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Comments to the US Environmental Protection Agency on the Proposed Repeal of the Clean Power Plan

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Attention Docket ID No. EPA-HQ-OAR-2017-0355

On behalf of Resources for the Future (RFF), I am pleased to share the accompanying comments to the United States Environmental Protection Agency (EPA) on the repeal of the Clean Power Plan (CPP).

RFF is an independent, nonprofit research institution in Washington, DC. Its mission is to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement. RFF is committed to being the most widely trusted source of research insights and policy solutions leading to a healthy environment and a thriving economy.

RFF is a 501(c)(3) and does not take positions on specific legislative proposals, although individual researchers are encouraged to offer their expertise to inform policy decisions. The views expressed here are those of the authors and may differ from those of other RFF experts, its officers, or its directors. All RFF research is public and available online for free.

For the past several decades, RFF experts have helped decisionmakers better understand air pollution and climate policy challenges. RFF has developed methods for assessing the costs and benefits of possible solutions, such as a clean energy standard, Clean Air Act regulation, and various state-level programs. RFF has an extensive history of expertise in this area, and RFF experts are uniquely positioned to provide unbiased information based on rigorous research and policy analysis.

As always, the goal at RFF is to identify the most cost-effective and net-beneficial ways, from an economic perspective, to meet energy policy objectives through regulation, policy, or market mechanisms. To that end, researchers at RFF have been actively analyzing the previous administration's Clean Power Plan proposal and this administration's proposed repeal and replacement.

Several RFF experts have provided comments on the issues listed below. All authors' comments are their own and submitted as independent authors.

- Emissions reductions that can be achieved by an "on-site" replacement to the Clean Power Plan, including increases in emissions at many plants and in some regions of the country, and potential disbenefits for human health: Dallas Burtraw, Amelia Keyes
- Consideration of the co-benefits of non-targeted pollution reductions; electricity sector assumptions for the CPP repeal RIA and an "on-site" replacement: Joshua Linn
- Methods and estimation of health co-benefits: Alan Krupnick, Amelia Keyes
- Methods and estimation of energy efficiency costs and costs savings: Dallas Burtraw, Amelia Keyes
- Methodological considerations for interim social cost of carbon dioxide estimates: Maureen Cropper, Robert Kopp, Richard Newell, William A. Pizer, Kevin Rennert, Casey Wichman

If you have any questions or would like additional information, please contact my colleague Dr. Dallas Burtraw at burtraw@rff.org.

Sincerely,

cc: Dallas Burtraw

Comments to the US Environmental Protection Agency on the Proposed Repeal of the Clean Power Plan

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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.
- 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 "at the facility" approach.
- The expected replacement would lead to increased utilization of coal plants at many facilities, and an overall increase in sulfur dioxide emissions nationally.
- 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.

II. Environmental and Public Health Consequences

The Clean Power Plan (CPP) is an important component of the US effort to reduce greenhouse gases. Its potential repeal has two implications compared to the reference case (without the CPP): one is the increase in greenhouse gas emissions in the US power sector, and a second is the increase in emissions of conventional air pollutants. My comments indicate that both outcomes are substantial in magnitude. Further, the EPA repeal of the CPP is being pursued with the weight of arguments in opposition to the CPP having identified a specific replacement known as an "at the facility" approach that would limit the regulation to technical measures that can be taken at an individual facility. Compared to this replacement, the potential withdrawal of the CPP can be expected to result in an *increase* in greenhouse gas emissions at many individual generation facilities and regions of the county, a seemingly perverse result under a regulation that required and restricted measures to those that can be taken at individual facilities. Further, the anticipated replacement could be expected to increase conventional air pollutants on a national basis compared to the no Clean Power Plan reference case, resulting in an actual worsening of air quality and additional health effects. Regulation of greenhouse gas emissions at existing facilities is mandatory within the regulatory framework of the Clean Air Act; hence, we compare the repeal with both the reference case and the expected replacement regulation.

