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Cost and Benefit Considerations in Clean Air Act Regulations

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Summary

The Clean Air Act (CAA) gives the Environmental Protection Agency (EPA) broad authority to set ambient air quality standards to protect public health and welfare. It authorizes emission standards for both mobile and stationary air pollution sources, including cars, trucks, factories, power plants, fuels, consumer products, and dozens of other source categories. Since 1970, EPA has used this authority to require emission controls for these sources. Emissions of the most widespread ("criteria") pollutants have been reduced by 72% during that period.

As directed by Congress and by executive orders, EPA has estimated the costs and benefits of major CAA (and other) regulations for the last four decades. Its most comprehensive recent studies and studies by the Office of Management and Budget (OMB) have concluded that the benefits of clean air regulations outweigh the costs by substantial margins. EPA's cost-benefit analyses of individual regulations, required by Executive Order 12866, show similar results: a review of the 55 economically significant CAA regulations promulgated from 2001 to 2016 found only two in which estimated costs exceeded benefits.

Nevertheless, many in Congress have expressed concern that Clean Air Act and other environmental regulations harm the nation's economy. One issue raised by critics is whether EPA underestimates the cost and other negative impacts of CAA rules—in part, by considering them individually, and not considering cumulative impacts. Another criticism is that the agency relies for most of its benefit assessments on the effects of reducing a single category of pollutants, particulate matter (PM). Research has tied PM to tens of thousands of premature deaths, and EPA often finds that reductions in PM emissions justify regulation, even where PM reductions are a "co-benefit" of reducing another targeted pollutant. A third issue critics raise is whether the methodology used to place monetary value on the avoidance of premature death—a technique referred to as calculating the "value of a statistical life"—inflates the estimated benefits of regulation.

This report examines these issues in the context of Clean Air Act regulation. It reviews EPA and Office of Management and Budget (OMB) studies of the cost and benefit of CAA regulations, and addresses the issues raised by agency critics. The report finds that

- The Clean Air Act authorizes EPA to set standards in multiple sections of the act: about half of the act's major regulatory authorities mention costs or economic considerations explicitly, and several others imply that costs may be considered; but other authorizing sections, including some key sections, make no mention of cost considerations.
- Where the statutory authorities do not mention cost consideration, they tend to fall into one of four categories: provisions in which Congress itself set the standards; provisions where Congress directed the agency to set health-based standards, without mentioning cost; broad authority to promulgate regulations to achieve an objective that Congress determined was necessary, but the specifics of which it could not anticipate; or authority to promulgate federal requirements in cases where states have failed to develop or implement adequate regulations on their own to meet a federal mandate.
- In all cases, even where the statute would prohibit consideration of cost in setting standards, EPA is bound by executive orders to provide estimates of costs and benefits if the rule would be economically significant.

- According to EPA, the estimated benefits of CAA regulation will exceed the estimated costs by more than 30 to 1 in the period 1990-2020. CAA regulations prevent 230,000 premature deaths annually, according to the agency.
- The estimated benefits of CAA regulations rely heavily on the effects of reducing particulate emissions, and on the value placed on the avoidance of premature death as a result of such controls.
- Many rules have benefits or costs that cannot be quantified or monetized in light of existing information.

President Trump has issued two executive orders that address the cost of EPA regulations: Executive Order (E.O.) 13771, signed January 30, 2017, and E.O. 13783, signed March 28, 2017. The former directs OMB to set regulatory "budgets" for executive branch departments and agencies and, in general, to rescind two regulations for every new one issued. The latter requires EPA to review—and, if appropriate, suspend, revise, or rescind—several CAA regulations affecting energy production, with an eye to avoiding regulatory burdens. At present, the effect of the two orders on future CAA regulations is unclear. The report discusses some of the possible implications.

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Introduction

In the past several Congresses, critics of the Environmental Protection Agency (EPA) have focused much of their attention on the agency's regulatory actions under the Clean Air Act (CAA). (For a summary of those actions, see CRS Report R41561, *EPA Regulations: Too Much, Too Little, or On Track?*, by (name redacted) and (name redacted) .) During this time, the Obama Administration promulgated numerous CAA regulations. In general, these regulations came in response to congressional authority or mandates under the Clean Air Act Amendments of 1970, 1977, and 1990. A number were also in response to court decisions that remanded to the agency regulations that the agency had promulgated—often under previous administrations. Critics have maintained that many of these regulatory actions would be too costly, harming a wide range of industries, and would not be justified by the benefits obtained.[1]

The Clean Air Act is not consistent in whether it allows or requires the consideration of costs and benefits in setting standards. (See "Clean Air Act Authorities," below.) The act requires or authorizes the EPA Administrator to promulgate regulations or set standards in more than 60 sections or subsections. In 25 of these sections or subsections, cost is not mentioned or implied as a factor to be considered. In the remaining sections and subsections where the Administrator is required or authorized to promulgate regulations—more than 40 of them in all—cost *is* either identified explicitly or implied as a factor to be considered.

Whether or not the statute requires a consideration of cost, EPA has prepared cost estimates for all economically significant rules since the Carter Administration as the result of executive orders.[2] Under Executive Order (E.O.) 12866, each economically significant regulatory action taken by Executive Branch agencies (under any statutory authority) must include estimates of the cost and benefits of the action in a Regulatory Impact Analysis (RIA) before it is proposed, and again before it is promulgated.[3] RIAs play a major role in the interagency review process overseen by the Office of Management and Budget, which precedes the publication of significant rules in the *Federal Register*.

Thus, there is a process for considering the costs and benefits of all Clean Air Act (and other) economically significant regulations. How well this process works is the question. One issue raised by EPA's critics is whether the agency underestimates the cost and other negative impacts of rules in these RIAs by considering them individually, and not considering cumulative impacts. A second criticism is that the agency relies for most of its CAA benefit assessments on the effects of reducing a single category of pollutants, particulate matter (PM). Research has tied PM to tens of thousands of premature deaths, and EPA often finds that reductions in PM emissions justify regulation, even where the target of the regulations is a different pollutant. A third issue critics raise is whether the methodology used to place monetary value on the avoidance of premature death—a technique referred to as calculating the "value of a statistical life"—inflates the estimated benefits of regulation. A fourth issue, not generally raised by critics, but often noted by

[1] See, for example, U.S. Chamber of Commerce, "Regulatory Areas: Energy and Environment," at https://www.uschamber.com/regulations/areas. Of the 38 EPA regulations listed by the Chamber, 24 are Clean Air Act rules.

[2] The Carter Administration order, "Improving Government Regulations," Executive Order 12044, signed March 23, 1978, is at http://www.thecre.com/pdf/12044.PDF.

[3] "Regulatory Planning and Review," Executive Order 12866, signed September 30, 1993, at http://www.plainlanguage.gov/populartopics/regulations/eo12866.pdf. For a discussion of E.O. 12866 and the regulatory review process, see CRS Report RL32397, *Federal Rulemaking: The Role of the Office of Information and Regulatory Affairs*, coordinated by (name redacted).

regulators, concerns the difficulty of identifying and estimating the full range of costs and benefits of environmental regulations.

This report examines these issues in the context of Clean Air Act (CAA) regulations. It begins with a review of EPA's CAA authorities and the role of cost considerations in CAA standard-setting.

Clean Air Act Authorities

The Clean Air Act, originally enacted in 1955 and amended numerous times since then, gives EPA sweeping powers to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." In the statute, Congress directs the EPA Administrator to, among other things

- set national ambient air quality standards;
- set emission standards for both stationary and mobile sources of air pollution;
- reduce emissions of 187 hazardous air pollutants that Congress itself listed in the statute;
- protect air quality in relatively pristine areas from significant deterioration;
- regulate fuels and fuel additives, both to protect public health and welfare and to prevent the impairment of emission control devices;
- require the use of renewable transportation fuels;
- control acid deposition;
- protect the stratospheric ozone layer by requiring the phase-out of ozone-depleting substances;
- issue permits and enforce the act's emission limits; and
- develop and enforce Federal Implementation Plans in states that fail to implement the act's requirements.

The specific authorities given to the Administrator are established in more than 60 different sections and subsections of the act, which range from broad authority to protect public health with an adequate margin of safety to detailed requirements that specify numerical emission limits or require that standards be at least as stringent as the emission limitation achieved by the best controlled similar source.[4]

Cost Consideration in Clean Air Act Authorities

Because the act's authorities are so fragmented, it can be difficult to generalize regarding the role of cost considerations in setting air quality standards. Many of the act's authorities allow or require the Administrator to "take into account" or "take into consideration" the cost or technical feasibility of specific emission requirements.

