Empirical evidence regarding the effects of the Clean Air Act on jobs and economic growth

This White Paper responds to a request dated February 1, 2011, from Congressmen Waxman and Rush. The purpose of the White Paper is to highlight relevant findings from the economics literature on the connection between environmental regulation – specifically, the Clean Air Act – and employment and economic growth in the United States.

Introduction

The purpose of the Clean Air Act is to protect the health and welfare of the American public. In addition, before being promulgated, regulations undergo a rigorous analysis overseen by the Office of Information and Regulatory Affairs. This includes looking for opportunities to increase health benefits as well as ways to lower costs and increase flexibility for businesses, to the extent allowable by statute. For the Clean Air Act in particular, the economic benefits from public health protection have been shown to greatly outweigh the costs. For example, in 1990 alone, the Clean Air Act (CAA) prevented an estimated 18 million child respiratory illnesses, 850,000 asthma attacks, 674,000 cases of chronic bronchitis, and 205,000 premature deaths. [1] The monetary value of these public health protections are projected to reach $2 trillion in 2020 alone. Over the period from 1990 through 2020, the monetary value to Americans of the Act's protection is projected to exceed the cost of that protection by a factor of more than 30 to 1.[2]

Nonetheless, there have been concerns about the impacts of the Clean Air Act on jobs and economic growth. This white paper addresses some of those concerns and reaches the following conclusions: (1) The Clean Air Act has provided tremendous economic benefits to the U.S. economy over the last 40 years by protecting public health, (2) clean air regulations promote job creation in some sectors of the economy that focus on environmental protection, offsetting the impacts on regulated sectors; and (3) the costs of pollution abatement are a very small fraction of total manufacturing costs and research has found that they play a negligible part in plant location decisions and have a very small impact on employment.

The Clean Air Act Protects Public Health and Supports Economic Growth.

Pollution and the associated impacts impose real costs on the economy which can slow economic growth and reduce the productivity of the workforce. Reduced pollution and the associated improved health mean fewer missed days at work and school, and lower expenses for health care. Protecting children from neurotoxins leads to workers with higher IQ. For example, in 1990, the Clean Air Act (CAA) prevented an estimated 18 million child respiratory illnesses, 850,000 asthma attacks, 674,000 cases of chronic bronchitis, and 205,000 premature

[1] EPA, *Section 812 Retrospective Analysis: The Benefits and Costs of the Clean Air Act, 1970 to 1990,* October 1997 (accessed February 8, 2011)

[2] USEPA (2010). *The Benefits and Costs of the Clean Air Act: 1990 to 2020. Revised Draft Report.* Prepared by the USEPA Office of Air and Radiation August 2010. Table 5-5. http://www.epa.gov/air/sect812/aug10/fullreport.pdf (accessed February 8, 2011).

deaths.[3] Just last year, the Clean Air Act is estimated to have saved over 160,000 lives; avoided more than 100,000 hospital visits; prevented millions of cases of respiratory problems, including bronchitis and asthma; enhanced productivity by preventing 13 million lost workdays; and kept kids healthy and in school, avoiding 3.2 million lost school days due to respiratory illness and other diseases caused or exacerbated by air pollution.[4] In addition, protecting ecological resources can increase the value they provide to the economy (e.g., reducing acid rain protects forest ecosystems).

In addition to healthier and more productive workers, lower air pollution translates into lower health care expenditures. Studies of environmentally-related illness provide an indicator of the costs of not regulating – or the potential benefits to be gained from regulating. Landrigan et al. (2002) estimated the contribution of environmental pollutants to the costs of pediatric disease in American children. Although they looked at only a subset of types of illness, and noted that there were uncertainties, they were able to conclude that the health care cost savings are potentially large. To quote:

> "Total annual costs are estimated to be $54.9 billion (range $48.8-64.8 billion): $43.4 billion for lead poisoning, $2.0 billion for asthma, $0.3 billion for childhood cancer, and $9.2 billion for neurobehavioral disorders. This sum amounts to 2.8 percent of total U.S. health care costs."[5]

The improvements in public health benefits that result from the Clean Air Act translate into tremendous economic benefits. Those benefits to the economy that can be monetized were estimated at $1.3 trillion in 2010 and are projected to reach $2 trillion by 2020, outweighing estimated costs by more than 30 to 1.[6] Over the two-decade period from 1990 to 2020, the Clean Air Act is estimated to deliver the present-value equivalent of $12 trillion dollars in net benefits, even without monetizing all of the health and welfare benefits.[7]

Recent Clean Air Act regulations have continued to have benefits that outweigh the costs. In its Reports to Congress in 2008, 2009 and 2010 on the Benefits and Costs of Federal Regulations,[8] OMB examined ten EPA regulations finalized in those years (seven of which were Clean Air Act regulations). All ten rules had benefits greater than costs (comparing midpoints of the range of benefits and costs.) As a group, total benefits were 7 times greater than costs.

