Impact of Clear Skies on the NOx SIP Call Region

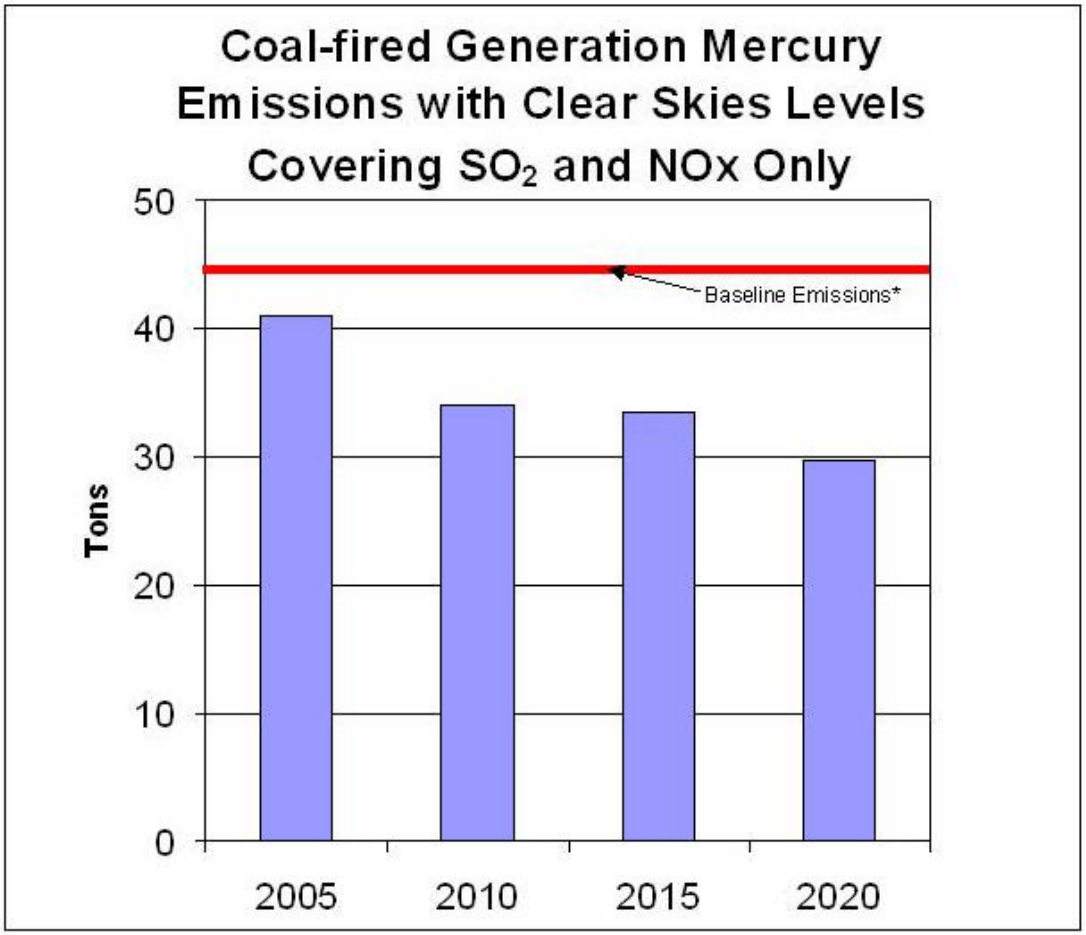
- Summertime NOx emissions in the SIP Call region with Clear Skies are significantly lower than the emissions predicted under the NOx SIP Call. The additional reductions with Clear Skies come from the approximately 25 GW of additional SCR retrofits by 2020.





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.

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.

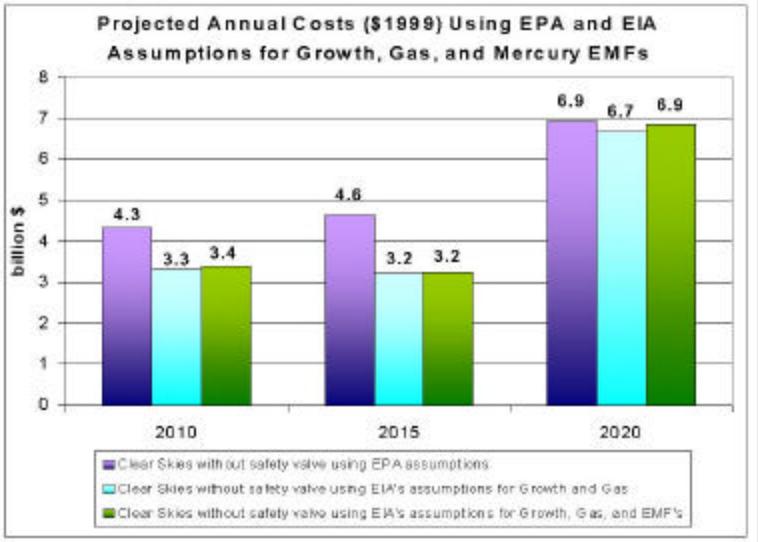
Note: The analysis presented represents EPA's estimates. EIA's modeling would likely show different impacts.

