# RGGI Emissions Trends

June 2010

Electric sector emissions in the RGGI region are down significantly since the start of the program, and remain well below the regional cap. In order to disseminate information on emissions in the RGGI region to the market and to other interested parties, this report analyzes the drivers behind RGGI emissions trends, including fuel-switching to natural gas, non-emitting electricity generation, economic conditions & electricity consumption, 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
- 8th auction conducted on June 9, 2010
- 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:

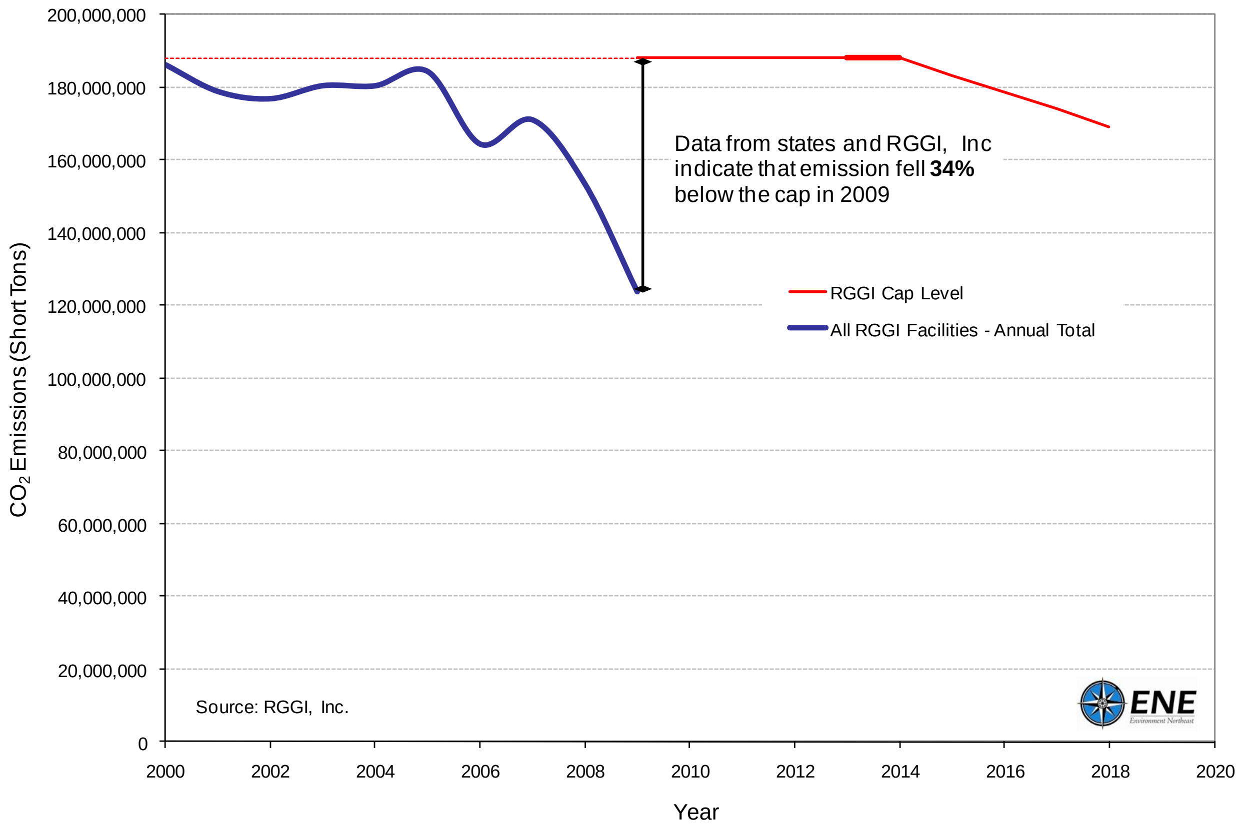
- Between 2008 and 2009 emissions decreased 9%, and total **2009 emissions fell 34% below the RGGI cap**.
- Emissions declines are primarily driven by low prices for natural gas, which emits less carbon dioxide ($CO_2$) than other fossil fuels in electricity generation. This unanticipated increase in natural gas utilization (displacing coal and fuel oil generation) demonstrates that **significant emissions reductions can be delivered rapidly and cheaply with existing infrastructure**.
- **Non-fossil generation – such as hydroelectric, wind, and nuclear power – is displacing high-$CO_2$ generation from coal and oil**, and increases in non-emitting generation will continue to reduce emissions in the years ahead.
- While the economic downturn has reduced electricity consumption and emissions over the past two years, stable electricity demand during the preceding period of economic growth (2001-2007) suggests that **the linkage between economic growth and emissions has weakened**, and an economic rebound may not increase emissions significantly.

