



Dominion Resources' "Unpaid Health Bills": The Hidden Public Costs of Soot and Smog From the State Line Coal Plant on the Chicago-Northwest Indiana Border and on the Shore of Lake Michigan Total: \$540 - \$720 Million Since 2002

Executive Summary

Dominion Resources, based in Virginia, owns and operates the very old, highly polluting State Line coal plant, which is located near millions of people on the Illinois-Northwest Indiana border just 13 miles from downtown Chicago and on the Lake Michigan shoreline. State Line was originally built between 1926 and 1929, and today, it still uses equipment built in 1955 and 1962. It is one of the oldest operating coal plants in the nation. The Federal Clean Air Act allows coal plants constructed before 1976, which have not since been modified, to defer achieving the more stringent emissions limits that are imposed on newer plants for particulate matter, sulfur dioxide and other pollutants.

Particulate matter (PM) is a complex mixture of diverse solid and liquid particles suspended in the air that cause soot and smog. Chronic exposure to PM can cause serious health problems and premature deaths. PM is directly emitted from coal plants, diesel trucks and locomotives as a by-product of combustion (primary PM) or distally created as other pollutants interact in the atmosphere (secondary PM). Even though pollution from coal

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plants demonstrably harms human health and the environment, many of the resulting economic costs are "hidden" and externalized to the public. The sound economic "polluter pays principle" calls for coal plant owners and other polluters to internalize these costs.

The U.S. Environmental Protection Agency (U.S. EPA) and other authoritative scientific panels have found PM to be among the most serious and costly public health harms from coal plant pollution.

- On July 6, 2010, the U.S. EPA proposed the Clean Air Act Transport Rule, which would require 31 states and the District of Columbia to significantly improve air quality by reducing power plant emissions that contribute to ozone and fine PM pollution in other states. According to the U.S. EPA: "The proposed rule would yield more than \$120 to

\$290 billion in annual health and welfare benefits in 2014, including the value of avoiding 14,000 to 36,000 premature deaths. This far outweighs the estimated annual costs of \$2.8 billion" (emphasis added). Other estimated health benefits include avoiding 21,000 cases of acute bronchitis, 23,000 nonfatal heart attacks, 26,000 hospital and emergency room (ER) visits, 1.9 million days when people miss work or school, 240,000 cases of aggravated asthma, and 440,000 cases of upper and lower respiratory symptoms.

- In December 2009, the Integrated Science Assessment on PM prepared for the U.S. EPA found sufficient scientific evidence to conclude that fine PM causes premature mortality and cardiovascular effects, is likely to cause respiratory effects, and may cause cancer and reproductive and developmental harms, even at levels far below the U.S. EPA's air quality standards.
- In 2006, the U.S. EPA tightened fine PM air quality standards from 65 to 35 micrograms per cubic meter of ambient air ($\mu\text{g}/\text{m}^3$) to prevent thousands of premature deaths each year and create health and visibility benefits worth billions of dollars annually. More recent scientific studies and policy assessments by the U.S. EPA point to strengthening the national ambient air quality standards for PM in order to further reduce the related health damages.

The National Research Council's recent study applied an economic model to estimate damages caused by air pollution at 406 coal plants across the nation. Using 2005 pollution emissions from the State Line Power Station, the Council determined that the **health and environmental damages from this coal plant cost the public in excess of \$77 million (in 2010 dollars) per year**. These costs primarily result from harms to human health in Northwest Indiana and the greater Chicago metropolitan area up to 200 miles from the plant. The cost estimates do not include the coal plant's contributions to more widespread environmental problems, such as global climate change. Coal plants are the largest single domestic source of greenhouse gas pollution; however, fully estimating the costs of climate change impacts was beyond the scope of that study.

The health- and environmental-related damages from the State Line coal plant costs the public in excess of \$77 million per year. The total costs since 2002 are about \$540 million - \$720 million according to the National Research Council's model.

A vast body of scientific research shows that the State Line coal plant's pollution causes serious harm to public health and imposes high economic costs. Beginning in 2002, the Environmental Law & Policy Center and other organizations have drawn public attention to the Harvard School of Public Health's Illinois Power Plant Study and its estimates of

premature deaths and illnesses caused by nine coal plants in the Chicago area and other parts of Illinois. Yet these coal plants have been allowed to continue polluting the region's air quality and, consequently, harming public health.

Over the eight years since these harms were modeled and publicized, the continued pollution from the State Line coal plant has likely caused about \$540 million to \$720 million (in 2010 dollars) in estimated health and related damages according to the National Research Council's model. These mounting costs have not generally been considered in the public debate over pollution from the State Line coal plant. Nor have the costs of this pollution been internalized and incorporated into the cost of the electricity generated and sold by Dominion Resources from this coal plant.

