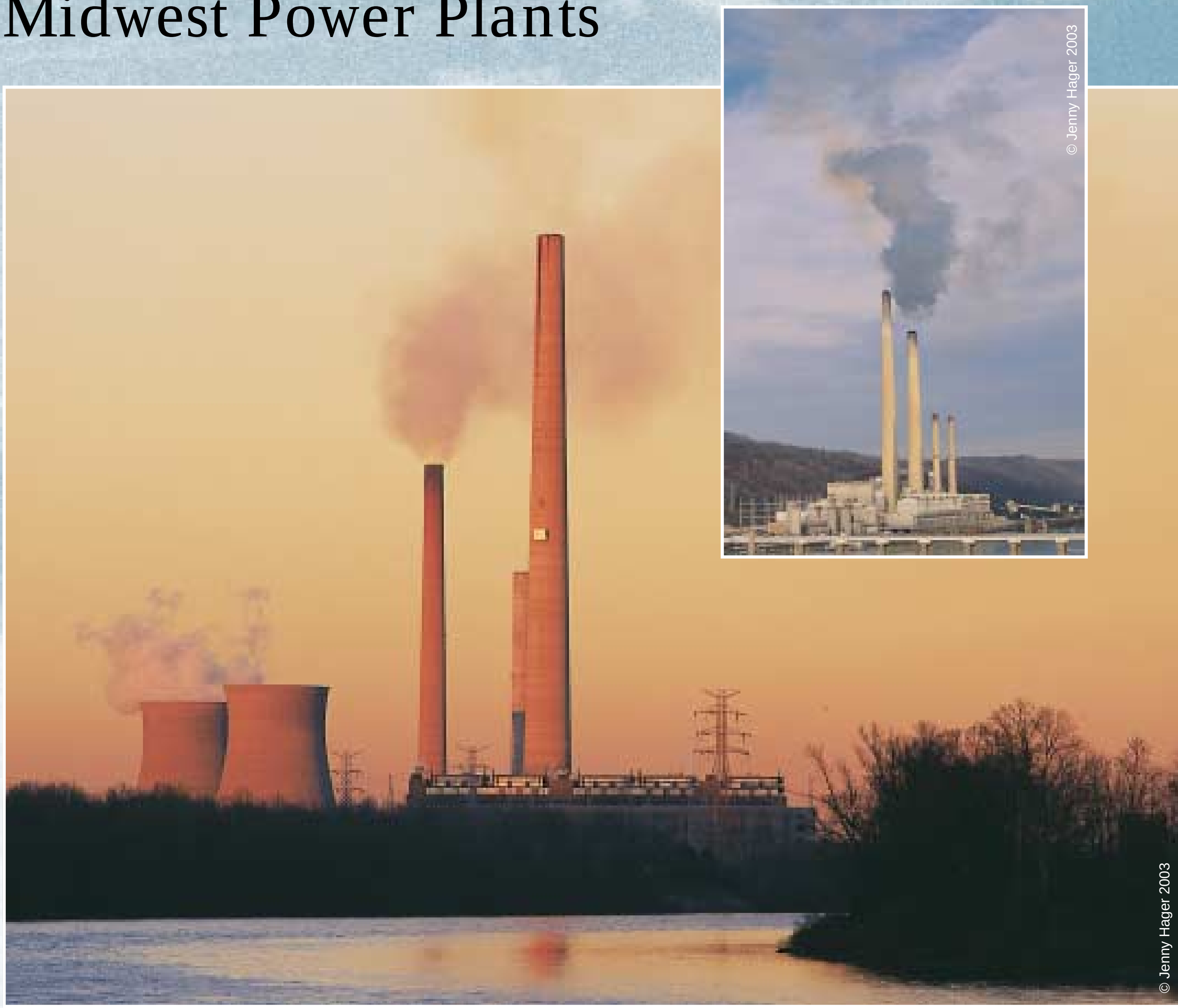
NITROGEN

Nitrogen Oxide Emissions and Midwest Power Plants



CLEAN AIR TASK FORCE

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Nitrogen Oxide Emissions and Midwest Power Plants

The release of nitrogen into our environment has more than doubled over the past century, contributing to problems such as ground level ozone, acid rain and other environmental challenges. In the Midwest, coal-fired power plants are one of the largest sources of nitrogen oxide pollution, accounting for 30 percent of total annual emissions. Power plants have remained exempt from modern pollution controls for decades. Some in the Midwest will be facing seasonal pollution controls beginning in 2004, others will remain uncontrolled. To fully address the threats this pollutant poses for our public health and environment, more will have to be done to reduce nitrogen oxide emissions from power plants in the Midwest.

Nitrogen Released From Fossil Fuels Are Harmful To Our Environment

Nitrogen, one of the earth's most abundant elements, is essential for life on earth. It is an important plant nutrient and a key building block of proteins. However, over the past century human activities – fertilizers, waste water treatment, animal wastes and atmospheric sources – have more than doubled nitrogen releases into the environment. This doubling has placed a demanding burden on our air, land and water resources.

The burning of fossil fuels is one of the major atmospheric sources of nitrogen. Combustion of fuels at high temperatures converts the elemental nitrogen in the air and fuel to nitrogen oxides (NO_x). Emissions from power plants and mobile sources are the largest source of NO_x in the US. From 1950 to 1997, the amount emitted into the atmosphere from fossil fuel combustion has increased by a factor of almost 40.[1]

After combustion and release, nitrogen oxides and their byproducts enter the environment in four important paths, each of which can affect human health and the environment:

- Nitrogen oxides are dangerous to breathe. When released from power plants or cars into nearby neighborhoods, they are associated with respiratory side effects such as asthma attacks.
- Ozone pollution (ground level ozone or smog) – a very strong airborne oxidizing agent with properties like chlorine bleach – forms when NO_x reacts with hydrocarbons in the presence of heat and sunlight. Ozone at ground level is linked with asthma attacks and even birth defects and also retards growth of trees and crops.
- Nitrogen oxides form small nitrate particles that are associated with serious health impacts like heart attacks and result in hazy skylines in our cities and national parks.
- Nitrogen oxides lead to pollution of soils, groundwater and estuaries. Nitrate particles can form nitric acids in the atmosphere contributing to acid rain and overloading ecosystems with nitrogen, effectively over-fertilizing them.