[4] A list of the regulatory authorities that the act grants the EPA Administrator and the relevant language of each is available from the authors.

Authorities That Mention or Imply Cost Considerations

A review of 67 sections, subsections, or provisions of the act that authorize regulations indicates that about half (34) specifically mention cost or economic considerations. Among the 34 sections are several major regulatory authorities, including the authority to

- set emission standards for new stationary sources (power plants, refineries, etc.) in Section 111;
- go "beyond the floor" in emission standards for sources of 187 hazardous air pollutants, under Section 112(d);
- set emission standards for motor vehicles (beyond the standards specifically listed in the act), under Sections 202(a) and 202(i);
- control mobile source air toxics, under Section 202(l);
- control or prohibit the manufacture and sale of fuels and fuel additives under Section 211(c);
- require the sale of reformulated gasoline in nonattainment areas, under Section 211(k);
- set emission standards for nonroad vehicles and engines, including construction equipment, recreational equipment, agricultural machinery, electric generators, and other sources, under Section 213; and
- set emission standards for locomotives, buses, and aircraft, under Sections 213, 219, and 231.

In eight other cases, consideration of cost is implied by the act, e.g., where it requires a standard that is "practicable" or "reasonably achievable." These sections of the act direct the EPA Administrator to

- consider the "remaining useful life of the existing source" to which an emission standard will apply, under Section 111(d);
- provide for the use of "generally available control technologies" to control area sources of hazardous air pollutants, under Section 112(d)(5);
- promulgate "reasonable regulations and appropriate guidance to provide, to the greatest extent practicable, for the prevention and detection of accidental releases" of extremely hazardous substances and take into consideration "the concerns of small business," under Section 112(r)(7);
- consider "the availability and feasibility of pollution control measures" in classifying nonattainment areas under Section 172;
- consider "such other factors as he [the Administrator] deems pertinent" and take into consideration "the restraints of an adequate leadtime for design and production" in setting vapor recovery standards for gasoline under Section 202(a)(5)
- impose emissions standards or emissions control technology requirements that "reflect the best retrofit technology and maintenance practices reasonably achievable" for retrofit of urban buses under Section 219(d);
- decide whether a requirement is "practicable, taking into account technological achievability, safety, and other relevant factors" in establishing an accelerated schedule for phasing out production and consumption of ozone-depleting substances under Section 606; and

- consider "the purpose or intended use of the product, the technological availability of substitutes ..., safety, health, and other relevant factors" in regulating nonessential products that release class I ozone depleting substances[5] under Section 610 (except for two specific categories of products that are listed in the statute).

A full list of the 42 provisions that mention or imply consideration of cost is provided in **Table 1**.

Table 1. Clean Air Act Authorizing Provisions That Mention or Imply Consideration of Cost

Section	Provision
111 (a) and (b)	New Source Performance Standards (NSPS)
111(d)	Existing Source Performance Standards
111(h)	Work Practice Standards in Lieu of NSPS or Section 111(d) Standards
112(d)(2) and (3)	Maximum Achievable Control Technology Standards for New Sources of Hazardous Air Pollutants[a]
112(d)(2) and (3)	Maximum Achievable Control Technology Standards for Existing Sources of Hazardous Air Pollutants[a]
112(d)(5)	National Emission Standards (NESHAP) for Area Sources of Hazardous Air Pollutants
112(d)(8)	National Emission Standards (NESHAP) for Coke Ovens[a]
112(f)	Residual Risk Standards to prevent adverse environmental effects
112(h)	NESHAP Work Practice Standards
112(k)	Area Source Program for Hazardous Air Pollutants
112(m)	Great Lakes and Coastal Waters
112(r)(7)	Accident Prevention
119(b)	Primary Nonferrous Smelter Orders
125	Measures to Prevent Economic Disruption or Unemployment
129(a)(2)	Solid Waste Combustion[a]
169A	Visibility Protection
172	Classification of Nonattainment Areas
183(e)	Control of Emissions from Consumer or Commercial Products
183(f)(1)	Standards for Loading or Unloading Tank Vessels
202(a)	Emission Standards for New Motor Vehicles
202(a)(3)(A) and (B)	Emission Standards for Heavy Duty Trucks
202(a)(3)(D)	Emission Standards for Rebuilt Engines
202(a)(5)	Gasoline Vapor Recovery
202(f)(3)	High Altitude Emission Standards
202(i)	Tier 2 Auto Emission Standards

[5] Class I substances, 20 of which are listed in Section 602(a) of the act, are defined by their potential to damage the Earth's ozone layer.

Section	Provision
202(k)	Evaporative Emission
202(l)(2)	Mobile Source Air Toxics
211(c)	Regulation of Fuels or Fuel Additives that Endanger Public Health or Welfare
211(c)	Regulation of Fuels or Fuel Additives that Impair the Performance of Emission Controls
211(h)	Reid Vapor Pressure Requirements
211(k)	Reformulated Gasoline for Conventional Vehicles
211(k)	Toxic Air Pollutant Emissions from Reformulated Gasoline
213(a)	Emission Standards for Nonroad Engines and Vehicles
213(a)	Emission Standards for Locomotives
219(a)	Urban Bus Standards
219(d)	Urban Bus Retrofit Requirements
231(b)	Aircraft Emission Standards
245	Standards for Heavy-Duty Clean-Fuel Vehicles
246	Centrally Fueled Fleets
407(b)(2)	Nitrogen Oxide Emission Reductions
606	Accelerated Phase-Out Schedule for Class I and Class II Substances
610	Nonessential Products Containing Chlorofluorocarbons (for products identified by the Administrator)[b]

Source: CRS analysis of the Clean Air Act.

a. Section 112(d)(2) and Section 129(a)(2) both modify the Administrator's authority to determine what is "achievable" by stating "taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements." In both cases, a statement that the standard "shall not be less stringent than…" follows the mention of cost, apparently requiring the Administrator to promulgate standards not less stringent than the best similar source (in the case of new sources) or the average of the top 12% (in the case of existing sources), regardless of cost. The statement regarding cost considerations would appear to apply only in cases where the Administrator promulgates a standard that goes beyond the minimum ("not less stringent than") floor. Similarly, Section 112(d)(8) modifies the Administrator's authority to establish coke oven standards by directing him to take into account costs and reasonable commercial door warranties, but the statement that, "Such regulations shall require at a minimum [followed by a list of specific standards]" follows the mention of cost, apparently requiring the Administrator to promulgate standards that meet the minimum listed requirements regardless of cost.

b. Section 610 states that the Administrator shall promulgate regulations that prohibit any person from selling or distributing two specific types of chlorofluorocarbon (CFC)-containing products. There is no mention of cost in connection with the regulation of these two types of product. The section also directs the Administrator to identify other nonessential CFC-containing products for such a prohibition. In the latter case, the Administrator is to consider the "technological availability of substitutes for such product and for such class I substance, safety, health, and other relevant factors," implying that cost may be considered. Thus, this authority, like that identified in note a., allows or requires the consideration of cost in some instances, but not in others, and the provision is listed in both **Table 1** and **Table 2** of this report.

Authorities That Neither Mention nor Imply Cost Consideration

In 25 CAA sections or subsections where regulatory authority is conferred on the Administrator (identified in **Table 2**), cost is not mentioned or implied as a factor to be considered. These

statutory authorities tend to fall into one of four categories: (1) provisions in which Congress itself set the standards; (2) provisions where Congress directed the agency to set health-based standards, without mentioning cost; (3) provisions in which Congress gave the agency broad authority to promulgate regulations to achieve an objective that Congress determined was necessary (generally protecting public health directly or indirectly, or protecting the environment), but the specifics of which Congress could not anticipate; or (4) a provision requiring EPA to promulgate federal requirements in cases where states have failed to develop or implement adequate regulations to meet a federal mandate. These authorities are discussed briefly in the sections that follow.

A. Standards Established by Congress

In the late 1980s, when the most recent major CAA amendments[6] were being drafted, Congress, frustrated with the slow progress being achieved under earlier versions of the statute and by the delays caused by litigation, limited EPA's discretion in setting emission standards in a number of cases by writing detailed regulatory requirements into the statute.[7]

Perhaps the most specific of these requirements appear in Section 202 of the act, which addresses motor vehicle emissions. Here, Congress listed the pollutants to be controlled, mandated specific numerical standards for their emission, and set schedules for implementation. EPA still needed to promulgate regulations to implement these standards, but the standards themselves were set by Congress to take effect on a date certain.

