Regulation Works

How science, advocacy and good regulations combined to reduce power plant pollution and public health impacts; with a focus on states in the Regional Greenhouse Gas Initiative

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Founded in 1996, The Clean Air Task Force works to help safeguard against the worst impacts of climate change by catalyzing the rapid global development and deployment of low carbon energy and other climate-protecting technologies through research and analysis, public advocacy leadership and partnership with the private sector.

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INTRODUCTION

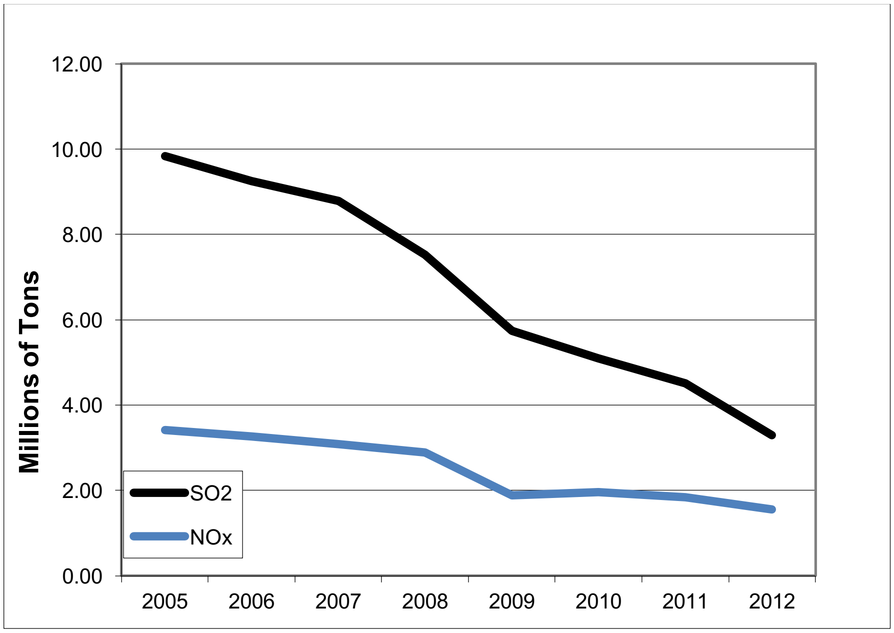
In 1996, Clean Air Task Force was founded to launch an effort to clean up emissions from coal-fired power plants. The goal was to dramatically slash emissions of mercury, sulfur dioxide (SO_2), nitrogen oxides (NOx) and carbon dioxide (CO_2). Dozens of other NGO's at the state and local level, state government's, and federal policy makers joined the effort to push for state and regional action as well as federal action.

As part of these efforts, CATF sought to document the impacts of power plant pollution through a series of studies looking at impacts ranging from mercury deposition, ozone smog, fine particle pollution and global warming pollution. In our inaugural study issued in 2000, we looked at fine particle pollution from power plants and its health impacts around the country. We used EPA's own methodologies, and commissioned its own consultants, to calculate the impact that fine particle pollution from power plants was having on America's health. The results were astounding, and the impact of the report itself was too. The goal of cleaning up coal-fired power plants entered the political scene, both in Congress and in the Presidential race, where both Al Gore and George W. Bush embraced the notion of reducing all four pollutants.

Fourteen years later, we are finally closing in on the objectives that the campaign first set out to achieve. Through enactment of state legislation and regulations, enforcement of existing laws, and finalization of new regulations for mercury through the Mercury and Air Toxics Rule (MATS), and for SO_2 and NOx emissions through EPA's interstate air pollution transport regulations, the public health impacts have dropped dramatically. The final piece of the puzzle is now being put into place, through EPA regulations to address climate-impacting CO_2 emissions for new and existing power plants. It has been a long path, but the achievement is huge.

What are fine particles?
Fine particles are a mixture of harmful pollutants (e.g. soot, acid droplets, metals) that originate primarily from combustion sources such as power plants, diesel trucks, buses, and cars. In 1997 EPA first set national health standards for fine particles (referred to EPA as "PM2.5" or particulate matter smaller than 2.5 microns – 2.5 millionths of a meter in diameter – less than one-hundredth the width of a human hair and smaller). Fine particles are either soot emitted directly from these combustion sources or formed in the atmosphere from power plant sulfur dioxide (SO2) or nitrogen oxides (NOx) emissions. Among airborne particles, the smallest (fine) combustion particles are of gravest concern because they are so tiny that they can be inhaled deeply and be absorbed into the bloodstream and transported to vital organs, thus evading the human lung's natural defenses.

National SO_2 and NOx Emission Trends



To illustrate this, let's look just at fine particle pollution from power plants. In 2000, 2004 and again in 2010, CATF issued studies based on work by Abt Associates quantifying the deaths and other adverse health affects attributable to the fine particle air pollution resulting from power plant emissions. Our 2004 study showed that power plant impacts exceeded 24,000 deaths a year, but by 2010 that toll had been reduced to roughly 13,000 deaths, due primarily to the impact that state and federal actions were beginning to have. Using the most recent emissions data, in 2014 we updated this analysis. In this update, CATF found that about 7,500 deaths each year are attributable to fine particle pollution from U.S. power plants. While this number is still far too high, it does represent a dramatic reduction in power plant health impacts over the past 14 years.