The State Line coal plant also emits large amounts of lung-damaging nitrogen oxides, sulfur dioxide and toxic mercury into the air. State Line emits more nitrogen oxide in relation to the amount of electricity generated than 75% of the coal plants investigated by the National Research Council.

Moreover, State Line kills large numbers of fish in Lake Michigan. State Line is one of several old coal plants around the Great Lakes which are still allowed to take in millions of gallons of water to cool their equipment and then pump the steaming hot water back into the lakes. Illinois and Indiana banned this old technology at newer coal plants decades ago because it is so destructive to aquatic life.

The high health and environmental costs imposed on the public by the State Line coal plant should be more fully considered by policymakers and the general public in making informed decisions about how this coal plant should be operated and regulated. These costs – and measures taken to avoid them – should be the responsibility of the cost-causer, Dominion Resources, which owns and operates this coal plant.

Introduction

The State Line coal plant is located on the coast of Lake Michigan on the Chicago-Northwest Indiana border. State Line operates as a two-unit, 515 megawatt (MW) coal plant. Unit 3, which has 197 MW generating capacity, began operations in 1955, and Unit 4, which has 318 MW generating capacity, began operations in 1962 (The older Unit 1 was built in 1929 and retired in 1978, and Unit 2 was built in 1938 and retired in 1979). Dominion Resources has not installed scrubbers and has largely failed to install other modern pollution controls on the State Line coal plant. It emits far more pollution than newer coal plants that meet the federal air quality standards designed to protect public health.

State Line's pollution affects the health of people across Northwest Indiana and the greater Chicago metropolitan area, up to over 100 miles from the plant.¹ About 78,000 people live within three miles of this coal plant, and more than 11 million people live within 100 miles.² Even larger numbers of people are affected when occupational and recreational exposures are considered.

Numerous scientific studies have demonstrated that the PM and PM-forming emissions from coal plants cause significant public health harms – premature deaths as well as cardiovascular, respiratory and neurological problems – and related costs.³ The increased mortality and morbidity causes both human suffering and billions in economic costs annually: lives lost, hospital admissions, ER and doctor visits, medications, lost work and school days, restricted activity days, etc.

Since 2002, the Environmental Law & Policy Center and other organizations have drawn attention to the Harvard School of Public Health's Illinois Power Plant Study.⁴ The study, published in the peer-reviewed, academic journal *Atmospheric Environment*, quantified the potential health benefits of reducing air pollution from nine older coal plants in the Chicago

The increased mortality and morbidity causes both human suffering and billions in economic costs annually.

area and other parts of Illinois. The study applied atmospheric dispersion models to estimate the incremental contributions of coal plants to ambient concentrations of PM, sulfates and nitrates. The Harvard School of Public Health researchers estimated the following

annual human health harms caused by pollution from the nine Illinois coal plants: 300 premature deaths, 14,000 asthma attacks and over 400,000 daily incidents of upper respiratory symptoms.⁵

¹ U.S. EPA, "Regulatory Impact Analysis for the Proposed Federal Transport Rule" at 327 (2010) (*Regulatory Impact Analysis*) ("concentrations of fine particles in most locations are composed of both local emissions and those transported over hundreds of miles and emission reductions far away can cause significant improvements in local air quality") http://www.epa.gov/ttn/ecas/regdata/RIAs/proposaltrria_final.pdf; National Research Council, *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use* (2010) (*Hidden Costs of Energy*); Levy, J., et al., "Using CALPUFF to evaluate the impacts of power plant emissions in Illinois: model sensitivity and implications," 36 *Atmospheric Environment* 1063 (2002) (*Harvard School of Public Health Illinois Power Plant Study*).

² *Coal Plants Near Residential Areas*; U.S. Census 2000.

³ *Hidden Costs of Energy*, *supra*; U.S. EPA, "Integrated Science Assessment for Particulate Matter" (Dec. 2009) (*Integrated Science Assessment*) <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=216546>; Abt Associates, *Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios* (2004).

⁴ *Harvard School of Public Health Illinois Power Plant Study*, *supra*.

⁵ Harvard School of Public Health Press Release, "Study Details Impact on Public Health of Nine Older Fossil Fuel Power Plants in Illinois" (Jan. 3, 2001) <http://www.hsph.harvard.edu/news/press-releases/archives/2001-releases/press01032001.html>; Levy, J., et al., "Development of a new damage function model for power plants:

The scientific evidence on public health harms and costs from coal plant pollution led the U.S. EPA to tighten limits on PM emissions and, under the 1977 Amendments to the Clean Air Act, to impose stricter standards for new coal plants.⁶ However, many older coal plants claim to be “grandfathered” or exempted from federal regulations on PM emissions under the Clean Air Act.⁷ In 1977, coal plant owners persuaded Congress that the older plants would soon be retired and replaced by new, cleaner facilities, and thus it would not be economically justified to require pollution control retrofits on the soon-to-be-retired old coal plants. However, more than thirty years later, State Line and many other old, highly polluting coal plants continue to operate, and they cumulatively cause billions of dollars in health and environmental costs each year. Because of this gap in federal regulations and the high human health and environmental costs, several state and local governments have acted to require that the older coal plants be cleaned up through installation of modern pollution control equipment, or shut down.