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).
Recent publications in leading scientific journals quantify the public health and ecological impacts of emissions reductions that are intended by the Clean Power Plan. Driscoll et al. (2015) provide analysis

(scenario 2) that 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. Scenario 2 also considered the ability for states to develop alternative plans, including mass-based standards, provided they achieve equivalent emissions reductions. Driscoll et al. also analyzed an alternative scenario (scenario 1) in which an "at the facility" regulatory approach is taken.

For comparison, Table 1 illustrates the emissions reductions anticipated by the EPA (2015) and the results anticipated in scenario 2 by Driscoll et al. (2015). This scenario is like the CPP, but was developed before the final EPA rule was released.

Table 1. Percent Change in National Emissions

	Final Clean Power Plan 2030	**Updated Assessment of Final CPP 2030**	**Scenario 2 (Analogous to Final CPP) 2020**	**Scenario 1 (At the Facility) 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., under the scenario 2 representation of the CPP, all the lower 48 states and the District of Columbia experience an improvement in air quality in 2020 compared to the no Clean Power Plan 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 by Driscoll et al. 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 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.

In addition to public health impacts, combustion of fossil fuels and especially coal has an important effect on ecological systems, resulting from 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.

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.[1] 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[2] for a replacement to the Clean Power Plan but it is skeletal in form, seeking input on several guiding questions, but with no indication of the direction EPA will take in presenting a

[1] https://www.epa.gov/ghgemissions/endangerment-and-cause-or-contribute-findings-greenhouse-gases-under-section-202a-clean
[2] https://www.eenews.net/assets/2017/12/18/document_cw_01.pdf

replacement proposal. From appearances, 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 "at the facility" or "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 – an at-the-facility 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 of greenhouse gases, and the flexibility and cost of implementing the alternative. Both criteria are explicit considerations in section 111(d), the relevant portion of the Clean Air Act.

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 a 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 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 at-the-facility 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 in their scenario 1, reported in Table 1 above, an at-the-facility regulation analogous to that described in Staudt and Macedonia (2014) that 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 in the power sector, roughly one-half of the level associated with the Clean Power Plan. Because most of these reductions have already occurred in the years since 2005, only a small amount of reductions would be attributable to an at-the-facility approach, and this is a small fraction of the reductions that would be achieved overall under the Clean Power Plan.

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 individual facilities because the agency does not have information about opportunities at individual facilities. Consequently, an at-the-facility 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) 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 lifetimes of existing coal facilities can be expected to erode from one quarter to nearly all of the emissions reductions that 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.
Driscoll et al. (2015) find an at-the-facility approach (scenario 1 in Table 1 above) leads to an *increase* in greenhouse gas emissions at many facilities compared to the no Clean Power Plan reference case. This perverse result is due to the rebound effect, and in some regions of the country this leads to increases in total greenhouse gas emissions. Further, the Driscoll et al. analysis finds that an at-the-facility approach results in a 3 percent *increase* in sulfur dioxide, and a 3 percent decrease in nitrogen oxides, compared to the reference case.

IV. 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. 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 accrue 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 many methodology changes that affect the results and render the repeal RIA an inadequate analysis of the effects of CPP repeal. Other authors in this submittal address two of these areas: the social cost of carbon and health co-benefits. In this section I describe a third area: the change in the accounting of energy savings and energy efficiency costs.

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, 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 gross costs of CPP compliance to appear to be higher.

OMB's February 2017 interim guidance document for Executive Order 13771 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 guidance document, cited in the repeal RIA, states that, "identifying cost savings, 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, 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. Hence, this accounting change inappropriately uses OMB guidance and misrepresents the costs and benefits of the proposed repeal in the repeal RIA.

The CPP does not mandate specific measures to achieve the environmental target. Because energy efficiency is one of several cost-effective methods for reducing CO_2, the modelled scenarios used in both the original and repeal RIAs assume that some level of energy efficiency would be used for compliance. However, because the rule 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 approach in the repeal RIA inappropriately over counts the gross costs of energy efficiency measures. The repeal RIA counts energy cost savings from energy efficiency under CPP as a benefit, and adds the costs of energy efficiency as a cost in addition to the production costs that would be necessary if there were no energy efficiency. EPA's approach would be equivalent to counting the additional generation of renewables as a benefit, measured at the cost of generation at fossil fuel sources that it displaced (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 if there were no renewables.

