RGGI Emissions Trends

Report no. 3 - March 20, 2008

The third auction of emissions allowances under the Regional Greenhouse Gas Initiative (RGGI) was held on March 18, 2009. In order to disseminate relevant information and increase market transparency, ENE (Environment Northeast) compiled the following report on emissions trends through the end of 2008, using data from the Environmental Protection Agency (EPA) and RGGI member states. The report examines emissions drivers, such as economic conditions, fuel-switching, electricity consumption, non-emitting electricity generation, and weather.

RGGI at a Glance:

- 10 States (ME, MA, NH, VT, RI, CT, NY, NJ, DE and MD)
- Applies to all fossil fuel-fired power plants 25 MW or greater
- Went into effect Jan 1, 2009
- Successful auctions 9/25/08 and 12/17/08
- Third auction 3/18/09
- Initial regional cap is 188 million tons CO_2
- Cap is two-phase:
  - Stabilization at initial level for 2009-2014.
  - 2.5% reduction per year 2015-2018 for total 10% reduction
- Compliance period is 3 years; first permits due March 1, 2012.

Summary of Key Findings:

- Data through the end of 2008 suggest that emissions from RGGI units are trending 19% below the RGGI cap, though emissions may not remain as low in 2009.
- Emissions have fallen as a result of the following conditions, the continuation of which is uncertain:
  - Oil has been more expensive than natural gas, and generators are correspondingly utilizing natural gas over oil – natural gas produces fewer emissions than oil, and the increased utilization of natural gas has reduced regional emissions significantly. However, the relationship between oil and natural gas prices in 2009 and beyond remains uncertain.
  - Electricity consumption has been stable in recent years and is now declining, primarily due to the economic downturn but also due to mild weather. This trend will likely continue if the economy does not improve; but hotter, more humid summers could drive up consumption and emissions in future years.
  - Availability of wind, hydro, and nuclear is increasing. The increase in non-emitting generation will likely continue at a modest pace as more wind power comes online in the future.
- ENE believes that allowance demand is driven by significant uncertainty about emissions trends over the first three year compliance period (2009-2011), and confidence that RGGI allowances will hold value in a federal climate system.

Emissions Data

In order to inform the public on developments within RGGI, ENE has conducted periodic assessments of regional emissions using EPA data from the Acid Rain Program (ARP). This third report[1] on RGGI emissions trends was delayed until after the auction in order to resolve discrepancies in EPA emissions data for a few power plants in Rhode Island.

The latest trend emerging from this analysis indicates that actual emissions remain below the RGGI cap level. Recently-released data from power plants in the Acid Rain Program (through the end of 2008) lead ENE to project that total emissions in 2007 were approximately 9% below the RGGI cap and 2008 emissions fell approximately 19% below the cap.

ENE projections through the end of 2008 describe the relationship between emissions and the cap, as shown below in Figure 1. Emissions data made available by the RGGI member states formed the basis for the analysis. Facility level data was collected for all power plants that report CO_2 emissions under the EPA Acid Rain Program, and ENE used this trend to project the overall emissions in the RGGI region (for more detailed description see Attachment 1). Note that ARP data does not include all RGGI facilities and thus should be used as an indicator, and ENE's projection may under- or over-predict total emissions from RGGI facilities.