The U.S. EPA initiated an enforcement action against the State Line coal plant in April 2009, citing 4,770 minutes of opacity (“soot and smoke”) violations from 2004 through 2008. The U.S. EPA has not reached an agreement with Dominion Resources. Moreover, in September 2010, the Environmental Law & Policy Center, along with the Respiratory Health Association and the National Resources Defense Council, filed a notice of intent to sue, claiming that the State Line coal plant repeatedly exceeded its permit limit for soot and smoke thickness. Although Indiana

The U.S. EPA, Environmental Law & Policy Center and other groups pointed to repeated violations of permit limits by the State Line coal plant, but Dominion Resources continues operating without necessary controls.

methodology and applications,” 33 Environmental Science and Technology 4364 (1999) See also estimates published in September 2010 by the Clean Air Task Force: annual Illinois plant impacts 621 premature deaths, 455 hospital admissions, and 1,018 heart attacks. Clean Air Task Force, The Toll From Coal (Sept. 2010) (The Toll From Coal) http://catf.us/coal/problems/power_plants/existing/map.php?state=Illinois.

⁶ U.S. EPA, “Implementation of the New Source Review (NSR) Program for Particulate Matter Less than 2.5 Micrometers (PM_{2.5}),” 73 Fed. Reg. 28321 (2008).

⁷ In 2009, the U.S. EPA accused Dominion Resources of modifying and upgrading the State Line coal plant, which triggers the more stringent Clean Air Act requirements, but having not installed required pollution controls. “Just Outside Chicago, a major polluter lurks; Indiana’s State Line, one of the nation’s dirtiest power plants, hangs on despite environmental dangers” Chicago Tribune (Sept. 18, 2010) (Hawthorne) http://articles.chicagotribune.com/2010-09-18/news/ct-met-dirty-power-plant-20100918_1_power-plants-jim-norvelle-major-polluter.

records show State Line violated its air permit 927 times over six years without justification, the Indiana Department of Environmental Management has not issued any fines and has no pending enforcement actions against the State Line coal plant and its owners.⁸

Section I below summarizes the scientific and economic findings on the public health benefits of reduced PM-forming emissions from coal plants. Recent authoritative scientific panels and studies have concluded that: (1) reducing PM pollution from coal plants over a wide range of ambient concentrations will benefit public health, and (2) the "hidden" costs of pollution from coal plants are high.

Section II below presents estimates of the damages caused by the State Line coal plant using the model applied by the National Research Council in its 2010 report. That model estimates that the State Line coal plant causes about \$77 million (in 2010 dollars) in health and environmental damages annually, based on 2005 emissions and excluding damages related to climate change.⁹ High levels of harmful emissions from these old coal plants have continued, likely resulting in about \$540 million to \$720 million (in 2010 dollars) in health and related damages over the eight years since the release of the Harvard School of Public Health's Illinois Power Plant Study.

Section I: Recent Authoritative Scientific Panels Have Concluded that Particulate-Forming Emissions from Coal Plants Harm Public Health

The findings by the U.S. EPA in 2006 and 2010, the Integrated Science Assessment for the U.S. EPA in 2009 and the National Research Council in 2010 on the health impacts of PM pollution from coal plants demonstrate the need to consider the hidden costs imposed on the public. Coal plants emit both primary PM and pollutants forming secondary PM. Primary PM, which exists as both fine (PM_{2.5}, with a diameter of less than 2.5 microns) and coarse (PM₁₀, with a diameter of up to 10 microns) particles, is generated as a combustion by-product and emitted directly from coal plants' smokestacks. Secondary PM_{2.5} is formed when SO₂ and various NO_x molecules undergo chemical transformations in the atmosphere. PM_{2.5} can travel long distances in the air and is of greater health concern than PM₁₀.

Nationally, coal plants are the largest source of sulfur dioxide (SO₂) emissions and among the largest sources of nitrogen oxides (NO_x) emissions, although other economic sectors

⁸ Laasby, "Power plant's smoke a bad habit" *Sun-Times Media* (Oct. 5, 2010)

<http://www.southtownstar.com/news/2772378,100510stateline.article>.

⁹ *Hidden Costs of Energy*, *supra*, at 82-99; data provided by National Research Council's Public Access Records Office. Other damages are comprised of certain environmental damages and resulting costs to industry, including agriculture, forestry and other sectors. Failure to capture many other environmental costs, such as climate change, acid rain and eutrophication of aquatic ecosystems, is a significant limitation of the models available for this report and thus underestimates the costs of the coal plants' pollution.

also contribute to the pollution problem.¹⁰ The amount of SO₂ emissions from a coal plant depends on the sulfur content in the coal burned and the pollution control equipment installed at the plant to capture or "scrub" the SO₂.