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, but was aimed at regulations mandating specific measures. 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.

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Comments on the Proposed Repeal and Replacement of the Clean Power Plan

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1. EPA should include co-benefits of non-targeted pollution reductions or avoided costs of other regulations when analyzing costs and benefits of a regulation.

In the RIA of the proposed CPP repeal, EPA considers several estimates of health co-benefits. These estimates are based on differing assumptions on the relationship between air pollution and health. These assumptions are discussed extensively elsewhere in these comments.

EPA requests comments on the interactions between a GHG rule and existing statutory and regulatory programs. Moreover, in the proposed CPP repeal, EPA requests comment on "the extent that the EPA should rely on consideration of the benefits due to reductions in the target pollution relative to the costs…" Here I argue that the EPA should rely on the effects of a regulation on non-targeted pollution, but in certain cases it should do so differently than it has, as I discuss next.

EPA should consider non-targeted pollution because failing to do so would result in regulations that are not ambitious enough from a societal perspective. For a hypothetical proposed regulation, suppose that the estimated benefits of reducing the targeted pollution are less than the estimated costs—that is, the proposed regulation would have negative net benefits if EPA includes only the benefits from the targeted pollutant. Suppose further that the estimated benefits of non-targeted pollution are sufficiently high that if the EPA were to include those benefits in its RIA, net benefits would be positive. If EPA were to break from historical practice and ignore the benefits of the non-targeted pollution, EPA may decide that the regulation is not justified on a benefit-cost basis and that the regulation should not be finalized. Such a decision would be detrimental to society, however, because the regulation would have created positive net benefits (that is, counting the benefits of the non-targeted pollution).

Thus, EPA should include the effects of the non-targeted pollution to avoid a situation in which it fails to adopt regulations that would benefit society. One might argue that EPA could improve social welfare by regulating the non-targeted pollution directly. However, this may not always be practical. To address this argument, it is worth distinguishing two general cases, because the treatment of the non-targeted pollution should differ across the two cases.

First, suppose EPA is proposing a hypothetical regulation that targets a particular pollutant, and that also reduces a non-targeted pollutant. Suppose further that EPA can reasonably assume that no other policies would affect emissions of the non-targeted pollutant. For example, suppose hypothetically that the non-targeted pollutant is particulate matter (PM) and that no areas exceed the National Ambient Air Quality Standards (NAAQS) for PM. In this hypothetical case EPA might expect that there would not be any state or federal policies that target PM. In this case, given the scientific evidence for the societal benefits of reducing PM below the NAAQS for PM, EPA should include those co-benefits of the regulation that targets a pollutant other than PM. Failing to do so could result in the EPA failing to adopt regulations that benefit society, for the reason discussed above.

Thus, in the first case, EPA should continue its long-standing practice of including co-benefits from non-targeted pollutants. However, there is a second case, and as I'll explain EPA should take a different approach in that case.

Specifically, suppose that the non-targeted pollutant is again PM, and that PM levels exceed the NAAQS. Suppose further—for simplicity—that the regulation would reduce PM levels so that the NAAQS are exactly attained. In that case, if EPA does not enact the regulation, EPA would expect states to adopt regulations that reduce PM levels so that the NAAQS are attained. With the regulation, EPA would expect the regulation to reduce PM levels so that the NAAQS are attained, and no additional state policies would be required. Note that the assumption that the regulation reduces PM so that the NAAQS are met simplifies this discussion, and the general conclusions would apply if this assumption doesn't hold.

In both cases—with or without the EPA regulation—the non-targeted pollutant is at the same level. Therefore, it would *not* be appropriate to count benefits of the non-targeted pollution reduction, because these reductions would occur with or without the regulation. However, with the regulation the state can avoid implementing the policy. Therefore, the avoided costs of the state policy should be counted when the EPA estimates net benefits of the regulation. The difference between the situation with and without the regulation is that with the regulation, the costs of the state policy are avoided. Moreover, if EPA were to include the co-benefits of PM rather than the avoided compliance costs, the EPA would overstate the net benefits of the regulation (i.e., assuming the state policy would have had positive net benefits).

