GENERAL ASSEMBLY TESTIMONY

January 11, 2018

Comments to the Maryland Office of the Attorney General and the Maryland General Assembly on the Proposed Repeal of the Clean Power Plan

Dallas Burtraw

Prepared for the Maryland Office of the Attorney General and the Maryland General Assembly

1616 P St. NW
Washington, DC 20036
202-328-5000 www.rff.org

RESOURCES FOR THE FUTURE

RESOURCES
FOR THE FUTURE

January 11, 2018

Comments to the Maryland Office of the Attorney General and the Maryland General Assembly on the Proposed Repeal of the Clean Power Plan

Submitted by:
Dallas Burtraw, Darius Gaskins Senior Fellow
Resources for the Future, 1616 P Street NW, Washington DC 20036
202.328.5087 | Burtraw@RFF.org

I am pleased to offer the attached comments to the Maryland Office of the Attorney General and the Maryland General Assembly on the U.S. Environmental Protection Agency's proposed repeal of the Clean Power Plan. I am writing as the Darius Gaskins Senior Fellow at Resources for the Future (RFF). RFF is a nonprofit and nonpartisan organization that conducts independent research—rooted primarily in economics and other social sciences—on environmental, energy, and natural resource policy issues. RFF neither lobbies nor takes positions on specific regulatory proposals, although individual researchers are encouraged to express their unique opinions—which may differ from those of other RFF experts, officers, and directors. All RFF research is available online, for free.

For the past several decades, RFF experts have helped decisionmakers better understand climate policy challenges and assess the costs and benefits of possible solutions, such as a clean energy standard, Clean Air Act regulation, and various regional and state-level programs, among others. As always, the goal at RFF is to identify the most effective ways—from an economic perspective—to meet environmental objectives through regulation, policy, or market mechanisms. To that end, researchers at RFF have been actively analyzing EPA's Clean Power Plan and assisting states and other stakeholders to understand the implications of their choices in developing ways to comply with the plan.

Drawing on my work and work of my colleagues and coauthors on peer reviewed scientific publications, I have developed comments on issues raised by the proposed repeal of the Clean Power Plan. These comments address the health consequences of repeal and the effect on the electricity industry from a national perspective and particular to Maryland. They also address the analysis presented by the EPA in support of the repeal. Finally, they address the forthcoming issue of a potential replacement to the Clean Power Plan. Although the subject of replacement is taken up in a different forum, the question of repeal is inevitably informed by the potential replacement.

Sincerely,

Dallas Burtraw

Dallas Burtraw
Darius Gaskins Senior Fellow, Resources for the Future

Comments to the Maryland Office of the Attorney General and the Maryland General Assembly on the Proposed Repeal of the Clean Power Plan

Prepared by
Dallas Burtraw
Darius Gaskins Senior Fellow
Resources for the Future
burtraw@rff.org

January 11, 2018

Contents

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

I. Key Findings

- The Clean Power Plan produces large and widespread improvements in air quality and health outcomes that far exceed costs.
- Every one of the lower 48 states and the District of Columbia can expect environmental improvement under the Clean Power Plan.
- In Maryland, the Clean Power Plan is expected to result in 100 fewer premature deaths per year.
- Repeal of the Clean Power Plan introduces delay and uncertainty that is disruptive to investment decisions and upsets the transformation toward a cleaner and more efficient energy system that is currently under way.
- Repeal of the Clean Power Plan is suggested without consideration of its replacement, exacerbating uncertainty in the industry.
- Indications from questions posed in the Advanced Notice of a Proposed Rulemaking for a replacement and in the legal arguments of opponents to the Clean Power Plan suggest a replacement standard would be limited in stringency to improvements that can be achieved at individual facilities - a so-called "inside the fence line" approach.
- The expected replacement would lead to increased utilization of coal plants at many facilities, and an overall increase in sulfur dioxide emissions nationally.
- In Maryland, the expected replacement would lead to 6 additional premature deaths per year compared to baseline, and 106 additional premature deaths compared to the Clean Power Plan.
- EPA's analysis in support of repeal is flawed and inadequate. The accounting of costs and benefits inappropriately applies guidance from the Office of Management and Budget.
- The analysis employs unorthodox assumptions in calculating the economic value of emissions reductions that are inconsistent with recommendations from the academic community, and does so using two different and inconsistent models, demonstrating insufficient rigor for an important regulation.

II. Environmental and Public Health Consequences

The Clean Power Plan is an important component of the US effort to reduce greenhouse gases. Its potential withdrawal has two substantial implications for the environment and public health. One is the change in greenhouse gas emissions in the US power sector and the signal this withdrawal has for other nations. This change is of central relevance, but is also addressed by many other writers. I focus my comments on a second implication, which is the change in emissions of conventional air pollutants that can be attributed to implementation of the Clean Power Plan.

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

A. National Air Quality Impacts, and Public Health and Ecological Effects

Greenhouse gas emissions in the power sector stem almost exclusively from combustion of fossil fuels, which leads to emissions of many other pollutants. Economic analysis by the EPA in the 2015 Regulatory Impact Analysis (EPA 2015) and our independent assessment (Burtraw et al. 2014) find that the economic benefits of reductions in conventional air pollutants are of equal or greater magnitude than the economic benefits of greenhouse gas emissions reductions when those reductions are valued at the social cost of carbon, as described by the Intergovernmental Working Group (IWG 2013). In section V, I discuss the social cost of carbon and the EPA's current proposal to change how it is calculated.

I have collaborated directly or indirectly on three recent publications in leading scientific journals that quantify the public health and ecological impacts of emissions reductions that are intended by the Clean Power Plan. Driscoll et al. (2015) examined state-specific outcomes from a rate-based performance standard analogous to one of the options given to states for compliance, including the ability to average and trade emissions rate credits across facilities on an interstate basis. The analysis also considered the ability for states to develop alternative plans, including mass-based standards, provided they achieve equivalent emissions reductions.

For comparison, Table 1 illustrates the emissions reductions anticipated by the EPA (2015) and the results anticipated by Driscoll et al. (2015), which were developed before the final EPA rule was released. (The comparison enables us to use the Driscoll et al. analysis to examine effects on Maryland in a separate section of my comments. Effects on a state-by-state basis are not reported in the EPA analysis.)

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

Table 1. Percent Change in National Emissions

	Final Clean Power Plan 2030	**Updated Assessment of Final CPP 2030**	**Beyond the Fence Line (Analogous to Final CPP) 2020**	**Inside the Fence Line (Replacement to CPP) 2020**
	EPA (2015)	EPA (2017)	Driscoll et al. (2015)	Driscoll et al. (2015)
Carbon Dioxide *Change from 2005 Levels*	-32%	-32%	-35%	-17%
Sulfur Dioxide *Change from Reference Case*	-21%	-31%	-27%	+3%
Nitrogen Oxides *Change from Reference Case*	-21%	-23%	-22%	-3%

In Driscoll et al., all of the lower 48 states and the District of Columbia experience an improvement in air quality in 2020 compared to the reference case. In order, starting with the state that experiences the greatest air quality benefits, the fifteen jurisdictions with the largest statewide average decreases in air pollution detrimental to human health include Ohio, Pennsylvania, District of Columbia, **Maryland**, West Virginia, Illinois, Missouri, Delaware, Kentucky, Indiana, Arkansas, Tennessee, Iowa, Virginia and New Jersey.

The economic value of these reductions in conventional air pollutants is estimated by mapping the change in emissions to a model of atmospheric transport and transformation of pollutants, then to a model of exposure and changes in health status, and finally to an economic estimate of the welfare impacts of changes in health status measured in a variety of ways. Driscoll et al. estimate cost of compliance in 2020 would be $17 billion (2010 dollars). Driscoll et al. assume a slightly faster compliance path than was described in the final Clean Power Plan so costs and benefits are realized sooner than in the final plan. They estimate the health co-benefits to be $29 billion per year, and the carbon emissions reduction benefits to be $21 billion per year. The measure of net benefits provides the most useful way to evaluate the policy from an economic perspective. Net benefits are measured as benefits minus costs, and are estimated to be $33 billion per year. This estimate is bracketed by the range of estimates developed in the 2015 analysis by EPA, which finds net benefits of $25 billion to $43 billion per year. Using the same

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

approach, the updated assessment associated with the repeal of the Clean Power Plan estimates net benefits of $15 billion to $38 billion if the Clean Power Plan is implemented.

Importantly, in 2017 the EPA exercised an unorthodox, new and very different methodology to arrive at an alternative estimate of net benefits. That approach suggests that the net benefits of the Clean Power Plan range from -$12.7 billion to $2.1 billion; in other words, it suggests a range of possible net benefits that is mostly negative meaning the Clean Power Plan costs are greater than benefits. The assumptions used to achieve this alternative estimate are different from the consensus approach in public health epidemiology and economics. I address this approach in detail in section V below.

In addition to public health impacts, combustion of fossil fuels and especially coal has an important effect on ecological systems, as a result of emissions of carbon dioxide, sulfur dioxide, nitrogen oxides, and mercury. These effects are well understood, but due to current data and modeling limitations, it is difficult to quantify and monetize the effects of ecological co-benefits of reductions in these pollutants on an incremental basis. Hence, both the analysis in support of the final rule (EPA 2015) and analysis in support of its repeal (EPA 2017) provide little information about ecological impacts. However, these co-benefits are an important consideration in evaluation of the Clean Power Plan.

Power plant carbon standards can improve crop and tree productivity, which generates co-benefits for commercial agriculture and ecosystem services (Capps et al. 2016). Acidification results when emissions of sulfur dioxide, nitrogen oxides and carbon dioxide are absorbed in water vapor in the atmosphere and then transported by wind and air current. Wet deposition (acid rain) and dry deposition cause acidification and damage to fresh water and marine ecosystems. Deposition of these pollutants contributes to ocean acidification. Some of the most convincing evidence that ocean acidification will affect marine ecosystems comes from warm water coral reefs. Deposition of nitrogen contributes to nutrient loading, considered as a major cause of hypoxia in Gulf of Mexico (Rebich et al. 2011). Atmospheric deposition of nitrogen as the most significant source of nitrogen contributions to this problem.