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[3] EPA, *Section 812 Retrospective Analysis: The Benefits and Costs of the Clean Air Act, 1970 to 1990*, October 1997 http://www.epa.gov/oar/sect812/1970-1990/chptr1_7.pdf (accessed February 8, 2011)
[4] USEPA (2010). *The Benefits and Costs of the Clean Air Act: 1990 to 2020. Revised Draft Report.* Prepared by the USEPA Office of Air and Radiation August 2010. Table 5-5.
[5] Landrigan PJ, Schechter CB, Lipton JM, Fahs MC, and Schwarz J. 2002. Environmental Pollutants and Disease in America's Children: Estimates of Morbidity, Mortality, and Costs for Lead Poisoning, Asthma, Cancer, and Developmental Disabilities. Environmental Health Perspectives. Vol 110, No 7, pp 721-8.
[6] USEPA (2010). *The Benefits and Costs of the Clean Air Act: 1990 to 2020. Revised Draft Report.*
[7] Non-monetized benefits include health effects from air toxics, UVb exposure, chronic respiratory diseases other than chronic bronchitis, and many ecosystem benefits.
[8] http://www.whitehouse.gov/omb/inforeg_regpol_reports_congress (accessed February 8, 2011)

A series of studies at led by Dale Jorgensen at Harvard found that implementing the CAA actually increased the size of the US economy. The study used information on the actual expenses incurred in the US to implement the CAA for the period 1970-1990, and the estimated benefits (avoided damages) that accrued from improvements in human health and welfare because of the reduced emissions of air pollutants. These adverse health and welfare effects appear in several ways in the study's economic model. Without the Clean Air Act implementation, the predicted increase in air pollution levels results in adverse effects on the productivity of the US workforce (restricted activity, lost work days, fatalities). Higher air pollution levels place other demands on the US economy, including increasing expenditures on medical care (hospital visits, other medical expenses), additional education expenses to compensate for diminished IQ levels, and other expenditures to address increased soiling and ecological damages (e.g., adverse effects on yields of agricultural crops). Researchers found that, while requiring pollution abatement does divert capital investment from other uses, even after accounting for this spending, the lower demand for health care and the more productive workforce actually increased the size of the economy.

The study concluded that:

- The 1970 CAA provides sustained, long-run net economic benefits.
- By 2010, the model results estimated that GDP was as much as 1.5% higher as a consequence of enactment of the CAA. [9]

In a similar exercise, EPA and contractors, under the review of EPA Science's Advisory Board, conducted a prospective study that simulated how the economy changed as a result of implementation of the Clean Air Act from 1990 to 2020. This study also shows net improvements in GDP over time, despite the fact that GDP (as a measure of economic output) fails to capture much of the value of health benefits to society as a whole. [10]

Impacts of the Clean Air Act on Employment

Economic research has shown that a proper assessment of employment impacts must consider how firms respond to regulations. Regulated firms often hire workers to produce more environmental control -- in the same way that they hire workers to produce more output. In fact, reducing pollution tends to be more labor intensive than producing many commodities. For example, Morgenstern et al. (2002) examined four heavily regulated industries (pulp and paper, refining, iron and steel, and plastic) and concluded:

> "We find that increased environmental spending generally does *not* cause a significant change in employment. Our average across all four industries is a net gain of 1.5 jobs

[9] Dale W. Jorgenson Associates (2002a). *An Economic Analysis of the Benefits and Costs of the Clean Air Act 1970-1990. Revised Report of Results and Findings*. Prepared for USEPA, National Center for Environmental Economics, Washington, DC. August 2001, with Appendices January 2002 and Welfare Revision August 2002). http://yosemite.epa.gov/ee/epa/eerm.nsf/vwRepNumLookup/EE-0565?OpenDocument (accessed February 8, 2011)

[10] USEPA (2010). *The Benefits and Costs of the Clean Air Act: 1990 to 2020. Revised Draft Report*. Prepared by the USEPA Office of Air and Radiation August 2010. http://www.epa.gov/air/sect812/aug10/fullreport.pdf (accessed February 8, 2011).