To summarize, if EPA is considering a regulation that reduces non-targeted pollutants, then as long as those emissions reductions would not have occurred because of some other policy (either state or federal), EPA should include the co-benefits of the non-targeted emissions reductions. But if the emissions reductions would have occurred because of some other policy (again, either state or federal), EPA should count avoided costs of those policies, but not co-benefits of the non-targeted pollutant.

Of course, there may be regulations in which both cases apply. This is the situation with the CPP, because some areas have PM levels below the NAAQS, whereas other areas have PM levels above the NAAQS. The EPA could apply the first methodology for areas that meet the NAAQS, and the second methodology for areas that do not meet the NAAQS.

Another potential difficulty is that, for the second case where the non-targeted emissions reductions would have occurred anyway, it may be uncertain which policies would have been enacted in the absence of the regulation being considered. EPA would have to estimate the avoided costs of those policies. It would not make sense to conduct a cost-benefit analysis that ignores the avoided costs.

2. EPA should update its electricity sector assumptions for the CPP repeal and replacement RIAs

The primary estimates of benefits and costs of repeal are based on the 2015 RIA for the final CPP. The estimates are based on modeling of the electricity system, using assumptions on future electricity demand, fuel prices, renewables costs, and other inputs to the model. To estimate the benefits and costs of the CPP, for example assuming mass-based standards, the EPA compares a simulation of the model without the CPP against a scenario that is otherwise identical but includes the mass-based CPP.

In the repeal RIA, the EPA makes three major changes to the final CPP RIA, including: treating energy efficiency savings as a benefit of the CPP (i.e., a foregone benefit of repeal); using a new social cost of

carbon dioxide; and considering different assumptions on the relationship between PM levels and health. All three of these changes are discussed elsewhere in these comments. Here, I focus on the fact that the repeal RIA uses the same underlying assumptions for the electricity sector modeling as the final CPP RIA. These comments are relevant to both the repeal and replacement RIAs.

Changes to the electricity sector that have occurred since the CPP was finalized affect estimated costs and benefits of repeal, as well as the costs and benefits of replacement. In fact, the repeal RIA discusses many of these changes, which have also been discussed in numerous studies including some of our own work (e.g., Burtraw et al. 2012 and Linn and McCormack 2017). For instance, between 2015 and 2017, EIA reduced its forecasts of electricity consumption in 2030 by 1.5 percent. All else equal, updating assumptions on consumption growth would imply lower emissions in the no-CPP scenario, and lower carbon emissions reductions of the CPP. Updating the consumption assumption would also result in lower estimated costs.

As another example, costs of renewables have continued to decline after 2015. Using updated cost assumptions would imply more renewables and lower emissions in the no-CPP scenario, and it would also imply lower costs of constructing renewables to comply with the CPP. Lower renewables costs would affect both benefits and costs of the CPP.

Thus, updating the assumptions would affect both benefits and costs of the repeal. There is no reason, a priori, to expect the changes in benefits and costs between 2015 and an updated analysis to cancel one another exactly. That is, updating these assumptions is likely to affect the estimated net benefits of repeal.

The question is, how large might this change be? In the repeal RIA, EPA notes that in 2016, it estimated credit prices under the CPP to be $4 per ton of carbon dioxide in 2030, which is about one-third of the credit prices it had estimated just one year prior. Because the credit prices reflect marginal costs of reducing emissions and not average costs, it would be incorrect to infer that updating the analysis would reduce compliance costs by one-third. However, this comparison suggests that the effect would be large relative to the estimated costs of the final CPP.

In the proposed repeal RIA, EPA compares emissions and other outcomes estimated in the Energy Information Administration's (EIA) Annual Energy Outlooks in 2016 and 2017. This comparison is of little use, however, because the EIA model differs in many ways from the model EPA uses to analyze the CPP. In other words, *I cannot think of a reasonable substitute for simply updating the assumptions used to model the net benefits of repealing the CPP*.