A. U.S. EPA's 2010 Proposed Clean Air Act Transport Rule

On July 6, 2010, the U.S. EPA proposed its Clean Air Transport Rule,¹¹ which would require 31 states and the District of Columbia to improve air quality significantly by reducing emissions that contribute to ozone and fine particle pollution in other states.¹² The proposal would require significant reductions in SO₂ emissions (71 percent below 2005 levels) and NO_x emissions (52 percent below 2005 levels) that cross state lines by 2014, with mandatory reductions starting in 2012.

Following extensive analysis of scientific studies and modeling,¹³ the U.S. EPA determined that the emissions reductions from the proposed Transport Rule would lead to significant annual health benefits. The U.S. EPA estimates that, in 2014, the Transport Rule would protect public health by avoiding:¹⁴

- 14,000 to 36,000 premature deaths,
- 21,000 cases of acute bronchitis,
- 23,000 nonfatal heart attacks,
- 26,000 hospital and ER visits,
- 1.9 million days when people miss work or school,
- 240,000 cases of aggravated asthma, and
- 440,000 cases of upper and lower respiratory symptoms.

¹⁰ U.S. EPA, Multipollutant Emission Control Technology Options for Coal-fired Power Plants at 1-2, 2-1, 2-2, 2-3 (2005).

¹¹ The Clean Air Transport Rule responds to a court decision remanding the Clean Air Interstate Rule (CAIR) that was issued by U.S. EPA in 2005. North Carolina v. EPA, 531 F.3d 896 (D.C. Cir. 2008). U.S. EPA estimated that, across 28 eastern states and the District of Columbia, CAIR would reduce SO₂ emissions by over 70 percent and NO_x emissions by over 60 percent from 2003 levels. According to U.S. EPA, this would result in \$85 to \$100 billion in health benefits and nearly \$2 billion in visibility benefits per year by 2015, providing health and environmental benefits valued at more than 25 times the cost of compliance. <http://www.epa.gov/CAIR/>.

¹² U.S. EPA, "Fact Sheet: Proposed Transport Rule Would Reduce Interstate Transport of Ozone and Fine Particle Pollution" (July 6, 2010) <http://www.epa.gov/airquality/transport/pdfs/FactsheetTR7-6-10.pdf> (EPA 2010 Fact Sheet).

¹³ Regulatory Impact Analysis, *supra*. U.S. EPA recognized that there are limitations in its ability to model the health damages from power plant emissions and to quantify the benefits of reducing emissions. As for the implications of these uncertainties, U.S. EPA observed: "There are some costs and important benefits that EPA could not monetize. Upon considering these limitations and uncertainties, it remains clear that the benefits of the proposed Transport Rule are substantial and far outweigh the costs." *Id.* at 1.

¹⁴ EPA 2010 Fact Sheet, *supra*, at 4.

According to the U.S. EPA's estimates based on valuing the mortality and morbidity benefits, the proposed Transport Rule would achieve more than \$120 billion to \$290 billion in annual health and welfare benefits in 2014.

The annual health benefits of this rule far outweigh the estimated annual direct costs of \$2.8 billion to the power sector to comply with the rule. The U.S. EPA anticipates that power plants may use the following to achieve emission reductions:¹⁵

- Operate already installed control equipment more frequently,
- Use low sulfur coal, or
- Install control equipment such as low NOx burners, Selective Catalytic Reduction, or scrubbers (Flue Gas Desulfurization).

The proposed Transport Rule is subject to comments by interested parties and final action by the U.S. EPA. The U.S. EPA anticipates adoption of the rule in 2011 with mandatory reductions starting the following year.¹⁶

B. U.S. EPA's Revised National Standard for Particulate Matter (2006)

In 2006, the U.S. EPA concluded its review of national ambient air quality standards for PM.¹⁷ The Agency noted that thousands of new scientific studies of the health effects of PM were published and peer-reviewed since the Agency last adopted particulate standards in 1997. The U.S. EPA found that exposure to PM_{2.5} caused the following health effects:¹⁸

Health effects associated with short-term exposure to PM_{2.5}:

- Premature death in people with heart and lung disease
- Non-fatal heart attacks
- Increased hospital admissions, ER visits and doctor's visits for respiratory diseases
- Increased hospital admission and ER visits for cardiovascular diseases
- Increased respiratory symptoms such as coughing, wheezing and shortness of breath
- Lung function changes, especially in children and people with lung diseases such as asthma
- Changes in heart rate variability
- Irregular heartbeat

¹⁵ Id. at 5.

¹⁶ U.S. EPA, "Proposed Air Transport Rule" 22, 28 (July 26, 2010) http://www.epa.gov/airtransport/pdfs/TRPresentationfinal_7-26_webversion.pdf.