## Emissions Data

Carbon dioxide emissions from RGGI power plants in 2009 totaled 123,718,594 tons, 9% below 2008 levels and 34% below the regional cap of 188,076,976 tons (Figure 1).

Emissions data made available by the RGGI member states and compiled by RGGI, Inc formed the basis for the analysis. Facility level data was verified for all power plants that report $CO_2$ emissions under the EPA Acid Rain Program.

**Figure 1: RGGI Facility 2009 $CO_2$ Emissions**




## Emissions Drivers

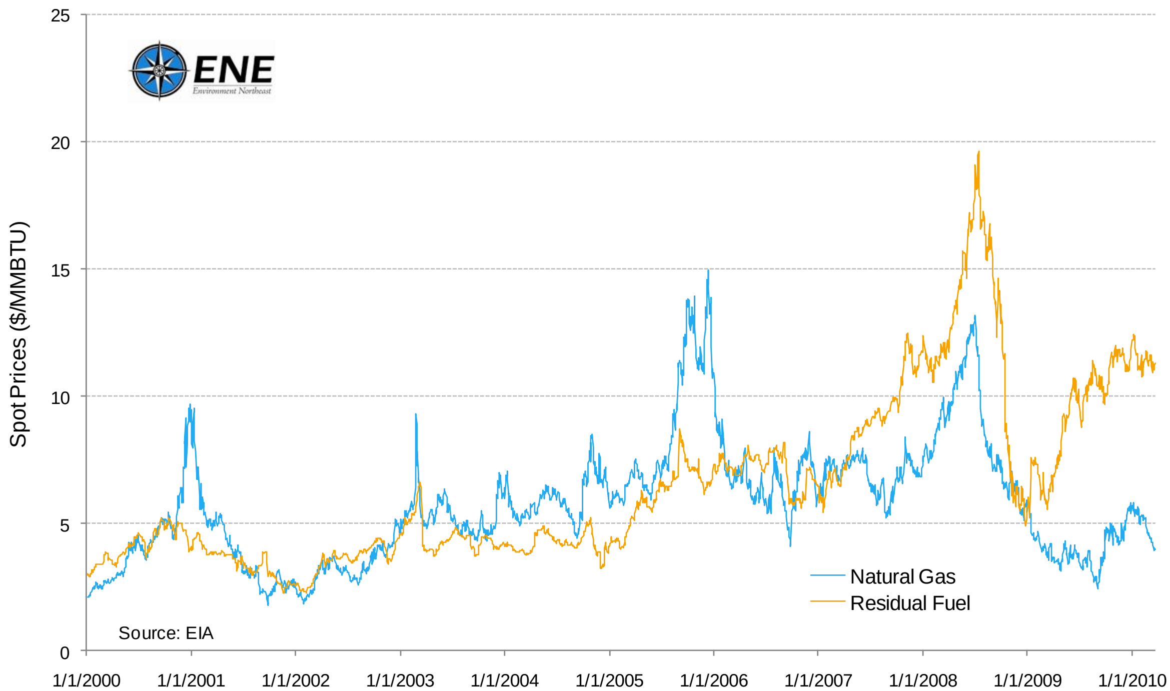
Carbon dioxide emissions in the RGGI region are driven by a number of factors, some of which are interrelated. In this report, emissions drivers are categorized under four headings:

- ***Energy Prices & Natural Gas Generation*** – describing the impact of cheap, low-emissions natural gas on the regional electricity generation mix;
- ***Non-Fossil Fuel Generation*** – describing how increased generation from renewable and nuclear sources has decreased the utilization of high-emissions coal and gas power plants;
- ***Economic Conditions & Electricity Consumption*** – describing the extent to which the recession has decreased electric demand; noting that economic growth and emissions are not as closely linked as commonly assumed; and
- ***Weather*** – describing the impact of weather conditions, (largely air-conditioning) on electricity demand and emissions.