There is also a more general point to be made here, concerning whether to update assumptions when repealing a regulation. Given the rapid changes in fuel prices, technology costs, and other factors in the electricity sector, estimated costs and benefits may change substantially between the final regulation, repeal, and replacement, even if the finalization and replacement occur close together in time. In other contexts, such as regulating industrial pollution, the factors affecting costs and benefits may change more slowly over time. Nevertheless, in cases when those inputs have changed enough to make it reasonable to expect large changes in costs or benefits, EPA should update its analysis. If the EPA proceeds with repealing the CPP, its benefit-cost analysis should use updated assumptions.

3. Setting standards within the "fence line" could affect generator operation and undermine emissions reductions

EPA requests comment on developing GHG guidelines. In the final CPP, EPA tried to minimize the extent to which the CPP would cause generation to increase for carbon-emitting sources not covered by the CPP—most particularly, newly constructed generation units. Because the CPP set standards for existing but not new sources, there was a possibility that the CPP could cause generation to shift from existing to new sources, undermining the emissions gains of the regulation. EPA attempted to reduce this risk in several ways, such as by offering states the option to include new sources in their emissions caps.

Although EPA has provided few details on a proposed replacement of the CPP, the agency appears to favor setting emissions standards based on reductions that can occur at an individual source. If the EPA pursues this approach, there are two ways the standards could affect generator operation and undermine emissions reductions caused by the standards.

First, if EPA allows states to comply by meeting an emissions cap, this cap would have to cover emissions from all existing fossil fuel-fired generators. Otherwise, the emissions cap would likely increase generation from uncovered generators, including existing and new fossil fuel-fired generators that are not covered by the cap. For example, suppose the cap applies to all steam units but not existing natural gas combined cycle units. Then, a state could comply with the cap if enough generation shifts from existing coal to existing gas-fired units. The increase in gas-fired generation caused by the cap would eliminate roughly half of the emissions reductions caused by the cap (i.e., assuming the rate of emissions per unit of generation for a coal-fired unit is twice that of a gas-fired unit).

Second, with a rate-based standard, the standard can affect unit-level operation. For example, suppose a coal-fired unit improves its fuel efficiency sufficiently to meet its emissions rate standard. The higher efficiency reduces its marginal operating costs, which could cause it to generate more electricity than if it had not made the efficiency improvement. Linn et al. (2014) estimate that this effect could erode 22 to 33 percent of the emissions reductions caused by an efficiency standard for coal-fired units. EPA should design the replacement CPP to minimize these adverse effects.

Comments on the Estimation of Health Co-benefits in EPA's Clean Power Plan

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Ancillary public health benefits, also described as co-benefits, compose a portion of the total benefits of the Clean Power Plan (CPP) and therefore compose a portion of the total foregone benefits of the CPP repeal. EPA is actively exploring ways to address uncertainty in the estimation of these ancillary benefits, and the Regulatory Impact Analysis (RIA) for CPP repeal does so by conducting a sensitivity analysis using a set of $PM_{2.5}$ cutpoints. The RIA also provides an alternative approach for estimating foregone benefits, in which only the foregone benefits from the targeted pollutant (CO_2) are considered and foregone co-benefits are excluded. This comment addresses these two elements of the RIA.

Addressing uncertainty in co-benefit estimation using cutpoints

The RIA states, "we seek comment from the public on how best to use empirical data to quantitatively characterize the increasing uncertainty in $PM_{2.5}$ co-benefits that accrue to populations who live in areas with lower ambient concentrations." It is legitimate for the administration to raise the issue of uncertainties, as there are still uncertainties about the link between levels of $PM_{2.5}$ and mortality risk despite the breadth of research on the topic.

The issue is how to best address in a benefit–cost analysis the uncertainties inherent in any empirical study or a body of research. One approach typically used in regulatory impact analysis is to represent model uncertainty. For the Clean Power Plan, in both the analysis of the original rule and the new analysis to support repeal, this involves presenting a range of benefit estimates to reflect the relationship between $PM_{2.5}$ concentrations and premature mortality found from different studies. However, the RIA for CPP repeal follows a less defensible method of accounting for uncertainty in regulatory impact analyses such as this—it presents two sensitivity analyses that assume the existence of a threshold, or cutpoint.