¹⁷ U.S. EPA, "National Ambient Air Quality Standards for Particulate Matter," 71 Fed. Reg. 61144, 61151-52 (Oct. 17, 2006) (U.S. EPA 2006 Particulate Standards).

¹⁸ U.S. EPA, "Fact Sheet: Final Revisions to the National Ambient Air Quality Standards for Particle Pollution (Particulate Matter)" 4-6 (Sept. 21, 2006) http://www.epa.gov/PM/pdfs/20060921_factsheet.pdf.

Health effects associated with long-term exposure to PM_{2.5}:

- Premature death in people with heart and lung diseases, including death from lung cancer
- Reduced lung function
- Development of chronic respiratory disease in children

The U.S. EPA lowered the 24-hour PM_{2.5} standard from the 1997 level of 65 µg/m³ to a more stringent standard of 35 µg/m³, a reduction of 46%. The decision retained the 1997 standards for annual PM_{2.5} and 24-hour inhalable PM₁₀.

The U.S. EPA cited strong health benefits from meeting the new 24-hour PM_{2.5} standard, achieving estimated annual reductions of:

- 2,500 premature deaths in people with heart or lung disease
- 2,600 cases of chronic bronchitis
- 5,000 nonfatal heart attacks
- 1,630 hospital admissions for cardiovascular or respiratory symptoms
- 1,200 ER visits for asthma
- 7,300 cases of acute bronchitis
- 97,000 cases of upper and lower respiratory symptoms
- 51,000 cases of aggravated asthma
- 350,000 days when people miss work or school
- 2 million days when people must restrict their activities because of particle pollution-related symptoms

The U.S. EPA estimated that the revised 24-hour PM_{2.5} standard would most likely yield between \$17 billion and \$35 billion of health and visibility benefits each year.

As part of the proceedings leading to its decision, the U.S. EPA organized a Clean Air Scientific Advisory Committee, which recommended PM_{2.5} standards with a maximum daily limit between 30 and 35 µg/m³, and an average annual limit between 13 and 14 µg/m³ (compared to the annual standard of 15 µg/m³ adopted in 1997). The U.S. EPA adopted a daily exposure standard at the top of the recommended range, and retained an annual exposure standard above the recommended range.¹⁹

In February 2009, the United States Court of Appeals for the D.C. Circuit reversed, in part, several aspects of the U.S. EPA's 2006 rulemaking decision and required further review of the annual standard for PM_{2.5}.²⁰ The Court held that the Agency failed to provide a reasoned

¹⁹ U.S. EPA 2006 Particulate Standards, *supra*, 71 Fed. Reg. at 61169.

²⁰ American Farm Bureau Federation v. U.S. EPA, 559 F.3d 512, 520-24 (D.C. Cir. 2009).

explanation for its decision to maintain the annual standard at a level above – i.e., less stringent than – the recommendations of its advisory committee, U.S. EPA staff and many parties to the proceeding. The U.S. EPA's review of its PM air quality standards is now going forward.

C. Integrated Science Assessment for Particulate Matter Performed for the U.S. EPA (2009)

In December 2009, the U.S. EPA issued the Integrated Science Assessment for Particulate Matter. This extensive report by a panel of scientists is “a review, synthesis, and evaluation of the most policy-relevant evidence, and communicates critical science judgments relevant to the National Ambient Air Quality Standards.”²¹

The Integrated Science Assessment evaluated the collective evidence from epidemiological, controlled human exposure and toxicological studies on the causes of health impacts. The Scientific Panel found sufficient evidence to conclude that a causal relationship:

- Exists between short-term and long-term exposures to PM_{2.5} and mortality as well as cardiovascular effects,
- Is likely to exist between short-term and long-term exposures to PM_{2.5} and respiratory effects,
- Is suggestive between long-term exposures to PM_{2.5} and cancer as well as reproductive and developmental outcomes, and
- Is suggestive between short-term exposure to PM₁₀ and mortality, cardiovascular effects and respiratory effects.²²

In particular, the report reviewed scientific studies addressing health effects at levels of PM below the standards adopted by the U.S. EPA in 2006. The Scientific Panel found studies demonstrating adverse health effects from PM at levels substantially below the U.S. EPA standards and below the lower end of the recommendation for daily exposure of the U.S. EPA's 2006 Clean Air Scientific Advisory Committee. For example, from epidemiological studies in locations with ambient concentrations ranging from 7 to 18 µg/m³, the Integrated Science Assessment found consistent positive associations between short-term PM_{2.5} and cardiovascular disease (measured in emergency room visits and hospital admissions). The Scientific Panel also reported that multicity studies in locations with mean 24-hour average PM_{2.5} levels above 12.8 µg/m³ found consistent increases in cardiovascular mortality associated with greater particulate exposure.²³

²¹ Integrated Science Assessment, *supra*, at 1-1.