Another major example can be found in Section 112, where Congress addressed emissions of hazardous air pollutants. Here, Congress listed 187 pollutants the emissions of which were to be controlled; defined the threshold quantity of emissions that would require sources to meet the most stringent standards; and required that sources meet emission limits at least as stringent as the emissions of the best controlled similar sources. The act mandated a 10-year schedule for promulgating standards.

B. Health-Based Standards

The cornerstone of the Clean Air Act consists of health-based standards for widespread air pollutants identified by EPA under Sections 108 and 109 of the act. These standards, termed National Ambient Air Quality Standards (NAAQS) are for air pollutants that, in the Administrator's judgment, "endanger public health or welfare" and "the presence of which in the ambient air results from numerous or diverse mobile or stationary sources."[8] The primary (health-based) NAAQS must be designed to protect public health with an adequate margin of safety. Using this authority, EPA has promulgated NAAQS for six air pollutants or groups of pollutants: sulfur dioxide (SO_2), particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone, and lead. The act requires EPA to review the scientific data upon which the standards are based, and revise the standards, if necessary, every five years.

[6] The Clean Air Act Amendments of 1990, P.L. 101-549.

[7] Congress included detailed prescriptive standards and deadlines in other environmental legislation in the 1980s, notably the Hazardous and Solid Waste Amendments of 1984 (P.L. 98-616).

[8] Section 108(a)(1)(A) and (B).

Table 2. Clean Air Act Authorizing Provisions That Do Not Mention Cost

Section	Provision
109(a)	Primary National Ambient Air Quality Standards
109(b)	Secondary National Ambient Air Quality Standards
110(c)(1)	Federal Implementation Plans
112(d)(2) and (3)	Maximum Achievable Control Technology Standards for New Sources of Hazardous Air Pollutants[a]
112(d)(2) and (3)	Maximum Achievable Control Technology Standards for Existing Sources of Hazardous Air Pollutants[a]
112(d)(8)	Coke Oven Standards[a]
112(f)	Hazardous Air Pollutant Residual Risk Standards to provide an ample margin of safety to protect public health
112 (k)	Area Source Program for Urban Hazardous Air Pollutants
126(c)	Interstate Pollution Abatement
129(a)(2)	Solid Waste Combustion[a]
166	Prevention of Significant Deterioration
202(a)	Onboard Vapor Recovery (for motor vehicles)
202(j)	Cold CO [Carbon Monoxide] Standard
202(m)	Emissions Control Diagnostics
211(i)	Sulfur Content of Diesel Fuel
211(o)	Renewable Fuels
219(c)	Urban Bus Low-Polluting Fuel Requirement
243	Emission Standards for Light-Duty Clean Fuel Vehicles
328	Air Pollution from Outer Continental Shelf Activities
407(b)(1)	Nitrogen Oxides Emission Reduction Program
604(c)	Production and Consumption of Class I (Ozone-Depleting) Substances
605(c)	Production and Consumption of Class II (Ozone-Depleting) Substances
609	Servicing of Motor Vehicle Air Conditioners
610	Nonessential Products Containing CFCs (for listed categories)
615	Authority of Administrator (regarding protection of the stratosphere)

Source: CRS analysis of the Clean Air Act.

a. As noted above in footnote a. to **Table 1**, Section 112(d)(2), Section 112(d)(8), and Section 129(a)(2), all modify the Administrator's authority to set standards by requiring that he take costs into account, but also set minimum requirements for the standards that must be met regardless of cost. As a result, these authorities are listed in both **Table 1** and **Table 2** of this report.

b. As noted above in footnote b. to **Table 1**, Section 610 requires the Administrator to promulgate regulations that prohibit any person from selling or distributing two specific types of chlorofluorocarbon (CFC)-containing products. There is no mention of cost in connection with the regulation of these two types of product. The section also directs the Administrator to identify other nonessential CFC-containing products for such a prohibition. In the latter case, the Administrator is to consider the "technological availability of substitutes for such product and for such class I substance, safety, health, and other relevant factors," implying that cost may be considered. As a result, the Section 610 authorities are listed in both **Table 1** and **Table 2** of this report.

NAAQS do not directly regulate emissions or directly compel actions by sources of pollution. In essence, they are standards that define what EPA considers to be clean air for the specified pollutants. Once a NAAQS has been set, the agency, using monitoring data and other information submitted by the states, identifies areas that exceed the standard and that must, therefore, reduce pollutant concentrations to achieve it. After these "nonattainment" areas are identified, state and local governments have up to three years to produce State Implementation Plans that outline the measures they will implement to reduce the pollution levels and attain the standards.

The issue of cost is a perennial one in NAAQS decisions. For 45 years, EPA has interpreted Section 109 as prohibiting the Administrator from considering costs in setting the standards. In 2001, this interpretation was affirmed in a unanimous Supreme Court decision, *Whitman v. American Trucking Associations*.[9] The Court pointed to numerous other CAA sections where Congress had explicitly allowed consideration of economic factors, concluding that if Congress had intended to allow such factors in the setting of a primary NAAQS, it would have been more forthright—particularly given the centrality of the NAAQS concept to the CAA's regulatory scheme. The court concluded that Section 109(b)(1) "unambiguously bars cost considerations from the NAAQS-setting process."[10]

C. Broad Authority

A third group of Clean Air Act standards are the result of Congress giving EPA authority to promulgate regulations to achieve an objective (generally, protecting public health directly or indirectly, or protecting the environment) that Congress determined was essential, but the specifics of which it might not have been able to anticipate. This authority is similar to that for health-based standards, but broader: it can be used to protect the environment or what the act defines as "welfare,"[11] in addition to public health, and it authorizes controls of specific substances and activities.

For example, under Title VI of the Clean Air Act, Congress directed the EPA Administrator to phase out the production and consumption of chemicals identified as Class I Ozone Depleting Substances (ODS). ODS affect the stratospheric ozone layer, which protects the Earth from harmful radiation. A list of ODS was provided in the statute. In addition, EPA was directed in Section 602(a) to add to the list "any other substance that the Administrator finds causes or contributes significantly to harmful effects on the stratospheric ozone layer." A schedule for the phase-out of these chemicals is provided in Section 604(c). There is no discussion of economic impact or cost in these sections.

Section 615 of the act is even broader:

> If, in the Administrator's judgment, any substance, practice, process, or activity may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, and such effect may reasonably be anticipated to endanger public health or welfare, the Administrator shall promptly promulgate regulations respecting the control of such

[9] 531 U.S. 457 (2001).

[10] For further discussion of the American Trucking case, see CRS Report RS20860, *The Supreme Court Upholds EPA Standard- Setting Under the Clean Air Act: Whitman v. American Trucking Ass'ns*, by (name redacted) and (name red acted) .

[11] The act defines welfare in Section 302(h): "All language referring to effects on welfare includes, but is not limited to, effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants."

> substance, practice, process, or activity, and shall submit notice of the proposal and promulgation of such regulation to the Congress.

There is no mention of cost or economic impact in the section.

D. Federal Implementation Plans

The fourth group of regulations for which the Clean Air Act does not require consideration of cost is the result of backup authority that Congress gave EPA. In general, the act envisions that states will be responsible for adopting regulations to attain National Ambient Air Quality Standards. Section 110 of the act discusses in great detail the implementation plans that states are to submit to EPA, describing how they will attain or maintain compliance with the NAAQS. EPA cannot compel a state to submit a State Implementation Plan. Rather, if a state fails to submit a satisfactory plan by the statutory deadline, or fails to correct a deficiency identified by the EPA Administrator, EPA is required to promulgate a Federal Implementation Plan for the state under Section 110(c) of the act. The statute provides that

> The Administrator shall promulgate a Federal implementation plan at any time within 2 years after the Administrator—
>
> > (A) finds that a State has failed to make a required submission or finds that the plan or plan revision submitted by the State does not satisfy the minimum criteria established under subsection (k)(1)(A) of this section, or
> >
> > (B) disapproves a State implementation plan submission in whole or in part,
>
> unless the State corrects the deficiency, and the Administrator approves the plan or plan revision, before the Administrator promulgates such Federal implementation plan.

There is no directive for the Administrator to consider cost or economic impact in developing such a plan.