This report focuses on the impacts of emissions of NO_X in the Midwest and demonstrates the need for steep reductions from power plants – beyond those reductions required by existing EPA regulations.

Power Plants Unnecessarily Release Millions Of Tons Of Nitrogen Oxides Into The Air

Due to a loophole in the Clean Air Act, millions of tons of NO_x are unnecessarily released into the atmosphere each year by "grandfathered" power plants. As a home to the some of the Nation's largest smokestack polluters, Midwest power plants release a disproportionately large share of NO_x into the air, despite the fact that pollution control technology is readily available that reduces over 90 percent of the emissions from the region's largest and dirtiest smoke-stacks. As Table 1 illustrates NO_x emissions from all sources in the six Midwest states discussed in this report (Minne-sota, Wisconsin, Michigan, Illinois, Indiana and Ohio) totaled almost 5 million tons in 1999, representing nearly 20 percent of all U.S. NO_x emissions.[2] Electric utilities in this six-state region emitted 1.5 million tons of NO_x in 1999, representing over 25 percent of the U.S. NO_x emissions from power plants. In the Midwest, coal combustion accounts for 97 percent of the NO_x emissions from electric utilities.

Table 1:

Nitrogen Oxide Emissions in Six Midwest States in 1999, tons per year

NO_x Emissions	All Sources	Power Plants	Power Plant %	Coal Plants	Coal Plants as % of Power Plants
Illinois	1,111,896	278,931	25.1	268,412	96.2
Indiana	860,290	350,017	40.7	349,028	99.7
Michigan	859,897	207,039	24.1	183,594	88.7
Minnesota	487,651	87,211	17.9	83,838	96.1
Ohio	1,149,097	431,481	37.5	429,518	99.5
Wisconsin	506,773	109,612	21.6	106,498	97.2
Total	4,975,604	1,464,291	29.4	1,420,888	97.0

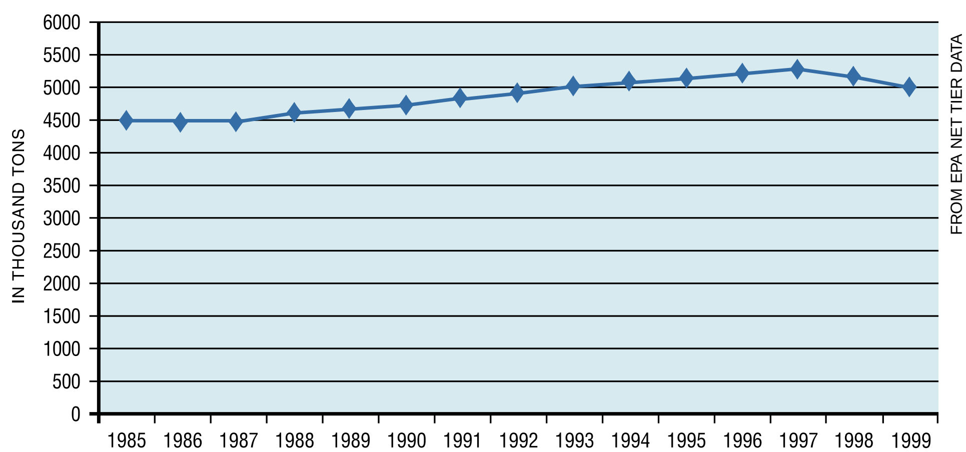
FROM EPA NET TIER AND CEMS DATA

Nitrogen Oxide Emissions Need To Be Significantly Reduced

Figure 1 demonstrates that NO_x emissions from power plants have been steadily increasing for years. Recently, there has been a slight decrease in anticipation of a federal rule that will require some states to reduce the summertime NO_x emissions from power plants in order to reduce ozone pollution starting in 2004. However, if the technology solutions were applied year round, not just during the summer, and to all states, the Midwest would receive significantly greater relief from NO_x pollution.

Figure 1:

NO_x Emissions from 1985 to 1999 in Six Midwest States



An Incomplete Step

In 1998, the US EPA adopted a rule requiring 19 states, including Illinois, Indiana, Michigan, and Ohio to develop state implementation plans (SIPs) to clean up summertime NOx emissions from coal-fired power plants. Minnesota and Wisconsin do not have to comply with this requirement. The pollution controls are only required to be operated during the summer because the scope of the rule focused on smog-causing pollution and did not attempt to address haze, fine particles or acid rain. As a result, starting in 2004, summer time NO_x emissions from the four Midwestern states included in the rule will be cut by nearly 250,000 tons per season.

While this federal rule is an important step, requiring the pollution controls to operate year round and requiring similar cuts in all coal- and oil-fired power plants, including those in Wisconsin and Minnesota, would result in an additional 450,000 ton reduction in Midwestern NO_x pollution.

Figure 2:

Comparison of Annual Power Plant NO_x Emissions and Reductions in SIP Call States (IL, IN, MI, OH), Ozone Season vs Potential Year-Round Controls

(Based on 2001 emissions)