Figure 1: RGGI Facility CO_2 Emissions from Various Sources

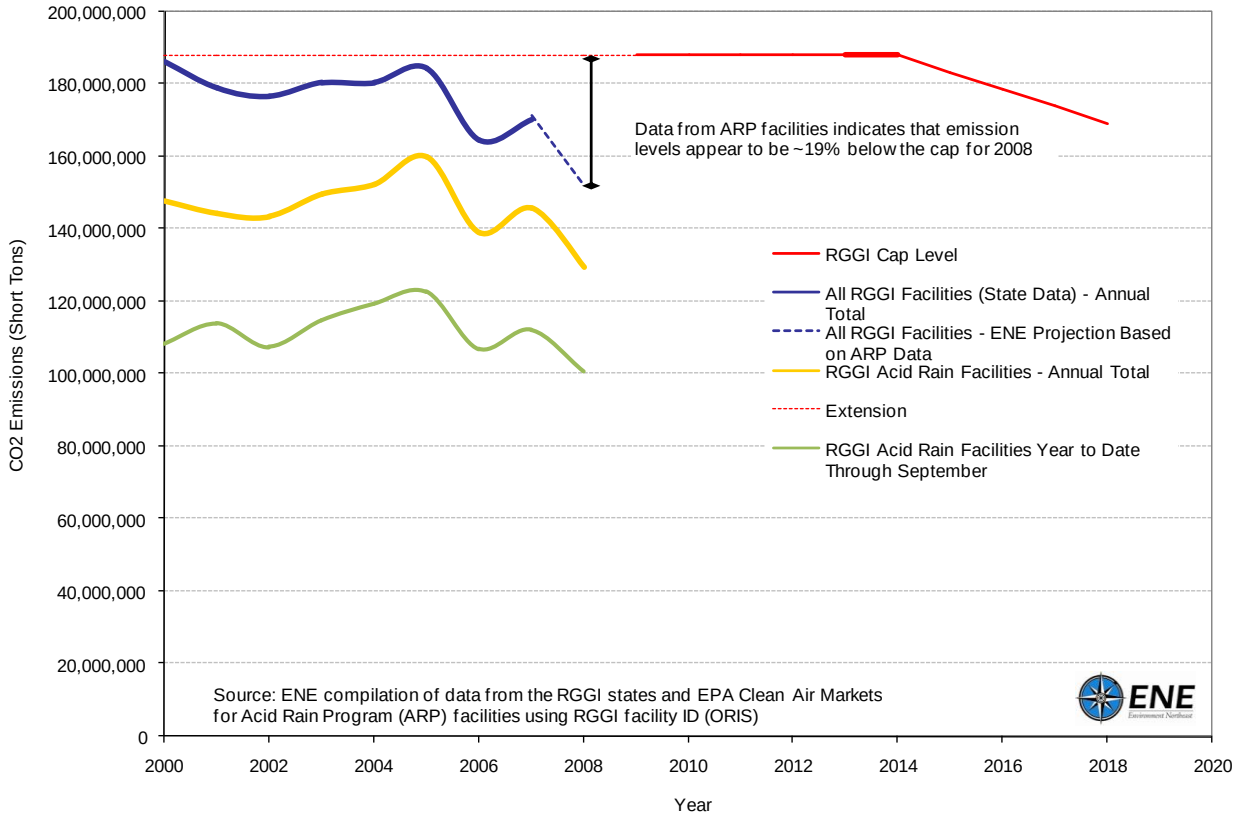
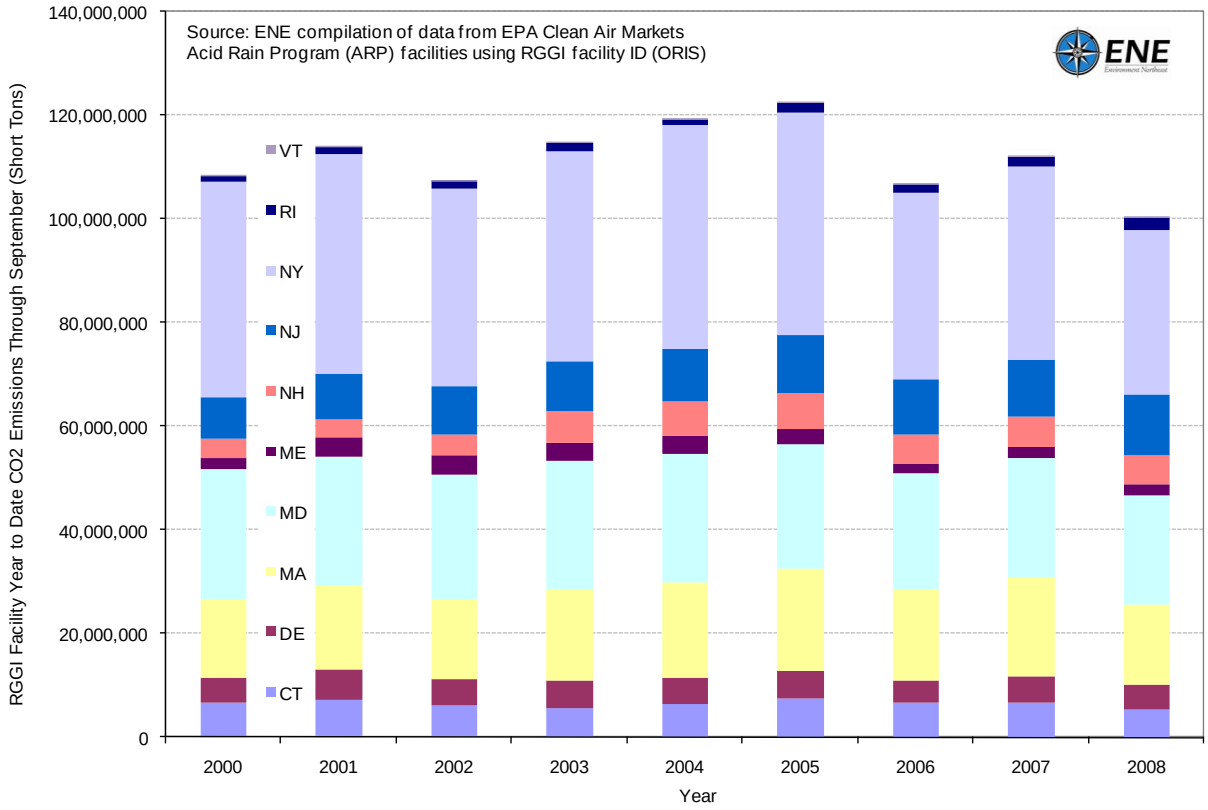


Figure 2 (below) shows 2008 RGGI ARP facility emissions by state. Although trends evidenced in 2008 data may not hold in future years, the existing data suggest that 2008 emissions fell well below the cap and declined from the levels seen in 2007.

Figure 2: Year-to-Date RGGI ARP Facility CO_2 Emissions by State (though September)



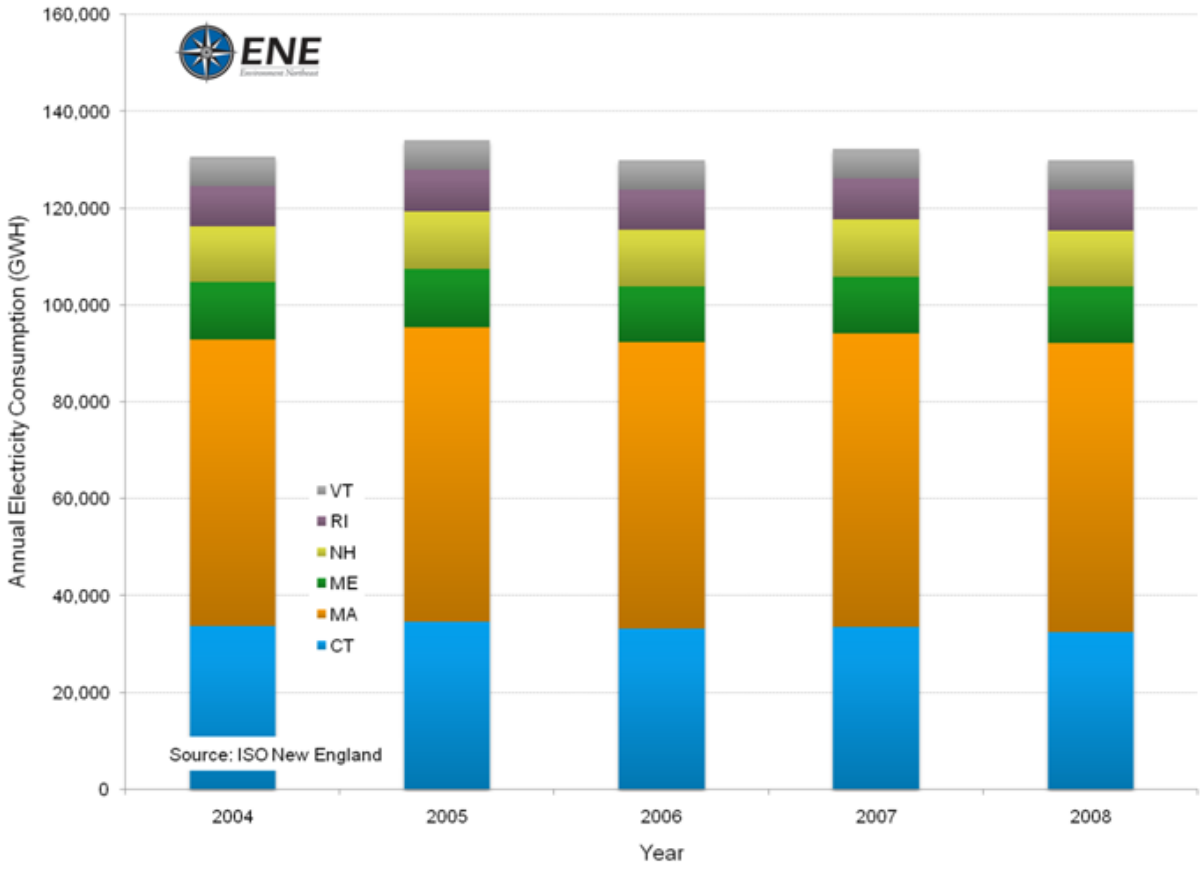
Note: Year-to-Date data covers different time frames at different points in this report. Latest available data was used at all times. YTD emissions data (Figures 1 and 2) is through December 2008; YTD electricity consumption data and weather data are through December 2008; and electric generation data is through November 2008.