Comparing National Health Impacts due to PM2.5 Pollution from Power Plants			
	2004	2010	2012
Mortality	23,600	13,200	7,500
Hospital Admissions	21,850	9,700	5,630
Heart Attacks	38,200	20,400	11,915
Asthma Attacks	554,000	217,600	126,400

This decrease reflects pollution reductions due to a variety of federal and state regulatory and enforcement initiatives supported by CATF, including the MATS[1] and interstate air pollution rules[2], and the active enforcement of

[1] http://www.epa.gov/mats/

[2] http://www.epa.gov/crossstaterule/

existing laws such as New Source Review (NSR)[3]. Since 2004, these measures have cut emissions of SO_2 and NOx, the leading components of fine particle pollution, by 68 percent and 55 percent respectively. This result was achieved through the near doubling of the number of scrubbers — the technology used for reducing SO_2 pollution — installed at power plants, as well as the retirement of many older, inefficient and heavily polluting coal plants. Yet, despite this progress, some in the power industry and several recalcitrant states persist in trying to overturn the MATS and interstate air pollution regulations in court, and reverse this life-saving trend.

The most recent analysis shows that strong regulations requiring stringent emission controls can have a dramatic impact in reducing air pollution across the country, saving lives, and avoiding a host of other adverse public health impacts. The study also shows that some areas of the country still suffer from unnecessary levels of pollution from power plants that could be cleaned up with the application of proven emission control technologies.

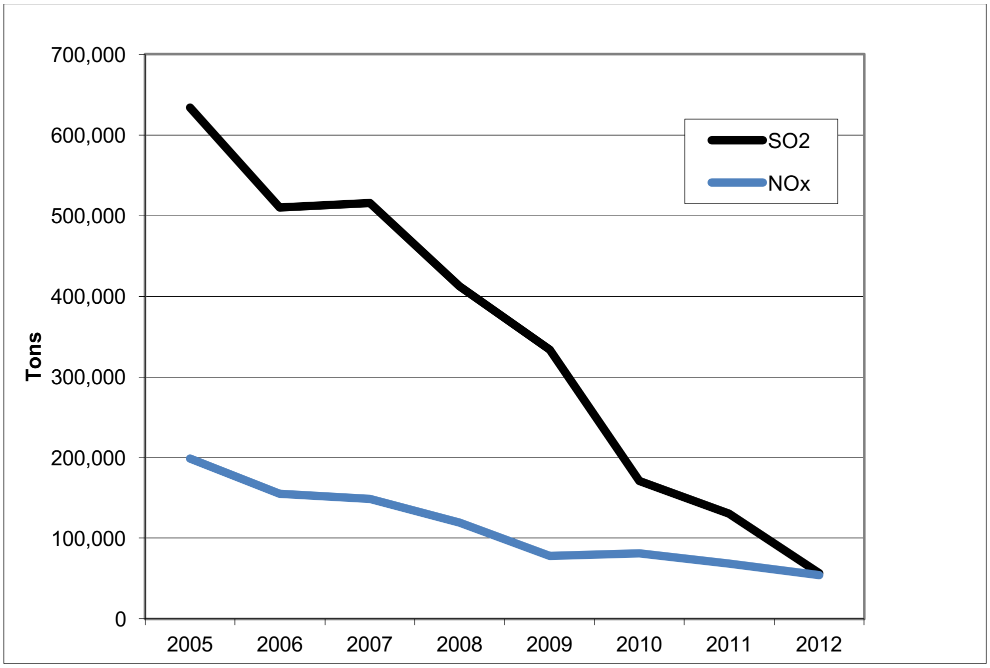
So our fight to clean up deadly emissions from power plants is by no means over, but the goal line is clearly in sight.

Northeast State power plant regulations have dramatically reduced emissions

State and regional efforts to curb power plant pollution have played a major role in the national emission reductions that we have seen to date. This is due not only to the reductions achieved by those states but also by the political pressure those states in turn have placed on the federal government to step up its efforts. In addition to the in-state actions taken below, many of the states in the RGGI region were active in pursuing actions under the New Source Review provisions of the clean air act, and helping to defend those provisions when proposals to gut the NSR regulations were pushed during the Bush Administration. The RGGI states are are also part of the Ozone Transport Commission, which in 1999, to address ozone pollution, initiated the first summertime NOx trading program for large sources, including power plants. EPA used the OTC program as a template when it required summertime NOx reductions starting in 2004 through the NOx SIP Call.

[3] http://www.epa.gov/nsr/

RGGI Region SO_2 and NOx Emission Trends



Here's a summary of what the RGGI states have done to date both on power plant clean up but also on energy efficiency programs:

Connecticut— Control of sulfur dioxide emissions from power plants and other large stationary sources of air pollution—This 2002 law requires power plants to meet a sulfur emission limit of 0.33 lb/mmBtu by 2005. This has resulted in an average 86% reduction in SO_2 emissions from CT's 6 largest fossil fuel-fired plants. NOx emission from power plants and other major stationary sources are covered by Section 22a-174-22, "Control of nitrogen oxides emissions," with varying limits depending on fuel and combustor type. Regulations to comply with CAIR's ozone season NOx trading program have also been adopted. Section 22a-174-22c.

A separate 2003 law (Public Act No. 03-72, "An act concerning mercury emissions from coal-fired electricity generators," required CT coal plants (Bridgeport Harbor) to cut mercury emissions by 2008 through achieving either an emissions standard of 0.6 lbs. of mercury per trillion Btu or a 90% efficiency in technology installed to control mercury emissions.

Connecticut has had a Renewable Portfolio Standard (RPS) in place since 2000. The RPS requires electricity suppliers to provide a specified percentage of the electricity they supply be generated by renewable resources. In 2015, electricity suppliers must provide 12.5, 3% and 4% of the electricity they supply from Class I, II, and III renewable sources respectively. These percentages rise to 20%, 3%, and 4% by 2020. Connecticut General Statutes Section 16-245m requires the state's electric and natural gas utilities to develop a three year plan for Connecticut's investments in energy efficiency. The current Plan for 2013-15 includes an investment of $222 million in energy saving measures to reduce electric and gas consumption. In 2011 Connecticut established the nation's first Green Bank, to attract private investment in the deployment of clean energy in Connecticut. A summary of initiatives and results from Connecticut's clean energy financing programs can be found in the Green Bank's Comprehensive Annual Financial Report for fiscal year 2014.