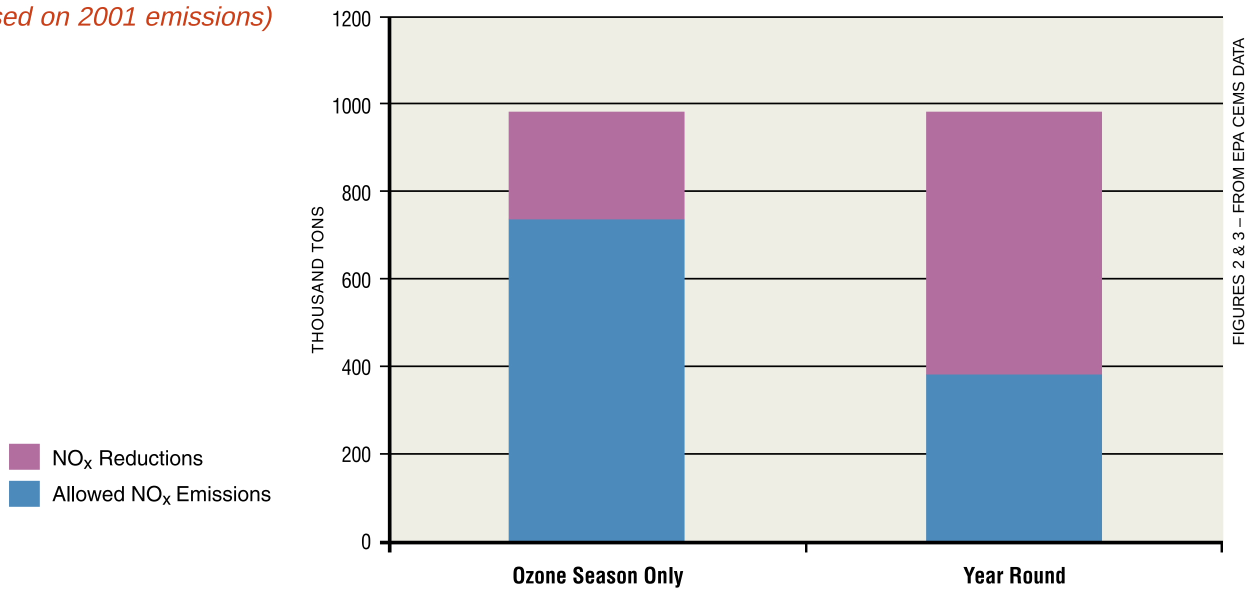
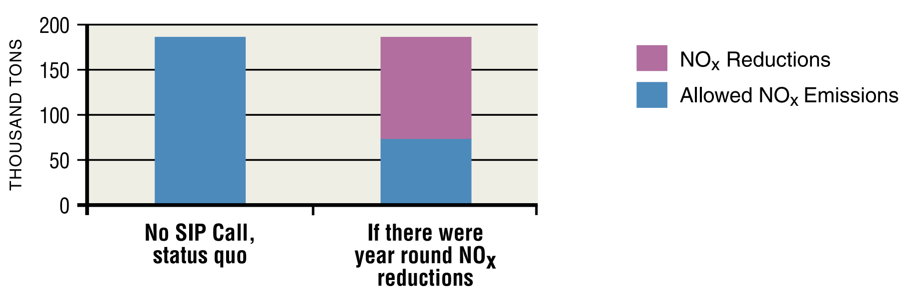


Figure 3:

Comparison Current Power Plant (no SIP requirement) NO_x Emissions from WI and MN vs Potential Year-Round NO_x Controls

(Based on 2001 emissions)



Nitrogen Oxides Pose A Serious Health Problem In The Midwest

Nitrogen dioxide causes respiratory ailments

Near emissions sources, short-term effects from nitrogen dioxide include coughs, exacerbation of existing respiratory problems, such as asthma and increases in respiratory illnesses in children.[3] Long-term exposure to local sources may alter lung tissues and lower resistance to lung infections.[4]

Nitrogen oxides contribute to unhealthy ozone levels in Midwestern urban centers

Ground level ozone can irritate lung airways, causing sunburn-like inflammations, and in some cases, in mortality.[5] Other reactions to breathing smoggy air include wheezing, coughing, pain when taking a deep breath, and breathing difficulties during exercise or outdoor activities.[6] The developing lungs of young children are particular susceptible to ozone, and exposure in utero can cause birth defects[7] and even infant death.[8] In the general population, people with respiratory problems are most vulnerable, but healthy people, who are active outdoors, can also be affected when ozone levels are high. And even at low concentrations, health problems can be triggered.[9] Table 2 provides state-specific information on health impacts from ozone.

Because production of tropospheric ozone is enhanced in the presence of heat and sunlight, formation of ground level ozone is largely a warm weather problem. From May through October, unhealthy ozone is a pervasive problem throughout the Midwest,[10] with bad air quality persisting for many hours throughout the summer.[11] This extended exposure has resulted in higher per capita respiratory hospital admissions from ozone in the Ohio River Valley than many other parts of the country.[12] Figure 4 is derived from a now-annual American Lung Association report that tracks ozone concentrations, nationwide over a three-year, rolling period. It shows that in the years 1998 to 2000, areas in the Midwest with at least one day of unhealthy ozone (as defined by EPA) were common. In most of these areas, unhealthy ozone occurred much more frequently than one day in a three-year period. Metropolitan-specific information can be found at the American Lung Association website.

Table 2:

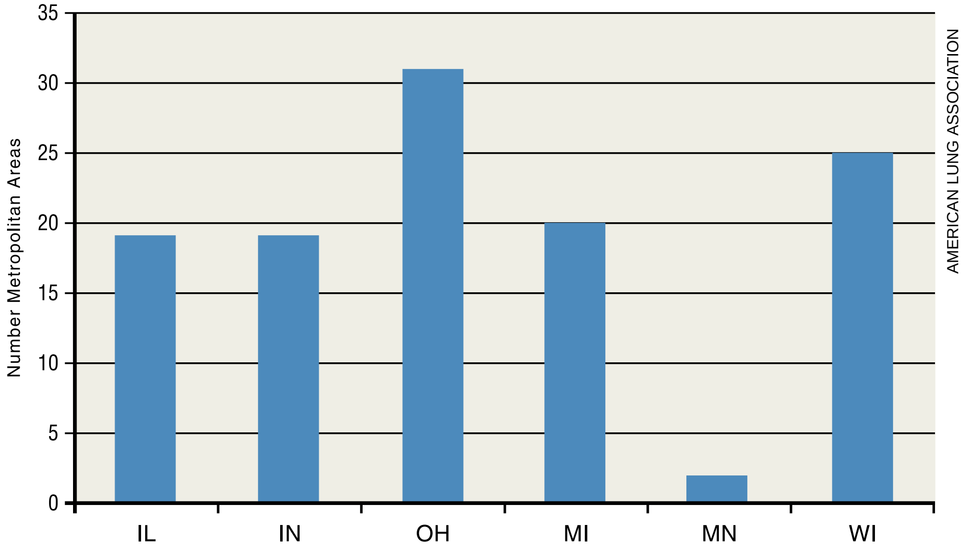
Modeled Ozone-Related Adverse Health Effects by State