ENE's analysis of this latest emissions data indicates that 2008 emissions are below the previous low of 2006 emissions. Significant uncertainty surrounds underlying drivers of emissions levels over the coming months and years. These drivers – including electricity consumption, weather, relative fuel prices, economic trends, and variations in non-emitting generation – will impact emissions trends and determine how constraining the cap will be in the future. An overall decline in emissions across the region is a very favorable trend environmentally and may allow the RGGI states to reduce the level of the cap more quickly in subsequent compliance periods.

Electricity Consumption

Emissions levels are directly related to electricity consumption within the RGGI region. Recent data from the New England Independent System Operator (ISO-NE)[2] indicates that 2008 electricity consumption dropped slightly from 2007 (Figure 3). Annual New York data for 2008 and state-level data from the PJM region (New Jersey, Delaware and Maryland) was unavailable, but it can be assumed that electricity consumption for the RGGI region in 2008 was below 2007 levels. Electricity consumption has essentially remained stable over the last 5 years, and the failure of energy consumption to increase at the rate anticipated (predicted at 1% annually when the RGGI cap was negotiated in 2005) is one cause of the discrepancy between real emissions and the cap.

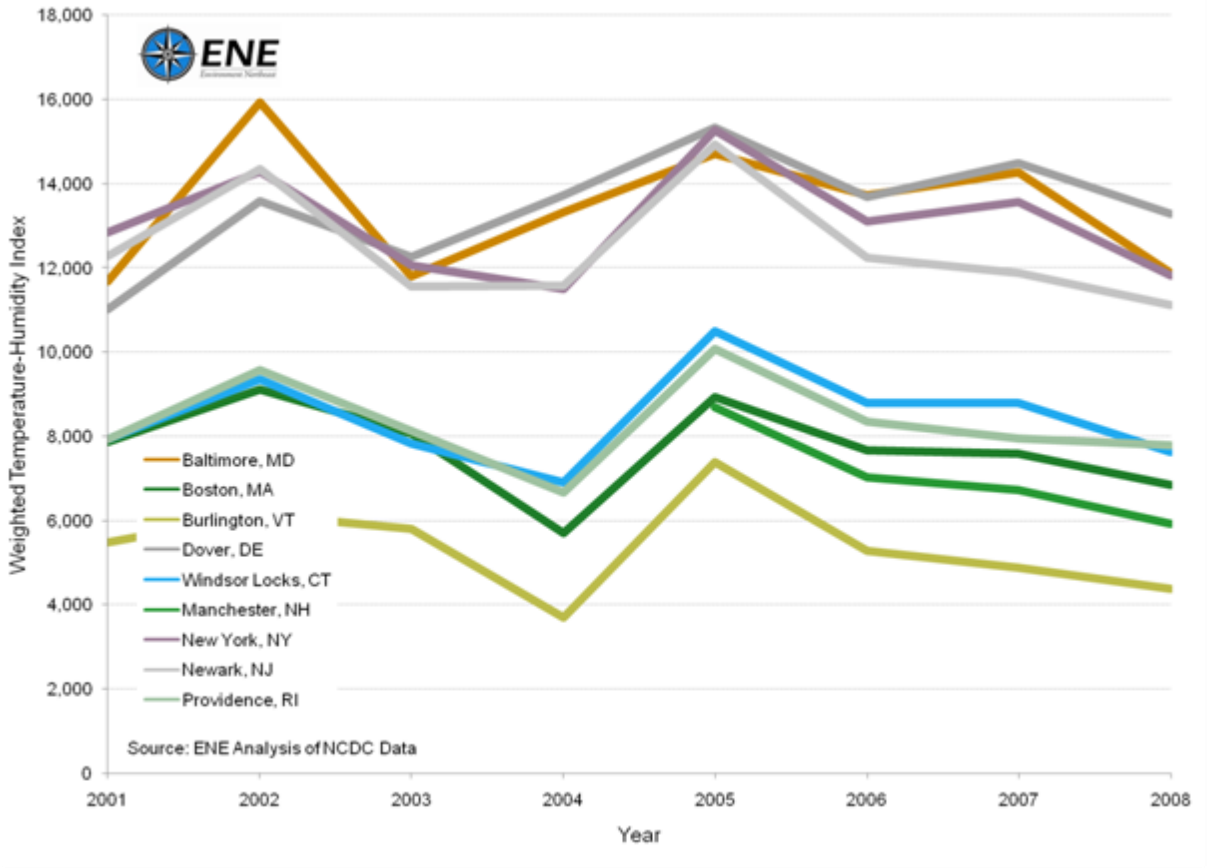
Figure 3: Annual New England Electricity Consumption



Weather

Weather is a significant driver of energy consumption and emissions within the RGGI region. Hot and humid summer weather leads to greater electricity consumption for air conditioning, and cold winter weather increases natural gas and heating oil consumption (only a small percentage of buildings in the region are heated with electricity). As home heating fuels are not covered under RGGI, ENE uses the temperature-humidity index[3] to gauge the impacts of weather on electricity consumption and associated emissions. The annual temperature-humidity index indicates that 2008 has been a moderate year in the RGGI region, which is reflected in the slight decrease in electricity consumption in summer months.