B. Environmental and Ecological Effects in Maryland

Emissions from combustion of fossil fuels directly affect the health of the public and of ecological systems in Maryland and also the ability of Maryland to comply with National Ambient Air Quality Standards.

Driscoll et al. estimate that, under their representation of the Clean Power Plan, in Maryland in 2020 the average annual concentrations of fine particulate matter ($PM_{2.5}$) would fall to 6.79 $\mu g / m^3$, a decrease of 0.20 $\mu g / m^3$, compared to the reference case without the Clean Power Plan. These changes are predicted to result in the avoidance of 100 premature deaths in Maryland

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

on an annual basis.[1] Throughout the multi-state eastern part of the PJM power region including New Jersey, Delaware, Maryland and Virginia, the health co-benefits are expected to total $3 billion annually (2010 dollars), with a 95 percent confidence interval of $230 million to $7 billion). The central case estimate of cost in this region is estimated to be $2.5 billion, so that expected net co-benefits are $440 million per year (Buonocore et al. 2016). It is important to note this includes only health co-benefits and does not include the benefits associated with climate change or ecological effects.

The impact of these changes in atmospheric concentrations of dangerous pollutants not only affects human health directly, but also affects the Maryland economy by contributing to the state's compliance with the National Ambient Air Quality Standards (NAAQS). The state must impose measures to achieve the NAAQS and the Clean Power Plan displaces the need for some of those measures in the future.

Maryland's valuable ecological resources are also directly affected by deposition associated with fossil fuel combustion. The EPA reports that atmospheric deposition contributes about one-third of the total nitrogen loads to the Chesapeake Bay. Direct deposition to the Bay's tidal surface waters accounts for 6 to 8 percent of the total (air and non-air) nitrogen load. Nitrogen deposited onto the land surface of the Bay's watershed and subsequently transported to the Bay contributes another 25 to 28 percent of the total nitrogen load.[2] Because the emissions sources that contribute to this deposition are primarily located outside of the state, regional or federal policy is required in order to mitigate nitrogen deposition. The Clean Power Plan provides important co-benefits in this regard.

III. The Alternatives to the Clean Power Plan Should Influence the Repeal Decision

In 2007 the U.S. Supreme Court affirmed EPA's authority to regulate greenhouse gases under the Clean Air Act (*Mass v EPA*) and in 2009 the EPA issued a formal finding that greenhouse gas emissions endanger the public health and welfare of current and future generations.[3] Consequently, under the Clean Air Act, the EPA has an obligation to act to mitigate this harm.

The possible repeal of the Clean Power Plan is proposed without consideration of an alternative means for the EPA to meet its obligation under the Clean Air Act. The EPA has issued an Advanced Notice of Proposed Rulemaking[4] for a replacement to the Clean Power Plan but it is skeletal in form, seeking input on a number of guiding questions, but with no indication of the

[1] As indicated by Table 1, their representation is about 10 percent more stringent than the final version of the Clean Power Plan, and the forecast of air quality improvements can be adjusted accordingly.
[2] https://www.epa.gov/chesapeake-bay-tmdl/air-pollution-chesapeake-bay-watershed
[3] https://www.epa.gov/ghgemissions/endangerment-and-cause-or-contribute-findings-greenhouse-gases-under-section-202a-clean
[4] https://www.eenews.net/assets/2017/12/18/document_cw_01.pdf

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

direction EPA will take in presenting a replacement proposal. For all intents and purposes, EPA is withdrawing the Clean Power Plan with no plan for its replacement.

In the absence of a replacement identified by EPA, one can look to the Advanced Notice of Proposed Rulemaking and the questions posed therein for an indication of what might ultimately take shape. In common terms, the approach that is expected is a so-called "inside the fence line" regulation that would redefine the *best system of emission reduction* to apply narrowly to measures that can be taken at an individual emissions source, in contrast to the approach taken in the Clean Power Plan, which views the best system to encompass the full set of options from the perspective of the operator of a facility.

The replacement regulation implied by the Advanced Notice of Proposed Rulemaking and expected by most observers – and inside the fence line approach – presents several problems that gravely undermine the alleged merits of the repeal of the Clean Power Plan. This concern takes two forms: achieved emissions reductions, and the flexibility and cost of implementing the alternative. Both of these criteria are explicit considerations in section 111(d), the relevant portion of the Clean Air Act. I discuss them below.

A. Consequences of the Clean Power Plan Alternative

A redefinition of the *best system of emission reduction* to include only measures that could be executed at an individual facility implies an improvement in the facility's emissions rate (tons/kWh), which describes the emissions per unit of electricity that is generated. The primary way that an improvement in emissions rate is achieved is through an improvement in the heat rate (mmBtu/kWh), which describes the energy input necessary to generate a unit of electricity, and which leads to a roughly proportional improvement in the emissions rate.

Emissions reductions that could be achieved through improvement of the emissions rate of emitting facilities, holding constant the utilization of those facilities, are substantially less than reductions that are described under the Clean Power Plan. A number of engineering studies have identified a range of possible emissions rate improvements that bookend the value of 4 percent, on average, across the fleet of coal-fired generators (e.g. Sargent & Lundy, LLC 2009). Opportunities at gas-fired units are substantially less and usually not considered.

Staudt and Macedonia (2014) evaluated performance of the best in class within a group of similar coal facilities, sorted for example by vintage, type and existing pollution controls, and found that investments to close 25 percent of the gap between the performance of a facility and the best facility in the group would amount to a 4 percent improvement across the fleet. Investments to close 40 percent of the gap would amount to a 6 percent improvement. Linn et al. (2014) conducted statistical analysis looking at 25 years of operating data for existing power plants to examine how their heat rates, and implicitly their emissions rates, vary in response to changes in fuel prices. They observe that within categories of types of plants, if all plants improved up to the 90 percentile level of performance, that it would result in a 6 percent

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

improvement across the fleet. However, empirically one observes improvements over the study period of 0.1 – 0.4 percent, so that much greater levels of improvement, while technically possible, are far outside of historically observed outcomes.

The potential for emissions reductions from an inside the fence line approach is substantially less than would be achieved under the Clean Power Plan, and could go in the unintended direction, and consequently the environmental benefits are also much less. Driscoll et al. (2015) estimate an inside the fence line regulation analogous to that described in Staudt and Macedonia (2014), and achieves an emissions rate improvement closing the gap from best in class by 40 percent through a series of modest investments. They find such an approach would yield a 17 percent reduction in carbon dioxide from 2005 levels, roughly one-half of the level associated with the Clean Power Plan. Most of these reductions have already occurred; only a small percent would be associated with the Clean Power Plan requirements, indicating that the inside the fence line approach results in a small fraction of the reductions that would be achieved overall in the power sector under the Clean Power Plan. Further, this approach would result in a 3 percent *increase* in sulfur dioxide, and a 3 percent decrease in nitrogen oxides, from the no Clean Power Plan reference case.

It is especially noteworthy that emissions of sulfur dioxide could increase under a replacement to the Clean Power Plan, with important impacts on Maryland. Because the public health consequences of emissions of sulfur dioxide accrue on a regional basis, the relevant factor is changes in coal generation on a regional basis. Driscoll et al. (2015) find that large areas of eastern and western US experience worsened air quality in 2020 compared to the reference case without the Clean Power Plan, and substantially worse compared to the Clean Power Plan.

In Maryland, the outcome is disturbing. According to Driscoll et al., generation from coal in the Pennsylvania, New Jersey, Maryland region falls by 26 percent under the Clean Power Plan. However, under an inside the fence line regulation, coal generation in this region is virtually unchanged from the reference case without the Clean Power Plan. Analysis of changes in air quality was conducted at the county level, and variation across the region mapped into an *increase* in human exposure overall in Maryland compared to the reference, with an associated decrement in health outcomes. In Maryland, the inside the fence line approach would lead to an *increase* in premature deaths of 6 per year, compared to the reference case baseline of no Clean Power Plan. That is, the inside the fence line approach would actually worsen public health outcomes in Maryland compared to a baseline with no policy. As described previously, the Clean Power Plan was found to result in 100 fewer premature fatalities. Hence, the net effect of repealing the Clean Power Plan and replacing it with an inside the fence line approach was found to be an increase of 106 additional premature mortalities in Maryland.

B. Flexibility and Cost of the Clean Power Plan Alternative

There is substantial variation in the heat rate and emissions rate of coal fired power plants, even for similar types of plants. It is not possible for the EPA to mandate specific investment at

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

individual facilities because the agency does not have information about opportunities at individual facilities. Consequently, an inside the fence line approach would require a one-size-fits all standard, aggregated at least with respect to groups of plants with similar characteristics. The imposition of a uniform standard for a group of plants is likely to raise the cost of emissions rate improvements on average compared to a flexible approach that enabled averaging across facilities. However, EPA faces a conundrum if it allows averaging across facilities because in many cases the least cost way to achieve emissions rate reductions will involve co-firing with biomass or natural gas at coal-fired plants. The conundrum is that the stopping point for such co-firing is hard to identify because the marginal cost of co-firing is constant when using natural gas, which is the most likely outcome. In other words, if emissions can be reduced by 1 percent for a given cost, they can be reduced by 10 percent for ten times that cost, and so on. Given the EPA's obligation to mitigate the harm of greenhouse gases, what justification would the EPA have to limit reductions to a small amount?