²² *Id.* at 2-9 – 2-13, 2-18.

²³ *Id.* at 2-9.

D. National Research Council Report (2010)

The National Research Council is administered by the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine. In response to a request by Congress in the Energy Policy Act of 2005, the National Research Council formed a committee to study the key external costs and benefits – related to health, environment, security and infrastructure – associated with the production, distribution and use of energy, but that are not reflected in market prices or fully addressed by current government policy. The resultant report, Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use, was issued in 2010.

Among other topics, the study quantified the impacts of pollution from coal plants on human health, agriculture and visibility. The study applied the Air Pollution Emission Experiments and Policy (APEEP) model to estimate the effects of emissions from 406 coal plants on ambient air quality and to calculate the damages associated with emitting a ton of each of four criteria pollutants (SO₂, NO_x, PM_{2.5} and PM₁₀) at each coal plant.²⁴ The categories of health damages from PM that were modeled by the National Research Council include premature mortality, chronic bronchitis, and respiratory and cardiovascular hospital admissions.²⁵ Additionally, the APEEP model includes costs associated with visibility impairment; ozone-related crop, timber, and recreation (forest canopy changes) damages; and SO₂-related damages to building materials. The model does not include the damages resulting from climate change.²⁶ The National Research Council concluded that there are health damages from any level of emissions; there is no threshold of low levels of emissions that cause no damages.²⁷

The calculations estimated aggregate annual health and related damages caused by emissions from coal plants in 2005 of approximately \$62 billion (in 2007 dollars). The

The National Research Council's calculations estimated aggregate annual health and related damages caused by emissions from coal plants in 2005 of approximately \$62 billion.

health damages are estimated at 4.4 cents per kWh for the average coal plant, and 3.2 cents per kWh for the plants weighted by net generation of electricity at the plant. By comparison, mean damages for natural gas plants were 0.16 cents per kWh when weighted by

²⁴ Hidden Costs of Energy, *supra*, at 6, 61, 423-29. APEEP can be used to compute the marginal damage of emissions on a source-specific basis for nearly 10,000 distinct sources of air pollution in the United States.

²⁵ *Id.* at 86, 428.

²⁶ *Id.* at 10. (coal plants are the largest single domestic source of greenhouse gas pollution).

²⁷ *Id.* at 87, 424-25. See also Abt Associates, Technical Support Document for the Powerplant Impact Estimator Software Tool 10 (2010); A. Lockwood, et al., Coal's Assault on Human Health (2009) (Physicians for Social Responsibility report); J. Romley, et al., The Impact of Air Quality on Hospital Spending (2010) (Rand Corporation report).

the amount of electricity generated.²⁸ In short, natural gas plants cause 95% less health and related damages than coal plants per kWh generated.

Over 90 percent of the damages associated with the air pollution modeled – more than \$56 billion (in 2007 dollars) annually – come from mortality caused by primary and secondary PM_{2.5}.²⁹ The National Research Council explained that primary PM_{2.5} has very high damages per ton emitted. Because there are much greater volumes of SO₂ and NO_x emissions than PM emissions from coal plant smokestacks, more health damages come from secondary PM_{2.5}.³⁰

Section II: Estimating the Economic Damages of Particulate Pollution from the State Line Coal Plant

This section presents estimated health and related damages of PM and PM-forming emissions from the State Line coal plant using the model applied by the National Research Council in its 2010 report. There is uncertainty in the models when they are used to estimate health and related damages for any one year from any single coal power plant. Nevertheless, based on many scientific studies and authoritative review panels, there is strong evidence that the health and related damages from the State Line coal plant are huge – likely \$540 million to \$720 million (in 2010 dollars) over the eight years since the release of the Harvard School of Public Health's Illinois Power Plant Study. Moreover, this coal plant continues to operate and pollute the air today, creating additional health and environmental costs.

A. National Research Council Estimates Using 2005 Data

The National Research Council's model reflects a wide distribution of pollution intensity (emissions per kWh) across the 406 coal plants. Factors accounting for the variation in the coal plants' health costs and related damages include: the plant size and amount of electricity produced; proximity to population centers; sulfur content of the coal burned; adoption, or not, of scrubbers and other pollution control technologies; and plant vintage (newer plants are subject to more stringent pollution controls).³¹

Dominion Resources bought the State Line plant in 2002 for approximately \$182 million.³² The State Line plant is located just 13 miles from downtown Chicago and near densely-

²⁸ Hidden Costs of Energy, *supra*, at 6-8, 91. The distribution of damages for gas-fired electricity generation had a large variance.

²⁹ *Id.* at 92, 97.

³⁰ *Id.* at 88 & n.24.

³¹ *Id.* at 91-92.