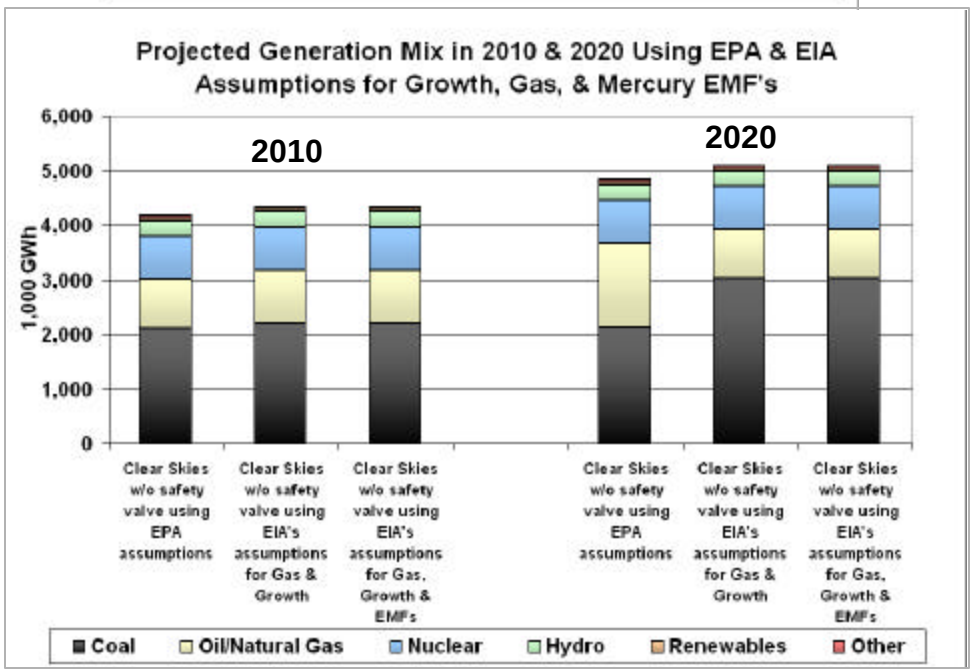
Impact of Changes in IPM Modeling Assumptions

- **EPA has explored the impact of changing assumptions in the model to:**
  - AEO 2003 natural gas prices
  - AEO 2003 electricity growth
  - Mercury emission modification factors (EMFs) used by EIA
- **To measure the pure impact of the assumptions, as opposed to the safety valve effect, a Clear Skies Case without the safety valve was used in IPM modeling of power grid behavior and emissions. With the safety valve modeled, the impacts would be smaller than those shown. (The sensitivity analysis did not extend to air quality and benefits analysis.)**
- **The assumptions used in the sensitivities for natural gas prices, electricity growth and mercury removal efficiencies were those used by EIA in its 2003 modeling.**

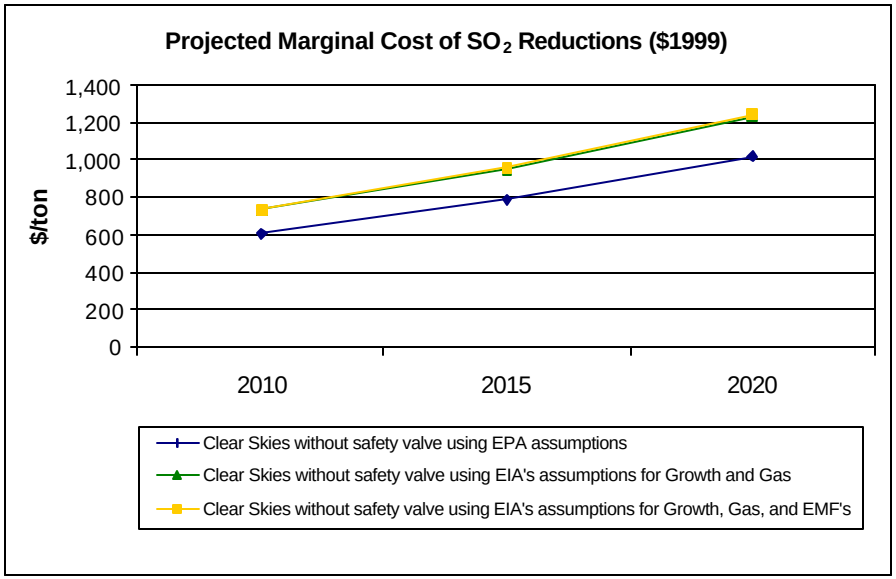
Effects of Assumptions for Natural Gas Prices, Electricity Growth, and Emission Modification Factors (EMFs)