Figure 5: RGGI Weighted Temperature-Humidity Index



Economic Trends

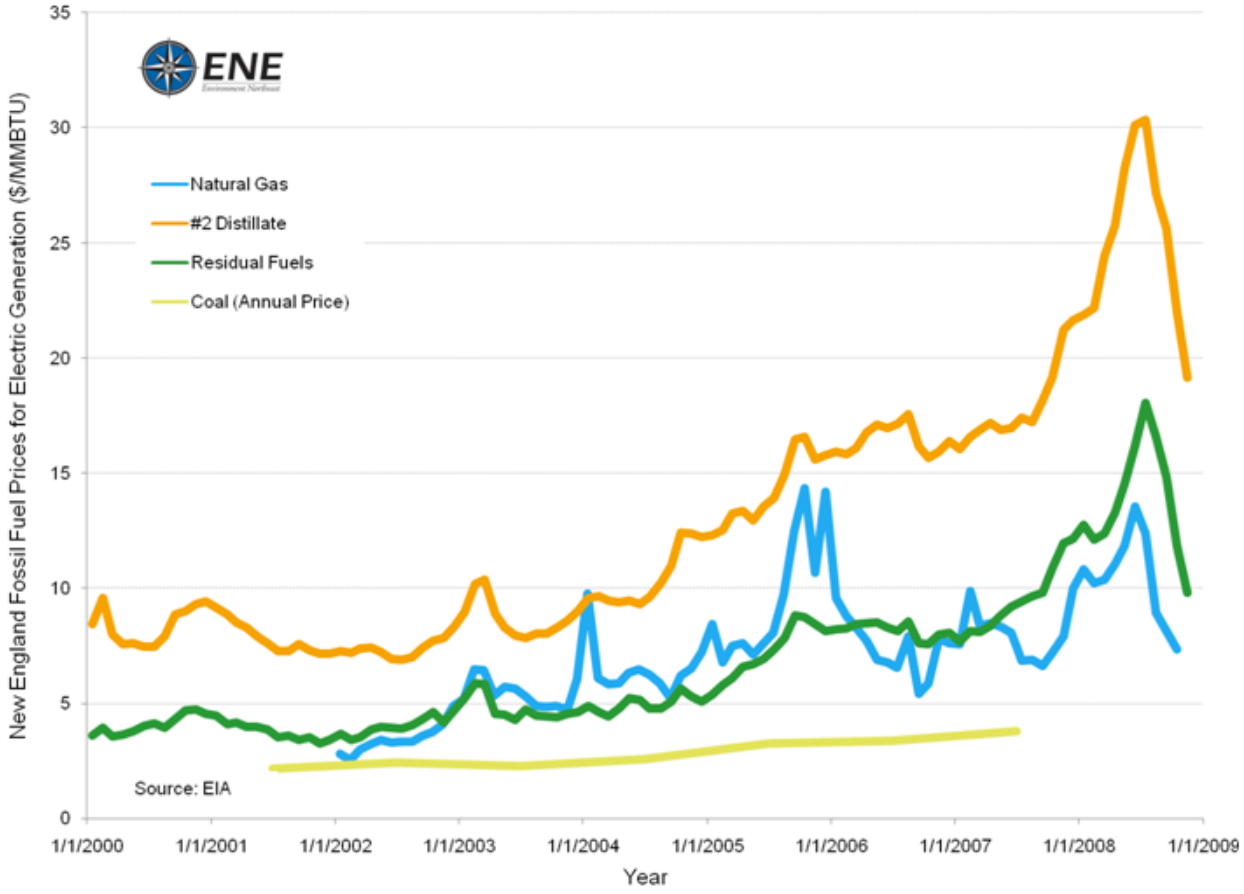
Economic growth has historically been a significant driver of emissions, with increased economic growth leading to increased electricity sales, leading, in turn, to higher emissions levels. Recently economic conditions in the RGGI region have worsened significantly, and reports from the Federal Reserve show increasing weakness in RGGI districts.[4] The economic downturn in the region appears to be reducing electricity consumption and driving emissions down.

Worth noting is the fact that economic growth in years before the downturn appears to have coincided with a period of relative emissions stability. The extent of this disassociation between economic growth and emissions is unclear, but it suggests that economic growth need not always increase emissions, and emissions may not return to historic levels when the economy recovers.

Energy Prices & Generation from Fossil Fuel Power Plants

Despite declines since mid-2008 peaks, energy prices remain above prices seen in the baseline years (2000-2004) used to determine the RGGI cap. The NEPOOL quarterly average wholesale electric price in the fourth quarter of 2008 was $60/MWh, about $10/MWh lower than it was at the same time last year.[5]

Figure 6: Monthly New England Fuel Prices[6]



Despite recent decreases, prices for oil remain higher than prices for natural gas. Higher oil prices have altered fuel combustion patterns in the region, leading to significant reductions in emissions. As oil prices rose in recent years and coal prices jumped over the summer, electricity generated from these fuels became more expensive than electricity from natural gas, renewable, and nuclear sources. This price advantage led to increased dispatch (utilization) of lower-emitting generation.

Of particular importance to regional emissions, the lower price of natural gas in relation to oil has led many dual fuel plants (those that can burn either residual fuel oil or natural gas) to favor natural gas or decreased the use of oil fired plants. The resulting drop in residual fuel use is illustrated in Figures 7 and 8 (below). Because natural gas has a lower carbon emissions factor (53.06 kg CO_2/MMBtu) than residual fuel oil (78.80 kg CO_2/MMBtu)[7], and natural gas plants are typically more efficient than oil fired plants, increasing use of natural gas reduces regional emissions.

However, the recent decline in oil and coal prices may reverse this trend, and emissions will increase if oil and coal use recover in the coming months and years.