per $1 million in additional environmental spending…. These small positive effects can be linked to labor-using factor shifts and relatively inelastic estimated demand." [11] [12]

A recent peer-reviewed study (2008) by Bezdek, Wendling, and DiPernab found that this spending on environmental protection (EP) can be powerful. They find:

> "Contrary to conventional wisdom, EP, economic growth, and jobs creation are complementary and compatible: Investments in EP create jobs and displace jobs, but the net effect on employment is positive. Second, environment protection has grown rapidly to become a major sales-generating, job-creating industry—$300 billion/year and 5 million jobs in 2003. Third, most of the 5 million jobs created are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, etc., and the classic environmental job (environmental engineer, ecologist, etc.) constitutes only a small portion of the jobs created. Most of the persons employed in the jobs created may not even realize that they owe their livelihood to protecting the environment. Fourth, at the state level, the relationship between environmental policies and economic/job growth is positive, not negative. States can have strong economies and simultaneously protect the environment. Finally, environmental jobs are concentrated in manufacturing and professional, information, scientific, and technical services, and are thus disproportionately the types of jobs all states seek to attract."[13]

Clean Air Act Regulations Support Jobs in Pollution Control, a Growing International Market

Although the costs of air pollution controls are small compared to the benefits, the money that is spent by industry to comply with regulations does not disappear from the economy. Expenditures for environmental protection go towards the purchase and installation of new equipment, spurring investments in the design, manufacture, installation, and operation of pollution-reducing technologies. All of those activities create employment, including work installing, operating, and maintaining pollution controls which must be done domestically.

Air pollution regulations also stimulate investment in innovative technologies to solve a broad spectrum of pollution problems. Some innovations, such as selective catalytic reduction (SCR) and ultralow NOx burner technologies resulted in healthy competition between manufacturers. In some cases, innovations in one sector were transferrable to other areas. For example,

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[11] Jobs Versus the Environment: An Industry-Level Perspective. Richard D. Morgenstern, William A. Pizer, and Jhih-Shyang Shih, *Journal of Environmental Economics and Management* | May 2002 | Vol. 43, no. 3 | pp. 412-436.

[12] These results are similar to Berman and Bui (2001) who find that while sharply increased air quality regulation in Los Angeles to reduce NOx emissions resulted in large abatement costs they did not result in substantially reduced employment.

[13] "Environmental protection, the economy, and jobs: National and regional analyses**"** Roger H. Bezdek, Robert M. Wendling and Paula DiPerna, Journal of Environmental Management Volume 86, Issue 1, January 2008, Pages 63-79. The authors use a broader definition of environmental employment than other studies that rely on DOC data.

improvements in mercury control technologies for waste incinerators led the way for innovations in sorbent technologies and other multipollutant controls for power plants, and these innovations have helped U.S. companies become a world leader in these technologies. (ICF, 2005).[14]

The environmental technology and services sector has experienced dramatic growth since the early 1970s, following the passage of the Clean Air Act and other environmental laws. By 2008 the industry was generating approximately $300 billion in revenues and supporting nearly 1.7 million jobs. Air pollution control equipment alone generated revenues of $18 billion in 2007.[15]

Environmental technology exports help the U.S. balance of trade, generating a $11 billion surplus in 2008. Environmental technology exports have grown dramatically from less than $10 billion in 1990 to about $44 billion in 2008, and the U.S. share of foreign environmental technology markets has been increasing.[16] Environmental technology export growth to China between 2002 and 2004 was 125 percent.[17] According to the Department of Commerce, "The U.S. is regarded as a world leader in many environmental technology categories including: engineering, design, construction and consulting services; … stationary and mobile source air pollution monitoring and control equipment; … and information systems/software for environmental management analysis."

Environmental protection is also growing rapidly as an international market. The Heads of the European Environmental Agencies estimate that the world market for environmental goods and services was worth $552 billion in 2005 and grew to $734 billion by 2010.[18] This market is comparable in size to the aerospace and pharmaceutical industries.

This growth translates to increased employment in these sectors. Many environmental technology industry jobs are high-tech, such as engineering and computer-aided design; others involve traditional manufacturing, transport, and communication. Jobs related to Clean Air Act implementation are widely dispersed throughout the states and occur in many sectors of the economy.