State	Repiratory Hospital Admissions	Cardiovasc. Hospital Admissions	Total Repiratory ER visits	Asthma ER Visits	Minor Symptoms	Shortness of Breath	Asthma Attacks
Illinois	2,400	740	7,200	770	4,000,000	24,000	310,000
Indiana	1,500	480	4,500	470	2,500,000	8,000	190,000
Michigan	2,100	670	6,300	660	3,600,000	20,000	280,000
Minnesota	1,100	340	3,300	300	1,600,000	1,700	120,000
Ohio	2,800	830	8,400	870	4,700,000	19,000	350,000
Wisconsin	1,400	420	4,200	380	1,900,000	5,100	150,000

ABT ASSOCIATES, 1999

Figure 4:

Number of Metropolitan Areas, by State, with at Least One Day of Unhealthy Ozone During 1998-2000



Nitrogen oxides contribute to dangerous fine particulate matter pollution

When present in the atmosphere, nitrates[13] form fine particles (or aerosols), less than 1/100th of a human hair.[14] Nitrate particulate matter can form a significant fraction of measured $PM_{2.5}$, an EPA-required measurement of all fine particles. Nitrates are typically so tiny they can be inhaled deeply and become lodged in the lungs where they have adverse health consequences. Particulates reduce lung function in children[15] and a mother's exposure can stunt in utero growth.[16] For adults, short-term exposure to $PM_{2.5}$ results in lost work days and raises the likelihood of incurring respiratory (bronchitis, asthma) and heart illnesses.[17] In addition to the short-term effects, long-term exposure increases the risk of death[18] and shortens life spans by a few months to a few years.[19] There is no "safe" threshold for $PM_{2.5}$ below which no effect occurs.[20]

As the concentration of fine particles rises, healthy adult lung function can decline, and risk for heart attacks increases.[21] What this means is that fine particles may adversely impact human health at any concentration.

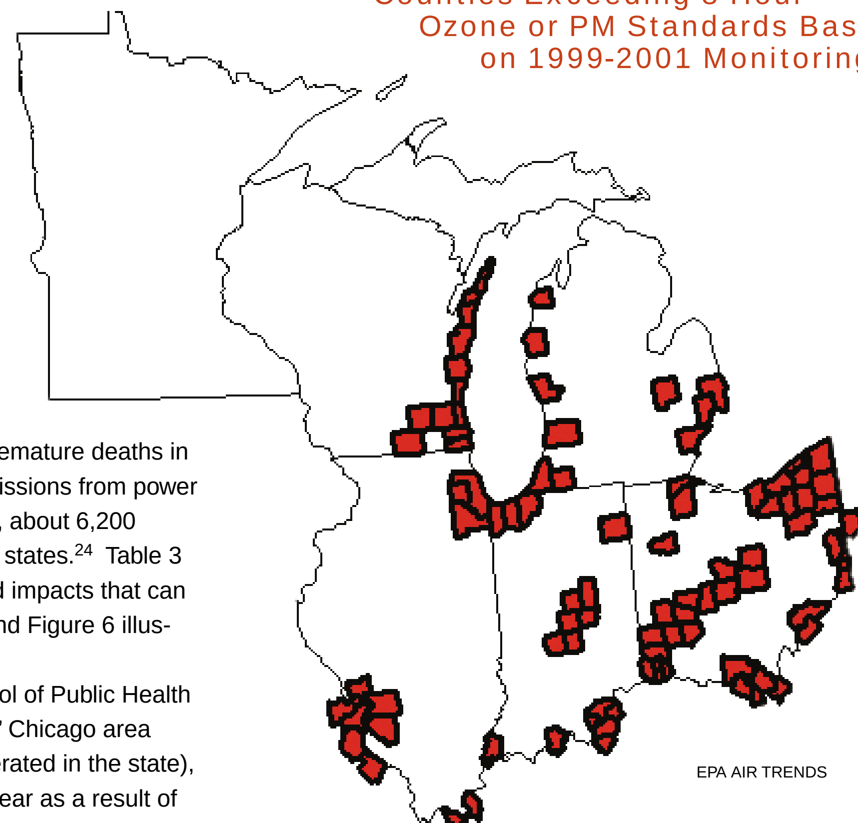
Populations most at risk of dying prematurely as a result of fine particles are the young, the old and persons who already suffer from lung and heart ailments. Studies have found communities with dirtier air to be associated with greater likelihood of premature death than areas with cleaner air.[22]

$PM_{2.5}$ pollution hurts thousands of people each year in the Midwest

Fine particles are a serious problem in the Midwest, with millions of residents living in areas where particulate matter levels exceed the national standard of 15 micrograms per cubic meter of air (ug/m^3). Figure 5 shows the combined $PM_{2.5}$ and ozone exceedances in the Midwest states. The high number of $PM_{2.5}$ exceedances makes it clear that people living in the Midwest are particularly at-risk to the impacts from fine particles. Nitrates, while a contributor to $PM_{2.5}$ year-round, have an even greater impact on $PM_{2.5}$ levels in winter months when they can make up over 50 percent of the particle mass.[23]

Figure 5:

Counties Exceeding 8 Hour Ozone or PM Standards Based on 1999-2001 Monitoring



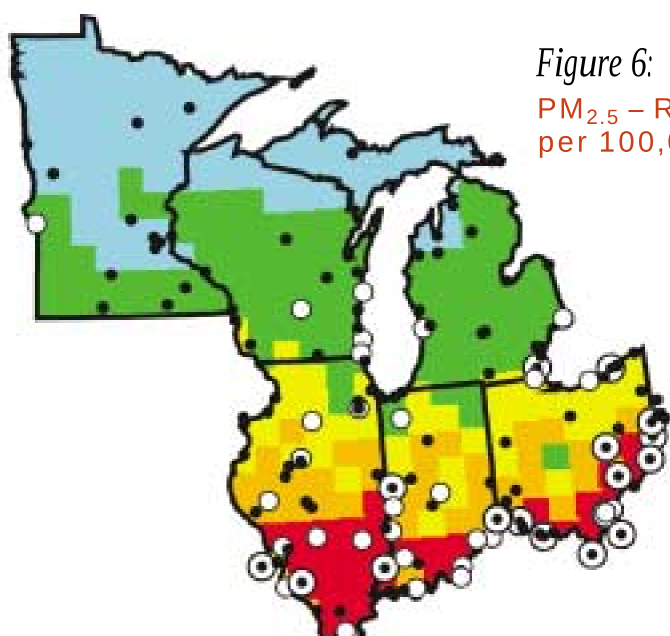
EPA AIR TRENDS

A recent report estimated 30,000 premature deaths in the U.S. each year are attributable to emissions from power plant-related particulate matter. Of these, about 6,200 deaths per year occur in the six Midwest states.[24] Table 3 summarizes state-by-state health-related impacts that can be attributed to fine particulate matter, and Figure 6 illustrates fine particle-related deaths.