³² Dominion Press Release, "Dominion, Mirant Complete Indiana Power Plant Sale" (June 3, 2002) <http://dom.mediaroom.com/index.php?s=43&item=677>

populated neighborhoods in Northwest Indiana, the south side of Chicago and southern Chicago suburbs. More than 11 million people live within 100 miles of the State Line coal plant.³³ Dominion has not installed scrubbers to reduce emissions at the State Line coal plant.

Table 1 shows the National Research Council's estimates of \$73 million (2005 data, 2007 U.S. dollars) in annual health costs and related damages from the State Line coal plant's emissions. Calculated in 2010 U.S. dollars, the estimated annual costs exceed \$77 million.

Table 1: Estimated Health Costs and Related Damages from State Line Coal Plant
(National Research Council estimates using 2005 data and 2007 U.S. dollars)

Pollutant	Emissions Amount (tons)	Damages (\$ per ton)	Est. Damages (\$mil)
Sulfur dioxide	7,951	\$7,018	\$55.8
Nitrogen oxide	6,847	\$1,855	\$12.7
Fine particulates	291	\$14,459	\$4.2
Coarse particulates	436	\$705	\$0.3
<i>Total Estimated Damages</i>			\$73 million

B. Need for Actions to Reduce Pollution and Health Costs from Dominion Resources' State Line Coal Plant

In addition to the health damages and related costs estimated by the National Research Council for 2005, the impacts of the State Line coal plant in other years call out for actions to reduce the plants' pollution. U.S. EPA and National Research Council data make clear that SO₂, NO_x and PM emissions from these plants appear to be on-going, and, in some cases, worsening problems for public health. (See Table 2 in the Appendix to this report.)³⁴

1. [SO₂ pollution from the State Line coal plant increased from 2002 to 2009, causing higher health damages.](#)

Far from reducing SO₂ emissions (by installing scrubbers or sufficient pollution control methods), Dominion Resources allowed the SO₂ emissions from this plant to increase from the level in 2002: SO₂ emissions were 16% higher in 2009, and 38% higher in 2008. The

³³ US Census Data 2000; [Coal plants near residential areas, supra](#) (population within one mile: 13,664; population within three miles: 77,931).

³⁴ See also [The Toll From Coal](#) (estimating that State Line annually caused 24 premature deaths, 38 heart attacks, 420 asthma attacks, 18 hospital admissions, 15 cases of chronic bronchitis, and 27 asthma ER visits) http://www.catf.us/coal/problems/power_plants/existing/map.php?state=Indiana.

upward trend in emissions means that annual damages are likely to be increasing as the coal plant continues to operate without sufficient pollution controls.

Moreover, SO₂ emissions were relatively low in the year modeled by the National Research Council (2005). SO₂ emissions were higher in six of the other seven years from 2002-2009. The average for these eight years was about 14% above the level in 2005.

These emissions data indicate that the health damages and related costs caused by State Line coal plant's SO₂ emissions over the 2002-2009 period likely exceeded eight times the amount estimated by the National Research Council for 2005, totaling more than \$470 million (in 2010 dollars).

While this plant's SO₂ emissions were down in 2009 from the 2008 level, this decline coincided with a substantial drop in the electricity produced by the plant. That change in utilization may be only temporary. Unless Dominion installs scrubbers or other pollution control technologies or techniques, this plant's SO₂ emissions may grow or continue at high levels, causing extensive health damages.

[2. NO_x emissions at the State Line coal plant averaged in excess of the levels in 2002 and 2005, causing higher health damages.](#)

Dominion Resource's State Line coal plant continues to emit large amounts of NO_x. Rather than reducing NO_x emissions by installing modern pollution control equipment, Dominion Resources instead allowed the NO_x emissions from 2002-2009 to average 7% above the 2002 level. Even more disturbing, the NO_x emissions in 2008 (the most recent year before the decline in electricity production) were 27% above the 2002 level. This upward trend in emissions would correlate with increasing annual health and environmental damages.

As in the case of SO₂ emissions, the year modeled by the National Research Council had relatively low NO_x emissions. NO_x emissions were higher in six of the other seven years from 2002 to 2009. The average for these eight years was almost 12% above the level in 2005.

These emissions data indicate that the health damages and related costs caused by State Line's NO_x emissions over the 2002-2009 period likely exceeded eight times the amount estimated by the National Research Council for 2005, totaling more than \$110 million (in 2010 dollars).

The decline in NO_x emissions from 2008 to 2009 coincided with the substantial drop in electricity production that may be only temporary. Dominion Resources has not implemented sufficient NO_x control technologies or techniques, and this coal plant's NO_x emissions may grow or continue at high levels, causing extensive health damages.

3. [Direct emissions of PM in 2005 were above the levels in 1999, causing high health damages.](#)

The National Research Council found that direct PM emissions cause high health and related damages per ton. Data on direct emissions of PM are available only for 1999, 2002 and 2005.

