

Iowa Coal & Health

A Preliminary Mapping Study



photo by Paul Deaton

A Report by the Iowa Chapter of Physicians for Social Responsibility

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Plains Justice

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ABOUT PHYSICIANS FOR SOCIAL RESPONSIBILITY

PSR has a long and respected history of physician-led activism to protect the public's health. Founded in 1961 by a group of physicians concerned about the impact of nuclear proliferation, PSR shared the 1985 Nobel Peace Prize with International Physicians for the Prevention of Nuclear War for building public pressure to end the nuclear arms race. Today, PSR's members, staff, and state and local chapters form a nationwide network of key contacts and trained medical spokespeople who effectively target significant threats to global survival. Since 1991, when PSR formally expanded its work by creating its environment and health program, PSR has addressed the issues of global warming and the toxic degradation of our environment. PSR presses for policies to curb global warming, ensure clean air, generate a sustainable energy future, prevent human exposures to toxic substances, and minimize toxic pollution of air, food, and drinking water. **Iowa PSR** is a proud member of this esteemed family of physician and health professional activists.

Cover photo: Grain processing plant in Muscatine, Iowa located within 1500 feet of an elementary school. Taken February 20, 2010

Executive Summary

This report represents a preliminary effort to correlate the known disease burden and costs to Iowans of relying on coal to produce energy. Information was drawn for correlation and analysis from a variety of publicly available scientific resources, databases, and recently published research pertinent to Iowa. Geographical mapping techniques were utilized to synthesize graphical views comparing the distributions of a group of index diseases with a variety of environmental pollution sources to facilitate visualization of these complex data sets. Qualitatively, results are provocative and strongly suggest correlations between coal combustion and health in Iowa. Areas of monitoring and reporting where inadequate information hampers the ability to make the highest quality estimates of health effects of coal combustion in Iowa are identified.

Ninety-two percent of Iowans live within 30 miles of a coal plant, and almost one out of three Iowa children attend school in close proximity to a coal plant. Additionally, Iowa is home to several of the oldest, least efficient and most polluting coal burning power plants in the nation, those grandfathered and exempted from stricter emissions limits after passage of the Clean Air Act in 1977. This means that not only does Iowa have more power plants per capita than almost all states, but many of Iowa's power plants emit relatively more pollution per unit of energy produced because of their age. Finally, Iowa also disposes a disproportionate amount of coal combustion waste. Numerous toxic substances naturally found in coal are concentrated in such waste. Iowa has lax regulations on coal combustion waste disposal and allows waste from other states to be brought into Iowa for disposal. Thus Iowa absorbs the waste from its own plants as well as that produced elsewhere despite the potential health and environmental impacts of the many toxic substances involved.

Most Iowans, including health care providers and public health workers, are not aware of the intensity of burning coal in Iowa or of coal combustion related health risks. To best serve patients, health care professionals have a responsibility to understand these issues and inform their patients about specific environmental health risks. While health care providers have a duty to prevent disease, they may be unaware of effective measures to reduce or prevent unperceived health risks. This report begins the education process in Iowa.

BURNING COAL HEALTH COSTS

Coal combustion emissions and waste residue contain numerous pollutants hazardous to health. Substantial scientific evidence demonstrates health and environmental harms at every stage of coal's life cycle, from the coal mine to the coal ash. No matter when, where, or how coal is mined, cleaned, transported, stored, burned, or its waste products disposed, coal based energy produces costly immediate and long term impacts on human health and the environment. Pollutants released into the environment when burning coal include mercury, fine particulate matter (PM_{2.5} and PM₁₀), nitrogen oxides (NO_x), sulfur dioxide (SO₂), volatile organic chemicals (VOC), and a long list of other harmful substances, including importantly, carbon dioxide.

These coal related pollutants accumulate in the environment and in human bodies. Fine particulate matter in particular is known to penetrate deeply into lung tissue and pass into the general circulation and cause disease in other organ systems. Both long- and short-term exposures to ambient levels of particulate matter air pollution have been associated with premature mortality. Coal is one of the major sources for atmospheric fine particulate matter. At the national level coal is responsible for about 19% of particulate matter, but in Iowa it accounts for 25%.