The first threshold, below which any reductions in $PM_{2.5}$ concentrations are considered to have zero benefit, is the $PM_{2.5}$ level set by the National Ambient Air Quality Standard (NAAQS). The health literature does not support such an assumption, a point made clear in a 2010 summary of expert opinions.[3] 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

[3] https://www3.epa.gov/ttn/ecas/regdata/Benefits/thresholdstsd.pdf

health benefits below this level are zero is not legitimate and thus these results cannot be used as evidence to justify repeal.[4]

The second threshold is set at the lowest measured level (LML) of $PM_{2.5}$ concentrations in the two epidemiological studies used in the RIA to derive the concentration-mortality response relationship (Krewski et al. 2009, LML = 5.8 µg/m3; Lepeule et al. 2012, LML = 8 µg/m3). Below the LML, the health benefits from reductions in $PM_{2.5}$ concentrations are assumed to be zero. 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 $PM_{2.5}$ levels. However, since the shape of the response function is unknown below the LML, a fair and transparent analysis should include a second bounding analysis in which the health benefits from reductions in $PM_{2.5}$ 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 in concave).

Another way of improving the analysis would be to ask where the threshold would have to be to translate to benefits low enough for the benefits foregone from repealing the rule to be equal to the cost savings from repeal. Given that result, one could then ask if there is any literature to support such a threshold.

Furthermore, if the threshold cases are included in the RIA they should be clearly described for what they are: sensitivity analyses, not main results. The benefit-cost analyses using the threshold analyses are presented in the Executive Summary (Tables 1-7 and 1-8) and are not described as sensitivity analyses, possibly leading to the mistaken conclusion that they comprise a portion of the main results.

Including co-benefits in foregone benefits calculation

The first set of net benefit estimates presented in the RIA are the net benefits associated with the targeted pollutant, CO_2. Foregone health co-benefits are not included. This methodology addresses 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."[5]

EPA's 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.

[4] See Krewski et al. (2009) and Lepeule et al. (2012):
https://www.healtheffects.org/system/files/Krewski140.pdf
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3404667/

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

Methodological Considerations for Interim Social Cost of Carbon Dioxide Estimates

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On October 16, 2017, the Environmental Protection Agency (EPA) issued a proposed rule, "Repeal of Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Generating Units"[6]. With the proposed rule, EPA provided a regulatory impact analysis (henceforth, the RIA) to quantify the effects of the proposed rule.[7] The rule proposes to repeal a number of previous requirements that would reduce carbon dioxide emissions, and the RIA assesses the associated economic effects of the rule's associated forgone climate benefits by employing an interim value for the federal government's social cost of carbon ($SC\text{-}CO_2$). This interim value for the $SC\text{-}CO_2$ and the related methodological changes from the federal government's previous estimation process for the $SC\text{-}CO_2$ are the subject of this comment.

[6] 82 Fed. Reg. 48035.
[7] US Environmental Protection Agency. "Regulatory Impact Analysis for the Review of the Clean Power Plan: Proposal".

In this comment we make the following three points and associated recommendations for revising the RIA:

1. The limited set of actions that EPA has taken to generate an interim value of the social cost of carbon are unresponsive to the January 2017 comprehensive set of recommendations for improving such estimates that were provided at the request of the federal government by the National Academies of Sciences, Engineering, and Medicine (NASEM). We recommend that EPA undertake efforts to apply the near-term recommendations of the NASEM report to the estimation of the SC-CO_2 and in the interim rely on the previous SC-CO_2 estimates.