If co-firing is not considered, then the cost of emissions reductions that could be achieved through emissions rate improvements at existing coal-fired plants would be substantially greater, and would also be substantially greater per ton of reduction than the expected cost of the Clean Power Plan. Based on engineering information, Sargent & Lundy, LLC (2009) expect reductions of about 4 percent on average across the fleet could be achieved for $10-$60 per ton. Linn et al. (2014) are able to estimate costs for only a smaller magnitude of improvement, based on historic evidence, and find that 0.6 percent – 2 percent improvements could be achieved at $10 per ton, holding utilization fixed. In contrast, analysis of the CPP from many sources (e.g. Burtraw et al. 2014) estimate that, for several times as many emissions reductions, the marginal costs per ton would be in the range of $10-$20, and average costs would be substantially less.

These estimates are all based on the assumption that there would be no rebound in the use of these plants. Rebound describes the potential increase in utilization of a plant and associated erosion of the emissions reductions that are anticipated. However, greater utilization may occur because, after investments have been made to make a plant more efficient, it costs less to use that plant so it may be used more. When the assumption of no rebound is relaxed, models predict substantial rebound. Linn et al. (2014) estimate rebound through greater utilization of existing facilities would erode 22 percent – 33 percent of the emissions reductions that would be expected if there was no rebound.

A second source of rebound occurs through the extended lifetime of plants that implement efficiency improvements. Because these plants are modernized and become more efficient, they are expected to remain in service beyond previously anticipated retirement dates. This affects the lifetime emissions from these plants, and some critics have suggested that it could lead to an overall increase in emissions, compared to the reference case baseline.

The rebound effect through increased utilization and increased life times of existing coal facilities can be expected to erode one quarter to nearly all of the emissions reductions that

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

would be expected from emissions rate improvements. A consequence of the change in use of these facilities is potentially an increase in conventional air pollution with a direct effect on health outcomes in Maryland.

These aspects of the potential and expected replacement to the Clean Power Plan invite criticism of the repeal of the Clean Power Plan before its alternative is fully described.

IV. Effects on the Electricity Industry of Delay and Uncertainty

The electricity sector is experiencing a rapid transformation away from traditional central power station fossil fuel technology and towards smaller and more flexible resources, including the increased use of natural gas and renewables. This change has contributed substantially to reductions in emissions (Linn and McCormack 2017). On a national level, in 2017 nearly half of utility-scale capacity that was newly installed was a renewable resource technology[5] and the addition of rooftop solar further re-enforces this trend. In Maryland, electric power generation from renewables has increased by almost 200 percent over the past decade, while generation from fossil sources has declined by over 40 percent over the same period.[6]

The Clean Power Plan does not explain the trend towards a cleaner electricity sector; the major factors are changes in the market including the precipitous decline in the price and expanded availability of natural gas, and the dramatic fall in the cost of renewable technologies. Nonetheless, the Clean Power Plan is important in providing guidance for the industry about the direction of environmental policy. The repeal of the Clean Power Plan, especially without an identified replacement, opens up many questions about the future for investors in the electricity sector. This uncertainty raises costs for industry and for consumers, and is one reason some industry participants have opposed the repeal of the Clean Power Plan.[7] The delay and uncertainty puts the sector at a disadvantage, and creates an opportunity and a need for state and regional policies to provide guidance for regulatory policy and infrastructure development that will provide a framework for investors.

V. Inadequate Analysis in Advance of Regulation

The proposed repeal of the Clean Power Plan, consistent with Executive Order 12866, is accompanied by a Regulatory Impact Analysis (RIA) estimating the costs and benefits of repeal.

---

[5] https://www.eia.gov/todayinenergy/detail.php?id=34472&src=email

[6] https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vi&geo=00000008&sec=008&freq=A&start=2001&end=2016&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0

[7] See, for example, Brief of *amicus curiae* Dominion Resources, Inc., in support of Respondent (U.S. EPA et al.) before the U.S. Court of Appeals for the District of Columbia Circuit, USCA Case #15-1363, Document #1606778. "…the Rule is compatible with current trends toward additional renewable and natural gas generation in the power sector based on market conditions and consumer demands…"

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

In this RIA, the benefits of CPP repeal are the avoided costs of complying with the CPP and the costs of CPP repeal are the foregone benefits that would be accrued were CPP implemented. The avoided costs of compliance and the foregone benefits of implementation are derived from the estimates of costs and benefits in the original CPP RIA, but the new repeal RIA incorporates a number of methodology changes that affect the results. In this section I describe three specific methodology changes that render the repeal RIA an inadequate analysis of the effects of CPP repeal.

A. Social Cost of Carbon

EPA's repeal RIA proposes new values and a methodological change to the federal government's estimation of the social cost of carbon (SC-CO2). The major methodology changes include an exclusive focus on the domestic value of the SC-CO2 and the addition of an SC-CO2 estimate that uses a 7 percent discount rate. I limit my comments on these changes, as they are addressed extensively by many other authors; however, the changes in SC-CO2 estimation methodology represent a major inadequacy in EPA's analysis of the impacts of CPP repeal and therefore merit some discussion here.

The focus on a domestic value of the SC-CO2 underestimates the full impacts of marginal CO2 emissions on US citizens; therefore, use of a domestic SC-CO2 in the repeal RIA leads to an underestimate of the foregone benefits from CO2 reductions. This is because the climate change impacts of CO2 emissions are intrinsically global and international interactions matter. If each country considered only their domestic costs of marginal CO2 emissions, the amount of CO2 mitigation would fall far below the level necessary to match the global costs of CO2 emissions.

The addition of SC-CO2 values using a 7 percent discount rate is also conceptually inappropriate. In Office of Management and Budget (OMB) guidance, the 7 percent discount rate is based on the historical before-tax return on private capital (OMB 2003). It is not appropriate to use this discount rate for estimating the SC-CO2 under EPA's estimation methodology, as EPA uses integrated assessment models that are intended to estimate the effective impacts on consumption rather than investment. The appropriate discount rate for estimates representing consumption equivalents is the 3 percent rate.

Finally, the changes taken to generate the interim value of the SC-CO2 fail to respond to the set of recommendations provided by the National Academies of Sciences, Engineering, and Medicine (NASEM 2017) at the request of the federal government. Applying the NASEM recommendations would create a SC-CO2 estimation process that is regularized, transparent, and incorporates scientific peer review and focused public comment.

B. Health Co-Benefits

EPA is exploring ways to quantify the health co-benefits of the CPP, and the magnitude of these co-benefits is great enough that different methods of quantifying them have substantial effects on the net benefits of repealing the regulation. The repeal RIA presents four sets of net benefits

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

results (Tables 1-5 to 1-8), each using a different method of accounting for health co-benefits. In the first estimate, only the foregone benefits from reducing the targeted pollutant (CO_2) are considered and foregone co-benefits of reducing PM2.5 are excluded. The second estimate follows the same methodology used in the original CPP RIA, in which all foregone health co-benefits are included. The third and fourth estimates assume the existence of PM2.5 thresholds, or cut-points, below which any reductions in PM2.5 concentrations are considered to have zero benefit. I argue that the first, third and fourth estimates presented in the repeal RIA are not adequate in representing the full magnitude of foregone health benefits.

The first set of net benefit estimates (Table 1-5), which exclude foregone health co-benefits, address a concern stated in the news release for the CPP repeal Notice of Proposed Rulemaking (NPRM): "The Obama administration relied heavily on reductions in other pollutants emitted by power plants, essentially hiding the true net cost of the CPP by claiming benefits from reducing pollutants that had nothing to do with the rule's stated purpose."[8] This statement is incorrect, and the estimation of net benefits that excludes foregone health co-benefits does not represent a full and fair analysis. The true net costs of repeal include the foregone co-benefits because controlling carbon dioxide emissions, given current mitigation options, inevitably will mean reducing other pollutants as well. Reductions in other pollutants provides benefits to the nation and to Maryland, helping to attain National Ambient Air Quality standards, which provides not only health benefits but also avoids the economic cost associated with noncompliance. Full exclusion of the reduction in conventional air pollutants that is achieved by the Clean Power Plan is far outside the mainstream practice in benefit-cost analysis and regulatory impact analysis.

The third and fourth sets of net benefit estimates, which use PM2.5 thresholds, address the uncertainty in PM2.5 co-benefits for populations who live in areas with relatively low ambient concentrations. It is legitimate to raise the issue of uncertainties, as there are still uncertainties about the link between levels of PM2.5 and mortality risk despite the breadth of research on the topic; however, the use of thresholds contradicts the epidemiological literature, a point stated in a 2010 summary of expert opinions (EPA 2010). Furthermore, the RIA, by including the threshold cases in the Executive Summary, fails to clearly describe these cases as what they are: sensitivity analyses to address uncertainty, not main results.

The threshold used in the third set of net benefit estimates (Table 1-7) is the PM2.5 level set by the NAAQS. Experts have been unable to identify a "knee" in the concentration-mortality response function, a point where the marginal observed health effects become smaller in number or less severe. Because the NAAQS standard concentration level of 12 micrograms per cubic meter (µg/m3) is well within the observed range of concentrations in the data used in key epidemiological studies, the assumption that health benefits below this level are zero is not legitimate.

[8] https://www.epa.gov/newsreleases/epa-takes-another-step-advance-president-trumps-america-first-strategy-proposes-repeal

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

The threshold used in the fourth set of net benefit estimates (Table 1-8) is the lowest measured level (LML) of PM2.5 concentrations in the two epidemiological studies used in the RIA to derive the concentration-mortality response relationship.[9] This assumption is potentially more defensible as a bounding analysis, because the data cannot identify the shape of the concentration-health response relationship at lower PM2.5 levels. However, since the shape of the response function is unknown below the LML, a fair and transparent analysis would include a second bounding analysis in which the health benefits from reductions in PM2.5 concentrations below the LML are assumed to be higher than the health benefits at observed levels of concentration (for instance by assuming that the concentration-response functions is concave).