Delaware—Delaware Administrative Code, Title 7, Section 1146, "EGU Multipollutant regulation," tightened limits as of 2012 on NOx emissions from power plants to 0.125 lb/mmBtu (24 hr basis), SO2 emissions from coal EGUs to 0.26 lb/mmBtu (24 hr basis) and mercury emissions from coal EGUs to 0.6 lb/TBTtu or a 90% reduction (quarterly basis). Each large EGU is also subject to a cap on mass emissions of NOx, SO2 and Hg. Delaware also adopted an RPS and has pushed for solar deployment, and invested more the $120 million in efficiency.

Maine— Maine Code of Rules, chapter 145, limits NOx emissions from EGUs at 0.15 or 0.22 lb/mmBtu (90 day avg), depending on plant size. Chapter 106 contains fuel sulfur limits for various sources.

Maine has had an RPS in place since electricity restructuring and increased in 2007. The RPS requires electricity suppliers to provide a specified percentage of the electricity they supply be generated by renewable resources. In 2014 electricity suppliers must provide 37% of the electricity they supply from renewable sources. This percentage increases by 1% per year to 40% in 2017. The Efficiency Maine Trust Act, 35-A M.R.S. section 10100 and 101103, directs the Trust to implement cost-effective conservation programs to help reduce energy costs for electricity consumers to the maximum amount possible, to increase consumer awareness regarding energy efficiency, to create more favorable market conditions for energy efficiency, to promote sustainable economic development and reduce environmental damage, and to reduce electricity demand and increase efficiency.

Maryland— Maryland Healthy Air Act—The emission reductions from Maryland's 2006 Healthy Air Act came in two phases. The first phase required reductions in the 2009/2010 timeframe and, compared to a 2002 emissions baseline, reduce NOx emissions by almost 70%, SO_2 emissions by 80%, and mercury emissions by 80%. The second phase was effective in 2012/ 2013. At full implementation, the HAA will reduce NOx emissions by approximately 75% from 2002 levels, SO_2 emissions will be reduced by approximately 85% from 2002 levels, and mercury emissions will be reduced by 90%.

The state's EmPOWER Maryland initiative mandates a 15 percent reduction in peak demand and per-capita electricity consumption and demand by 2015 from 2007 levels. Ten percent of the overall reduction must come from measures implemented by the state's utilities and five percent from other energy efficiency programs. To date, Maryland has achieved a 10.8 percent reduction in peak electricity demand. The EmPOWER Maryland program has funded measures that will reduce ratepayer electricity use by more than 2 million MWh per year and save $250 million annually.

Massachusetts— MA DEP regulation 310 CMR 7.29, "Emission standards for power plants," requires MA power plants to meet a NOx standard of 1.5 lb/MWh (annual) and 3.0 lb/MWh (month), and an SO_2 standard of 3.0 lb/MWh (annual) and 6.0 lb/MWh (month). Also, mercury emissions are to be reduced by 85% by 2008 (or meet a rate of 0.0075 lb/GWh), 95% by 2012 (or a rate of 0.0025 lb/GWh).

Massachusetts has had an RPS in place since 2003. The RPS requires electricity suppliers to provide a specified percentage of the electricity they supply be generated by renewable resources. In 2014 electricity suppliers must provide 9% of the electricity they supply from Class 1 renewable sources. This percentage increases by 1% per year. Massachusetts Green Communities Act requires the state's investor owned electric and natural gas utilities to prepare energy efficiency plans and pursue "all cost effective energy efficiency."

New Hampshire— NH RSA 125-O, "Multiple pollutant reduction program," places a cap on NOx and SO2 emissions from NH's existing fossil fuel-fired power plants and requires an 80% reduction in mercury emissions from NH's coal plant (Merrimack Station). The program has been estimated to reduce NOx emissions by 90% since 1990, and SO_2 emissions by 75% above and beyond the Phase II requirements of Title IV of the federal Clean Air Act.

New Hampshire's RPS requires each electricity provider to meet customer load by purchasing or acquiring certificates representing generation from renewable energy based on total megawatt-hours supplied. New Hampshire's RPS statute divides renewable energy sources into four separate classes: Class I new renewable facilities that began operation after January 1, 2006; Class II new solar technology facilities; Class III existing eligible biomass technologies or methane gas facilities; and Class IV existing small hydroelectric generation facilities**.** The RPS requirement increases from 15.8% (6% Class I) for 2015 to 24.8% for 2025 (15% Class I). The electric utilities in New Hampshire have established a set of energy efficiency programs. A variety of programs exist, serving residential, commercial, and industrial customers.

New York— Starting in 2004, New York's Acid Deposition Reduction Program (ADRP) required additional reductions beyond the EPA NOx SIP Call by annualizing the summertime NOx program and reducing SO2 emissions by up to half of what was allowed under the federal Title IV requirements. The ADRP effectively required the same level of emission reductions as the later promulgated CAIR rules for New York. NY's power plant regulations, 6 NYCRR Part 243, "CAIR NOx Ozone Season Trading Program," Part 244, "CAIR NOx Annual Trading Program," and Part 245 "CAIR SO_2 Trading Program," simply implement EPA's CAIR rulemaking. In 2007, New York enacted 6 NYCRR Part 246, "Mercury Reduction Program for Coal-Fired Electric Utility Steam Generating Units," which establishes an emission cap on facility-wide mercury emissions for the years 2010 through

2014 for existing larger EGUs. New coal-fired EGUs are limited to a mercury emission limit of 0.6 lb/TBtu (30 day average), and from 2015, existing coal-fired EGUs are subject to the same limit.