EPA's Use of Cost-Benefit Analysis

Although the statute prohibits the consideration of cost in setting some standards, EPA is subject to executive orders that require the estimation of costs and benefits any time an agency develops "economically significant" regulations. Executive Order 12866 defines an "economically significant" regulation as any rule that may "have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities."[12] The term "effect on the economy" means that a rule may be considered economically significant if it has costs *or* benefits of over $100 million.[13] The cost and benefit estimates are to be provided by the regulatory agency before rules are proposed for public comment, and again before they are issued in final form. E.O. 12866 states that, "Each agency shall assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs."

OMB has issued a number of guidance documents that agencies are required to follow when estimating costs and benefits of regulations. OMB's most significant guidance document is

[12] "Regulatory Planning and Review," Executive Order 12866, 58 *Federal Register* 51735, October 4, 1993.

[13] The phrase also includes transfer rules that transfer sums of over $100 million.

Circular A-4 on "Regulatory Analysis."[14] The circular states that it was "designed to assist analysts in the regulatory agencies by defining good regulatory analysis ... and standardizing the way benefits and costs of Federal regulatory actions are measured and reported." EPA's agency-specific document, "Guidelines for Preparing Economic Analyses (2010),"[15] is built on the analytical framework of Circular A-4.

Circular A-4 states that a "good regulatory analysis should include the following three basic elements: (1) a statement of the need for the proposed action, (2) an examination of alternative approaches, and (3) an evaluation of the benefits and costs—quantitative and qualitative—of the proposed action and the main alternatives identified by the analysis."[16]

With regard to analytical approaches, the circular states that agencies should use both cost-benefit analysis (CBA) and cost-effectiveness analysis. Cost-benefit analysis, in this context, involves the systematic identification of all of the costs and benefits associated with a forthcoming regulation, including nonquantitative and indirect costs and benefits, and how those costs and benefits are distributed across different groups in society. Cost-effectiveness analysis seeks to determine how a given goal can be achieved at the least cost. When all benefits and costs can be expressed in monetary units, CBA can clearly indicate which approach is most efficient in terms of net benefits. However, in many (and perhaps most) cases, agencies are not able to express all of the benefits or costs in monetary units. In such cases, cost-effectiveness analysis is available to consider the most economically efficient approaches.

Economic Externalities, Market Failures, and Government Regulation

Market failure describes an economic situation where the individual incentives for rational behavior do not lead to rational outcomes for the society. Market failure may arise from various economic circumstances, including externalities, monopolies, public goods, and information asymmetries.

Environmental problems are a classic case of economic externality. Externalities arise when an individual, a firm, or a government takes an action but does not bear all the costs (negative externality) or all the benefits (positive externality) of the action. An example of a negative externality would be a factory that pollutes as a result of its production process. This pollution may pose health risks for nearby residents or degrade the quality of the air or water. However, the additional cost to address any health issues or to help maintain the cleanliness of the air or water are not directly paid by the owner of the factory.

Many economists argue that the existence of externalities justifies government intervention in the markets through legislation or regulation. Ideally, regulation would be designed to get individuals or firms to "internalize the externality" by considering the full costs of production. In outlining this consideration, E.O. 12866 states that "Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the wellbeing of the American people." Many environmental regulations are designed to require firms to "internalize the externality" through a variety of policy instruments (e.g., performance standards, taxes and fees, or trading schemes).

Measuring Costs and Benefits

In ideal circumstances, regulations should be designed to maximize "net benefits" (that is, maximizing the value of "total benefits" minus "total costs"). To better assess net benefits, it is important to understand the market failures and economic externalities for which environmental regulations (including air emissions regulations) try to correct. Analyzing environmental

[14] OMB Circular A-4, "Regulatory Analysis," September 17, 2003, at http://www.whitehouse.gov/omb/assets/regulatory_matters_pdf/a-4.pdf. The circular took effect for "economically significant" proposed rules on January 1, 2004, and for "economically significant" final rules on January 1, 2005.

[15] See EPA, *Guidelines for Preparing Economic Analyses*, December 17, 2010, at https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses

[16] OMB Circular A-4, p. 2.

regulations in terms of market theory can help show that the consideration of costs and benefits are often the opposite side of the same coin (See Text Box).

OMB's circular and EPA's guidelines summarize a variety of methods the agency can use to determine the total costs and total benefits of a regulation—including those which are difficult to quantify and monetize.

- In measuring costs, the guidance documents ask the agency to assess the direct costs to the regulated firms, including pollution control equipment, record keeping and reporting requirements and labor for equipment installation, operation, maintenance, and monitoring. Further, the agency should attempt to analyze additional and/or indirect impacts on consumers, small businesses, government entities (including administrative cost and savings), international trade, and energy and employment effects.[17]
- In measuring benefits, the guidance documents ask the agency to use the best reasonably obtainable scientific, technical, economic, and other information available to quantify—and, if possible, monetize—the impacts of regulations. For example, the benefits of a regulation that reduces emissions of air pollution might be quantified in terms of a variety of health, climate, visibility, and ecosystem effects. Such benefits may include the number of premature deaths avoided each year; the number of prevented nonfatal illnesses and hospitalizations; the number of prevented lost work or school days; improvements in visibility in specific regions; and improvements in ecosystem health as measured by specific indicators (e.g., lake acidification). These quantified benefits may be monetized using a number of tools and indicators, including EPA's Environmental Benefits Mapping and Analysis Program and various metrics such as Value of Statistical Life, Quality-Adjusted Life Years, and Social Cost of Carbon,[18] among others.
- Some benefits are difficult to quantify and monetize. In such cases, the guidance documents ask the agency to include a qualitative discussion of benefits results. The discussion should explain why a quantitative analysis was not possible and the reasons for believing that these non-quantified effects may be important for decision making.

CRS looked at the RIAs prepared by EPA under the G. W. Bush and Obama Administrations. From 2001-2016, EPA completed RIAs for 55 CAA rules under the executive order. Information concerning these rules is provided in **Table 3**.

In general, the agency concluded that the benefits of these rules would exceed the costs: 46 of the 55 RIAs reached this conclusion. Two rules, one promulgated in 2005 and the other in 2011, projected costs greater than benefits. In the other seven cases, either ranges of cost and benefit had a substantial overlap, or the agency was unable to quantify or monetize the costs or benefits.

[17] EPA uses a variety of methods, models, and tools to estimate economic impacts. See "Economic and Cost Analysis for Air Pollution Regulations," at https://www.epa.gov/economic-and-cost-analysis-air-pollution-regulations.

[18] On March 28, 2017, President Trump issued Executive Order 13783, "Promoting Energy Independence and Economic Growth." It states that "it is essential that agencies use estimates of costs and benefits in their regulatory analyses that are based on the best available science and economics." His order then effectively withdrew the federal "social costs of greenhouse gases" (SC-GHG, or social cost of carbon), a tool to monetize the climate-related benefits of federal regulations and programs that would reduce GHG emissions. The withdrawn SC-GHG could also have been used to estimate the climate-related costs of revising or rescinding regulations that would increase GHG emissions. For additional discussion, see CRS In Focus IF10625, *Social Costs of Carbon/Greenhouse Gases: Issues for Congress*, by (name redacted).

Table 3. RIAs for Economically Significant CAA Rules, 2001-2016

Year	# of Economically Significant CAA Regs	# for which Estimated Benefits Exceeded Costs	# for which Estimated Costs Exceeded Benefits	# with Substantial Overlap of Cost and Benefit Ranges	# for which Costs or Benefits Were Undetermined
2001	0				
2002	1	1			
2003	1	1			
2004	5	3			2
2005	3	2	1		
2006	3	3			
2007	2	2			
2008	5	4		1	
2009	2	1			1
2010	7	7			
2011	7	6	1		
2012	5	5			
2013	1	1			
2014	1	1			
2015	6	4			2
2016	6	5			1
Total	55	46	2	1	6

Source: CRS, based on OMB, Office of Information and Regulatory Affairs (OIRA), *Historical Reports*.

In addition to E.O. 12866, the Clean Air Act itself, in Section 317, requires the EPA Administrator to prepare an economic impact assessment for several types of air quality standards, including

- section 111 new stationary source performance standards and regulations for existing stationary sources,
- title I, part C, prevention of significant deterioration standards,
- section 202, mobile source standards,
- section 211(c) fuel and fuel additive standards, and
- section 231, aircraft standards.[19]

The assessment is to contain an analysis of (1) the costs of compliance with any such standard or regulation; (2) the potential inflationary or recessionary effects of the standard or regulation; (3) the effects on competition of the standard or regulation with respect to small business; (4) the

[19] Section 317 also lists "title I, part B, ozone and stratosphere protection standards," among the standards for which economic impact assessments must be prepared, but title I, part B was repealed by the Clean Air Act Amendments of 1990, P.L. 101-549.

effects of the standard or regulation on consumer costs; and (5) the effects of the standard or regulation on energy use.