Products of coal combustion are known to induce or exacerbate asthma, chronic obstructive pulmonary disease (COPD), cardiovascular, and neurologic diseases. Each of these conditions are increasing in the population as a whole and contribute significantly to four of the top five leading causes of death in the US: heart disease, cancer, stroke, and chronic lower respiratory diseases. In fact, burning coal contributes to or exacerbates many of the most significant public health problems faced today all around the world. Technologic improvements installed by coal industries lessen the amount of hazardous substances released, yet Iowans across the state, continue to be exposed regularly to coal based pollutants that exceed federal standards—standards that many agree could be much stronger.

Some Iowans are more vulnerable than others to air and water pollution. Children, elders, outdoor workers, and Iowa's minority populations are more susceptible to the harmful effects of burning coal. The burden in suffering, lost work and school days, and economic costs to Iowa, not just to those directly impacted, is significant. Nevertheless, coal is rarely mentioned as a potential causative factor in discussing these costly diseases with affected patients or in public health campaigns.

In many parts of the state coal is one of several sources of airborne irritants. Coal emissions readily interact with several other unregulated pollutants intensively distributed across Iowa. For example, products of coal combustion interact and combine with the chemicals released by large scale agriculture. Given Iowa's intense and variable wind patterns and the presence of coal burning across much of the state, rural Iowans are also adversely impacted. The copious use of nitrogen fertilizers on Iowa's vast corn fields, and the large number of confined animal feeding operations (CAFOs) both release reactive nitrogen, sulfur oxides and fine particulate matter which in a manner similar to coal adversely affects health, the environment, and the climate.

Most official attention and concern focuses on the high financial costs incurred by any regulation of coal, or the promotion of cleaner alternatives without serious attention to very real health costs. Utilizing the Environmental Protection Agency's Co-Benefits Risk Assessment (COBRA) Screening Model, it is estimated that reducing the level of emissions in Iowa to that found on average in most states would save the state \$71,785,903 on health expenditures annually. Most of the savings are due to the reduction in premature mortality from reduced exposure to fine particulate matter. Reduction in chronic illnesses, chronic bronchitis and non-fatal heart attacks, account for a savings of \$4,756,373 or 6.6% of the total. The rest of the savings on health outcomes in this scenario are found in reductions in infant mortality, respiratory and cardiovascular hospital admissions, acute bronchitis, upper and lower respiratory symptoms, asthma emergency room visits, minor restricted activity days and lost work days.

Geographical Information Systems (GIS) mapping techniques provide a basis for visually demonstrating and examining the distribution of pollutant emissions and the specific health concerns of coal for Iowans: asthma, COPD, acute respiratory infections, ischemic heart disease, stroke, respiratory cancer, and diabetes. Iowa enjoys an image of being a clean and healthy rural state, but when the sites and emission characteristics of Iowa's coal burners are layered over the state's health a picture emerges of several "hot spots" for excess prevalence of these diseases of concern.

Available data indicates that the current level of effort to identify, track, monitor or regulate coal related risks are inadequate to protect public health. Only a small number of the components found in coal emissions are monitored or regulated despite their known or suspected adverse health impacts. The interacting nature of pollutants from several sources and the final common expression of

diseases as manifestations of exposures makes assigning specific blame to one source or another difficult but not impossible.

As scientific awareness of potential harms induced by exposure to coal combustion continues to grow, public awareness and the ability to monitor or intervene in the production of coal related environmental toxic elements remains limited. The report suggests further paths of investigation and possible strategies for prevention and reduction of known health risks. Health professionals, as community leaders, are encouraged to take active roles in advocating for a healthier future for Iowans.

RECOMMENDATIONS

Of the detailed steps required to promote health and prevent health risks related to coal included at the end of the report, the authors feel the following items are most urgently needed to reduce dependence on coal, protect public health and the environment:

- Support funding to more comprehensively track and monitor adverse health events
- Tightened standards for energy efficiency and their enforcement
- A moratorium on new coal plants in Iowa & shuttering of the oldest burners
- Tightened standards for PM_{2.5}
- Systematized clean-up and containment of coal ash waste at the state & federal level
- Elimination of coal subsidies and tax and financial incentives

Undoubtedly, these recommendations will not be easy or quick. These and others will require efforts at all levels local, state, regional, national and international, to bring about the changes most urgently needed. Long term improvements and regulations at any level require public funding and oversight. Efforts have already begun in some areas in various Iowa farming communities or on Iowa's college campuses. The authors hope that readers will utilize this information to create a healthier Iowa by supporting such efforts and promoting cleaner, sustainable alternatives to unhealthy coal.