New York has pursued an energy efficiency goal of reducing energy consumption 15 percent by 2015. As a result of the Energy Efficiency Portfolio Standard, the 2009 New York State Energy Plan projected emissions reductions of more than 9 million tons of CO2 in 2015, as well as 6,544 tons of NOX and 9,040 tons of SO2. New York's RPS calls for 30 percent of the state's electricity to come from renewable sources by 2015. In April of 2014, the PSC commenced the Reforming the Energy Vision (REV) regulatory proceeding to reform New York State's electric industry and utility regulatory practices. The REV Regulatory Docket aims to maximize utilization of all behind-the-meter resources such as demand management, energy efficiency, clean distributed generation, and storage to reduce the need for costly new infrastructure. The Clean Energy Fund (CEF) proceeding complements the REV Regulatory Docket by reshaping the State's energy efficiency, distributed renewable energy and energy innovation programs to reflect a common objective. As proposed by NYSERDA in 2014, the CEF would provide $5 billion to the statewide clean energy economy over ten years, starting in 2016.

Vermont— Does not presently have any fossil fuel-fired power plants. Vermont's Sustainably Priced Energy Enterprise Development (SPEED) program and the Clean Energy Development Fund have been long-standing programs to set renewable energy goals and provide funding for renewable energy projects. In 2014, the legislature revised the existing net metering statute to provide more opportunities for new net-metered renewable electricity. Energy efficiency services, including both the electric and thermal sectors, are primarily provided by the state's energy efficiency utility, Efficiency Vermont, whose activities are funded through a systems benefits charge on electricity bills and by the proceeds of the RGGI auction of allowances.

RGGI is helping drive emission reductions and change the make up of the electric power sector

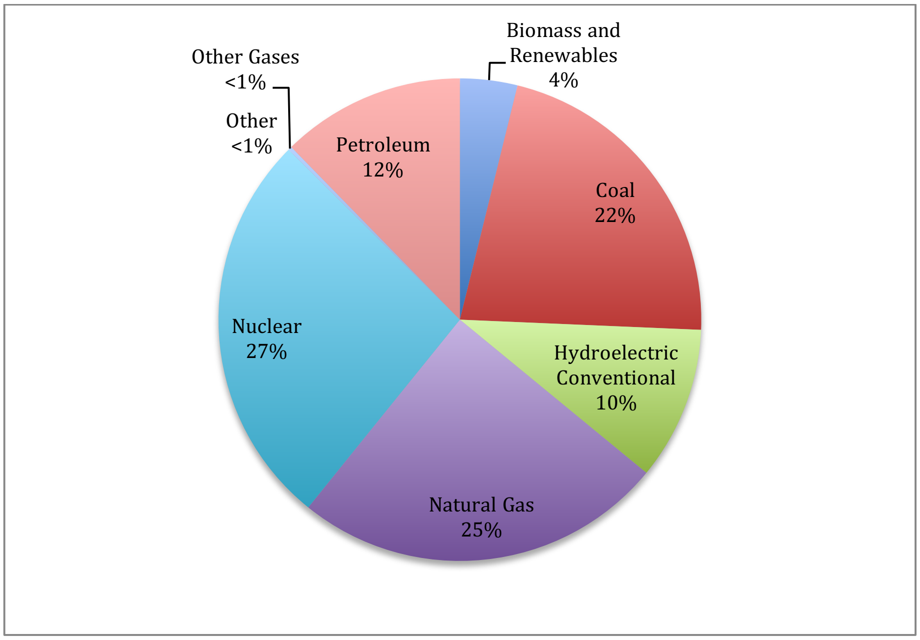
The Northeast states and Mid-Atlantic States that make up the Regional Greenhouse Gas Initiative (RGGI) have played a leading role in reducing power plant emissions. Their efforts originally focused on reducing power plant pollutants such as Nitrogen Oxides, Mercury and SO2 then later added a focus on curbing CO_2 as well.

> **The Regional Greenhouse Gas Initiative** (RGGI) is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce power sector CO2 emissions.

In 2003, New York initiated discussions with Northeastern and Mid-Atlantic states to develop a strategy for reducing greenhouse gas emissions from power plants. The initiative gave rise to RGGI, and held its first auction for CO_2 allowances in 2008. The current program runs through 2020, requiring 2.5% annual reductions in CO_2 emissions from affected plants.