The repeal RIA acknowledges that, while the primary analysis is derived from modeling results from the original RIA, the US economy and the electric power sector specifically have undergone significant changes that likely affect the impacts of the CPP. The repeal RIA therefore presents a set of alternative results based on the Energy Information Administration (EIA) 2017 Annual Energy Outlook (AEO) projections. These results differ from the main results in unintuitive ways. In particular, while CPP causes fewer CO2 emissions reductions under the 2017 AEO case, it causes greater SO2 emissions and greater health co-benefits. This is an important result, but it is unclear what are the mechanisms behind the result and to what extent the differences between models used in the 2015 RIA projections and the 2017 AEO projections play a role. The RIA should include greater transparency in this regard and should more clearly explain the drawbacks of using two different models to represent changes in economic conditions over time.

C. Energy efficiency and energy cost savings

The repeal RIA makes an accounting change in the benefit-cost analysis by counting the energy cost savings from energy efficiency measures as a benefit. The original CPP repeal RIA, in contrast, counted these energy savings under the cost category, such that they offset the total costs of compliance with the CPP. This accounting change has no effect on the net benefits of the rule, but EPA cites it as a necessary change for compliance with Executive Order 13771 according to OMB guidance. Compliance with EO 13771 depends on the gross cost savings of repealing the rule rather than the net benefits, and moving the energy savings from energy efficiency measures to the benefits category causes the total costs of CPP compliance to be higher.

OMB's February 2017 interim guidance document provides the following question and answer, "Can effects such as future energy cost savings for rules that require the adoption of more energy efficient technologies be counted against the compliance costs of a regulatory action for purposes of Section 2(b) of the EO? *In most circumstances, such effects would not be counted as offsets to costs according to OIRA's reporting conventions for benefit-cost analysis*" (OMB 2017a). The subsequent April 2017 document, cited in the repeal RIA, states that, "identifying cost savings,

[9] Krewski et al. 2009, LML = 5.8 µg/m3; Lepeule et al. 2012, LML = 8 µg/m3.

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

such as fuel savings associated with energy efficiency investments, as benefits is a common accounting convention followed in OIRA's reports to Congress on the benefits and costs of Federal regulations" (OMB 2017b). This guidance certainly applies to regulations that mandate or invest in a certain level of energy efficiency. Examples of regulations that do this include appliance standards and mobile source standards. However, I argue that this guidance does not apply to the case of the CPP where energy efficiency investments are not required and are one of many compliance options, and thus it is not appropriately used in the repeal RIA.

The CPP is a regulation aimed at reducing emissions; it does not mandate specific measures to achieve this outcome. Because energy efficiency is a cost-effective method for reducing CO2, the modelled scenarios used in both the original and repeal RIAs assume that some level of energy efficiency is used for compliance. However, because the rule allows but does not require energy efficiency measures to be used for compliance, the RIA should not follow OIRA's common accounting conventions for regulations that mandate energy efficiency investments.

EPA's action of counting energy cost savings from energy efficiency under CPP as a benefit, and adding the costs of energy efficiency as a cost in addition to the production costs that would be necessary if there were no energy efficiency would be equivalent to counting the additional generation of renewables as a benefit (because it reduces the production costs associated with other resources) while adding the cost of renewables to the cost of fossil fuel generation that otherwise would have occurred in the absence of renewables – an absurd approach. The proper way to conceive of costs for a regulation aimed at reducing emissions is to identify the total private system costs of compliance and the difference between that estimate and the reference case. A careful reading of the OMB guidance makes clear that it was not intended for application to flexible regulations such as the Clean Power Plan aimed at emissions reductions, but was aimed at regulations mandating specific measures. EPA has misapplied this guidance. Although the net calculation of benefits (benefits minus costs) is not affected by this accounting, the practice does have implications with respect to Executive Order 13771 and provides misleading information to policy makers and the public. Consequently, the accounting of benefits and costs is seriously flawed.

References

Jonathan J. Buonaocore, Kathleen F. Lambert, Dallas Burtraw, Samantha Sekar, and Charles T. Driscoll, 2016. "An Analysis of Costs and Health Co-Benefits for a U.S. Power Plant Carbon Standard,", *PLoS ONE,* 11(6): e0156308. DOI: 10.1371/journal.pone.0156308 (June 7).

Dallas Burtraw, Josh Linn, Karen Palmer and Anthony Paul, 2014. The Costs and Consequences of Clean Air Act Regulation of CO2 from Power Plants, American Economic Review: Papers & Proceedings, 104(5): 557-562.

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

Shannon L. Capps, Charles T. Driscoll, Habibollah Fakhraei, Pamela H. Templer, Kenneth J. Craig, Jana B. Milford, and Kathleen F. Lambert, 2016. Estimating potential productivity cobenefits for crops and trees from reduced ozone with U.S. coal power plant carbon standards, J. Geophysical Research: Atmospheres, 121 (14): 14,679-14,690.

Charles T. Driscoll, Jonathan Buonocore, Jonathan I. Levy, Kathleen F. Lambert, Dallas Burtraw, Stephen B. Reid, Habibollah Fakhraei, Joel Schwartz, 2015. U.S. Power Plant Carbon Standards and Clean Air Co-Benefits, *Nature Climate Change,* 5: 535-540.

Environmental Protection Agency (EPA), 2010. Technical Support Document: Summary of Expert Opinions on the Existence of a Threshold in the Concentration-Response Function for PM2.5-related Mortality. Research Triangle Park, NC. June. Available at: https://www3.epa.gov/ttn/ecas/regdata/Benefits/thresholdstsd.pdf. Accessed January 10, 2018.

Environmental Protection Agency (EPA), 2015. Regulatory Impact Analysis for the Clean Power Plan Final Rule, https://19january2017snapshot.epa.gov/sites/production/files/2015-08/documents/cpp-final-r.

Environmental Protection Agency (EPA), 2017. Regulatory Impact Analysis for Review of the Clean Power Plan: Proposal, https://www.epa.gov/sites/production/files/2017-10/documents/ria_proposed-cpp-repeal_2017-10.pdf.

Interagency Working Group on Social Cost of Carbon (IWG), 2013. Technical Support Document: Technical Update for the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866, Washington DC: US Office of Management and Budget.

Krewski D., M. Jerrett, R.T. Burnett, R. Ma, E. Hughes, Y. Shi, et al., 2009. Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality, HEI Research Report, 140, Health Effects Institute, Boston, MA.

Lepeule, J., F. Laden, D. Dockery, and J. Schwartz, 2012. Chronic Exposure to Fine Particles and Mortality: An Extended Follow-Up of the Harvard Six Cities Study from 1974 to 2009, Environmental Health Perspectives, 120(7): 965-70.

National Academies of Sciences, Engineering, and Medicine (NASEM), 2017. *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide*. Washington, DC: The National Academies Press. https://doi.org/10.17226/24651.

Office of Management and Budget (OMB), 2003. Circular A-4. https://www.whitehouse.gov/omb/circulars_a004_a-4. Accessed January 10, 2018.

Office of Management and Budget (OMB), 2017a. Interim Guidance Implementing Section 2 of the Executive Order of January 30, 2017, Titled "Reducing Regulation and Controlling Regulatory Costs" [Memorandum]. Available at:

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

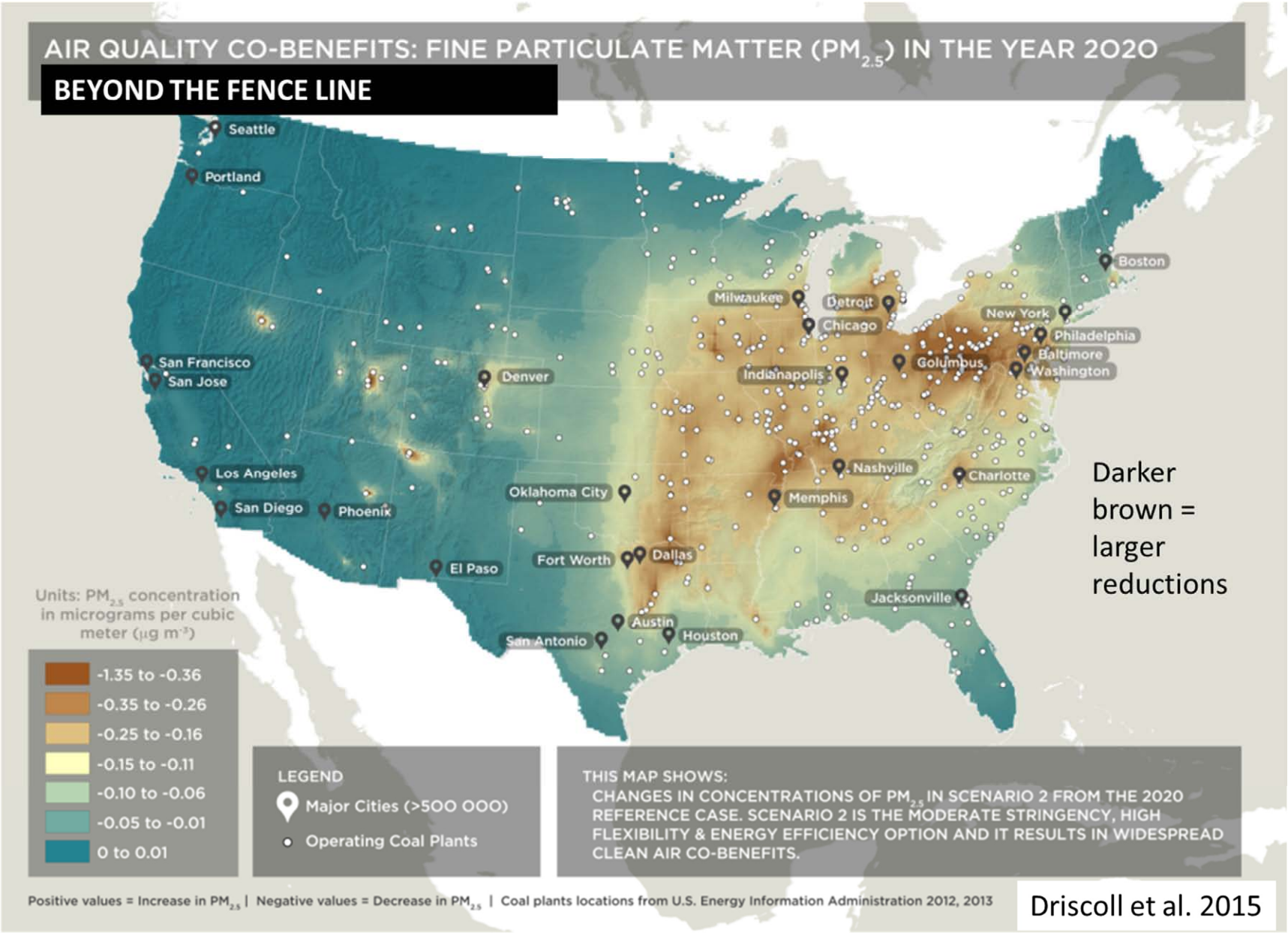
https://www.whitehouse.gov/sites/whitehouse.gov/files/briefing-room/presidential-actions/related-omb-material/eo_iterim_guidance_reducing_regulations_controlling_regulatory_costs.pdf. Accessed January 10, 2018.