According to a recent Harvard School of Public Health study of only nine power plants in Illinois' Chicago area (representing one fifth of the power generated in the state), there are about 320 excess deaths per year as a result of the fine particulate matter related to emissions from these plants.[25] The study found that per capita health risks were greater close to the power plants and that the risks were greatest in inner city Chicago.

Figure 6:

$PM_{2.5}$ – Related Deaths per 100,000 Population



ABT ASSOCIATES, 2000

Table 3:

Estimated Health Impacts from Fine Particulate Matter

ESTIMATE – Year 2007 / current emissions									
State	**Pop 2007**	**Deaths**	**Hosp**	**Asthma Attacks**	**Deaths per 100,000**	**Chronic Bronchitis**	**Asthma ER Visits**	**Work Loss Days**	**Minor Restricted Activity Days**
Illinois	12,434,632	1,695	1,113	33,126	24.6	1,021	385	282,705	1,454,490
Indiana	6,253,063	1,024	681	20,469	29.8	626	239	172,816	885,690
Michigan	9,813,453	870	578	18,527	16.3	564	215	158,856	817,280
Minnesota	5,070,807	246	182	5,821	9.0	175	60	49,836	258,057
Ohio	11,577,089	1,915	1,252	37,067	29.7	1,145	443	313,289	1,602,140
Wisconsin	5,570,223	447	318	9,348	14.6	283	100	79,303	408,749

ABT ASSOCIATES, 2000

Particulate matter equals hazy parks and city skylines, especially in winter months

The spectacular scenic vistas in Midwest parks, wilderness areas and city skylines are blighted by the same fine particles that lodge deep into peoples' lungs. These particles degrade sharp, colorful scenes, leaving them shrouded in a milky white haze. Nitrates contribute to the hazy air, diminishing our ability to enjoy scenic views and urban landscapes and tarnish the image of our cities. As shown in Figure 7, on an annual basis, nitrates represent about one-fifth of the light-extinguishing particles in Minnesota's Boundary Waters National Park.

Haze Conditions from Navy Pier, Chicago, Illinois in 2001.

Note degradation in visibility under moderate particulate matter levels.

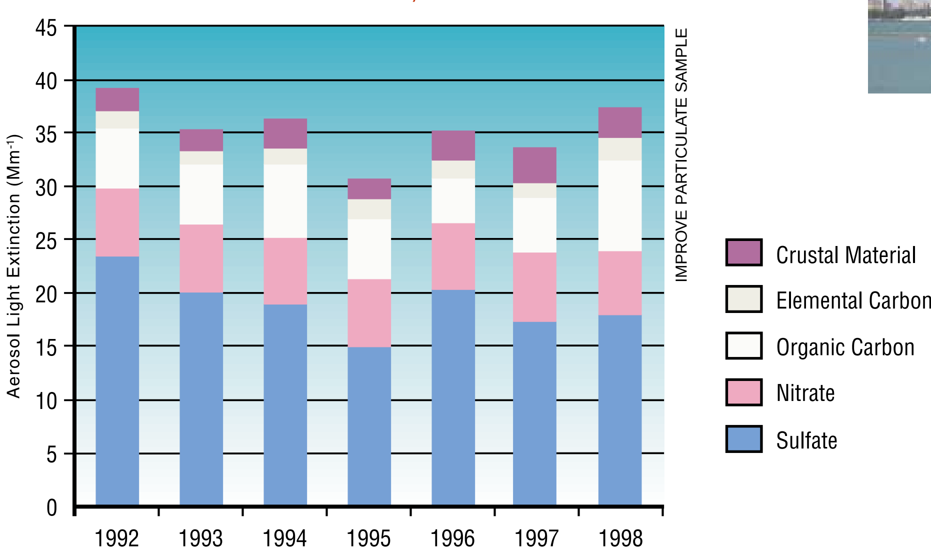
Left: August 26, 2000 – $PM_{2.5}$ = 35 µg/m³

Below: August 16, 2000 – $PM_{2.5}$ <10.0 ug/m³

PHOTOS: ILLINOIS EPA

Figure 7:

Contribution of NO_X and Other Species to Visibility Deterioration in Boundary Waters National Park, 1992-1998