Figure 7: RGGI Region Electric Generation from Residual Fuels vs. Natural Gas

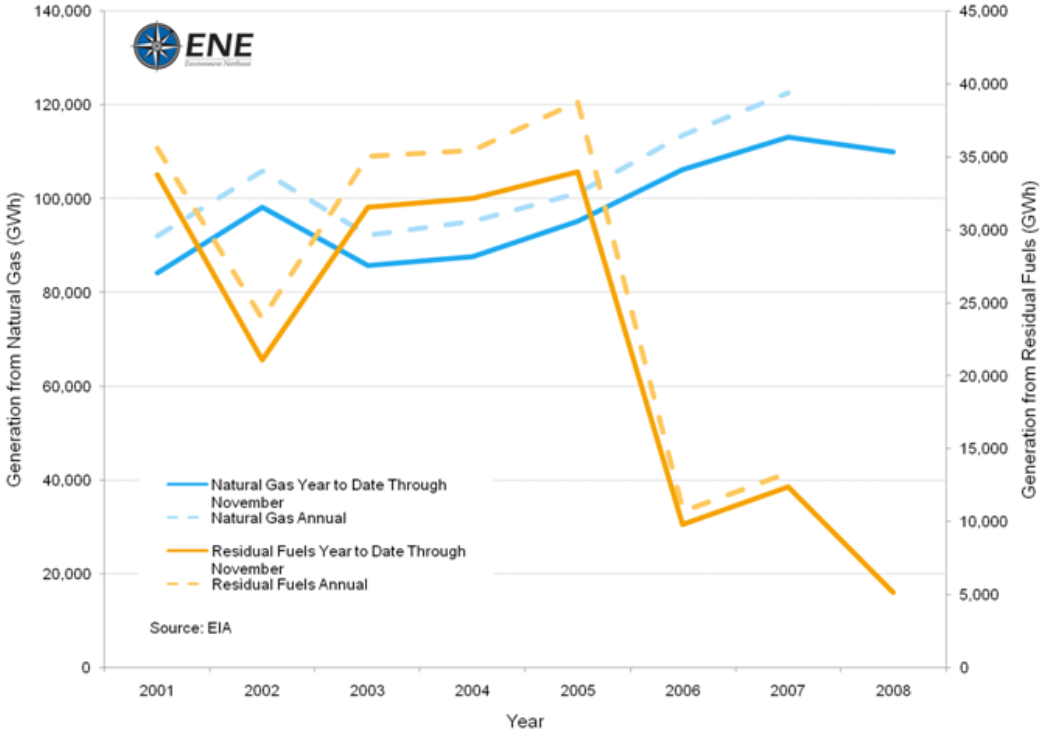
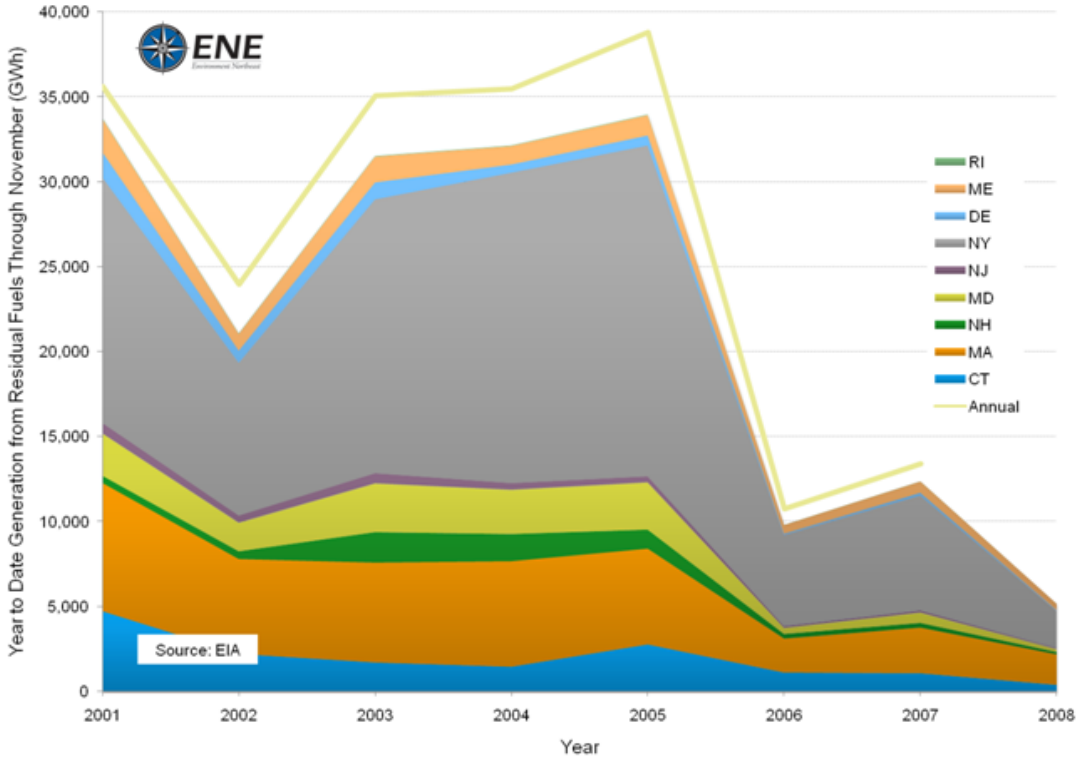


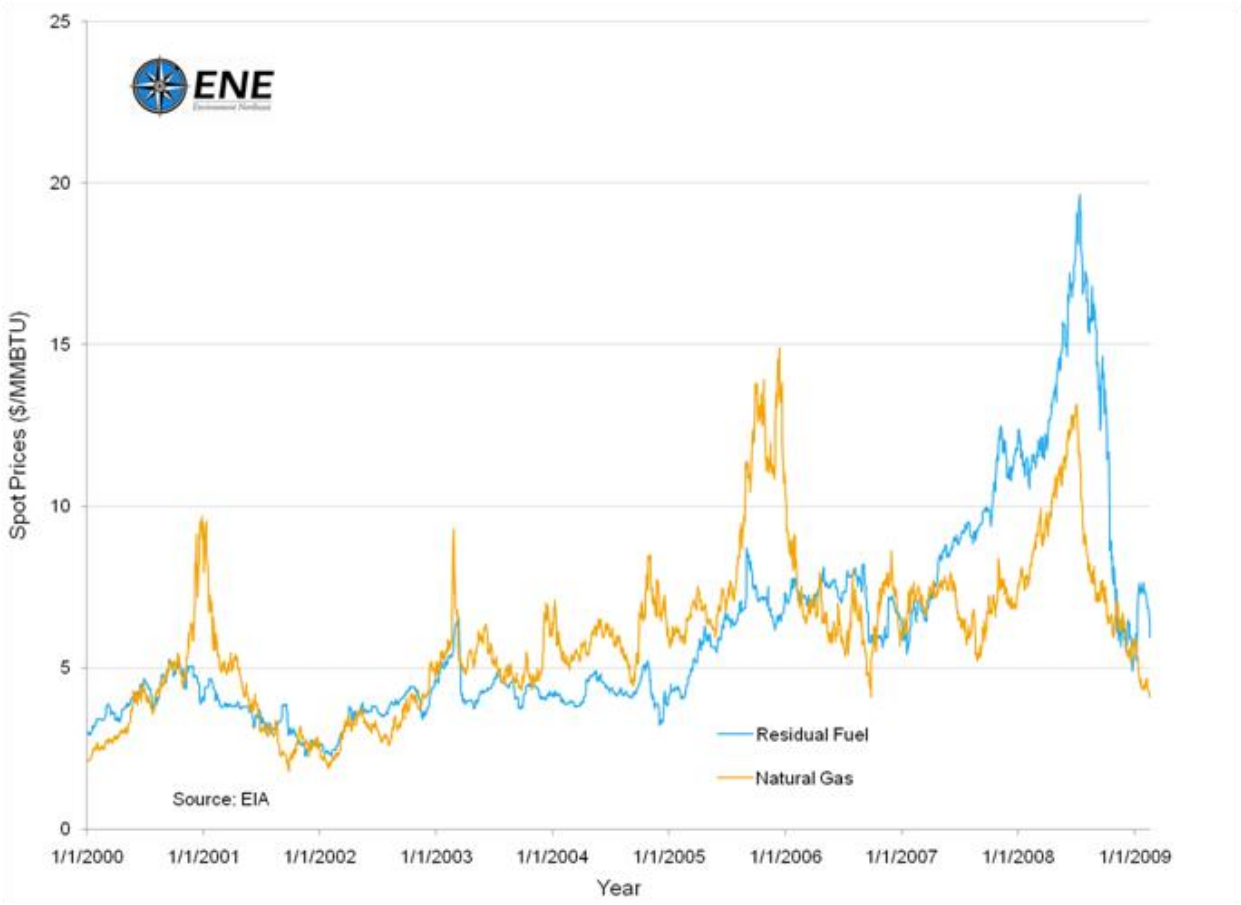
Figure 8: Year to Date Electric Generation from Residual Fuel by State (through November)