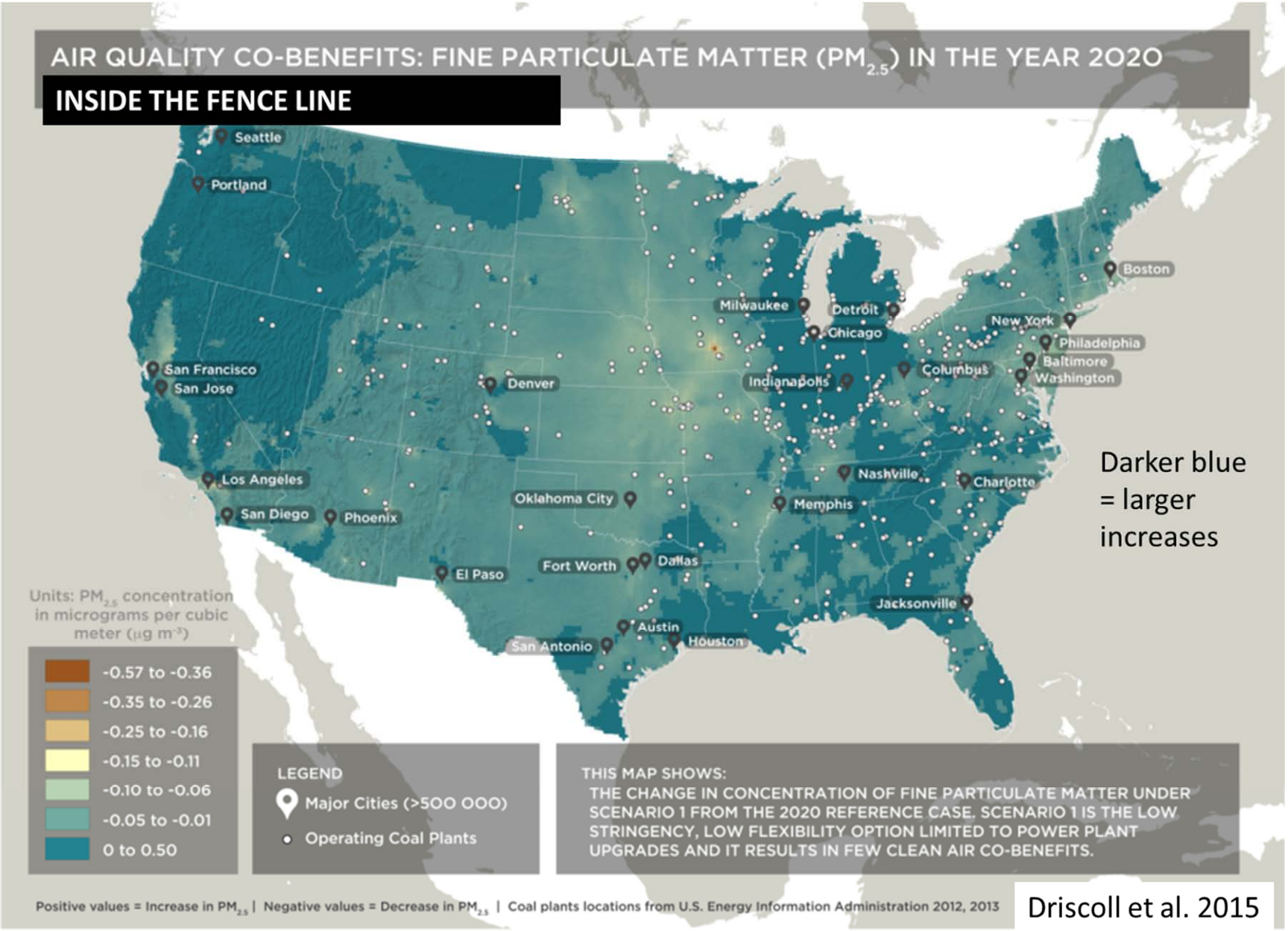
Office of Management and Budget (OMB), 2017b. Guidance Implementing Executive Order 13771, Titled "Reducing Regulation and Controlling Regulatory Costs" [Memorandum]. Available at: https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2017/M-17-21-OMB.pdf. Accessed January 10, 2018.

Richard Rebich, Natalie Houston, Scott Mize, Daniel Pearson, Patricia Ging, C Hornig, 2011. Sources and Delivery of Nutrients to the Northwestern Gulf of Mexico from Streams in the South-Central United States. Journal of the American Water Resources Association, 47 (5): 1061-1086.

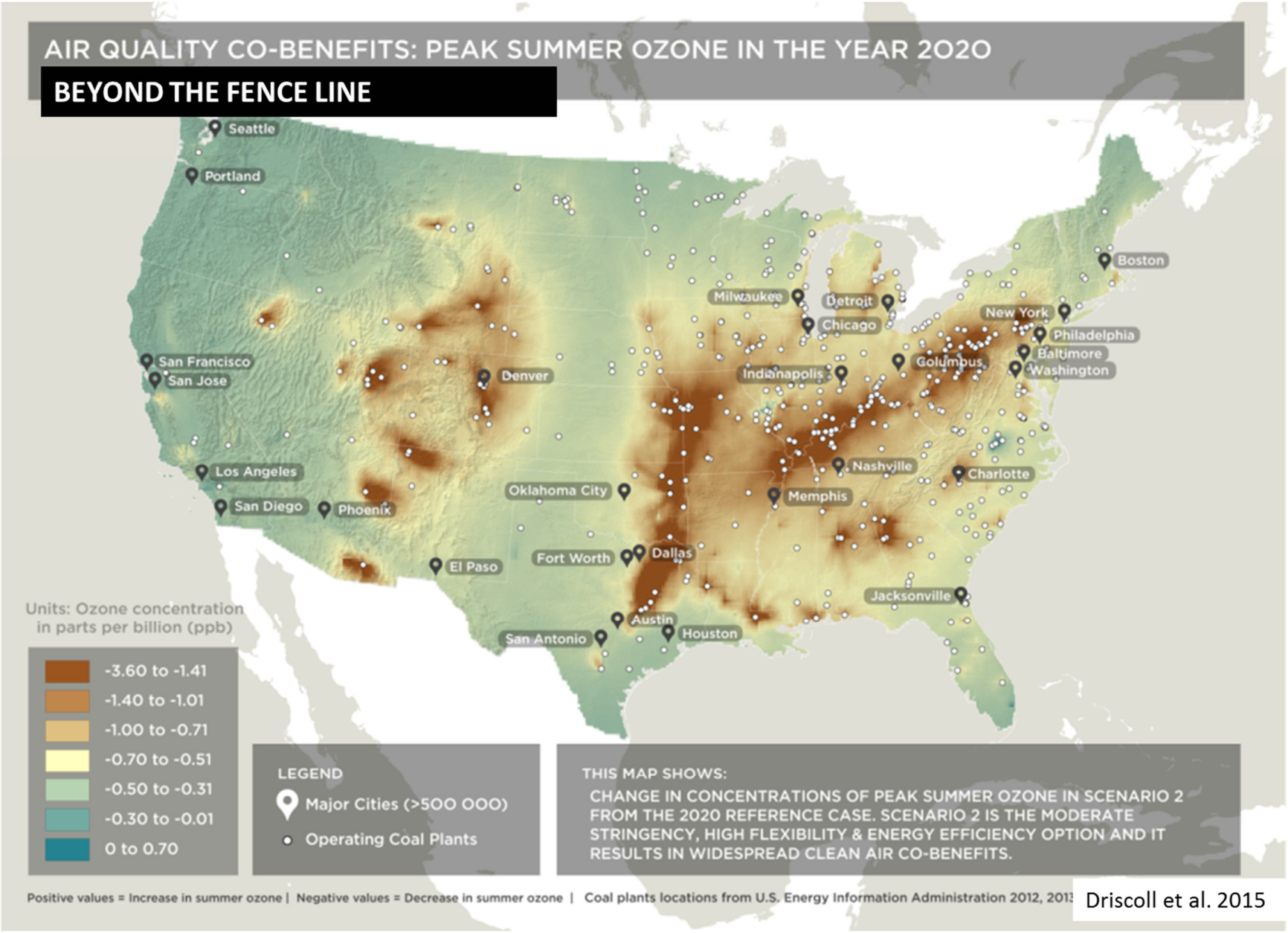
Appendix: Maps of Air Quality Benefits and Health Outcomes