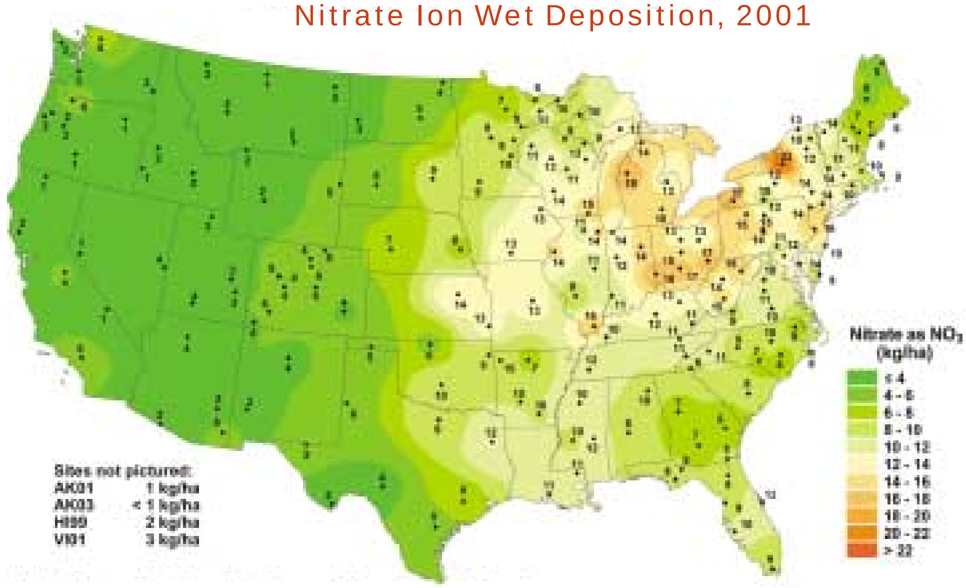


Ecosystems Are Damaged By Nitrogen And Ozone

Midwest has high exposure to nitrate acid deposition

Nitrates fall to the earth's surface as acid deposition in rain, snow and fog as well through dry deposition. How a site handles this acidity depends on the level of deposition, soils and underlying geology. Figure 8 demonstrates that the Midwest states have among the highest deposition of nitrates the country. However, most of the soils in the Midwest are well buffered – that is they have ample supplies of bases such as calcium and magnesium to neutralize high acid inputs. A lower elevation, especially when compared to higher elevation sites to the east, also provides protection.

Figure 8:
Nitrate Ion Wet Deposition, 2001



NATIONAL ATMOSPHERIC DEPOSITION PROGRAM/
NATIONAL TRENDS NETWORK – http://nadp.sws.uiuc.edu

But not all sites in the region are well buffered. The sandstone-based soils of southern Illinois, Indiana and Ohio are vulnerable to acid inputs. In areas of highest deposition, these soils were found to have higher acidity, less calcium, and reduced populations and species diversity of earthworms and other invertebrates. In addition, growth declines of oaks were correlated to the acidity of the site, i.e. the more acidic, the less growth.[26]

EASTERN KENTUCKY UNIVERSITY

And being well buffered does not mean that there is no impact. Modeling work conducted in the early 90s showed that the buffering capacity of Ohio soils downwind of Akron and Cleveland were depleted much faster than soils in parts of the states that received less acidic deposition, suggesting that eventually these buffered soils, and the plants that rely on them, can be altered by acid rain.[27]

Finally, Minnesota and Wisconsin are home to many naturally acidic lakes. In these lakes, there is very little natural buffering capacity, and thus even small changes in acidic deposition can harm the aquatic life in those lakes.

There is also demonstrated damage occurring close to the borders of Midwest states. Sugar maple health across thousands of acres in western Pennsylvania is degraded,[28] and acid-sensitive fish have disappeared from Pennsylvania streams where they formerly occurred in large numbers.[29]

Figures 9 and 10 show nitrate deposition at National Atmospheric Deposition Program sites in two representative Midwestern states – Wisconsin and Ohio – for the years 1997 through 2001.[30] These charts reflect that at most sites nitrate deposition is either unchanged or on the rise. (Note that not all sites have data for all five years.) This raises a troubling point, that despite declining emissions, that there is not an equivalent change in the nitrate deposition burden.

Figure 9:
Nitrate Deposition, Wisconsin 1997-2001

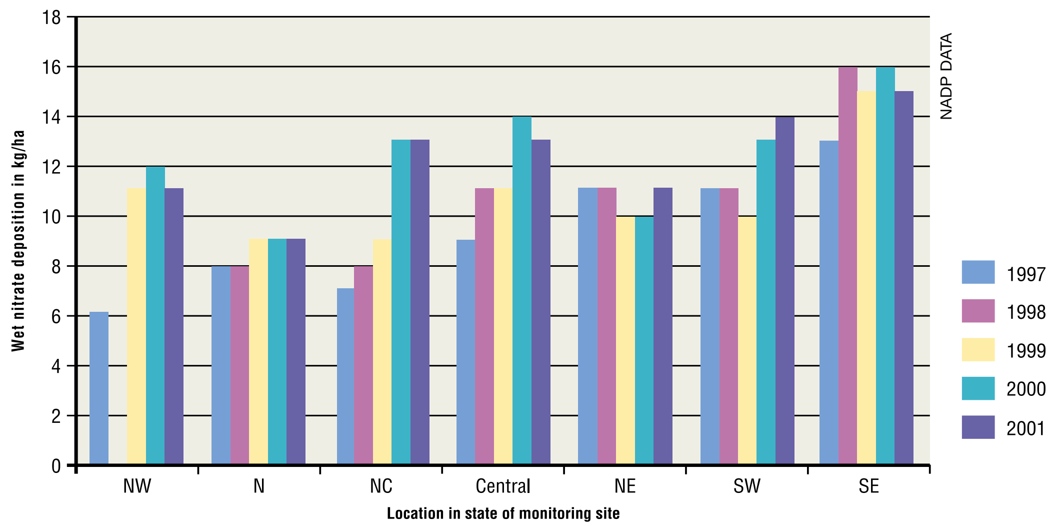
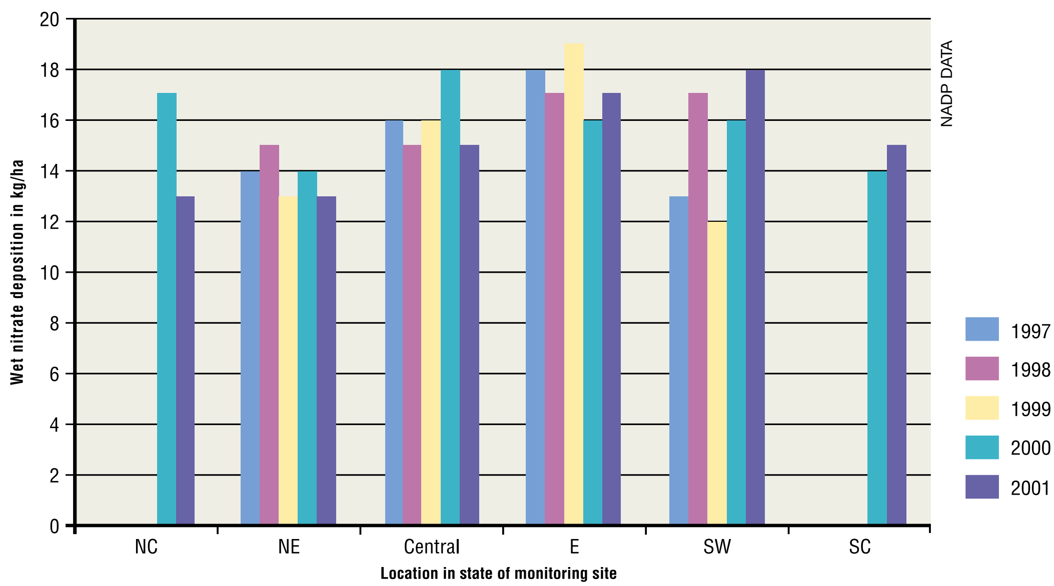