2. The analysis focuses exclusively on a domestic value for the SC-CO_2 that omits important economic interactions and considerations related to the global nature of climate change. This biases the interim estimates downward relative to the true impact on US citizens. If EPA wishes to consider domestically focused damages—in advance of scientific tools that meet the needs identified in the NASEM report—we recommend that EPA consider and present domestically focused SC-CO_2 estimates and global SC-CO_2 estimates together as a range

3. The adoption of the 7 percent discount rate that represents the before-tax rate of return on private capital under the Office of Management and Budget's (OMB) Circular A-4[8] is conceptually inappropriate for SC-CO_2 estimation, as it is methodologically inconsistent with the output of the integrated assessment models used to generate the supporting damage estimates. We recommend that EPA implement the near-term recommendations of the NASEM report with respect to discounting, and in the interim continue to use the previous estimates based on the 2.5 percent, 3 percent, and 5 percent discount rates.

The NASEM Report

In its discussion of uncertainty in the SC-CO_2, the RIA highlights a number of potential areas for improvement of the methodology underpinning the federal government's estimation of the SC-CO_2. In response to a study request in 2015 from the federal government's Interagency Working Group on the Social Cost of Carbon that was formerly chartered with developing and maintaining estimates of the social cost of greenhouse gas emissions, a NASEM committee conducted a comprehensive evaluation of potential updates to the estimation methodology for the social cost of carbon dioxide.

On January 11, 2017, the NASEM committee released the culmination of its evaluation in the form of the report, *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide* (henceforth, the NASEM report). The report puts forward a number of conclusions and recommendations on how to improve the conceptual underpinnings, empirical methods, and data used to calculate the SC-CO_2, as well as the transparency and flexibility of the process by which future estimates are generated.[9] The results and recommendations of this report, though focused on the calculation of damages resulting from the emissions of carbon dioxide, are also broadly applicable to the social costs of other greenhouse gases, such as methane and nitrous oxide. The NASEM report addresses many of the issues highlighted in the RIA, among others.

[8] Executive Office of the President of the United States. 2003. Circular A-4. https://www.whitehouse.gov/omb/circulars_a004_a-4 (accessed November 4, 2017).
[9] 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

Major Recommendations of the NASEM Report: Integrated Framework, Scientific Criteria, and Process

The NASEM report offers:

> "Both near- and longer-term recommendations [that] provide guidance to improve the scientific basis, characterization of uncertainty, and transparency of the SC-CO_2 estimation framework within the federal regulatory context for which the SC-CO_2 was developed.
>
> The committee specifies criteria for future updates to the SC-CO_2. It also recommends an integrated modular approach for SC-CO_2 estimation to better satisfy the specified criteria and to draw more readily on expertise from the wide range of scientific disciplines relevant to SC-CO_2 estimation. Under this approach, each step in SC-CO_2 estimation is developed as a module—socioeconomic, climate, damages, and discounting—that reflects the state of scientific knowledge in the current, peer-reviewed literature.
>
> Because it is important to update estimates as the science and economic understanding of climate change and its impacts improve over time, the committee recommends that estimates of the SC-CO_2 be updated in a three-step process at regular intervals of approximately 5 years. This timing would balance the benefit of incorporating evolving research against the need for a thorough and predictable process. For each module, the committee recommends near-term changes given the current state of the science. The recommended changes would be feasible to implement in the next 2-3 years and would improve the performance of each part of the analysis with respect to the primary criteria." [10]

We note with concern that the technical efforts and process involved in producing the new SC-CO_2 estimates as part of EPA's proposed rule are not responsive to these major recommendations of the NASEM report with respect to the establishment of an integrated framework, the application of recommended scientific criteria, or the following of a regularized process that incorporates scientific peer review and focused public comment. We recommend that EPA undertake efforts to apply the near-term recommendations of the NASEM report to the estimation of the SC-CO_2 and in the interim rely on the previous SC-CO_2 estimates.

[10] NASEM, *supra*, Executive Summary, p. 2-3.