### *Energy Prices & Natural Gas Generation*

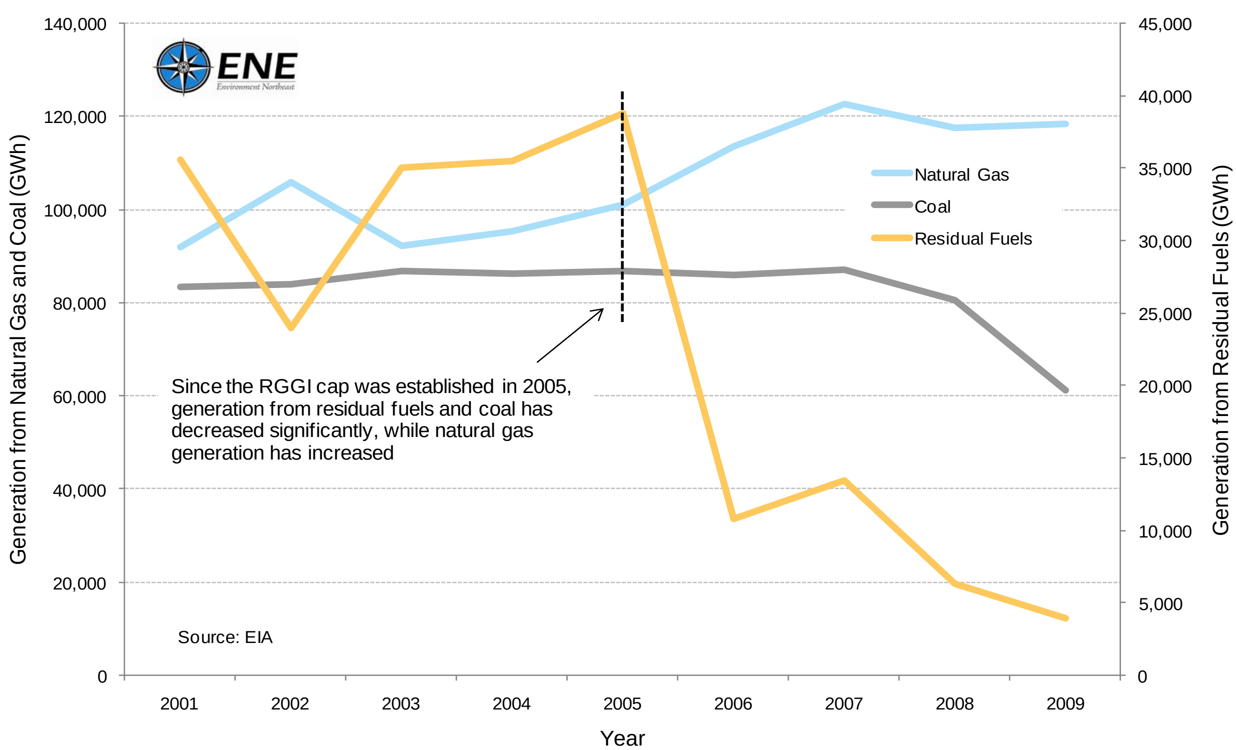
Electric sector emissions are largely determined by the type of fuel used to generate electricity, and increased utilization of low-emissions natural gas has decreased RGGI region emissions significantly. The relative prices of residual fuel and natural gas are particularly important in the RGGI region, as significant capacity exists to generate power from either fuel, facilitating the utilization of whichever fuel is cheapest. For the majority of the past 3 years natural gas has been cheaper (Figure 2).

**Figure 2: National Spot Prices for Residual Fuel and Natural Gas**




Low natural gas prices have led to decreased utilization of residual fuel and coal generation. (Coal prices vary across the region, but have generally increased since 2003, according to EIA.) In the RGGI region residual fuel generation in 2009 was down 38% from 2008 levels and 90% from 2005 levels, while coal generation decreased 24% from 2008 levels and 30% from 2005 levels (Figure 3).