Figure 10:
Nitrate Deposition, Ohio 1997-2001



Loss of species diversity

Most ecosystems have developed with a limited supply of nitrogen. Increases of nitrogen, therefore, can cause a shift in the dominant species and reduce species diversity as the plants adapted to take advantage of high nitrogen are able to force out many native plants. Research at the University of Minnesota has shown that increased nitrogen in grass-lands changes plant and insect species composition and species diversity.[31] Increasing the nitrogen available in the soil can offer an edge to some weeds that have evolved to take advantage of normally rare periods of abundant nitrogen. Rapidly growing weeds, which are often invaders from other ecosystems, can overwhelm native species.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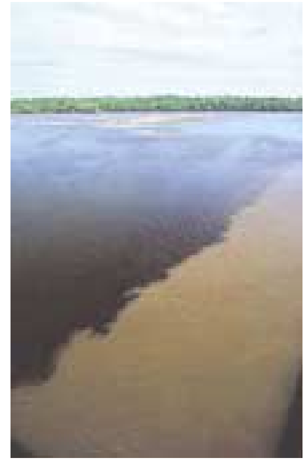
In sugar maple forests across northern tier states – from north-eastern Minnesota to southwestern Michigan – deposition of nitrogen has been found to alter nitrogen cycling and accelerate the loss of plant nutrients from forest soils.[32] The changes from these soil changes may be subtle, but if they persist they could affect long-term forest health.

Gulf of Mexico dead zone

Nitrogen from watersheds originating in Great Lake states is contributing to the "dead zone" in the Gulf of Mexico, which, in the summer of 2002, covered 8500 square miles, the size of Massachusetts.[33] When the nitrogen-rich waters of the Mississippi River flow into the poorly mixed, shallow Gulf waters, excessive algae is produced. This excess algae consumes oxygen during decomposition, leaving waters oxygen depleted.[34] Fish and other marine animals need oxygen for survival. When it is not available, some species die, and others swim into more oxygen-rich waters.

Atmospheric sources of nitrogen account for nearly 20 percent of the total amount of nitrogen reaching the Gulf. Over half of that 20 percent comes from Midwest sources.[35]

In the Ohio River watershed, nearly 25 percent of the region's nitrogen that reaches the Gulf of Mexico comes from the atmosphere. Smaller, but not insignificant, amounts come other Midwest states that feed into the Mississippi River. By percent, contribution from Ohio is followed closely by Indiana, then Illinois, Wisconsin and Minnesota.[36]



NOAA

Ozone suppresses crop yield and tree growth

Ozone affects plants through short-term, highly concentrated exposure as well as prolonged exposure at lower concentrations. There is no "safe" threshold ozone concentration or seasonal exposure level above which effects do not occur. Depending on the duration of exposure and sensitivity of plants, injury can even result from exposures that typically occur throughout the growing season. Once in the plant, ozone interferes with plant chemistry, reduces plant growth and yield and/or compromises the ability of a plant to withstand other stresses such as cold, insects and diseases.

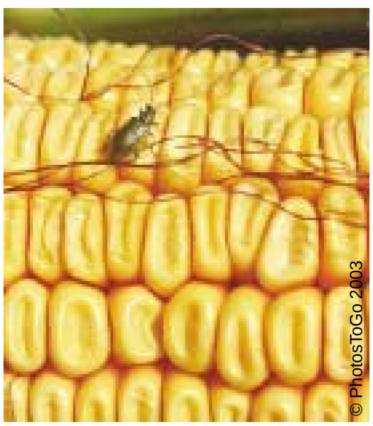


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Table 4 shows exposure to ozone for the three major commodity crops grown in Minnesota, Wisconsin, Michigan, Illinois, Indiana and Ohio (representing up to 80 percent of regional crop production) is costing Midwest farmers between $227,330,000 - 664,278,000 annually.[37]

These same levels of ozone affect forests as well. The US Forest Service has identified areas in Michigan and Wisconsin where forests show visible signs – mottled and discolored leaves – of ozone impacts.[38] Modeling results indicate that tree growth is slowed in all Midwest states for black cherry, red maple, white pine and aspen.[39]

Table 4:

Impact of Ozone in 1997 on Major Crops by State

State	Annual production value for corn, soybeans & wheat *(in thousand dollars)*	Estimated value in production without ozone loss *(in thousand dollars)*	Annual cost of crop loss of three major commodity crops due to ozone exposure *(in thousand dollars)*
Illinois	$6,872,106	$6,917,825 - 7,049,096	$45,719 - 176,990
Indiana	$3,621,561	$3,709,463 - 3,799,839	$87,902 - 178,278
Michigan	$1,204,150	$1,214,788 - 1,237,666	$10,638 - 33,516
Minnesota	$4,655,007	$4,655,007 - 4,743,453	$0 - 88,446
Ohio	$2,938,770	$3,021,841 - >3,093,193	$83,071 - >154,423
Wisconsin	$1,717,072	$1,717,072 - 1,749,697	$0 - 32,625
Total	**$21,008,666**	**$21,235,996 - >21,672,944**	**$227,330 - >664,278**

EPA AND USDA DATA

Current Planned Reductions Of Nitrogen Oxide Emissions Do Not Go Far Enough

Under the EPA's ozone transport rule that was finalized in 1998, most states east of the Mississippi River must significantly reduce their summertime emissions of NO_x to control ozone formation. This rule directly impacts power plant emissions from four Midwest states: Illinois, Indiana, Ohio and Michigan. These four states were required to develop state implementation plans (SIPs) to reduce ozone, and NO_x cutbacks are an important part of these reduction strategies. These cuts are required only during the summertime to control ozone concentrations when they are at their highest. However, making the cuts only in summer months does not help curb problems related to winter NO_x emissions – in particular the dominance of NO_x in winter fine particulates and the deposition of nitrates in non-summer months when ecosystems are particularly sensitive. And the ozone transport rule does not cover Minnesota or Wisconsin, and both of these states have areas on the verge of being in non-attainment with the new ozone standard being implemented now by EPA. Table 5 shows expected NO_x reductions under the SIP call as well as what the reductions would be were the cuts extended year round and geographically.