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

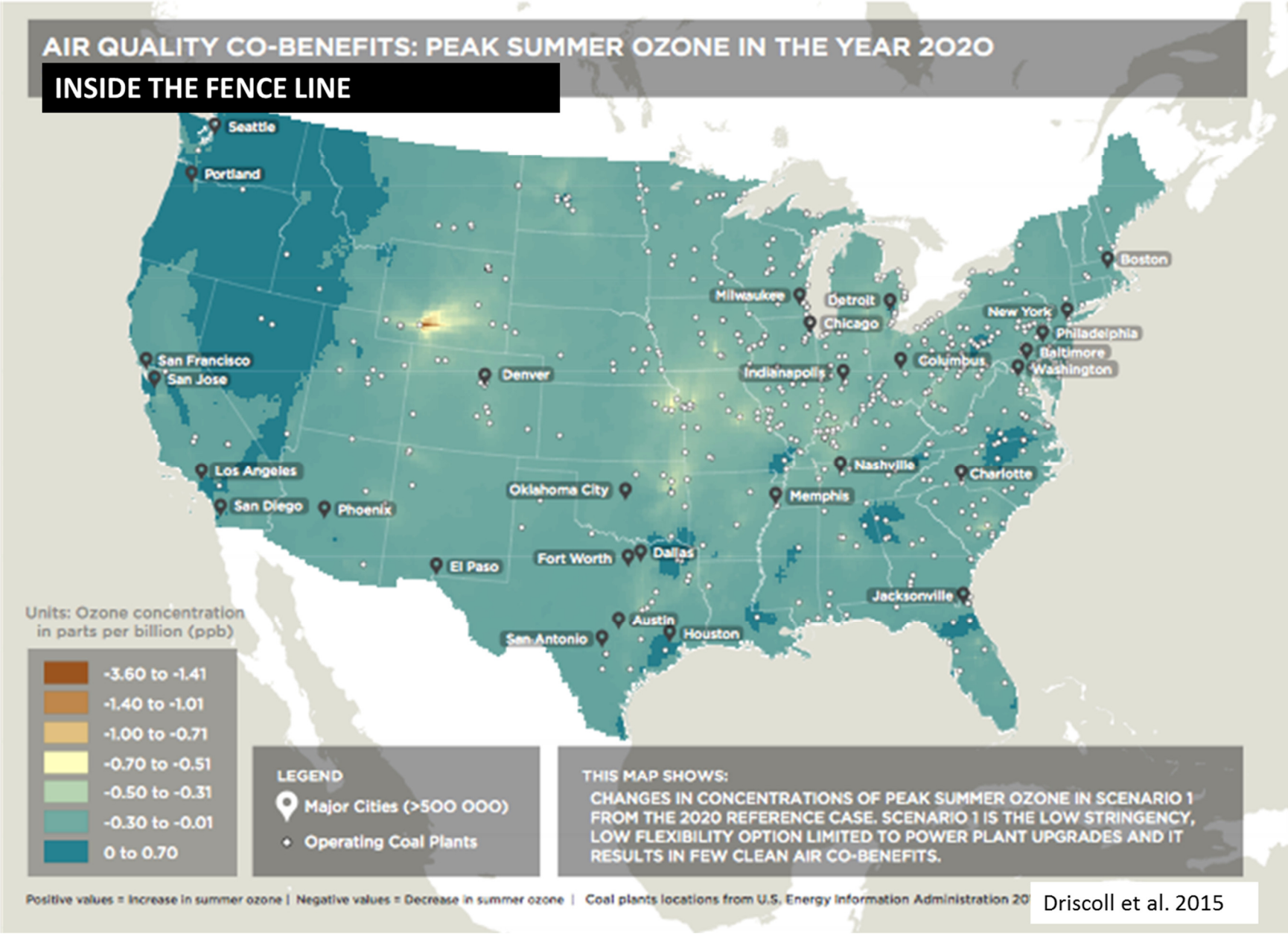

AIR QUALITY CO-BENEFITS: FINE PARTICULATE MATTER ($PM_{2.5}$) IN THE YEAR 2020
BEYOND THE FENCE LINE
Seattle
Portland
San Francisco
San Jose
Los Angeles
San Diego
Phoenix
Denver
El Paso
Oklahoma City
Fort Worth
Dallas
Austin
San Antonio
Houston
Milwaukee
Detroit
Chicago
Indianapolis
Nashville
Memphis
Jacksonville
Columbus
New York
Philadelphia
Baltimore
Washington
Boston
Charlotte
Units: $PM_{2.5}$ concentration in micrograms per cubic meter ($\mu g\ m^{-3}$)
-1.35 to -0.36
-0.35 to -0.26
-0.25 to -0.16
-0.15 to -0.11
-0.10 to -0.06
-0.05 to -0.01
0 to 0.01
LEGEND
Major Cities (>500 000)
Operating Coal Plants
THIS MAP SHOWS:
CHANGES IN CONCENTRATIONS OF $PM_{2.5}$ IN SCENARIO 2 FROM THE 2020 REFERENCE CASE. SCENARIO 2 IS THE MODERATE STRINGENCY, HIGH FLEXIBILITY & ENERGY EFFICIENCY OPTION AND IT RESULTS IN WIDESPREAD CLEAN AIR CO-BENEFITS.
Positive values = Increase in $PM_{2.5}$ | Negative values = Decrease in $PM_{2.5}$ | Coal plants locations from U.S. Energy Information Administration 2012, 2013
Darker brown = larger reductions
Driscoll et al. 2015



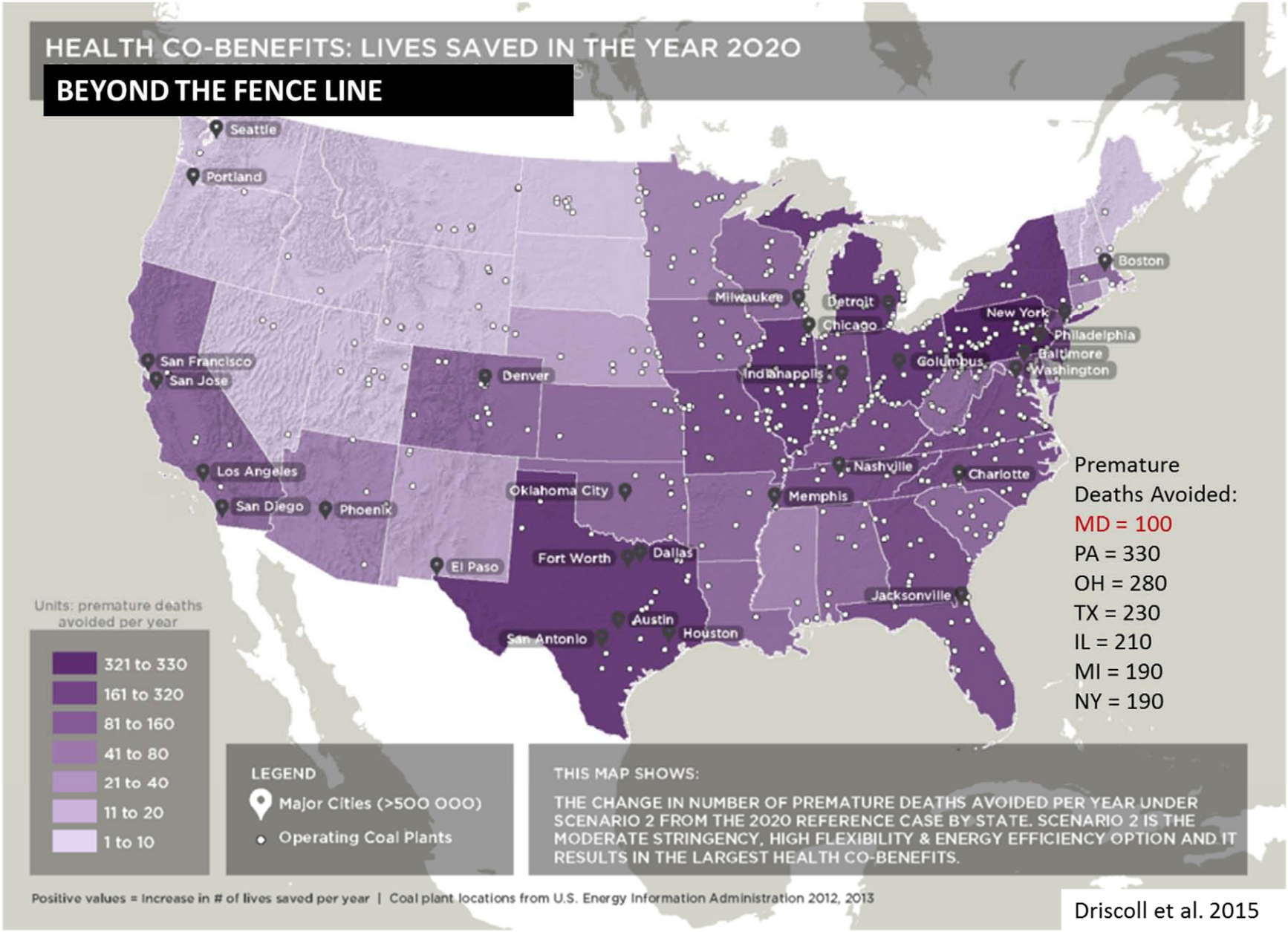
1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org