Methodology

Qualitative and quantitative methods were utilized: Cluster analysis, GIS mapping, and the EPA COBRA tool. Combined, these methods provide a preliminary spatial and economic assessment of the health costs of burning coal in Iowa. Data was obtained from publicly accessible government sources, including the EPA, DNR, and EIA, and scientific peer reviewed sources that assess health impacts of coal emissions and coal combustion waste products. These environmental and emissions data sets were paired with Iowa county-level demographic and health data. Maps of the sites of Iowa's coal burners, their emissions, their combustion waste products storage sites, along with the locations of Iowa's many CAFOs were overlaid on Iowa's health outcome data. Demographic profiles of vulnerable Iowans were similarly used to compare their locations with likely emission plumes of coal plants.

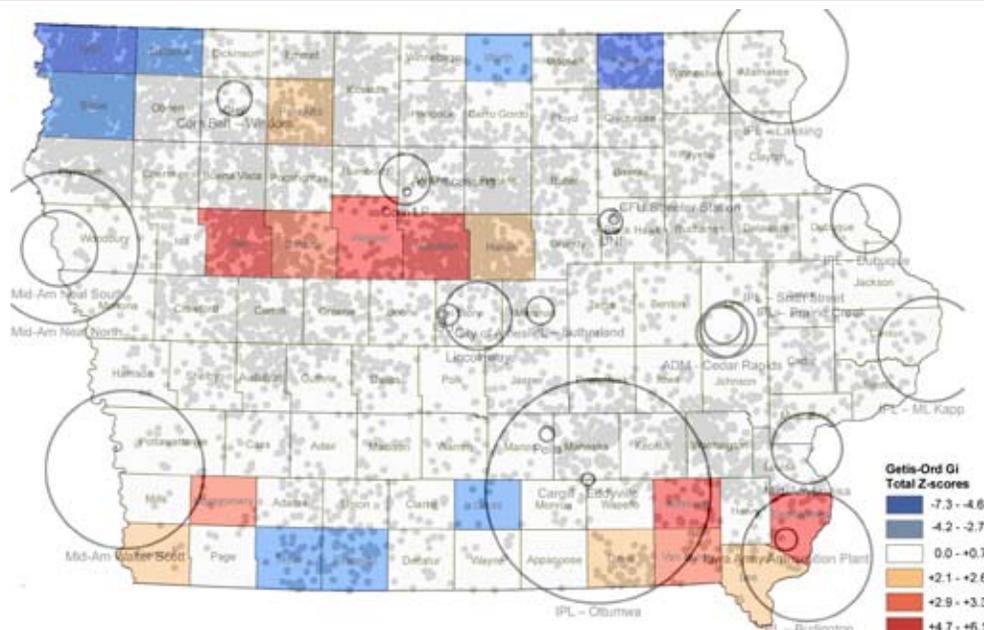
The EPA COBRA tool provided a first-order approximation of the costs and benefits of different coal emission scenarios comparing outcomes of changes in ambient particulate matter concentrations, related health effects, and economic impacts. The tool was used to identify scenarios that might benefit from further evaluation with more sophisticated air quality modeling approaches. For example, the COBRA tool was used to address the question: what would be the impact on Iowa's health if the percentage of electricity generated from burning coal in Iowa were reduced enough to align with the national average?

When using these tools, the authors recognized that monitoring and record keeping to date is not done with the goal of ecological and epidemiological analysis in mind but to meet national and local reporting and record keeping requirements that are not standardized across industry types and/or agencies. Additionally, each data set has significant numbers of data points missing. Reconciling and weighing many factors and variables made the compatibility and interpretation of disparate data sets challenging.

Results

The graphical summary of the GIS results are shown in the following overlay map comparing known coal combustion and CAFO sources to hospital discharges and disease hot spots (see the full report for a more extensive collection of maps and other results). As an example, Map 16 overlays the PM_{2.5} coal plant emissions and the location of Iowa CAFOs with the results of the hot/cold spots analysis for the six diagnoses of concern combined: asthma, COPD, acute respiratory infections, respiratory cancer, coronary artery disease, and stroke. Even given the limitations of the data sets used including a recognition that data points are missing from some of the coal burners and hospital discharges, a pattern of "hot spots" or elevated disease rates, emerged. Areas of elevated diseases of concern are noted in southwestern, southeastern, and north central Iowa.