Declining use of residual fuel has clearly reduced emissions, with the annual residual fuel generation trend very closely matching the total RGGI emissions trend. However, in the last few months the price of oil has plummeted. Oil's price decrease *relative* to natural gas (and in absolute terms) is most evident in monthly spot market data (Figure 9), which shows that residual fuel prices approached those of natural gas (on a $/MMBTU basis) around the New Year. Oil prices have since recovered in comparison to natural gas, but the time may be approaching when natural gas is no longer cheaper than oil.

The decrease in oil prices is an important development that may increase use of residual fuels in dual-fuel plants, which would lead to increased emissions. 30,000 GWh of residual fuel generation creates roughly 25 million short tons of CO_2 annually. A decrease in oil emissions is only somewhat offset by increasing emissions from natural gas and other power sources, and the downward pressure on emissions caused by high relative oil prices may reverse, causing emissions to increase.

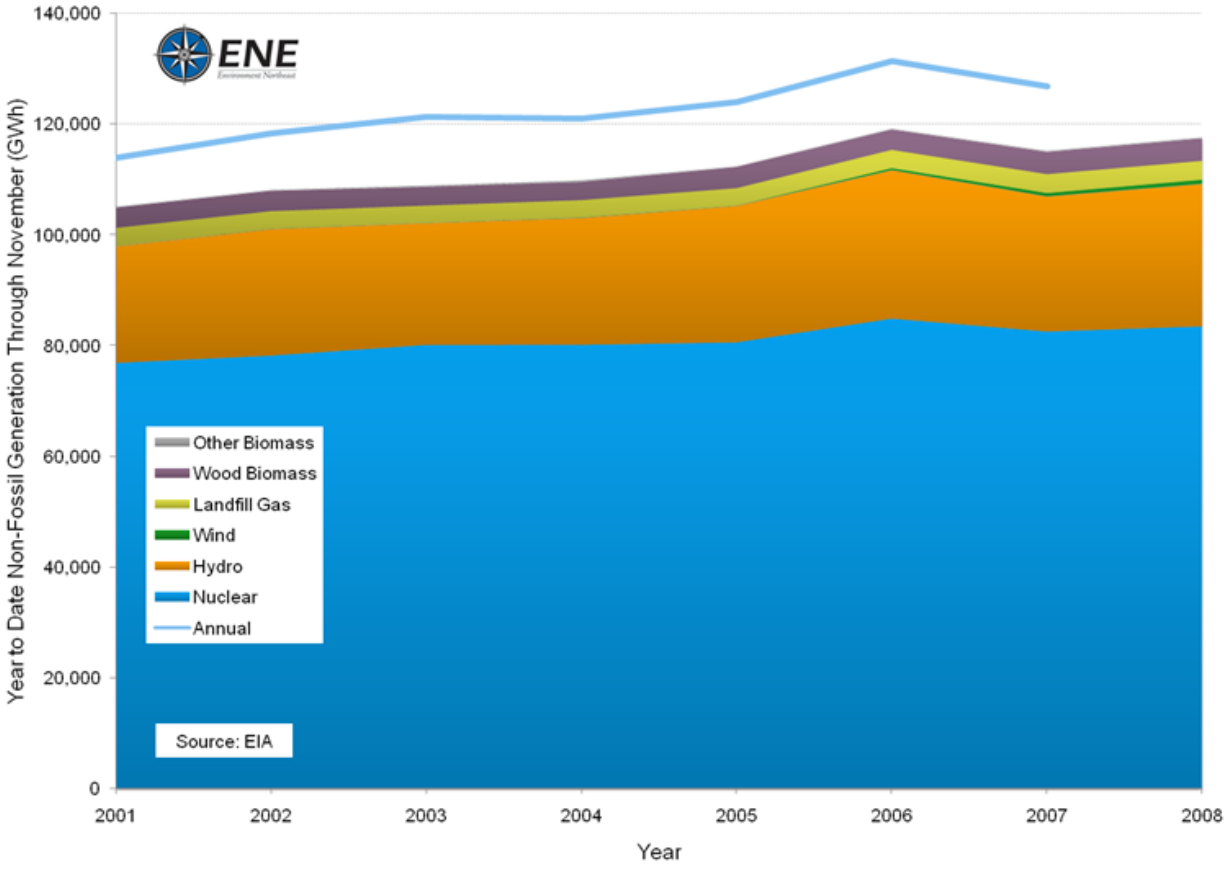
Figure 9: National Spot Prices for Residual Fuel and Natural Gas



Non-Fossil Fuel Generation

Non-fossil fuel generation affects emissions in the RGGI region by displacing electricity from fossil fuel generators and thereby reducing emissions. This is true for any non-CO_2 emitting resource including nuclear, hydro, wind, and other renewables. Recent data indicate that annual generation from hydro, wind, and nuclear increased nearly 10% between 2001 and 2007 (see Figure 11 below), and EIA predicts that nuclear generation will continue to increase in the near term.[8]