RGGI Region Generation Share By Fuel Type 2005

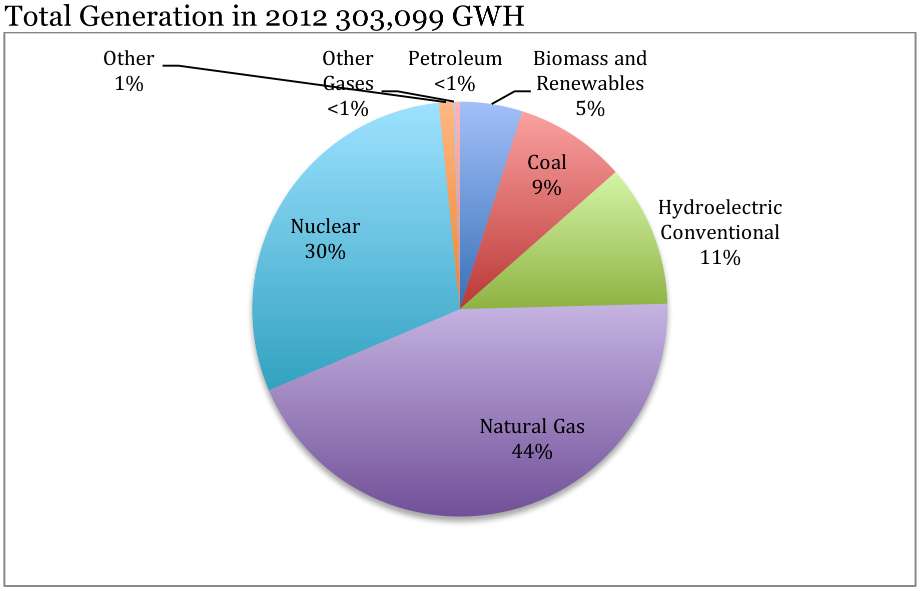
Total Generation in 2005=343,100 GWH



Source: EIA

RGGI Region Generation Share By Fuel Type 2012

Total Generation in 2012 303,099 GWH



Source: EIA

Conventional pollutant regulation at the state and National level as well as RGGI's climate policy and state renewable standards have driven a dramatic shift in generation. Aggressive energy efficiency investment in the RGGI region has reduced total generation by 12% between 2005 and 2012, even though the regional economy grew significantly. In 2005, coal and oil-fired power plants made up 34% of generation, by 2012, generation from oil declined from 12% to less than 1% and coal plants made up only 9% of total generation. Natural gas generation was the primary replacement.

Methodology

The data in this report is derived from a software tool developed by Abt Associates for the Clean Air Task Force called the Powerplant Impact Estimator (PIE). PIE was developed specifically to estimate the health and economics of electric generating units (EGUs) in the United States. In particular, we focus on the impacts in the years 2010, 2015, and 2020 of reducing ambient concentrations of particulate matter less than 2.5 microns in aerodynamic diameter (PM2.5) – an air pollutant that has been linked to a variety of serious health effects, including asthma attacks, chronic bronchitis, hospital admissions, and premature mortality.

To estimate the PM2.5-related benefits associated with reducing emissions from EGUs, the PIE model first calculates the impact on ambient air quality, and then using the results from epidemiological studies, it estimates the number of adverse health impacts (e.g., avoided deaths), and then finally it estimates the associated economic benefits. This three-step process is the standard approach for evaluating the health and economic benefits of reduced air pollution. EPA used this approach when evaluating the National Ambient Air Quality Standards (U.S. EPA, 2006), the Clean Air Act (U.S. EPA, 1999b), the benefits of reducing greenhouse gases (Abt Associates Inc., 1999), the health effects of motor vehicles (U.S. EPA, 2000; 2004), and other major regulations.

Abt Associates developed the PIE tool, to support assessments of the human health benefits of air pollution reductions and their associated economic benefits. PIE is the result of years of research and development, and reflects methods that are based on the peer-reviewed health and benefits analysis literature.

PIE is based on a damage function approach, which involves modeling changes in ambient air pollution levels, calculating the associated change in adverse health effects, such as premature mortality, and then assigning an economic value to these effects. For changes in the concentrations of particulate matter and ozone, this is typically done by translating a change in pollutant levels into associated changes in human health effects. These health effects are then translated into economic values.

The first step in this process involves health impact functions, which are derived from concentration- response functions reported in the peer-reviewed epidemiological literature. A typical health impact function has four components:

1. an effect estimate, which quantifies the change in health effects per unit of change in a pollutant, and is derived from a particular concentration-response function from an epidemiology study;
2. a baseline incidence rate for the health effect;

3. the affected population; and
4. the estimated change in the concentration of the pollutant.

The result of these functions is an estimated change in the incidence of a particular health effect for a given change in air pollution. Examples of health effects that have been associated with changes in air pollution levels include premature mortality, hospital admissions for respiratory and cardiovascular illnesses, and asthma exacerbation.

The second step in the damage function approach involves estimated unit values that give the estimated economic value of avoiding a single case of a particular endpoint – a single death, for example, or a single hospital admission. These unit values are derived from the economics literature, and come in several varieties.

- For some endpoints, such as hospital admissions, we use cost of illness (COI) unit values, which estimate the cost of treating or mitigating the effect. COI unit values generally underestimate the Abt Associates Inc. 2 July 2010 true value of reductions in risk of a health effect, since they include hospital costs and lost wages, but do not include any estimate of the value of avoided pain and suffering.
- For other endpoints, such as asthma exacerbation, we use willingness to pay (WTP) unit values, which are estimates of willingness to pay to avoid an asthma exacerbation.
- Typically value of statistical life (VSL) unit values are used for reductions in risk of premature mortality.

Returning to the previous equation, estimating the economic benefit of the estimated change in health incidence is a simple matter of multiplying by the associated unit value.

Finally, the calculation of total benefits involves summing estimated benefits across all non-overlapping health effects, such as hospital admissions for pneumonia, chronic lung disease, and cardiovascular- related problems.

A PIE analysis relies on first estimating a reduction in air pollution emissions. The determination of the emission reduction occurs outside of PIE and is used as input to the PIE analysis. After the user enters this information into PIE, the model then estimates:

1. the reduction in ambient $PM_{2.5}$ levels in each county in the continental United States;
2. the associated reduction in the incidence of various adverse health effects; and
3. the associated economic benefit of these reductions in adverse health effects.

For detailed information on each step see:

"Technical Support Document for the Powerplant Impact Estimator Software Tool".[4]

Results

In this report we sought to analyze the changes in health impacts caused by the power plants in the RGGI states over the 2005 to 2012 time period using the emissions reported to the EPA's Continuous Emissions Modeling System (CEMS) database. The baseline year was 2012 for which we had a detailed, plant-by-plant analysis of health impacts. Impacts for the earlier years were calculated from the 2012 baseline by comparing emissions in those years to 2012 emissions. Emissions of SO_2, NOx and PM2.5 were factored into the analysis. The reductions in emissions and health impacts from 2005 to 2012 were very significant.

- Mortality dropped from 1,500 to 180.
- Asthma incidents dropped from 26,000 to 3,000.
- Hospital admissions dropped from 1,200 to 145.
- Health impacts dropped from $12.3 billion to $1.4 billion.