The standards listed in section 317 generally mention or imply cost as a consideration in the statute; thus, the economic impact assessment is to inform that consideration. However, section 317 also states that "nothing in this section shall be construed to provide that the [assessment] affects or alters the factors which the Administrator is required to consider in taking any action [when promulgating or revising the listed standards]."

The section is limited in two other respects. In subsection (d), it gives the Administrator discretion to limit the time and resources devoted to the required analyses:

> The assessment required under this section shall be as extensive as practicable, in the judgment of the Administrator taking into account the time and resources available to the Environmental Protection Agency and other duties and authorities which the Administrator is required to carry out under this Act.

And in subsection (e), it provides that

> Nothing in this section shall be construed ... to authorize or require any judicial review of any such standard or regulation, or any stay or injunction of the proposal, promulgation, or effectiveness of such standard or regulation on the basis of failure to comply with this section.

Issues Raised by EPA's CAA Cost-Benefit Analyses

A number of issues have been raised regarding EPA's cost-benefit analyses for Clean Air Act rules. Four issues are discussed below.

1. Cumulative Impacts of Clean Air Act Regulations

A frequent criticism of EPA's Clean Air Act regulations is that the agency underestimates the cost and other negative impacts of rules by considering them individually, and thus potentially ignoring cumulative impacts. Other critics assert that, by considering rules individually, EPA cost-benefit analyses may double count the benefits of simultaneous regulations. EPA's RIAs do focus on individual rules, because both the statute—in the many places that it requires consideration of cost or economic factors—and E.O. 12866 require the agency to weigh costs and economic factors and consider options for individual rules.

The agency starts RIAs with a baseline of state and federal regulatory requirements already promulgated. The RIA then estimates the additional costs and benefits of the proposed or final rule under consideration. In both proposed rule and final rule RIAs, the agency generally considers more stringent and less stringent options in order to provide analysis of the costs and benefits of each.

In some cases, there may be more than one rule addressing pollution from a specific industry under development simultaneously. This happens when the agency is implementing congressional directives found in different sections of the act. For example, in the past five years, fossil-fueled power plants have been the subject of rules addressing interstate transport of sulfur dioxide and nitrogen oxides (under Section 110(a)), emissions of hazardous air pollutants (under Section 112(d)), and emissions of the greenhouse gas carbon dioxide (under Sections 111(b) and (d)). As individual rules are promulgated and implemented, their requirements are added to the baseline, but when several rules are *proposed* simultaneously, each rule's impact must be examined in isolation in order to comply with statutory and executive order directives. Addressing the rules in

isolation means that the cost-benefit analysis may ignore the cumulative economic impact of new regulations. It can also mean that adding the costs and benefits of simultaneous proposals might lead to double counting and over-estimating both costs and benefits.

Although developing required rules simultaneously may pose analytical issues, it has practical advantages for the regulated entities. It can allow a regulated facility to choose pollution control approaches that address several problems at once, e.g., installing a scrubber that will both reduce sulfur dioxide emissions and address hazardous air pollutants, or switching to cleaner fuels that eliminate or reduce the pollution problems addressed by all of the proposed regulations. It may also save on compliance costs by permitting the affected entities to address multiple regulations during a single outage.

EPA Studies of Cumulative Costs and Benefits

Although most cost-benefit analyses have focused on individual rules, EPA has conducted three analyses of the cumulative impact of Clean Air Act regulations, as required by Section 812 of the Clean Air Act Amendments of 1990.[20] Each of the three analyses found that the benefits of Clean Air Act regulations far exceed the cost.

- The first of the studies, a retrospective study entitled, *The Benefits and Costs of the Clean Air Act, 1970 to 1990*, was completed in 1997. It estimated that the cumulative cost of Clean Air Act regulations between 1970 and 1990 was $523 billion (in 1990 dollars). The benefits of those regulations outweighed the costs by more than an order of magnitude, according to the agency. The estimated economic value of benefits ranged from $5.6 to $49.4 trillion over the 20-year period, depending upon the assumptions employed, with a mean value of $22.2 trillion. Human health effects accounted for the vast majority of this economic value: the agency concluded that the regulations reduced premature mortality by 205,000 persons annually.[21]

  The agency noted a number of limitations and uncertainties in the data. On the cost side, the agency noted that the estimate " ... does not include several potentially important indirect costs which could not be readily quantified, such as the possible adverse effects of Clean Air Act implementation on capital formation and technological innovation."[22] On the benefit side, the agency noted, "... it is important to recognize the substantial controversies and uncertainties which pervade attempts to characterize adverse human health and ecological effects of pollution in dollar terms."[23] In addition, the estimates "

[20] Section 812 of the 1990 amendments amended Section 312 of the underlying statute. Although the requirement is codified with Section 312 (at 42 U.S.C. 7612), the studies are generally referred to as the Section 812 studies. Section 812 required the Administrator, in consultation with the Secretary of Commerce, the Secretary of Labor, and the Council on Clean Air Compliance Analysis, to submit a report to Congress within 12 months of enactment summarizing all costs incurred previous to the enactment of the Clean Air Act Amendments of 1990 in the effort to comply with CAA standards, and all benefits that have accrued to the United States as a result of such costs. The section required updates to the report every 24 months thereafter; the updates were to make projections into the future regarding expected costs, benefits, and other effects of compliance with CAA standards, as well as updating the first report.

[21] See U.S. EPA, *The Benefits and Costs of the Clean Air Act, 1970 to 1990*, Report to Congress, October 1997, Table ES-1 and, more generally, pp. ES-2 to ES-9, at https://www.epa.gov/sites/production/files/2015-06/documents/contsetc.pdf.

[22] Ibid., Abstract, p. 2.

[23] Ibid., p. ES-7.

... do not include a number of other potentially important benefits which could not be readily quantified, such as ecosystem changes and air toxics-related human health effects."[24] Nevertheless, the agency concluded, "Given the magnitude of difference between the estimated benefits and costs, ... it is extremely unlikely that eliminating these uncertainties would invalidate the fundamental conclusion that the Clean Air Act's benefits to society have greatly exceeded its costs."[25]

- The second study, a prospective study entitled *The Benefits and Costs of the Clean Air Act, 1990 to 2010*, was released in November 1999. The study estimated the cost of compliance for regulations under the 1990 amendments to Titles I through V of the Clean Air Act at $19 billion annually in the year 2000 (in 1990$), rising to $27 billion annually in 2010. The estimated economic value of benefits ranged from $16 billion to $160 billion annually in 2000, and $26 billion to $270 billion in 2010. Although costs slightly exceeded benefits at the low end of the benefit estimate, EPA concluded that benefits exceeded cost by more than 4 to 1 for the central estimate.[26] The study estimated costs and benefits separately for Title VI, which deals with protection of the stratospheric ozone layer. The benefits and costs for this title were estimated for a 175-year period, reflecting the slow nature of repairing the ozone layer. The agency estimated benefits of $530 billion over that time, with costs of $27 billion.[27]
- The third study, another prospective study, is entitled *The Benefits and Costs of the Clean Air Act, 1990 to 2020*. This study was released in March 2011. The study estimated the annual cost of compliance for regulations under the 1990 amendments to the Clean Air Act at approximately $65 billion in 2020, with a central estimate of benefits of $2 trillion. Using the central estimates, benefits exceed costs by 31 to 1. As with the earlier studies, "Most of these benefits (about 85%) are attributable to reductions in premature mortality associated with reductions in ambient particulate matter.... " The agency estimated that "cleaner air will ... prevent 230,000 cases of premature mortality" in 2020, at a cost of $280,000 per premature mortality avoided.[28]

OIRA Reports on the Cost and Benefit of Regulations

The Office of Information and Regulatory Affairs (OIRA) in the President's Office of Management and Budget (OMB) is the office that conducts interagency reviews of proposed and final regulations under E.O. 12866. In addition, OIRA prepares annual reports to Congress on the cost and benefit of regulations.[29]

[24] Ibid., Abstract, p. 2.

[25] Ibid.