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[14] The Clean Air Act Amendments: Spurring Innovation and Growth While Cleaning the Air. http://www.icfi.com/Markets/Environment/doc_files/caaa-success.pdf (accessed February 8, 2011).
[15] DOC International Trade Administration. "Environmental Technologies Industries: FY2010 Industry Assessment. http://web.ita.doc.gov/ete/eteinfo.nsf/068f3801d047f26e85256883006ffa54/4878b7e2fc08ac6d85256883006c452c/$FILE/Full%20Environmental%20Industries%20Assessment%202010.pdf (accessed February 8, 2011)
[16] Id.
[17] DOC's International Trade Administration "Energy and Environment Export News," August 2005. Pg. 7. http://www.ita.doc.gov/media/publications/pdf/eeen02.pdf (accessed February 8, 2011).
[18] Network of Heads of the European Environment Protection Agencies. 2005. "The Contribution of Good Environmental Regulation to Competitiveness." http://www.eea.europa.eu/about-us/documents/prague_statement/prague_statement-en.pdf (accessed February 8, 2011).

The table below presents the average employment impacts associated with the manufacture, installation and operation of one example of air pollution abatement technology: scrubbers to reduce sulfur dioxide pollution.[19]

EXHIBIT 1. SUMMARY OF EMPLOYMENT IMPACTS PER MODEL SCRUBBER

MODEL SCRUBBER	MODEL SCRUBBER DESCRIPTION	ONE-TIME EMPLOYMENT IMPACTS (ANNUAL EQUIVALENT FTEs)[2]	RECURRING ANNUAL EMPLOYMENT IMPACTS (FTEs PER YEAR)[3]
Model Scrubber 1	Medium/Large Utility Boilers	848 – 1,001	103
Model Scrubber 2	Small Utility Boilers	409 – 493	39
Model Scrubber 3A[1]	Large Industrial/ Institutional Boilers (method 1)	333 – 400	29
Model Scrubber 3B[1]	Large Industrial/ Institutional Boilers (method 2)	77 - 91	16
Model Scrubber 4	Small- and Medium-Sized Industrial/Institutional Boilers	40 – 48	6

Notes:
1. As described in later sections of this document, Model Scrubbers 3A and 3B are different analytic variants of the same model scrubber. Both represent scrubbers at large industrial boilers, but we estimate employment impacts for Model Scrubber 3A based on one methodology and Model Scrubber 3B based on another.
2. One-time employment impacts reflect the labor required for the manufacturing and installation of each model scrubber, including the labor required to produce scrubber components (e.g., the absorber vessel) that scrubber makers purchase from other firms.
3. Recurring employment impacts include labor required for the operation, maintenance, and administrative support for each scrubber over its full lifetime of operation.

The installation of control equipment like scrubbers which has been triggered by new air regulations have often led to impressive job growth for these sectors. Spurred by the implementation of the CAA, the U.S. boilermaker population grew by approximately 35 percent, or 6,700 boilermakers, in just two years, between 1999 and 2001, according to data from the International Brotherhood of Boilermakers.[20] The creation of additional jobs has continued. Over the past seven years, the Institute for Clean Air Companies (ICAC) estimates that implementation of just one rule – the Clean Air Interstate Rule Phase 1 – resulted in 200,000 jobs in the air pollution control industry.[21]

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[19] Jason Price, Nadav Tanners, Jim Neumann (IEc) and Roy Oomen (ERG), Employment Impacts Associated with the manufacture, Installation and Operation of Scrubbers, Memo to Ellen Kurlansky, January 15, 2010

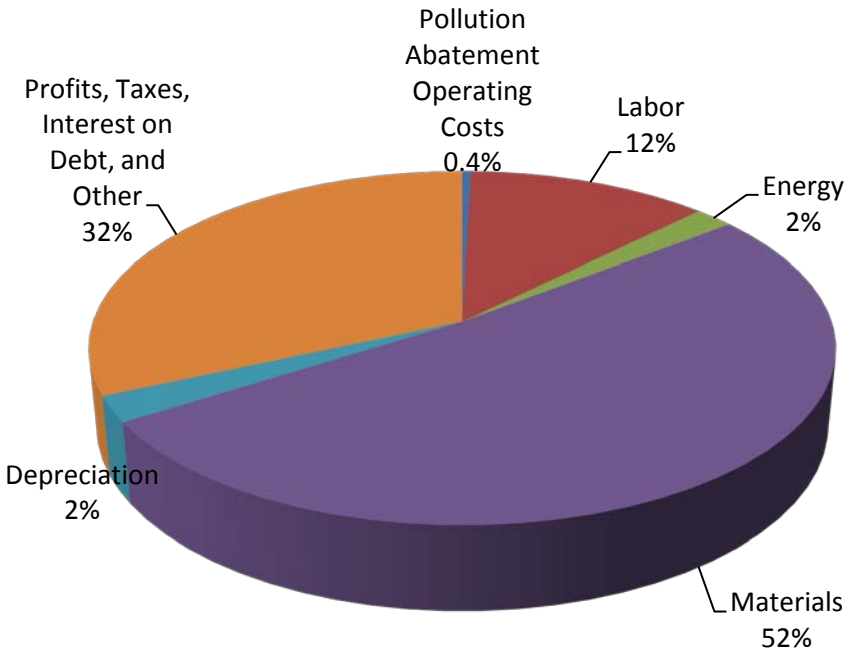
[20] International Brotherhood of boilermakers, *Boilermaker Labor Analysis and Installation Timing*, March 2005, EPA Docket OAR-2003-0053 (docket of the Clean Air Interstate Rule)