Reductions in overall health impact related emissions over that time period were 88.5%. The reduction in each of the health impacts is the same as the reduction in emissions. The reduction in CO_2 emissions, while not factored into the health impact calculations, was 42.3%. The dollar cost to society of the health impacts went down by the same 88.5%.

The following tables show the year-by-year health impacts and health impact valuations for a range of important health effects. The ranges for mortality come from two different studies of the relationship between air pollution and mortality. In the valuation tables, the range for total valuation comes from using these two different studies.

[4] Available at: http://www.catf.us/resources/publications/view/137

Health Impacts RGGI Region					
	Mortality	Bronchitis Acute & Chronic	Heart Attacks	Asthma Incidents	Hospital Admissions
2005	1,585-4,070	3,165	2,715	26,510	1,255
2006	1,385-3,550	2,765	2,360	23,180	1,090
2007	1,395-3,580	2,790	2,380	23,380	1,100
2008	1,170-3,005	2,345	1,995	19,635	925
2009	910-2,340	1,825	1,550	15,290	720
2010	435-1,110	860	750	7,195	345
2011	335-865	670	580	5,600	265
2012	180-470	370	315	3,070	145

Health Impact Valuation ($millions) RGGI Region						
	Mortality	Bronchitis Acute & Chronic	Heart Attacks	Asthma Incidents	Hospital Admissions	Total
2005	$11,470-$29,440	$424	$294	$2	$29	$12,305-$30,275
2006	$10,000-$25,660	$370	$255	$1	$25	$10,725-$26,390
2007	$10,090-$25,905	$373	$258	$2	$25	$10,830-$26,645
2008	$8,450-$21,685	$313	$216	$1	$21	$9,065-$22,300
2009	$6,600-$16,950	$244	$168	$1	$17	$7,085-$17,430
2010	$3,100-$7,960	$115	$81	$0	$8	$3,330-$8,185
2011	$2,440-$6,265	$90	$63	$0	$6	$2,620-$6,445
2012	$1,335-$3,430	$49	$34	$0	$3	$1,435-$3,530

Where Did the Emission Reductions Come From?

With all the actions at the state, region and Federal level, it is difficult to determine exactly what led to the reduction in emissions. In reality, the various policies, regulations and laws reinforced each other in the region to lead to a dramatic reduction in emissions, but to also change the makeup of the energy sector in the RGGI region. Fossil fuel use dropped considerably between 2005 and 2012, with coal use dropping by almost 64 percent. Across the board, the NOx and SO_2 emission rates dropped for not only coal but also gas due to emission control installations. The most dramatic drop though is the drop in SO_2 and NOx emissions in the region. SO_2 is down by over 90 percent and NOx is down by almost 73 percent.

Fuel Use and Emission Trends 2005-2012

Fossil Use Reduction	31.8%
Coal Use Reduction	63.9%
Natural Gas Use Increase	24.4%
Coal SO2 Rate in 2005	1.593
Coal SO2 Rate in 2012	0.395
Overall NOx Rate in 2005	0.194
Overall NOx Rate in 2012	0.077
Coal NOx Rate in 2005	0.330
Coal NOx Rate in 2012	0.230
Natural Gas NOx Rate in 2005	0.046
Natural Gas NOx Rate in 2012	0.025
SO2 Emission Reductions	91.0%
NOx Emission Reductions	72.9%
CO2 Emission Reductions	42.3%

Conclusions

The overall level of emissions and corresponding health impacts for the RGGI region has been significantly reduced from 2005 to 2012. There are a number of causes for the emission reductions. Clearly a major cause is the substitution of natural gas generation for coal generation. Another important cause is the reduction of emission rates for both coal and gas generation through instillation of emission controls. Finally, an additional cause for emission reductions is not directly shown in this analysis, but can be inferred from the data in the table above. This is the increased use of both energy efficiency and renewable resources for electrical generation. This increased usage is indicated by the reduction in overall fossil fuel use from 2005 to 2012.

Additional detailed tables showing the state-by-state trends are attached as a separate appendix.

Appendix -- State by State Data

Table A1. Health Impacts by State

		Mortality Laden	Mortality Pope	Bronchitis Acute & Chronic	Heart Attacks	Asthma Incidents	Hospital Admissions
Connecticut							
	2005	43	17	34	31	280	14
	2006	38	15	30	27	250	12
	2007	35	13	27	25	226	11
	2008	35	14	28	25	232	11
	2009	19	7	15	14	125	6
	2010	21	8	16	15	137	7
	2011	6	2	4	4	37	2
	2012	2	1	2	2	14	1
Delaware							
	2005	527	205	416	352	3,485	164
	2006	493	192	389	329	3,259	153
	2007	562	219	444	375	3,714	174
	2008	538	210	425	359	3,558	167
	2009	282	110	223	188	1,863	87
	2010	255	99	201	170	1,686	79
	2011	166	65	131	111	1,098	52
	2012	71	28	56	47	468	22
Maine							
	2005	11	4	8	8	69	3
	2006	2	1	2	2	15	1
	2007	5	2	4	4	34	2
	2008	4	2	3	3	26	1
	2009	4	2	3	3	25	1
	2010	4	1	3	3	23	1
	2011	3	1	2	2	17	1
	2012	2	1	2	1	14	1
Maryland							
	2005	2,232	869	1,748	1,457	14,690	681
	2006	2,180	849	1,708	1,423	14,350	665
	2007	2,151	838	1,685	1,404	14,157	656
	2008	1,790	697	1,402	1,168	11,779	546
	2009	1,548	603	1,212	1,010	10,186	472
	2010	318	124	249	207	2,091	97
	2011	328	128	257	214	2,157	100