The tons of direct PM emissions increased sharply at the State Line coal plant comparing 2002 to 1999, and in 2005 these emissions remained above the 1999 levels. In 2005, PM_{2.5} emissions exceeded the 1999 level by 10%, and PM₁₀ emissions were 50% above the 1999 level. Damages from these emissions over the 2002-2009 period were likely about eight times the estimate for 2005, totaling about \$38 million (in 2010 dollars).

In summary, the National Research Council's model and the U.S. EPA data do not provide estimated health and related damages for each individual year of Dominion Resource's operation of the State Line coal plant. There is little doubt that these damages have been large and are continuing at a high level each year. The National Research Council's estimate of about \$77 million (in 2010 dollars) in health costs and related damages in 2005, together with the factors described above, suggest that the total harms to public health and related damages from Dominion Resource's State Line coal plant exceeded \$618 million (eight times the estimate for 2005; in 2010 dollars) during the 2002 through 2009 period following the release of the Harvard School of Public Health's Illinois Power Plant Study. Using the average emissions over this period, the estimated health damages are about \$720 million (in 2010 dollars). As a conservative lower bound, the health damages are expected to exceed \$540 million (in 2010 dollars).

Conclusion

Several recent scientific studies have concluded that PM-forming emissions from coal plants cause premature mortality as well as increased respiratory and cardiovascular health problems. The U.S. EPA's cost-benefit analysis for the proposed Transport Rule in 2010, the Integrated Science Assessment of PM performed for the U.S. EPA in 2009, the U.S. EPA's order strengthening the ambient air quality standards for PM in 2006 and the National Research Council report on hidden costs of energy in 2010 evaluated the collective evidence from epidemiological, controlled human exposure and toxicological studies. These analyses found that adverse health effects occur at levels of emissions below the current U.S. EPA standards and that each ton of emissions causes incremental harms and costs.

The public health and environmental costs of coal plants are high. The U.S. EPA estimates that by reducing coal plant emissions of ozone and PM_{2.5}, the proposed Transport Rule would achieve more than \$120 billion to \$290 billion in annual health and welfare benefits in 2014. These benefits would be 50 - 100 times greater than the estimated annual direct costs. Using a different set of models and 2005 data, the National Research Council estimated aggregate national annual health costs and other damages of \$62 billion related to coal plants' emissions of SO₂, NO_x, PM_{2.5} and PM₁₀. Although there are uncertainties in the models used to estimate the health impacts and associated costs of coal plant emissions, there is little doubt, based on thousands of scientific studies and authoritative review panels, that these health costs are very large.

Over the eight years since the premature deaths and illnesses from these plants were highlighted by the Harvard School of Public Health's Illinois Power Plant Study, the cumulative health costs and related damages from State Line amount to about \$540 million to \$720 million.

The pollution from Dominion Resource's State Line coal plant spreads over nearby densely populated neighborhoods in Northwest Indiana, the south side of Chicago and southern suburbs, and across the Chicago metropolitan area, hundreds of miles from the plant. The model applied by the National Research Council estimates that these coal plants cause substantial health costs: more than \$77 million annually, using 2005 emissions data as expressed in 2010 dollars. Over the eight years since the premature deaths and illnesses from coal power plants in the Chicago area were highlighted by the Harvard School of Public Health's Illinois Power Plant Study, the cumulative health costs and related damages from State Line likely amount to between \$540 million and \$720 million (in 2010 dollars). These cost estimates do not include environmental and public health damages from climate change.

The public health costs of pollution from the State Line coal plant are too significant to overlook. Public health and related damages should be more strongly considered in the public policy debate in light of the substantial economic costs and human suffering caused by pollution from this old coal plant still operating on the Lake Michigan coast on the Illinois - Northwest Indiana border in the Chicago metropolitan area.

Appendix

Table 2: Operations and Emissions Data for Dominion's State Line Power Plant 1999-2009 (U.S. EPA Clean Air Markets and Air Data)³⁵

year	Heat Input (mmBtu)	Gross Load (MWh)	SO2 tons	NOx tons	PM2.5 tons	PM10 tons
1999	25,696,601	2,349,995	7,085	8,115	265	290
2000	32,197,989	3,351,289	8,994	9,586	NA	NA
2001	29,043,523	3,022,373	7,860	7,866	NA	NA
2002	31,889,859	3,175,569	8,443	7,141	320	488
2003	32,810,600	3,250,234	8,011	8,370	NA	NA
2004	33,496,533	3,316,175	9,701	8,348	NA	NA
2005	29,664,467	2,996,424	7,949	6,848	291	436
2006	29,751,269	2,973,392	7,348	7,288	NA	NA
2007	33,430,848	3,401,115	9,333	8,205	NA	NA
2008	38,573,500	3,981,241	11,625	9,102	NA	NA
2009	27,641,392	3,015,681	9,776	5,991	NA	NA

³⁵ 2005 data on PM from National Research Council.