Reducing NO_x emissions year round and including Minnesota and Wisconsin gets NO_x emissions close to the target range of power plant pollutant reduction bills that have been introduced in the US Congress, illustrating that by many disparate measures, the Midwest has a ways to go to fully clean up its power plant NO_x emissions.

Table 5:

Current Power NO_x Emissions to SIP Call and Potential Year-Round Reductions, in tons

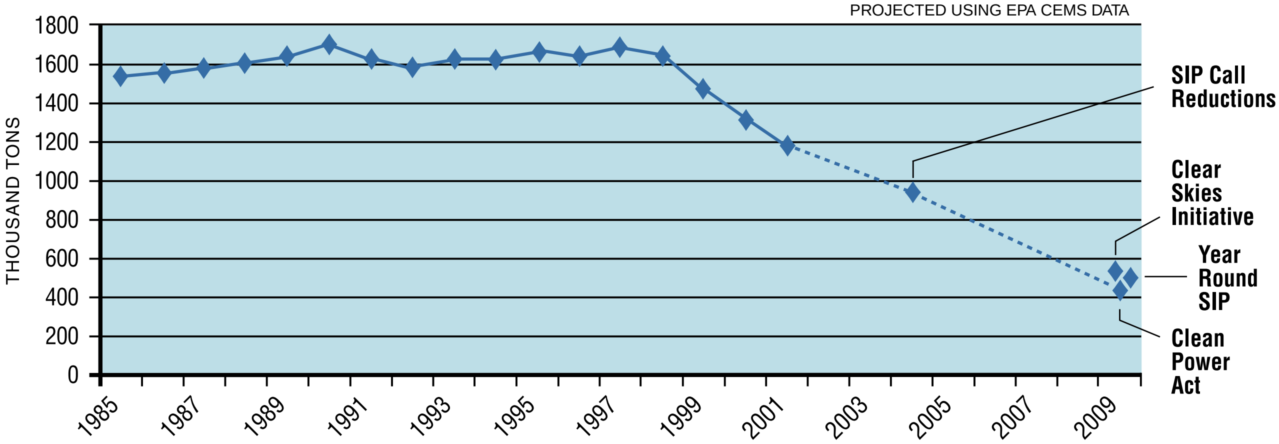
State	Power plant emissions during 2001	Year round NO_x emissions under summer-time SIP call	NO_x emissions allowed if included WI & MN and were year-round
Illinois	199,859	148,957	73,692
Indiana	306,531	226,541	114,555
Michigan	140,951	114,688	77,921
Minnesota	81,083	81,083	32,126
Ohio	332,957	243,491	118,239
Wisconsin	101,083	101,083	40,051
TOTAL	**1,162,464**	**915,843**	**456,584**

PROJECTED USING EPA CEMS DATA

Figure 11:

Emissions Midwest Power Plant NO_x 1985-2001, with Current SIP Call and Targets from Proposed Power Plant Legislation and Year-Round SIP Cuts

PROJECTED USING EPA CEMS DATA



Technologies To Reduce Nitrogen Oxides From Power Plant Have Been In Use For Two Decades

Emissions controls are in use today that minimize the formation of NO_x during the combustion process and reduce the amount of NO_x formed during combustion prior to exiting the stack into the atmosphere. Selective catalytic removal (SCR) systems typically reduce as much as 90 percent and on some occasions even a higher percentage of NO_x gas emissions from coal-fired power plant smokestacks.[40] SCR technologies, which add only a small fraction to the cost of electricity, have been used worldwide since the 1980s.

HUNTINGTON ENVIRONMENTAL SYSTEMS

Solutions

Call on state and federal lawmakers to:

- **Clean up power plants.** Electric power generation is responsible for approximately one-third of the NO_x emissions in the United States. For over thirty years, the oldest, dirtiest coal-burning power plants have circumvented the most protective air emissions standards required of modern plants. As a result, these grandfathered power plants are allowed to emit as much as four times more NO_x than modern power plants. And while some Midwest power plants are beginning to clean up under the summertime reduction rule, the rule does not cover all of the Midwest and does not address wintertime NO_x impacts. All polluting power plants must be made to comply with year-round modern emissions control standards. Proven NO_x emission controls, together with more efficient fuel-burning processes, mean that there are no technological barriers to cleaning up the oldest and dirtiest plants. Modernizing power plants will protect our health and environment.

Call on EPA to:

- **Aggressively implement the new ozone and $PM_{2.5}$ standard.** EPA will soon be designating areas as out of attainment with national air quality standards for ozone and fine particle pollution. All Midwestern states, except Minnesota, have areas that are certain to fail one or both standards. The agency must help the states meet these standards as soon as possible by adopting a rule to reduce interstate pollution from power plants.
- **Stop the effort to weaken the Clean Air Act.** The EPA has proposed revising a section of the Clean Air Act, known as New Source Review, in a way that will allow grandfathered power plants to increase pollution and undercut the ability of state and local officials to meet new air quality standards. The New Source Review program requires that any facility that makes a major modification and increases their air emissions must install the best available control technology. The changes to the program were first proposed by Vice-President Cheney as part of the Administration's energy policy. Some of the proposed changes would allow grandfathered power plants to invest as much as $150 million per year to rebuild old plants and perpetuate their grandfathered status under the law, while claiming the investments are "routine maintenance," thus allowing them to avoid having to install pollution controls.
- **Aggressively enforce lawsuits against power plants that illegally upgraded their facilities.** EPA has taken enforcement actions against numerous Midwest power plants for upgrading the capacities of their coal plants and evading the permitting process that would require new air pollution controls. The agency must ensure these actions, brought under the current New Source Review provision, are completed, and the plants are required to clean up.

You can:

- **Use less energy.** The United States uses more energy per capita than any other country. Using less energy and using energy more efficiency will reduce the amount of nitrogen in our air and water.

Endnotes

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