	2012	239	93	187	156	1,570	73
Massachusetts							
	2005	405	158	313	290	2,587	131
	2006	266	104	206	191	1,701	86
	2007	280	109	217	200	1,788	90
	2008	242	95	187	173	1,548	78
	2009	189	74	146	135	1,206	61
	2010	193	75	149	138	1,234	62
	2011	116	45	89	83	739	37
	2012	58	23	45	42	371	19
New Hampshire							
	2005	126	49	97	88	803	40
	2006	101	39	77	70	643	32
	2007	104	41	80	73	664	33
	2008	91	35	70	63	578	29
	2009	81	32	62	57	518	26
	2010	90	35	69	62	571	28
	2011	58	23	45	41	370	18
	2012	8	3	6	6	51	3
New York							
	2005	727	283	547	491	4,588	222
	2006	468	182	353	316	2,956	143
	2007	442	172	333	299	2,790	135
	2008	302	118	227	204	1,905	92
	2009	215	84	162	145	1,356	66
	2010	229	89	172	154	1,443	70
	2011	186	72	140	125	1,173	57
	2012	91	35	68	61	572	28
Rhode Island							
	2005	1	0	1	1	7	0
	2006	1	0	1	1	6	0
	2007	1	0	1	1	8	0
	2008	1	0	1	1	8	0
	2009	1	1	1	1	8	0
	2010	1	1	1	1	9	0
	2011	1	1	1	1	10	0
	2012	1	1	1	1	9	0
Vermont							
	2005	0	0	0	0	1	0
	2006	0	0	0	0	1	0
	2007	0	0	0	0	1	0

2008	0	0	0	0	1	0
2009	0	0	0	0	0	0
2010	0	0	0	0	1	0
2011	0	0	0	0	0	0
2012	0	0	0	0	0	0

RGGI w/o New Jersey

2005	4,072	1,586	3,164	2,716	26,509	1,255
2006	3,551	1,383	2,765	2,359	23,181	1,093
2007	3,581	1,395	2,790	2,380	23,383	1,102
2008	3,004	1,170	2,343	1,997	19,634	925
2009	2,339	911	1,824	1,553	15,287	720
2010	1,110	433	861	751	7,195	345
2011	863	336	669	581	5,601	267
2012	472	184	367	316	3,071	146

Table A2. Health Impact Valuations by State ($millions)

		Mortality Laden	Mortality Pope	Bronchitis Acute & Chronic	Heart Attacks	Asthma Incidents	Hospital Admissions	Total w/ Laden	Total w/ Pope
Connecticut									
	2005	$312.1	$121.7	$4.6	$3.4	$0.0	$0.3	$321.3	$130.9
	2006	$278.1	$108.4	$4.1	$3.0	$0.0	$0.3	$286.3	$116.6
	2007	$252.2	$98.3	$3.7	$2.7	$0.0	$0.3	$259.7	$105.8
	2008	$258.0	$100.6	$3.8	$2.8	$0.0	$0.3	$265.6	$108.2
	2009	$139.5	$54.4	$2.0	$1.5	$0.0	$0.1	$143.6	$58.5
	2010	$152.8	$59.6	$2.2	$1.6	$0.0	$0.2	$157.3	$64.1
	2011	$40.9	$15.9	$0.6	$0.4	$0.0	$0.0	$42.1	$17.2
	2012	$16.1	$6.3	$0.2	$0.2	$0.0	$0.0	$16.5	$6.7
Delaware									
	2005	$3,851.4	$1,499.8	$55.7	$38.5	$0.2	$3.8	$3,961.4	$1,609.8
	2006	$3,601.7	$1,402.5	$52.1	$36.0	$0.2	$3.5	$3,704.5	$1,505.4
	2007	$4,104.0	$1,598.1	$59.3	$41.0	$0.2	$4.0	$4,221.2	$1,715.4
	2008	$3,931.9	$1,531.1	$56.8	$39.3	$0.2	$3.9	$4,044.2	$1,643.4
	2009	$2,058.7	$801.7	$29.8	$20.6	$0.1	$2.0	$2,117.5	$860.5
	2010	$1,862.9	$725.4	$26.9	$18.6	$0.1	$1.8	$1,916.1	$778.6
	2011	$1,213.4	$472.5	$17.5	$12.1	$0.1	$1.2	$1,248.0	$507.2
	2012	$517.5	$201.5	$7.5	$5.2	$0.0	$0.5	$532.2	$216.3
Maine									
	2005	$79.4	$30.9	$1.1	$0.8	$0.0	$0.1	$81.7	$33.3