[21] November 3, 2010 letter from David C. Foertner, Executive Director of the Institute of Clean Air Companies, to Senator Thomas R. Carper (http://www.icac.com/files/public/ICAC_Carper_Response_110310.pdf (accessed February 8, 2011)

The Clean Air Act, Abatement Costs, and Competition

Critics argue that pollution abatement costs will drive manufacturing overseas. However, pollution abatement costs are a small fraction of total manufacturing costs. The U.S. Census Bureau has conducted an annual survey of the U.S. manufacturing sector to measure Pollution Abatement Costs and Expenditures (PACE).[22] From this statistically-based PACE survey, Census estimates total pollution abatement costs by industry in the U.S. The PACE survey results suggest that pollution abatement operating costs are only a small portion of overall costs of manufacturing (0.4%), this includes not just air pollution abatement but also all other pollution abatement costs. Figure 1 shows the relative magnitude of each cost category for the manufacturing sector.

Figure 1. Pollution Abatement Costs are a Very Small Percentage of Total Manufacturing Costs



Source: U.S. Census Bureau, Pollution Abatement Costs and Expenditures: 2005
U.S. Census Bureau, Annual Survey of Manufacturers: 2005

Because most industries incur abatement costs that are less than 1 percent of their total cost even small changes in wage rates, capital costs or raw material costs are likely to have a much larger impact than any changes in environmental regulation. Reducing abatement costs by 10 percent will only reduce the total costs faced by industry by less than 1 tenth of 1 percent. Conversely, lowering raw materials costs by 10 percent could reduce total costs by 5 percent.

[22] The PACE survey was conducted annually between 1973 and 1994 (with the exception of 1987), but was discontinued after 1994 by the U.S. Census Bureau for budgetary reasons. EPA helped fund the survey to collect data for 1999 and 2005, but resource constraints have prevented further surveys. Data from 1999 are not included because it is not directly comparable to other years. See http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/pace2005.html#whatare (accessed February 9, 2011)
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The PACE survey also allows examination of the changes in abatement costs over time (1973-1994, when data were collected each year). As a percent of GDP, abatement costs have been remarkably constant over time and always less than 0.3% of GDP (usually between 0.25% and 0.3% of GDP). These costs remained low despite huge gains in air quality over the same time period, suggesting that industry found ways to reduce costs as regulations became more stringent.[23]

Because the composition of the US economy has changed during this period away from heavy industry and to a more service-oriented economy, another way to examine trends is to focus more exclusively on how pollution expenditures for affected manufacturing industries in the US relate to their overall level of economic activity. The share of total revenues devoted to pollution abatement expenses by US manufacturing has been small (ranging between 0.4%-0.6%) since 1980, despite a substantial increase in the number and scope of environmental regulations impacting this sector of the US economy. Focusing further on the most heavily regulated industries among US manufacturers, pollution abatement costs remain a small part of total revenue. Even for these industries, the share of revenue devoted to financing pollution abatement costs reached a high of 2% (petroleum sector in 1994), and has typically been observed to lie between 1.0-1.5% for these industries since 1980. [24]

A related line of literature explores whether environmental regulations (including clean air regulations) harm U.S. competitiveness. In a widely cited review, Jaffe, Peterson, Portney, and Stavins concluded that: "Overall, there is relatively little evidence to support the hypothesis that environmental regulations have had a large adverse effect on competitiveness, however that elusive term is defined."[25] Similarly, Taylor (2005) concluded that while environmental regulation can affect trade and investment flows it is only one of a number of factors that affect firms' decisions to relocate.[26] Furthermore, Levinson (2009, 2010) determined that the pollution intensity of U.S. imports has actually declined over time. While not directly addressing the pollution havens hypothesis, this research provides strong evidence that any tendency U.S. environmental regulations might have to "offshore" employment is overwhelmed by other economic forces. [27]