[26] U.S. EPA, *The Benefits and Costs of the Clean Air Act, 1990 to 2010*, Report to Congress, November 1999, pp. ii-iv, at https://www.epa.gov/sites/production/files/2015-07/documents/fullrept.pdf. The report contains a discussion of the limitations and uncertainties of the data similar to that in the 1997 report.

[27] Ibid., p. v.

[28] U.S. EPA, *The Benefits and Costs of the Clean Air Act from 1990 to 2020*, Final Report, March 2011, Abstract.

[29] These reports are required under the Regulatory Right-to-Know Act (31 U.S.C. § 1105), which was enacted as part of the Treasury and General Government Appropriations Act for FY2001 (P.L. 106-554).

The latest such final report, for 2015, includes estimates of the aggregated annual benefits and costs of regulations reviewed by OMB over the last 10 years.[30] In a section on "EPA Air Rules," the report states: "Across the Federal government, the rules with the highest estimated benefits as well as the highest estimated costs, by far, come from the Environmental Protection Agency and in particular its Office of Air and Radiation. Specifically, EPA rules account for 61 to 80 percent of the monetized benefits and 44 to 55 percent of the monetized costs."[31] The OMB report stated that EPA Office of Air rules in the 10-year period had benefits that were 4 to 21 times as great as their cost.[32]

2. The Role of Particulate Matter in EPA Regulatory Impact Analyses

A second criticism of EPA cost-benefit analyses is that the estimated benefits often rely on the effects of reducing a single category of pollutants, particulate matter (PM). Research has tied PM to tens of thousands of premature deaths, and EPA often finds that reductions in PM emissions justify regulation, even where the target of the regulations is a different pollutant.

In many of these cases, the RIAs do not monetize the benefits of controlling the emissions that were the primary target of the regulation. For example, an RIA that accompanied the 2004 National Emission Standards for Hazardous Air Pollutants from Industrial, Commercial, and Institutional Boilers and Process Heaters (the "2004 Boiler MACT") estimated that there would be $16 billion of annual benefits due to reductions in sulfur dioxide and particulate matter emissions. But it also stated

> This analysis does not quantify the benefits associated with reductions in hazardous air pollutants (HAP). The magnitude of the unquantified benefits associated with omitted categories and pollutants, such as avoided cancer cases, damage to ecosystems, or materials damage to industrial equipment and national monuments, is not known.[33]

Of the 22 EPA air rules considered in the 2015 OIRA report cited above, the highest estimated benefits were for three rules promulgated in 2005, 2007, and 2012.[34] For these rules, and others promulgated under the Clean Air Act, OIRA notes

> the large estimated benefits of EPA rules issued pursuant to the Clean Air Act are mostly attributable to the reduction in public exposure to fine particulate matter (referred to in many contexts as PM). While some of these rules monetize the estimated benefits of emissions controls designed specifically to limit particulate matter or its precursors, other rules monetize the benefits associated with ancillary reductions in particulate matter that come from reducing emission of hazardous air pollutants which are difficulty (sic) to quantify and monetize because of data limitations. For example, in the case of the Utility

[30] Office of Management and Budget, *2015 Report to Congress on the Benefits and Costs of Federal Regulations and Agency Compliance with the Unfunded Mandates Reform Act*, at https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/2015_cb/2015-cost-benefit-report.pdf.

[31] Ibid., p. 12.

[32] Ibid., Table 1-2.

[33] U.S. EPA, *Regulatory Impact Analysis for the Industrial Boilers and Process Heaters NESHAP*, Final Report, February 2004, p. 10-1.

[34] The three rules are the Clean Air Fine Particle Implementation Rule issued in 2007, with benefits estimates ranging from $19 billion to $167 billion per year; the Clean Air Interstate Rule issued in 2005, with benefits estimates ranging from $12 billion to $152 billion; and the National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units ("Utility MACT" or "MATS" rule) issued in 2012, with benefits estimates ranging from $28 billion to $77 billion (all figures in 2001$).

> MACT, particulate matter "co-benefits," make up the majority of the monetized benefits, even though the regulation is designed to limit emissions of mercury and other hazardous air pollutants. The consideration of co-benefits, including the co-benefits associated with reduction of particulate matter, is consistent with standard accounting practices and has long been required under OMB Circular A-4.[35]

Defining "Particulates"

Particulate matter (also known as particle pollution, particulates, or PM) is a category of pollutants rather than a specific chemical. EPA identifies PM as "a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles."[36] Hazardous air pollutants, if not particles themselves, often adhere to particles in the emissions. Because PM includes so many different pollutants, many of the regulations targeting hazardous air pollutants rely on technologies that capture PM. Given the broad nature of particulate emissions, most of the available pollution control technologies (scrubbers, fabric filters, electrostatic precipitators, carbon or other sorbent injection, use of catalysts, etc.) capture particulate emissions or PM precursors.[37]

There are hundreds of air pollutants that Congress required or authorized EPA to regulate under the Clean Air Act. Congress directed EPA to set emission standards for sources of 187 hazardous air pollutants that are listed in the statute. Many of these are categories of pollutants (e.g., arsenic compounds, fine mineral fibers, polycyclic organic matter) rather than individual substances, so there are more than 187 pollutants to consider. Although there is research indicating that these pollutants are carcinogenic, mutagenic, teratogenic, neurotoxic, cause reproductive dysfunction, or are otherwise acutely or chronically toxic, in most cases there are not data regarding the concentrations to which populations are exposed, or epidemiological data regarding illness or mortality associated with exposure to the individual pollutant. The agency proceeds with regulation because it was directed by the statute to do so, but it may not be able to quantify or monetize the benefits of regulating emissions of a specific substance.

The agency does, however, have an established, peer-reviewed methodology for estimating the benefits of reductions in emissions of particulate matter,[38] which have been linked to increased mortality in numerous scientific studies. Most air pollutants are particulates, and most EPA air quality regulations reduce particulate emissions, either as the targeted pollutant, or as a co-benefit of reducing emissions of some other pollutant.

3. The Value of a Statistical Life[39]

Another reason that particulates play such an important role in RIAs is that they are linked to premature mortality. When premature mortality is avoided, the monetization of that benefit, using

[35] OMB, *2015 Report to Congress*, p. 13 [note omitted].

[36] U.S. EPA, Office of Air and Radiation, "Particulate Matter," at http://www.epa.gov/pm/.

[37] The term "precursor" refers to a pollutant that reacts with other substances in the atmosphere to form another air pollutant. Sulfur dioxide (SO_2), for example, is a precursor of sulfate particles and sulfuric acid, both of which are considered particulates.

[38] For a discussion of this methodology, see, for example, U.S. EPA, *Regulatory Impact Analysis (RIA) for Residential Wood Heaters NSPS Revision*, Final Report, February 2015, pp. 7-1 to 7-9, at http://www2.epa.gov/sites/production/files/2015-02/documents/20150204-residential-wood-heaters-ria.pdf.

[39] This section of this report, discussing the value of a statistical life, is adapted from archived CRS Report R41140, *How Agencies Monetize "Statistical Lives" Expected to Be Saved By Regulations*, by (name redacted) . Curtis Copeland is no longer at CRS; questions about that report can be directed to (name redacted), Specialist in Government Organization and Management.

what is called "the value of a statistical life," generally is greater than the value of all other benefits combined.[40] This raises another issue: the role played by the methodology used to value lives saved.