	2006	$16.9	$6.6	$0.2	$0.2	$0.0	$0.0	$17.4	$7.1
	2007	$39.5	$15.4	$0.6	$0.4	$0.0	$0.0	$40.6	$16.5
	2008	$29.7	$11.6	$0.4	$0.3	$0.0	$0.0	$30.5	$12.4
	2009	$28.3	$11.0	$0.4	$0.3	$0.0	$0.0	$29.1	$11.8
	2010	$26.9	$10.5	$0.4	$0.3	$0.0	$0.0	$27.6	$11.3
	2011	$19.1	$7.4	$0.3	$0.2	$0.0	$0.0	$19.6	$8.0
	2012	$15.7	$6.1	$0.2	$0.2	$0.0	$0.0	$16.1	$6.6
Maryland									
	2005	$16,309.0	$6,351.2	$235.0	$159.2	$1.0	$15.8	$16,769.9	$6,812.2
	2006	$15,930.9	$6,204.0	$229.6	$155.5	$0.9	$15.4	$16,381.2	$6,654.3
	2007	$15,717.4	$6,120.8	$226.5	$153.5	$0.9	$15.2	$16,161.6	$6,565.1
	2008	$13,076.7	$5,092.5	$188.4	$127.7	$0.8	$12.7	$13,446.3	$5,462.1
	2009	$11,308.4	$4,403.9	$163.0	$110.4	$0.7	$11.0	$11,628.0	$4,723.5
	2010	$2,321.2	$904.0	$33.5	$22.7	$0.1	$2.2	$2,386.8	$969.6
	2011	$2,395.0	$932.7	$34.5	$23.4	$0.1	$2.3	$2,462.7	$1,000.4
	2012	$1,743.5	$679.0	$25.1	$17.0	$0.1	$1.7	$1,792.8	$728.3
Massachusetts									
	2005	$2,958.6	$1,154.2	$43.3	$31.7	$0.2	$3.0	$3,046.0	$1,241.6
	2006	$1,945.7	$759.0	$28.5	$20.9	$0.1	$2.0	$2,003.2	$816.5
	2007	$2,045.4	$797.9	$30.0	$21.9	$0.1	$2.1	$2,105.8	$858.4
	2008	$1,770.6	$690.7	$25.9	$19.0	$0.1	$1.8	$1,822.9	$743.0
	2009	$1,379.8	$538.3	$20.2	$14.8	$0.1	$1.4	$1,420.6	$579.0
	2010	$1,411.9	$550.8	$20.7	$15.1	$0.1	$1.4	$1,453.7	$592.5
	2011	$844.9	$329.6	$12.4	$9.1	$0.0	$0.9	$869.9	$354.6
	2012	$424.6	$165.6	$6.2	$4.6	$0.0	$0.4	$437.1	$178.2
New Hampshire									
	2005	$921.8	$359.5	$13.4	$9.6	$0.1	$0.9	$948.6	$386.2
	2006	$738.1	$287.8	$10.7	$7.7	$0.0	$0.7	$759.5	$309.3
	2007	$762.7	$297.4	$11.0	$8.0	$0.0	$0.8	$784.8	$319.6
	2008	$663.8	$258.9	$9.6	$6.9	$0.0	$0.7	$683.0	$278.1
	2009	$594.6	$231.9	$8.6	$6.2	$0.0	$0.6	$611.9	$249.1
	2010	$655.8	$255.8	$9.5	$6.9	$0.0	$0.7	$674.9	$274.8
	2011	$425.3	$165.9	$6.2	$4.4	$0.0	$0.4	$437.7	$178.2
	2012	$58.3	$22.8	$0.8	$0.6	$0.0	$0.1	$60.0	$24.4
New York									
	2005	$5,307.4	$2,069.2	$75.1	$53.7	$0.3	$5.2	$5,457.3	$2,219.1
	2006	$3,419.9	$1,333.3	$48.4	$34.6	$0.2	$3.3	$3,516.5	$1,429.9
	2007	$3,227.3	$1,258.2	$45.7	$32.6	$0.2	$3.1	$3,318.5	$1,349.4
	2008	$2,203.8	$859.2	$31.2	$22.3	$0.1	$2.1	$2,266.1	$921.5
	2009	$1,568.4	$611.5	$22.2	$15.9	$0.1	$1.5	$1,612.7	$655.8
	2010	$1,669.3	$650.8	$23.6	$16.9	$0.1	$1.6	$1,716.4	$697.9
	2011	$1,356.6	$528.9	$19.2	$13.7	$0.1	$1.3	$1,394.9	$567.2

	2012	$661.6	$257.9	$9.4	$6.7	$0.0	$0.6	$680.3	$276.6
Rhode Island									
	2005	$7.5	$2.9	$0.1	$0.1	$0.0	$0.0	$7.7	$3.1
	2006	$7.2	$2.8	$0.1	$0.1	$0.0	$0.0	$7.4	$3.0
	2007	$8.6	$3.4	$0.1	$0.1	$0.0	$0.0	$8.9	$3.6
	2008	$8.8	$3.4	$0.1	$0.1	$0.0	$0.0	$9.1	$3.7
	2009	$9.4	$3.7	$0.1	$0.1	$0.0	$0.0	$9.7	$3.9
	2010	$9.7	$3.8	$0.1	$0.1	$0.0	$0.0	$10.0	$4.1
	2011	$10.8	$4.2	$0.2	$0.1	$0.0	$0.0	$11.2	$4.6
	2012	$10.4	$4.1	$0.2	$0.1	$0.0	$0.0	$10.7	$4.4
Vermont									
	2005	$1.2	$0.5	$0.0	$0.0	$0.0	$0.0	$1.2	$0.5
	2006	$1.4	$0.5	$0.0	$0.0	$0.0	$0.0	$1.4	$0.6
	2007	$1.4	$0.5	$0.0	$0.0	$0.0	$0.0	$1.4	$0.6
	2008	$1.1	$0.4	$0.0	$0.0	$0.0	$0.0	$1.1	$0.4
	2009	$0.5	$0.2	$0.0	$0.0	$0.0	$0.0	$0.5	$0.2
	2010	$0.6	$0.2	$0.0	$0.0	$0.0	$0.0	$0.6	$0.2
	2011	$0.5	$0.2	$0.0	$0.0	$0.0	$0.0	$0.5	$0.2
	2012	$0.5	$0.2	$0.0	$0.0	$0.0	$0.0	$0.5	$0.2
RGGI w/o New Jersey									
	2005	$29,436	$11,468	$424	$294	$2	$29	$30,274	$12,306
	2006	$25,662	$9,997	$370	$255	$1	$25	$26,391	$10,726
	2007	$25,906	$10,092	$373	$258	$2	$25	$26,643	$10,828
	2008	$21,686	$8,448	$313	$216	$1	$21	$22,303	$9,065
	2009	$16,948	$6,602	$244	$168	$1	$17	$17,430	$7,084
	2010	$7,958	$3,101	$115	$81	$0	$8	$8,186	$3,329
	2011	$6,266	$2,441	$90	$63	$0	$6	$6,445	$2,620
	2012	$3,432	$1,337	$49	$34	$0	$3	$3,530	$1,435