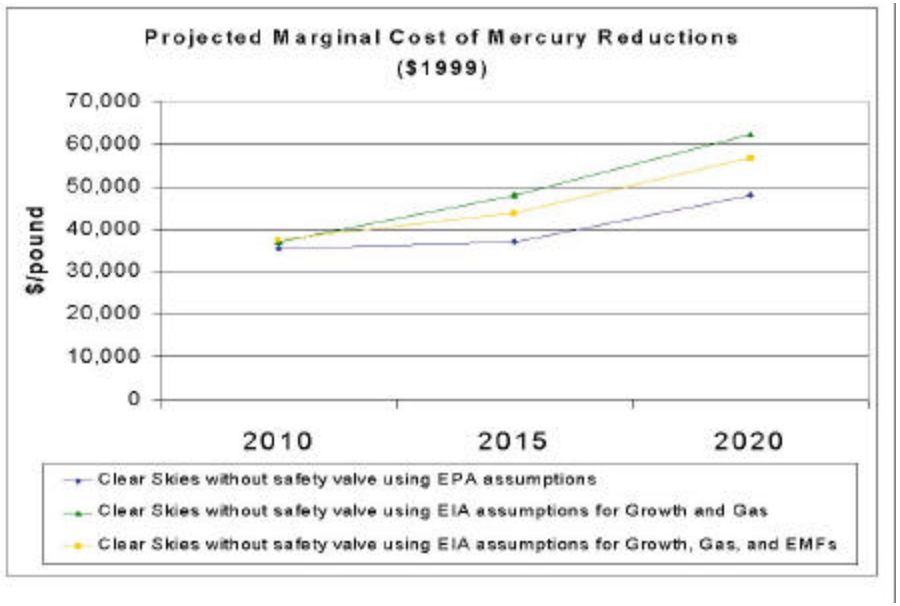
- Projected annual costs decline or remain about the same when the model is run with EIA's natural gas assumptions, electricity growth assumptions, and/or EMFs. Assumptions lead to building much cleaner new coal-fired capacity that leads to lower overall cost.
- Annual costs increase less than 10% by 2020.
- Coal-fired generation increases.
- Allowance prices are relatively close, except for mercury.

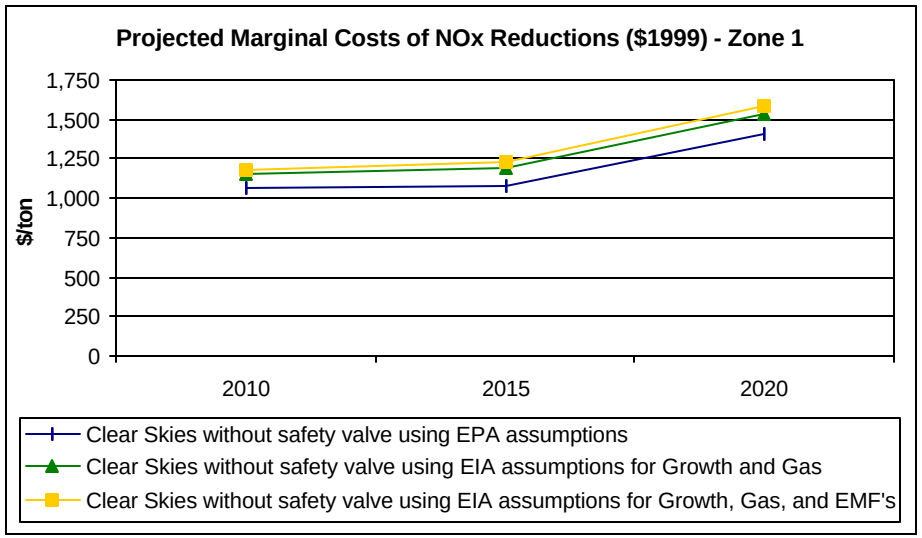


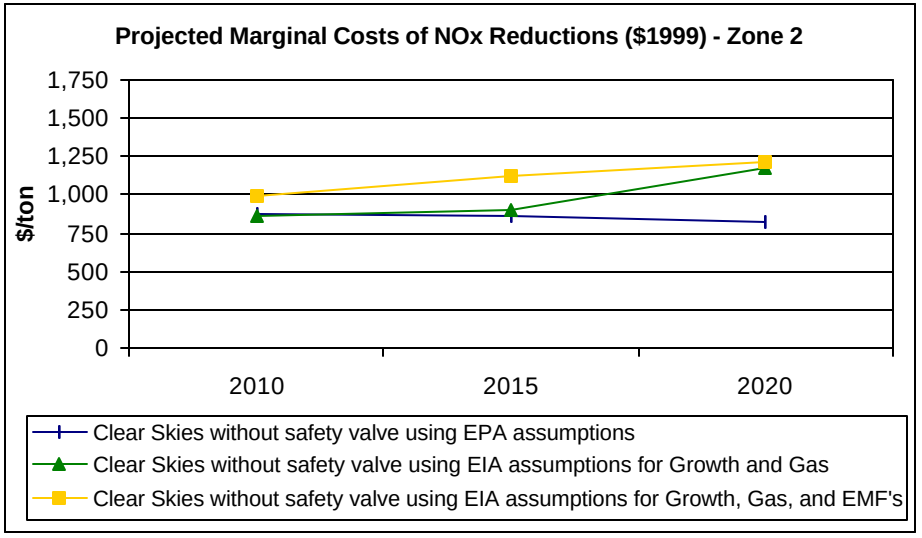


Effects of Assumptions for Natural Gas Prices, Electricity Growth, and EMFs









Conclusion

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

- **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.

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.