1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

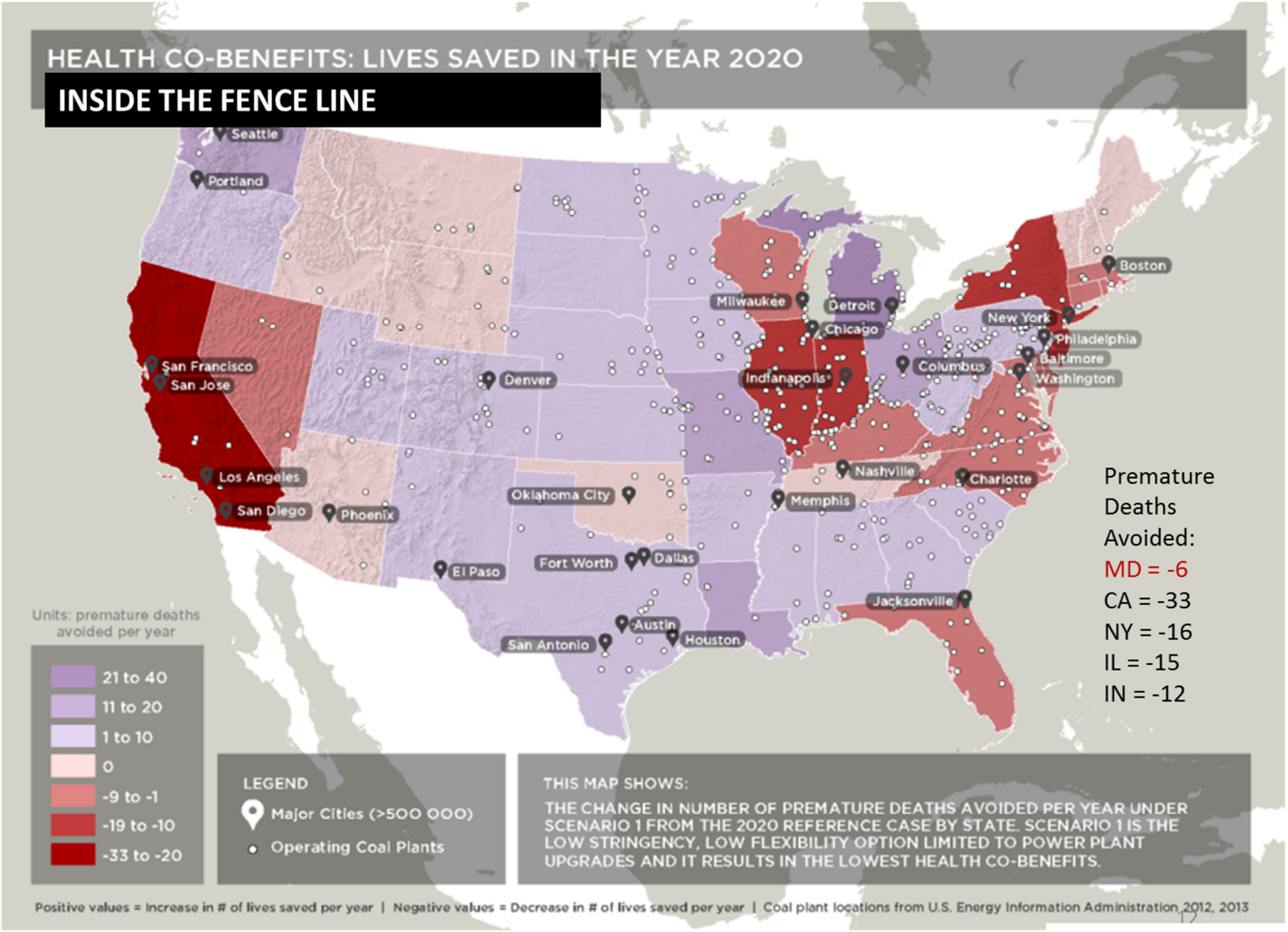


1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org



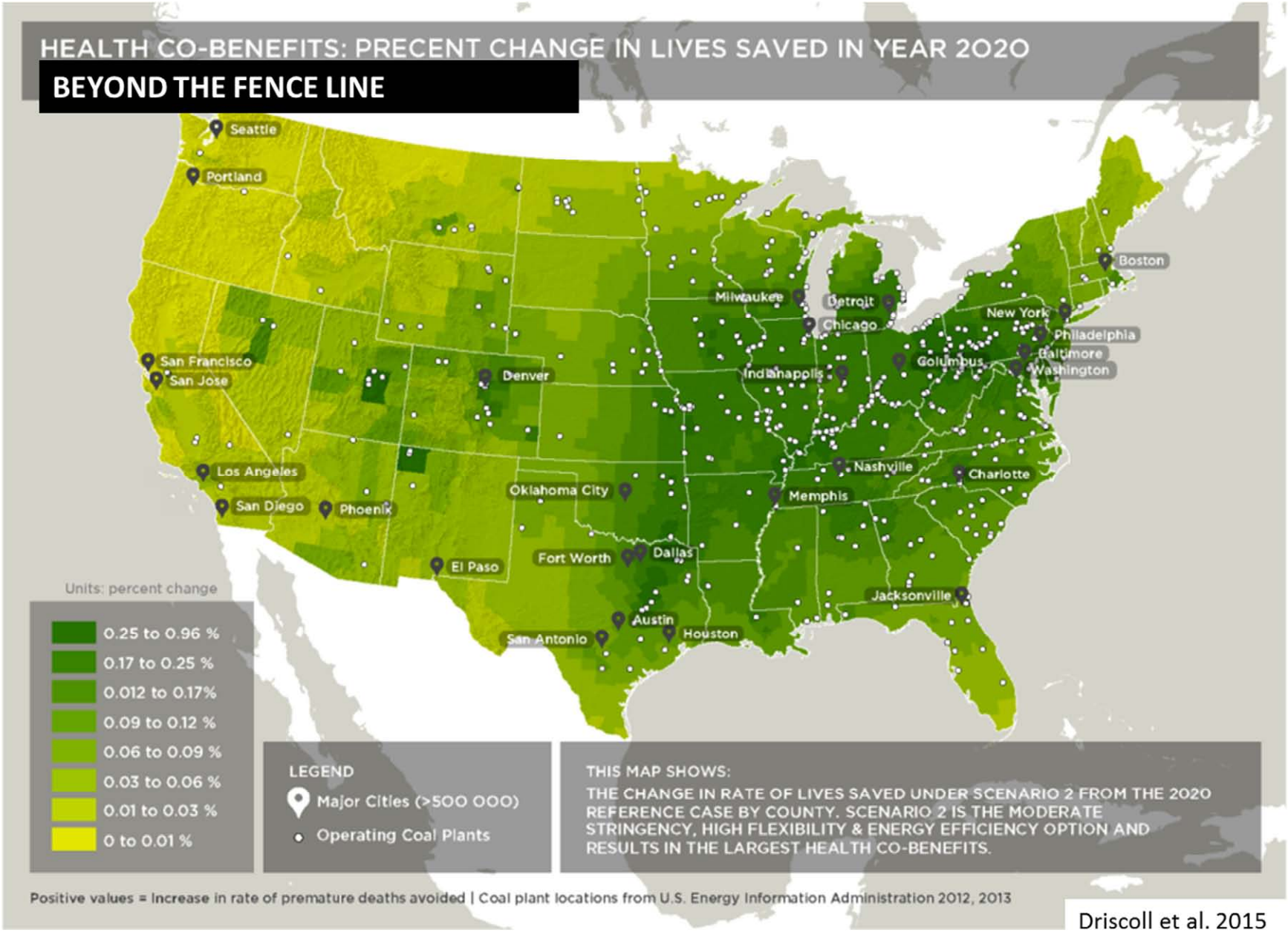
Driscoll et al. 2015

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org



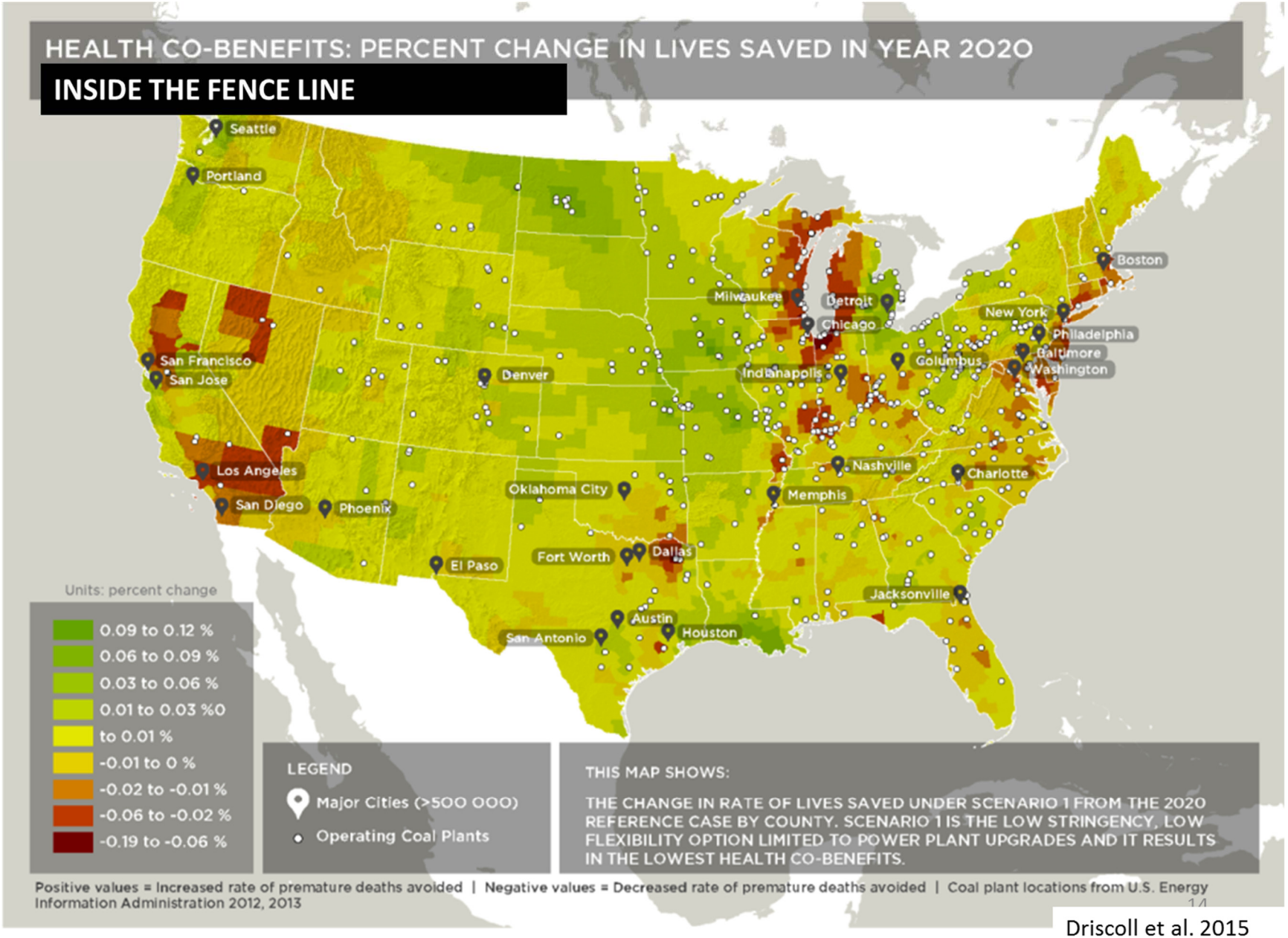
Driscoll et al. 2015

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org



Driscoll et al. 2015

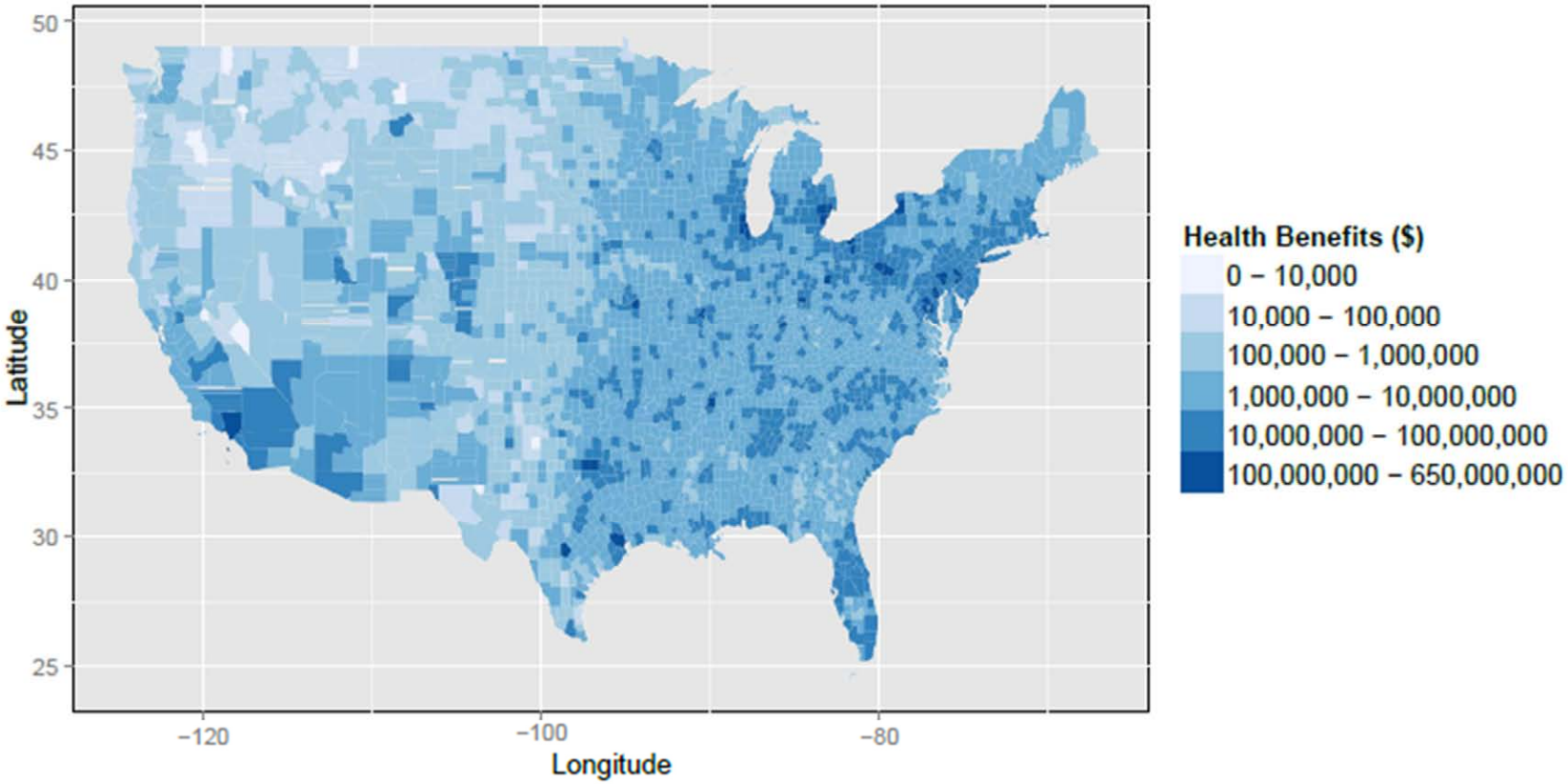
1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org