Adoption of Domestic Rather than Global Damages

An important departure from the federal government's previous methodology for estimating the SC-CO_2 is EPA's decision to count only direct domestic benefits from carbon mitigation in its calculation of interim values of the SC-CO_2. Though this choice is consistent with a narrow application of prior regulatory analysis practice under OMB's Circular A-4, it is unnecessarily and unreasonably constrained for addressing inherently global pollutants such as greenhouse gases. US greenhouse gas emissions account for about 14 percent of the global total. If all countries considered only the domestic effects of their greenhouse gas emissions, about 86 percent of climate change impacts on US citizens would be ignored—considered in no decision. An analytic focus solely on direct impacts to the United States of US emissions, when generalized, therefore omits the vast majority of the total impacts the United States faces from climate change.

In addition, damages from US emissions of greenhouse gases are felt not just within US borders, but also abroad. Though such damages occur on foreign soil, their economic effects can be felt within the United States through the globally interconnected economy. As the NASEM report stated, current integrated assessment models do not take full account of "potential implications of climate impacts on, and actions by, other countries, which also have impacts on the United States,"[11] which could affect the United States "through such pathways as global migration, economic destabilization, and political destabilization."[12] Regulatory actions taken by the United States also may be reflected in policy actions taken by other countries, with perhaps the clearest example of such reciprocal action being the Canadian government's full incorporation in its own regulatory analysis of the prior US federal values for the social costs of carbon dioxide, methane, and nitrous oxide.

This set of complicated global interactions is an important component of any complete calculation of damages felt by US citizens from domestic emissions, but it is omitted in EPA's revised methodology. In the absence of this full set of considerations, EPA's interim SC-CO_2 estimates are biased downward. While the scientific, economic, and geopolitical basis of climate change as a global problem should inform reasoned decision making, if EPA wishes to consider domestically focused damages—in advance of scientific tools that meet the needs identified in the NASEM report—we recommend that EPA consider and present domestic-focused SC-CO_2 estimates and global SC-CO_2 estimates together as a range in the central analysis.

Use of a 7 Percent Discount Rate

EPA has also departed from the prior approach of the federal government's method to discounting in its calculation of the SC-CO_2 by adopting a 7 percent discount rate. Though the addition of an estimate calculated using a 7 percent discount rate is consistent with past regulatory guidance under OMB Circular A-4, it is inappropriate for use in estimating the SC-CO_2 through EPA's methodology. The integrated assessment models used to generate the estimates report their output in terms of "consumption-equivalent" impacts, which are intended to reflect the effective impact on people's consumption (as opposed to investment). Standard economic practice is to discount consumption equivalents at the "consumption rate of interest"—which, according to OMB's current guidance, is a 3 percent discount rate.

[11] *Ibid*, Conclusion 2-4, pp. 9, 53.
[12] *Ibid*, pp. 9, 53.

It is therefore inappropriate to use such modeling results with OMB's 7 percent discount rate, which is intended to represent the historical before-tax return on private capital. None of the researchers whose model results were used to generate the interim values employs a discount rate as high as 7 percent in their work. In addition to the 3 percent rate, the prior SC-CO_2 estimates also included sensitivities using 2.5 percent and 5 percent discount rates, which were modifications of the 3 percent consumption discount rate to take into account uncertainty in future economic growth and potential correlations between economic growth and climate damages. Moreover, a recent report from the Council of Economic Advisers found that evidence supports a rate lower than 3 percent as the norm for the consumption rate of discount, which it suggested should be at most 2 percent given historical trends and expected future conditions.[13]

The NASEM report recommended that discounting occur via use of what is termed the "Ramsey formula" with parameters "that are consistent with theory and evidence and that produce certainty-equivalent discount rates consistent, over the next several decades, with consumption rates of interest."[14] This recommendation is relatively straightforward to implement, as it does not require significant new model development. Nonetheless, this recommendation not been adopted in the RIA. Rather, as described above, the RIA introduces a discount rate that is not based on the consumption rate of interest.

For these reasons, we recommend that EPA implement the near-term recommendations of the NASEM report with respect to discounting, and in the interim continue to use the previous estimates based on the 2.5 percent, 3 percent, and 5 percent discount rates.

[13] Council of Economic Advisers (CEA). 2017. *Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate*. https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf (accessed November 4, 2017).
[14] NASEM, *supra*, Recommendation 6-2, pp. 19. 180.