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[23] Notes: Starting in 1992, the PACE Survey collected PAOC on non-media and other. Non-media consists of expenditures on underground storage tanks and site cleanup, while 'other' consists of expenditures on noise abatement, radiation abatement, multimedia and not elsewhere classified. For consistency across time, PAOC in 1992, 1993 and 1994 do not include expenditures on non-media and other. Including non-media and others, PAOC as a percent of total GDP in 1992 is 0.30% (compared to 0.28% without non-media), 0.28% in 1993 (compared to 0.26% without non-media), and 0.29% in 1994 (compared to 0.26% without non-media)

[24] U.S. Census Bureau, Pollution Abatement Costs and Expenditures

[25] A.B. Jaffe, S.R. Peterson, P.R. Portney, and R. Stavins, "'Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?" *Journal of Economic Literature* 33(1995):132-163. (accessed February 8, 2011)

[26] M. Scott Taylor, 2005. "Unbundling the Pollution Haven Hypothesis," The B.E. Journal of Economic Analysis & Policy, Berkeley Electronic Press, vol. 0(2). (accessed February 8, 2011)

[27] Arik Levinson, "Technology, International Trade, and Pollution from US Manufacturing" *American Economic Review* 2009, 99:5, 2177–2192.
Arik Levinson, "Offshoring pollution: Is the U.S. increasingly importing polluting goods?" *Review of Environmental Economics and Policy* 4(1) Winter 2010, pp. 63-83.

Finally, the costs attributed to environmental protection may overstate the true economic costs – as in cases where the entire cost of capital improvements is attributed to pollution control expenditure, even though the expenditures also help improve operating efficiency. For example, Morgenstern, Pizer, and Shih (2001) investigated how much $1 spent on "environmental protection" really costs an industry. Using statistical analysis and facility specific data bases on manufacturers, they determined how much of the investment in pollution control (including air pollution controls) was truly long term additional costs and how much resulted in cost saving process improvements. For some industries, notably plastics, the industry actually saved money as productivity was boosted. On average, the study concluded, $1 spent on environmental pollution control reflected a real expense of only 87 cents.[28]

Business Support for the Clean Air Act Benefits

In December 2010, fourteen business organizations representing over 60,000 firms wrote President Obama and Congressional leaders urging them to support EPA's mission and to reject efforts to block, delay or weaken implementation of the Clean Air Act. In their letter, the groups note that studies consistently show that the economic benefits of implementing the Act far exceed the costs of controlling air pollutant emissions. They wrote: "In short, the Clean Air Act provides lawmakers with an example of how responsible environmental measures can both ignite new industries and send a market signal to investors and entrepreneurs that innovation and investment in the clean energy sector is good business.".[29]

The same month, 8 major utilities sent a letter to the editor of the Wall Street Journal saying, "Contrary to claims that EPA's agenda will have negative economic consequences, our companies' experience complying with air quality regulations demonstrates that regulations can yield important economic benefits, including job creation, while maintaining reliability."[30]

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[28] Richard Morgenstern, William A. Pizer, and Jhih-Shyang Shih, The Cost of Environmental Protection, *Review of Economics and Statistics* | November 2001 | Vol. 83, No. 4 | pp. 732-738 | Related Discussion Paper 98-36

[29] American Business for Clean Energy, December 15, 2010, *More Than 60,000 Firms In U.S. Business Groups Urge Congress To Support EPA, Caution That Clean Air Act Rule Delays Could Drive Up Business Costs* http://www.americanbusinessforcleanenergy.org/ckfinder/userfiles/files/121510_Businesses_for_CAA_news_release_FINAL.pdf (accessed February 8, 2011)

[30] Peter Darbee, chairman, president and CEO,PG&E Corp.; Jack Fusco, president and CEO, Calpine Corp.; Lewis Hay, chairman and CEO, NextEra Energy, Inc.; Ralph Izzo, chairman, president and CEO, Public Service Enterprise Group, Inc.; Thomas King, president, National Grid USA,; John Rowe, chairman and CEO, Exelon Corp.; Mayo Shattuck, chairman, president and CEO, Constellation Energy Group; Larry Weis, general manager, Austin Energy , "We're OK With the EPA's New Air-Quality Regulations," Letter to the Editor, Wall Street Journal, December, 8, 2010.