The value of statistical lives saved (VSL) has played an important role in RIAs for many years. EPA adopted guidelines under President Reagan that, in updated form, have guided its VSL analyses since 1983. The guidelines were most recently updated in 2010.[41]

In general, the VSL is estimated by using one of two methodologies: "willingness to pay" (stated preference), or "willingness to accept" (revealed preference). The first of these methods uses surveys in which respondents are asked how much they would be willing to pay to avoid particular risks or outcomes. For example, if 100,000 people are each willing to pay an average of $50 to reduce a 1 in 100,000 risk of dying from exposure to a particular risk, then the value of a statistical life for the population relative to that risk is $5 million ($50 times 100,000). Revealed preference studies, on the other hand, use data from market transactions or observed behavior to estimate the value of certain risks. One example is wage-risk studies, in which researchers compare workers' earnings in occupations with varying levels of on-the-job risks.[42]

The Office of Management and Budget's Circular A-4, which more fully delineates the regulatory analysis requirements in Executive Order 12866, was "designed to assist analysts in the regulatory agencies by defining good regulatory analysis ... and standardizing the way benefits and costs of Federal regulatory actions are measured and reported."[43] It states that economists tend to view willingness-to-pay as "the most appropriate measure of opportunity costs,"[44] and that the willingness-to-pay approach is "the best methodology to use if reductions in fatality risks are monetized."[45] In monetizing health benefits, the circular states that a willingness-to-pay measure is "the conceptually appropriate measure as compared to other alternatives (e.g., cost of illness or lifetime earnings), in part because it attempts to capture pain and suffering and other quality-of-life effects," and also because it "allows you to directly compare your results to the other benefits and costs in your analysis."[46]

Released in 2003, the circular noted that academic studies had identified VSLs from $1 million to $10 million, but it did not recommend that agencies use any particular VSL.[47] A 2010 EPA guidance reported academic estimates of VSL ranging from $0.85 million to $19.8 million in

[40] Other benefits considered in Regulatory Impact Analyses include health benefits, such as the avoidance of nonfatal heart attacks, hospital and emergency room visits, cases of respiratory symptoms, cases of aggravated asthma, cases of chronic bronchitis, number of days when people miss work, and the number of days when people must restrict their activities. Environmental effects, including improvements in visibility in national parks, reductions in damage to ecosystems and building materials, and improvements in fishing, agricultural yields, and forest productivity, are also frequently identified as benefits of a rule in RIAs.

[41] U.S. Environmental Protection Agency, *Guidelines for Preparing Economic Analyses*, December 17, 2010, at https://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0568-51.pdf/$file/EE-0568-51.pdf.

[42] For additional information, see archived CRS Report R41140, *How Agencies Monetize "Statistical Lives" Expected to Be Saved By Regulations*, by (name redacted) , or U.S. Office of Management and Budget, 2014 Report to Congress on the Benefits and Costs of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities, p. 15, at https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/2014_cb/2014-cost-benefit-report.pdf.

[43] OMB Circular A-4, "Regulatory Analysis," September 17, 2003, p. 1. The circular is available at https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/regulatory_matters_pdf/a-4.pdf.

[44] Ibid., p. 20.

[45] Ibid., p. 29.

[46] Ibid., p. 28.

[47] Ibid., p. 30.

2006 dollars.[48] The guidance states that EPA uses a 1997 estimate of VSL, updated to current dollars by applying the Gross Domestic Product price deflator. In recent RIAs, the agency has used an estimate of $9.9 million in 2015 dollars.

4. The Difficulty of Quantifying Costs or Benefits

A fourth issue, recognized by both proponents and opponents of cost-benefit analysis, is the difficulty of quantifying both costs and benefits. Cost-benefit analysis is an imperfect tool that may fail to provide accurate projections in both cases. At least three factors contribute to or help explain the difficulty: a) the key role played by assumptions in making projections; b) the paucity of retrospective studies that might provide better methods or data; and c) particularly for benefits, the inability to quantify or monetize effects in light of existing information.

a. Assumptions

On the cost side, assumptions need to be made regarding the control technology or production methods that will be used to achieve compliance, and the costs of various inputs, such as energy, the price of which may be subject to substantial volatility. New technologies may encounter unforeseen implementation difficulties that result in cost overruns. On the other hand, control options have often benefitted from technology improvements or economies of scale that result in lower costs than predicted. Varying assumptions can lead to large differences between EPA's cost-benefit estimates and those of affected stakeholders.[49]

Often the assumptions, whether made by stakeholders or by EPA, fail to foresee broad economic factors that end up determining how industry will comply with the standard being promulgated. For example, when EPA promulgated the Mercury and Air Toxics Standards (MATS) for electric power plants in 2012, the RIA concluded that coal-fired power would increase its share of total electric power, rising 14% from its 2009 level to 1,982 billion kilowatt-hours in 2015, while natural gas-fired power would decrease 16% to 710 billion kilowatt-hours. Given this reliance on coal-fired plants, the power sector would need to make an enormous investment in pollution control equipment to clean up their emissions.

A major factor in the RIA's analysis was the price of natural gas: the analysis concluded that natural gas would cost $5.32 per million Btu in 2015 after the rule took effect. (The price was expressed in 2007 dollars, which would be $6.07 in 2015 prices.) With gas at this price—and projected to increase further[50]—it would make sense to invest in keeping coal-fired power plants running. By 2015, however, the cost of natural gas had fallen to $2.63, and most analysts concluded that prices would remain low.[51] As a result, rather than spend the money to control emissions from coal-fired power plants (which the RIA estimated at $9.6 billion per year), many utilities found it easier and cheaper to retire coal-fired plants and increase the use of natural-gas-fired plants; in many cases, these plants were available and underutilized. The result was that

[48] U.S. Environmental Protection Agency, National Center for Environmental Economics, *Guidelines for Preparing Economic Analyses*, September 2000, available at http://yosemite.epa.gov/ee/epa/eed.nsf/pages/Guidelines.html. The discussion regarding valuation of mortality and morbidity risks is on pp. 87-98.

[49] See, for example, the discussion of industry and EPA estimates of the costs and benefits of the 2015 Ozone NAAQS in CRS Report R43092, *EPA's 2015 Ozone Air Quality Standards*, by (name redacted) and (name redacted) .

[50] In April 2012, the U.S. Energy Information Administration's *Annual Energy Outlook* (AEO 2012) projected reference case (Henry Hub) natural gas prices at $8.95 per MMBtu in 2030.

[51] In AEO 2015, the price was projected to remain below $6.00 through 2030. AEO 2016 projected prices below $5.00 as late as 2040.

coal-fired power declined to 1,352 billion kilowatt-hours (32% below the RIA projection) in 2015, and natural gas-fired power increased to 1,333 billion kilowatt-hours (88% above the RIA projection).

b. Retrospective Studies

The MATS rule RIA illustrates another issue related to the cost of regulations. While EPA and other agencies churn out dozens of RIAs annually as they develop regulations, there are few studies of the actual cost of rules once they've been implemented (what economists refer to as "ex post" costs, as opposed to the "ex ante" costs estimated in RIAs). EPA recognizes this issue. A 2014 agency study states:

> In 2010, then Deputy Administrator Bob Perciasepe inquired about research on retrospective cost analysis, particularly of past EPA regulations. An investigation of the literature revealed that the collection of retrospective analyses of EPA regulations is thin and no generalized conclusions could be drawn. Bob Perciasepe asked the National Center for Environmental Economics (NCEE) to design and launch a retrospective cost analysis with the goal of improving EPA's cost assessments.[52]

The result was *Retrospective Study of the Costs of EPA Regulations: A Report of Four Case Studies*.[53] The report states: "The literature posits a number of hypotheses for why one might expect ex ante and ex post cost estimates to differ, yet ex post cost case studies are too few in number and narrow in scope to lend strong support for one hypothesis over another."[54] The report produced four case studies:

> For each case study, we assessed whether it would be possible to collect sufficient ex post compliance cost information using only publicly-accessible data sources. In general, we found that while data for some necessary components are readily available, the cost information is generally lacking. ... While several of the case studies are suggestive of overestimation of costs ex ante, we do not consider the current evidence to be conclusive.[55]

c. Quantification and Monetization

Most rules also have benefits that cannot be quantified or monetized in light of existing information. It is common for EPA to list in its RIAs benefits that it believes will result from a rule, but that it was unable to quantify or monetize. In the RIA for the Cross-State Air Pollution Update Rule, promulgated in October 2016, for example, EPA stated: "Data, time, and resource limitations prevented the EPA from quantifying the impacts to, or monetizing the co-benefits from several important benefit categories.... "[56] The agency listed seven categories of health benefits and 25 categories of welfare benefits that it did not quantify.

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[52] U.S. Environmental Protection Agency, National Center for Environmental Economics, *Retrospective Study of the Costs of EPA Regulations: A Report of Four Case Studies*, August 2014, Acknowledgements, at https://yosemite.epa.gov/ee/epa/eerm.nsf/vwan/ee-0575.pdf/$file/ee-0575.pdf.

[53] Ibid.

[54] Ibid., p. vii. On page 4, the report summarizes five earlier studies by a variety of authors, who found that ex ante costs were often overestimated.

[55] Ibid., pp. vii-viii.

[56] U.S. Environmental Protection Agency, *Regulatory Impact Analysis of the Cross-State Air Pollution Rule (CSAPR) Update for the 2008 National Ambient Air Quality Standards for Ground-Level Ozone*, p. ES-16, at https://www3.epa.gov/ttn/ecas/docs/ria/transport_ria_final-csapr-update_2016-09.pdf.