Map 16: Iowa Coal facility PM_{2.5} total emissions, location of Iowa CAFOs, and hot/cold spot cluster analysis for the six diagnoses: asthma, COPD, respiratory infection, respiratory cancer, coronary heart disease, and stroke, 2004-2006
Key: Circle size indicates total PM_{2.5} for each coal facility. Grey dots indicate location of CAFOs regardless of size. Colors indicate the total Getis-Ord Gi Z-score value. Positive Z-score values indicate diagnosis hot spots. Negative Z-score values indicate diagnosis cold spots. SO₂ and NO_x emission overlays are similar to this PM_{2.5} overlay



Conclusions and Significance

“The American people have a right to air that they and their children can breathe without fear.”

— Lyndon Baines Johnson

This report was motivated by the principle that the public has a right to know about toxic substances with potential to induce illness that have been introduced into the shared physical environment, whether into the airshed or watershed. This mapping project provides an entry point for health professionals and others interested in learning more about reducing preventable diseases caused or exacerbated by the emissions and toxic waste produced when burning coal.

The study suggests that for a group of diseases recognized to be adversely affected by air, coal is a serious but unacknowledged exacerbating factor in Iowa. Coal combustion emissions combine with those from industrial, agricultural and other sources of PM, NO_x, SO₂ to adversely affect the health of Iowans. Furthermore these pollutant sources may be sited to further combine with social determinants of health especially to adversely affect minority populations in Iowa.

The authors are well aware that association is not the same as causation. This report's findings suggest the need for more careful study and response in the near future. This study has taken analysis as far as can be done with existing publicly accessible data. It will be important to acquire restricted and protected health outcome data that has finer than county-level granularity and includes hospital discharge data from states bordering Iowa. In more advanced research, account should be taken of coal facility emissions from states bordering Iowa. Moreover, it is critical that new basic monitoring data is needed to further evaluate these important questions. A more precise study and analysis requires actual measurement of ambient air quality including particulate matter. Ideally, data on personal exposure monitoring and lung function testing is needed. Closer attention must be paid to the location of schools and effects on children. An expanded time frame should be used to allow determination of trends. And, of course, more funding is needed.

Given the complexities of environmental pollution, the incomplete database assembled for this report, and the semi-quantitative nature of emissions, this study does not point to a single source as being the most egregious in producing adverse health outcomes in Iowa. Rather, it is likely that complex interactions, unique to Iowa, of toxic

emissions associated with producing energy and industrial agricultural activities leads to worsening health outcomes. Furthermore, the changing climate with rising temperature, humidity, and precipitation conspire with the variety of emissions to create a toxic soup of the totality of air, water, and soil pollution of Iowa. Yet, the presence of coal facilities are found in relation to each of the “hot spots” in Iowa for a set of preventable diseases that are known to be exacerbated by coal combustion pollution.

We can do much better. As indicated by the number of exceedances for air quality standards, Iowa has several counties close to upper limits at risk of being officially found to out of compliance and sanctioned for nonattainment of current national PM_{2.5} standards. Take note, current standards elsewhere like California, Canada, and the European Union are more strict than U.S. national standards.¹ World Health Organization recommended standards are still more strict than all these. Considering these trends, even when Iowa is in attainment with the current U.S. standards, further tightening of standards is inevitable.

Predictable illness as a result of doing business is not just an externality to be overlooked by business and a problem to addressed only by affected individuals. These costs can and should be internalized by the coal-burning electricity industry as part of the cost of doing business. Despite difficulties in ascertaining or assigning specific causation, the likelihood that combustion emission related factors produce or exacerbate chronic diseases can no longer be overlooked. Even in this study based on existing but incomplete epidemiological and geographical measures, environmental factors can be found with significant effect sizes comparable to those found in peer reviewed scientific literature.

This investigation is offered as another of the emerging answers to questions regarding the true costs to the human family of continued reliance on fossil fuels, especially coal. These risks are unjustified considering that less polluting options for energy production from natural gas to the many benign renewable energy technologies ready for use today—wind, solar, geothermal and biomass—are readily applicable to Iowa.