Driscoll et al. 2015

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

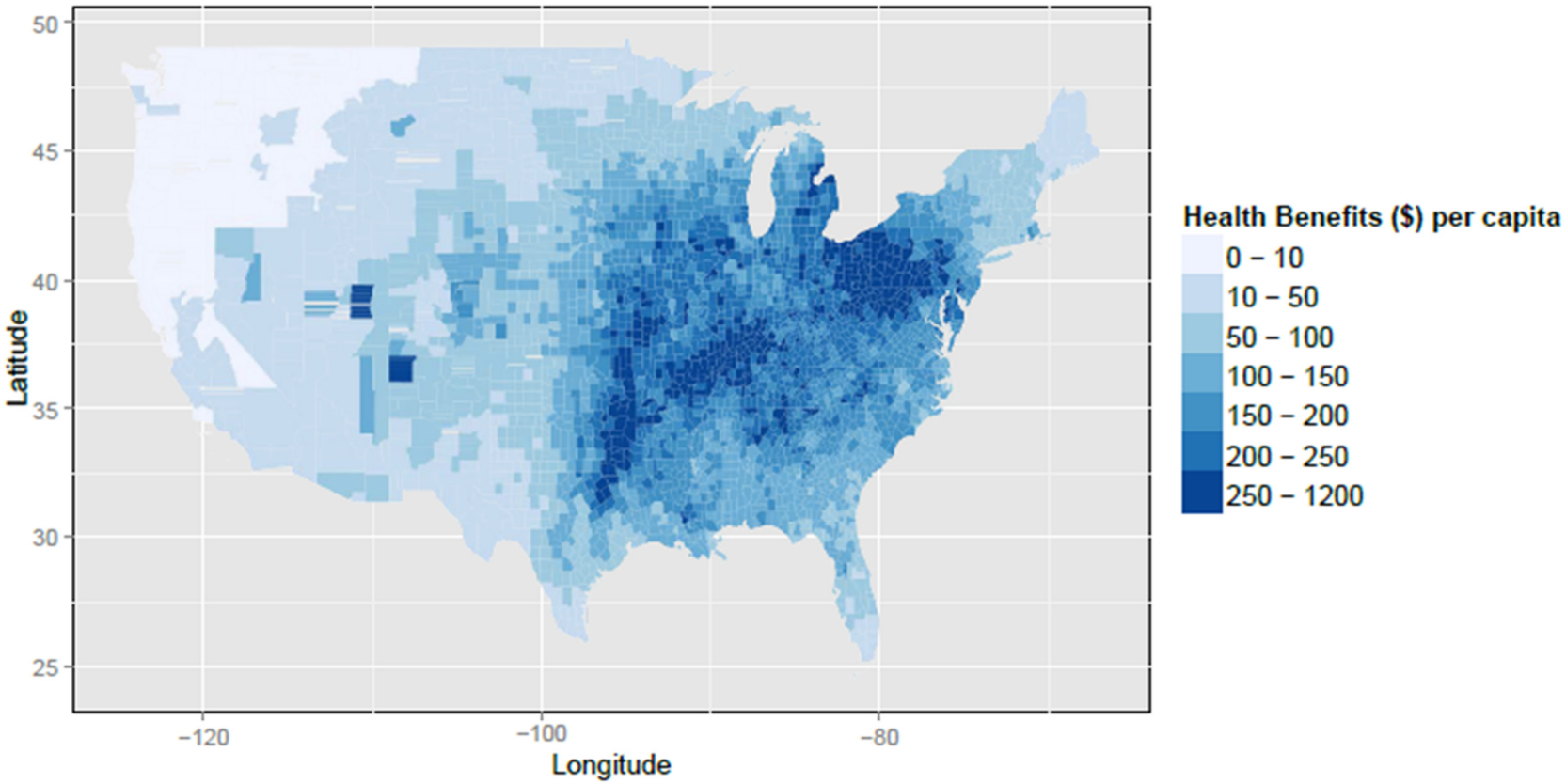
Value of Health Benefits Beyond Fence line



Buonocore et al. 2016

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

Per Capita Value of Health Co-benefits Beyond the Fence line



Buonocore et al. 2016

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org

1616 P St. NW Washington, DC 20036-1400 Tel 202.328.5087 fax 202.939.3460 burtraw@rff.org www.rff.org