OMB's Circular A-4 recognizes these difficulties. It states:

> It will not always be possible to express in monetary units all of the important benefits and costs. When it is not, the most efficient alternative will not necessarily be the one with the largest quantified and monetized net-benefit estimate. In such cases, you should exercise professional judgment in determining how important the non-quantified benefits or costs may be in the context of the overall analysis.[57]

Concluding Observations

Although many parts of the Clean Air Act require the EPA Administrator to promulgate regulations without mentioning consideration of cost, EPA is bound by the statute in some cases and by executive orders in the case of each economically significant rule to provide estimates of the costs and benefits during the rulemaking process.[58] The agency has indicated that benefits exceed costs, usually by a wide margin, for the vast majority of its CAA rules: as noted earlier, according to EPA, the estimated cumulative benefits of CAA regulations during the period 1990-2020 will exceed the estimated costs by more than 30 to 1.

Projecting that benefits will exceed costs may not be sufficient under the Trump Administration, however. The President has spoken repeatedly of the need to reduce the cost of regulation, which he believes has restrained the growth of the economy and "killed" jobs. On January 30, 2017, he signed Executive Order 13771, "Reducing Regulation and Controlling Regulatory Costs." A second Executive Order, E.O. 13783, "Promoting Energy Independence and Economic Growth," signed March 28, 2017, addressed specific Clean Air Act regulations.

The first of these two executive orders addressed regulations promulgated by all federal agencies. Press coverage focused on its requirement that " ... whenever an executive department or agency ... publicly proposes for notice and comment or otherwise promulgates a new regulation, it shall identify at least two existing regulations to be repealed."[59] Other elements of the order are also worth noting:

- First, the executive order does not mention the benefits of regulation. It focuses exclusively on costs.
- Second, it establishes a process under which agencies shall be given an annual regulatory budget, with the Director of OMB identifying "a total amount of incremental costs that will be allowed for each agency in issuing new regulations and repealing regulations for the next fiscal year." For FY2017, the E.O. directs that "the total incremental cost of all new regulations, including repealed regulations, to be finalized this year shall be no greater than zero, unless otherwise required by law or consistent with advice provided in writing by the Director of the Office of Management and Budget.... "
- Third, it requires the Director of OMB to "provide the heads of agencies with guidance on the implementation of this section. Such guidance shall address, among other things, processes for standardizing the measurement and estimation

[57] OMB Circular A-4, p. 2.

[58] In addition, in 2015, the Supreme Court held that EPA is required to consider costs when determining if it is "appropriate and necessary" to regulate power plants under Section 112. *Michigan v. EPA*, 135 S. Ct. 2699 (2015). For additional information, see CRS Report R43699, *Key Historical Court Decisions Shaping EPA's Program Under the Clean Air Act*, by (name redacted) and (name redacted) .

[59] "Reducing Regulation and Controlling Regulatory Costs," Executive Order 13771, January 30, 2017, Section 2.

of regulatory costs; standards for determining what qualifies as new and offsetting regulations; standards for determining the costs of existing regulations that are considered for elimination; processes for accounting for costs in different fiscal years; methods to oversee the issuance of rules with costs offset by savings at different times or different agencies; and emergencies and other circumstances that might justify individual waivers of the requirements of this section." Guidance was issued on April 5, 2017.[60]

- Fourth, it states that, "Nothing in this order shall be construed to impair or otherwise affect ... the authority granted by law to an executive department or agency, or the head thereof.... "

How this order will affect CAA rules remains to be seen. It gives the OMB Director new authority in tasking him with the provision of guidance, the identification of regulatory budgets, and the discretion to grant waivers from the order's requirements. The April 5, 2017, guidance reinforces this, stating in numerous places that OMB (in the form of the Director of its Office of Information and Regulatory Affairs (OIRA)) will address issues "on a case-by-case basis."[61]

Some rules under the Clean Air Act might be exempt from the executive order's requirements. Whether this is the case will depend on what interpretation is given to the order's language exempting from the regulatory budgets regulations that are "otherwise required by law." The authority granted by law to the EPA Administrator in at least 25 sections or subsections of the CAA (identified in **Table 2**) directs the Administrator to set or review standards without subjecting that authority to cost considerations. In many other cases—whether or not the CAA allows consideration of costs—binding deadlines for EPA rulemaking have been established by the courts. The OMB guidance describes such cases as "judicially required rulemaking," and includes in this category rules for which deadlines have been established by a settlement agreement or consent decree.[62] This might cover a substantial number of CAA rules.[63]

The second of the two orders, E.O. 13783, requires reviews of all agency actions "that potentially burden the development of domestically produced energy resources, with particular attention to oil, natural gas, coal, and nuclear energy resources."[64] The order addresses specific CAA regulations, including the Clean Power Plan for existing fossil-fueled electric generating units

[60] Executive Office of the President, Office of Management and Budget, "Guidance Implementing Executive Order 13771, Titled 'Reducing Regulation and Controlling Regulatory Costs,'" Memorandum from Dominic J. Mancini, Acting Administrator, Office of Information and Regulatory Affairs, April 5, 2017, 17 p., at https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2017/M-17-21.pdf.

[61] Ibid. See the responses to questions 16, 17, 18, 19, 22, 27, 28, and 37.

[62] Ibid., Q6, p. 5.

[63] It is not entirely clear what OIRA will do in such cases: the guidance states that statutorily or judicially required actions "may qualify for a full or partial exemption from EO 13771's requirements." (Answer to Q33) Later in the same Answer, it states that "EO 13771 does not prevent agencies from issuing regulatory actions in order to comply with an imminent statutory or judicial deadline, even if they are not able to satisfy EO 13771's requirements by the time of issuance. However, agencies will be required to offset any such EO 13771 regulatory actions as soon as practicable thereafter." Elsewhere, in discussing regulatory actions in which the law prohibits the consideration of costs in determining a statutorily required standard, the guidance states, "Because EO 13771 applies only to the extent permitted by law, agencies are still required to comply with their statutory obligations. Accordingly, if a statute prohibits consideration of cost in taking a particular regulatory action, EO 13771 does not change the agency's obligations under that statute. However, agencies will generally be required to offset the costs of such regulatory actions through other deregulatory actions taken pursuant to statutes that do not prohibit consideration of costs. Because each agency's obligations will differ depending on the particular statutory language at issue, these issues must be addressed on a case-by-case basis." (Answer to Q18)

[64] Executive Order 13783, "Promoting Energy Independence and Economic Growth," March 28, 2017, Section 2.

(EGUs) and two proposed rules related to it, the New Source Performance Standards for new and modified EGUs, and the New Source Performance Standards for the Oil and Natural Gas Sector. Each of these rules would control emissions of greenhouse gases from an energy-producing sector. The E.O. directs EPA to review these rules "for consistency with the policy set forth in section 1 of this order," and, if appropriate, to "suspend, revise, or rescind" them.

Section 1 lists many goals, including to

- "promote clean and safe development of our nation's vast energy resources,"
- "ensure that the Nation's electricity is affordable, reliable, safe, secure, and clean,"
- "take appropriate actions to promote clean air and clean water," and
- ensure that "necessary and appropriate environmental regulations comply with the law, are of greater benefit than cost, when permissible, achieve environmental improvements for the American people, and … employ the best-available peer-reviewed science and economics."

Most of the commentary on this executive order has presumed that the purpose of the reviews will be to rescind the rules in question; but the rules were originally justified by EPA as measures that would achieve most of Section 1's listed goals. Rescinding the rules would likely require a new justification that can withstand judicial scrutiny. Thus, "review" of the rules does not automatically equate with "rescind."[65]

Whatever becomes of these specific rules, EPA's administration of the Clean Air Act under the Trump Administration is likely to function differently than it did in the Obama Administration. The CAA gives the EPA Administrator broad discretion in deciding whether regulations are necessary and how stringent they should be: many sections of the act, even some that don't allow consideration of cost, include phrases such as "in the judgment of the Administrator" or "as determined by the Administrator." Such language would seem to allow the Administrator a measure of discretion that will continue to shape Clean Air Act and other EPA regulations—both in deciding on the stringency of new regulations and in deciding whether new regulations are warranted. Unless this language is modified, it will also continue to provide fertile ground for legal arguments regarding the power that Congress delegated to EPA when it fashioned the various authorities that the act provides.

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[65] For a discussion of the required procedures for amending or rescinding rules, see CRS Report R41546, *A Brief Overview of Rulemaking and Judicial Review*, by (name redacted)