ENDNOTES

1. For a more complete description of the air quality monitoring similarities and differences between the EU and the US see: Danish National Environmental Research Institute. *Comparison of the EU and US Air Quality Standards & Planning Requirements 4 Oct 04*. 58 pgs. Accessed 6/24/10 at http://ec.europa.eu/environment/archives/cafe/activities/pdf/case_study2.pdf.

Getting Beyond Coal in Iowa

“Science is built up of facts, as a house is built of stones; but an accumulation of facts is no more a science than a heap of stones is a house.”

— Henri Poincaré

Often societies must act without all scientific answers definitively in hand. Paralleling the evidence regarding toxic health effects of coal combustion are other compelling lines of scientific findings. An example is the evidence for anthropogenic global warming through accelerating accumulation of greenhouse gases in the atmosphere with consequent global warming and climate change. The effect on Iowa’s climate includes increasing precipitation and humidity, which together accelerate entry of coal combustion toxic emissions into the watershed and exacerbate chemical reactions in the atmosphere creating small and dangerous particulate matter. Science can provide building blocks as a foundation for action, but in the end action must be taken.

Among U.S. states, Iowa imports and burns disproportionately more coal and burns it in some of the oldest and least efficient facilities in the nation. To reduce Iowa’s dependence on imported coal and disproportionate burden of associated health costs, Iowa has a number of options.

For example, to reduce dependence on coal and save health dollars, Iowa can:

- raise and enforce standards for renewable energy;
- increase funding for and promotion of energy efficiency programs including building codes, appliance and equipment standards and an efficiency resource standard for electricity providers;
- refuse to permit new coal plants, or allow existing plants to expand;
- shutter the oldest and/or least efficient (dirtiest) coal plants;
- lower standards for PM_{2.5} with no grandfathering;
- designate that the Iowa Department of Natural Resources and Iowa Department of Public Health join efforts to incorporate public health standards in the permitting, compliance and regulatory process governing Iowa air standards.

State efforts alone are insufficient; pollution and health risks do not honor state lines. State by state projects can be cumbersome, confusing and ineffective. State efforts alone are also notorious for inviting polluters to pursue business in the least regulated states. Efforts to provide energy while protecting public health and our shared environment must be national. The federal government should:

- limit subsidies to fossil fuel sourced energy, including for extraction and combustion, and coal gasification;
- put a price on carbon to encourage utilities to reduce use of coal;
- increase funding for renewable energy sources, research, development and renewable electricity standards, tax and financial incentives.

Similarly, state and federal agencies need to address the coal combustion waste (CCW) issue systematically and comprehensively. The toxicity of CCW should no longer be ignored. Definitions matter, and surface disposal is not a “beneficial use” of this toxic waste product considering the potential public health impact. Close monitoring of the most mobile sentinel molecules such as sulfate, iron, manganese, calcium, magnesium, sodium, and chloride is needed to serve as markers for leaking CCW sites. Detection of unsafe CCW sites must lead to mandated action.

Specific recommendations for the management of CCW include:¹

- discontinue the practice of allowing CCW to be used for land development, dispose in lined landfills to prevent leaching into water sources;
- provide publicly available long term groundwater monitoring at existing fill sites after a structural fill is closed;
- require cleanup by developers if monitoring data reveal that groundwater or surface water has been contaminated by coal ash;
- require deeds of structural fill affected property permanently record such use.

Finally, important for many reasons beyond evaluating the coal issue, is the need to carefully monitor significant health events. As indicated throughout this report, the quality of data on Iowa’s disease incidence and trends could be described as uneven at best. Given the clear link between air quality and human health, the State of Iowa should improve data collection that relates to air quality and adverse health effects. The science that informs policy and many tools like the EPA’s COBRA software and others rely on such data.

ENDNOTES

1. Several of these recommendations are more completely described in “Unlined Landfills?: The Story of Coal Ash Waste in our Backyard” Sierra Club North Carolina Report, April 7, 2010. Accessed 8/1/10 at http://nc.sierraclub.org/work/docs/FINAL_coal_ash_report.pdf.
2. Lane, Sam. Some concerned about UI’s use of coal boilers. *Daily Iowan*. Accessed 8/1/10 at <http://www.dailyiowan.com/2010/05/10/Metro/17244.html>.

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Web: www.psriowa.org/PDFs/iowa-coal-and-health-exec-summm.pdf