Figure 11: RGGI Region Electricity Production from Non-Fossil Sources



The net effect of a steady increase in non-fossil generation is significant. Wind generation – although small today – is growing rapidly. Investments in state-of-the-art wind facilities and aggressive renewable portfolio standards in the region will support expansion of wind, so it is likely to become a larger part of the regional resource mix. Hydro generation is also up in 2008, primarily due to increased precipitation replenishing reservoirs. Finally, nuclear generation has increased, due to both uprates (increased capacity) and higher capacity factors (increased utilization rates). Uprates approved for nuclear plants within RGGI since 2001 are adding 686 MW of nuclear power, or 0.6% of total capacity.[9]

Between 2001 and 2007 annual non-fossil generation has increased by about 15,000 GWh, which is roughly equivalent to reducing emissions by 5 million short tons of CO_2, assuming that new generation replaces natural gas on the margin. Over time, new renewables are likely to provide additional non-emitting generation, though growth in nuclear generation and even the continued operation of nuclear plants is restrained by high capital costs, regulatory uncertainty, and public concern regarding safety, lack of waste disposal sites, and nuclear proliferation risks.

Auction Dynamics

In addition to emissions trends, an analysis of supply and demand characteristics of RGGI auctions must consider perceived market value of emissions allowances. Recent developments within RGGI and at the federal level indicate that emissions constraints are assuming a central role in environmental and energy policy, and that future climate regulation will build on RGGI and likely preserve the value of RGGI allowances. The successful conduct of the first three RGGI auctions (which cleared at $3.07/ton, $3.38/ton, and $3.51/ton) removed uncertainty about auction functionality, and indicates tacit support

from regulated generators and other market participants. Beyond RGGI, the federal government is proposing ambitious emission reductions through a cap and trade system that incorporates existing initiatives, implying that RGGI allowances will maintain value into the future.

Results of the first three RGGI auctions revealed that demand for allowances was robust amongst both affected generators and other market participants. According to the market monitor report[10] prepared by Potomac Economics after the second auction:

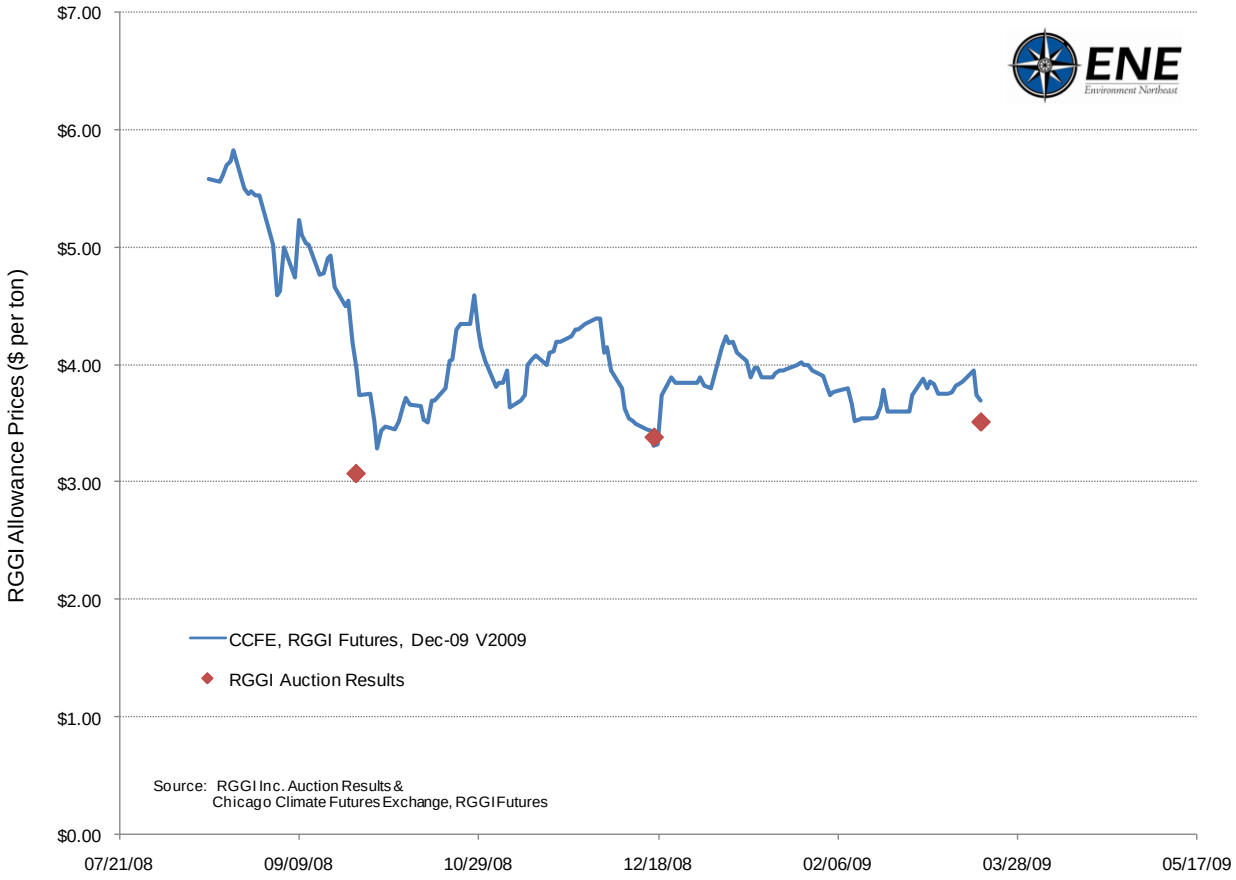
- Sixty-nine separate entities submitted bids to purchase 3.5 times the available supply of allowances.
- Generators purchased more than 80% of allowances, non-compliance entities purchased close to 20% of allowances, and participation from individuals and environmental organizations was insignificant.
- Bids ranged from $1.86 to $7.20, with a mean average of $3.03 and a median average of $3.00.
- The largest successful bid won 7,876,000 allowances at a cost of $26,620,880.

These results indicate that the regulated sector (generators) and voluntary participants have made significant investments (over $262 million to date) in RGGI allowances. Thus, market participants now have a vested interest in the continuity of RGGI and the preservation of allowance value. Additionally, generators may make investments in allowances now – while prices are relatively low – for use in future years when prices may increase or the cap may be adjusted downward.

Any new commodity market goes through an initial, and sometimes volatile, period of "price discovery" as market participants learn the systems and underlying fundamentals. There is every reason to anticipate that RGGI allowance prices may be unsettled and experience some price volatility through the first rounds of auctions.

On March 17th, 2009 RGGI futures (12/09 delivery) were trading at $3.85/ton on the Chicago Climate Exchange (CCX)[11]. The disparity between these futures prices and the second auction clearing price of $3.38/ton may reflect increasing confidence in carbon markets in general and RGGI in particular. This analysis is supported by PointCarbon's March 13th *Carbon Market North America*,[12] which reported that traders of RGGI allowances are bullish on 3rd auction results for two reasons: 1) they want to avoid over-selling in the run-up to the auction because they lost money when allowances cleared higher than expected in the 2nd auction, and 2) because they believe that RGGI allowances will be honored in federal climate legislation.

Figure 12: RGGI Futures and Auction Prices



Conclusion

Recent data indicate that 2008 emissions through September from covered RGGI units may have fallen as much as 19% below the cap. Regional emissions remain below peak levels seen in 2005, and emissions drivers such as declining electricity consumption, the relative expense of oil in comparison to natural gas, slowing economic growth, and increased non-emitting generation provide ample reason for this decline in emissions.

Lower emissions are a favorable trend, but ENE believes this trend may not continue indefinitely.

- Oil has been more expensive than natural gas and generators are correspondingly utilizing natural gas over oil – the impact of this phenomenon is surprisingly large but the relationship between oil and natural gas prices in 2009 and beyond remains uncertain.
- Electricity consumption has been stable in recent years and is now declining, primarily due to the economic downturn but also due to mild weather. This trend will likely continue if the economy does not improve; but hotter, more humid summers could drive up consumption and emissions in future years.
- Availability of wind, hydro, and nuclear is increasing. The increase in non-emitting generation will likely continue at a modest pace as more wind power comes online in the future.

ENE believes that allowance demand is driven by significant uncertainty about emissions trends over the first three year compliance period (2009-2011), confidence in RGGI's permanence and in the anticipation that RGGI allowances will hold value in a federal climate system.

Rockport, ME / Portland, ME / Hartford, CT / Boston, MA / Providence, RI /
Charlottetown, PEI, Canada
www.env-ne.org

Derek K. Murrow, Director Policy Analysis, 203-495-8224, dmurrow@env-ne.org
Peter Shattuck, Research Analyst, 617-742-0064, pshattuck@env-ne.org
Jamie Howland, Policy Analyst – Data and Energy, 860-246-7121, jhowland@env-ne.org

Environment Northeast is a nonprofit research and advocacy organization focusing on the Northeastern United States and Eastern Canada. Our mission is to address large-scale environmental challenges that threaten regional ecosystems, human health, or the management of significant natural resources. We use policy analysis, collaborative problem solving, and advocacy to advance the environmental and economic sustainability of the region.

Endnotes:

[1] Previous reports from 9/3/08 and 12/15/08 are available at: http://www.env-ne.org/projects/open/p/id/331/state/Regional%20Initiatives

[2] The RGGI region includes both the NY ISO and a portion of the PJM ISO, but data is not as readily available for these regions.

[3] Weighted temperature-humidity index (wTHI): A measure of how hot and humid a location is over a period of time relative to a base level at which air conditioning is first needed. The temperature-humidity index (THI) is computed for each day by multiplying the day's average temperature by 0.55, adding it to the day's dew point multiplied by 0.2, and adding 17.5. The base level, 65, is then subtracted, with negative values set equal to zero. The weighted temperature humidity index takes into account the past two days' weather, which also impacts cooling loads, as the third day of a heat wave typically requires more cooling than the first. The weighted figure is calculated by multiplying a day's THI by 10 and adding the two previous day's THI's multiplied by 5 and 2, respectively. Each day's weighted THI is summed to create a wTHI measure for a specified time period. Weighted temperature-humidity indices are used in energy analysis as an indicator of air conditioning energy requirements or use.

[4] March 2009 "Beige Book" reports for districts 1-3 (Boston, New York & Philadelphia) indicate declining economic activity and demand. Reports available at: http://www.federalreserve.gov/fomc/beigebook/2009/

[5] Market data for ISO New England available at: http://iso-ne.org/markets/mkt_anlys_rpts/index.html

[6] Natural gas price is for Massachusetts because EIA does not report a regional price. Given the state's central location and large consumption, prices for Massachusetts are most representative of those of the region.

[7] EIA, Appendix H of the instructions to Form EIA-1605, Available at: www.eia.doe.gov/oiaf/1605/excel/Fuel%20Emission%20Factors.xls

[8] EIA, 2008, *Annual Energy Outlook 2008 with Projections to 2030*, Available at: www.eia.doe.gov/oiaf/aeo/electricity.html

[9] Information on nuclear uprates available from EIA at: http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/power-uprates.html.

[10] Available at: http://rggi.org/docs/Auction%202%20Post_Auction_Report_Market%20Monitor_b.pdf.

[11] earth2tech.com/2008/08/18/us-cap-and-trade-launch-highlights-hurdles/

[12] Available at: http://www.pointcarbon.com/news/cmna/1.1077526

Attachment 1: Emissions Data Methodology

Data Sources

ENE compiled emissions data from two sources for this analysis. Facility-level data was collected for all power plants that report CO_2 emissions under the EPA Acid Rain Program (ARP).[1] ARP data is drawn from continuous emissions monitors at each facility and reported in short tons. ARP data was imported for the years 1995 to 2008. State-reported emissions data was obtained from the RGGI Web site[2] or through direct communication with RGGI state regulators.

All other data sources are reported within the figures.

Emissions Analysis Methods

ENE compiled RGGI facility emissions data through the following steps:

- Compiled state-reported emissions data for 2000-2006, with the exception of New Jersey, which is through 2004 only.
- Compiled a list of RGGI facility codes based on the state data tables available on the RGGI Web page (233 facilities in 10 states)
- Compiled EPA ARP data from January 2000 through June 2008 for all facilities in the 10 states
- Identified the RGGI facilities that report CO2 emissions to EPA through the ARP
- Calculated the annual changes in emissions for the RGGI facilities that report through the ARP.
- Projected the 2005-2006 state-reported emissions trend by assuming that New Jersey's emissions changed at the same rate as the rest of the region for those years.
- Projected the 2005-2007 emissions trend by assuming overall emissions for the region changed at the same rate as the emissions from RGGI facilities in the ARP program.

[1] EPA Clean Air Markets, ARP Data, Available at: http://camddataandmaps.epa.gov/gdm/

[2] Regional Greenhouse Gas Initiative (RGGI). Available at http://www.rggi.org/docs/CO2_2000_2006.xls