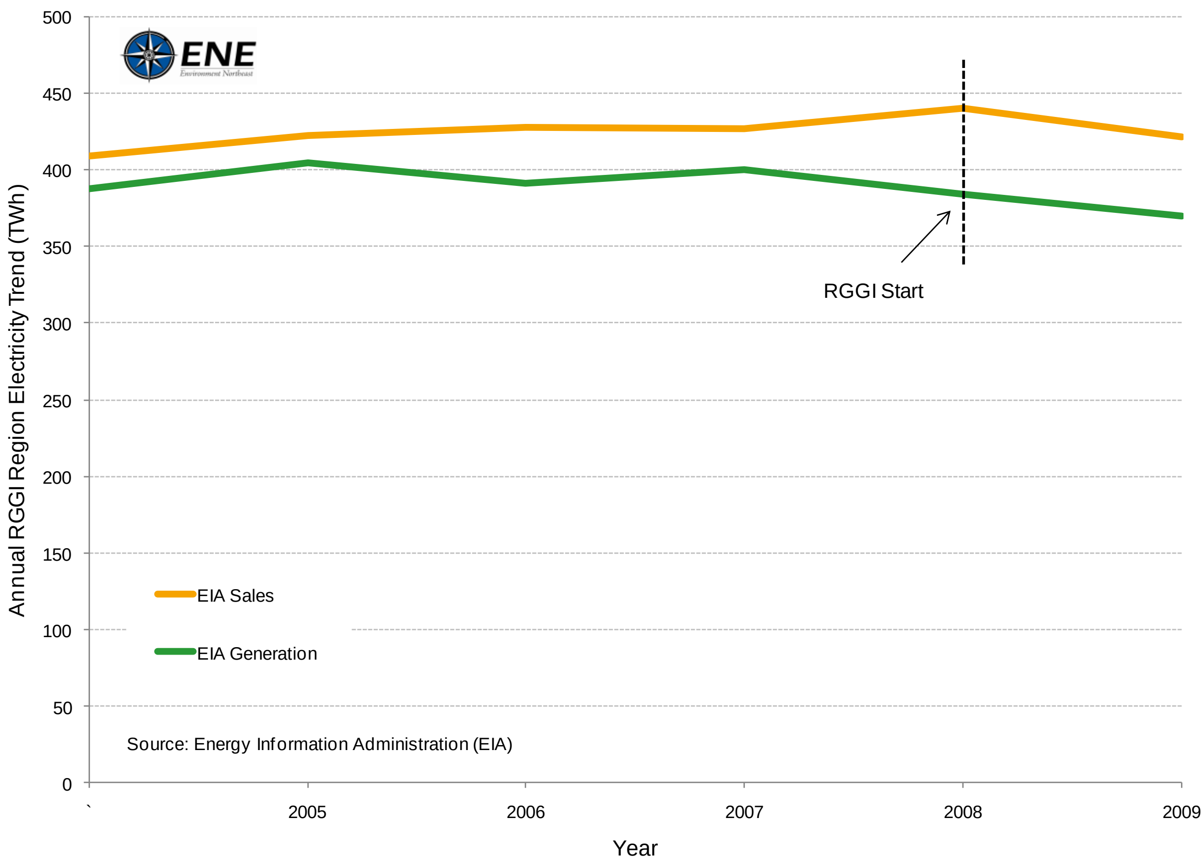
**Figure 3: RGGI Region Electric Generation from Natural Gas, Coal and Residual Fuels**



To produce the same amount of heat, natural gas emits 44% less carbon than coal and 33% less carbon than fuel oil,[1] and natural gas plants are typically more efficient. Using the average efficiency of each type of generation,[2] it can be estimated that since 2005 (when the RGGI cap was established), emissions from residual fuel and coal generation have *decreased* by approximately 65.1 million tons, while emissions from natural gas generation have *increased* by approximately 8.4 million tons, for a *net decrease* of 56.7 million tons.

The addition of RGGI allowance costs to electric generation prices does not appear to be causing leakage of emissions to generation sources outside of the RGGI region. Since RGGI began adding carbon costs to electricity prices on January 1, 2009, electricity sales have decreased by 4.4%, while generation decreased by only 3.5%, implying that electricity imports have actually *declined* since the start of RGGI (Figure 4).

**Figure 4: RGGI Region Electricity Trends**




## *Non-Fossil Fuel Generation*

Non-fossil fuel electricity – including nuclear, hydro, wind, and other forms of renewable energy – is displacing fossil fuel generation and reducing emissions across the region. Data indicate that non-fossil fuel generation increased 4.1% from 2008 to 2009, and has risen 15% since 2001 (Figure 5).

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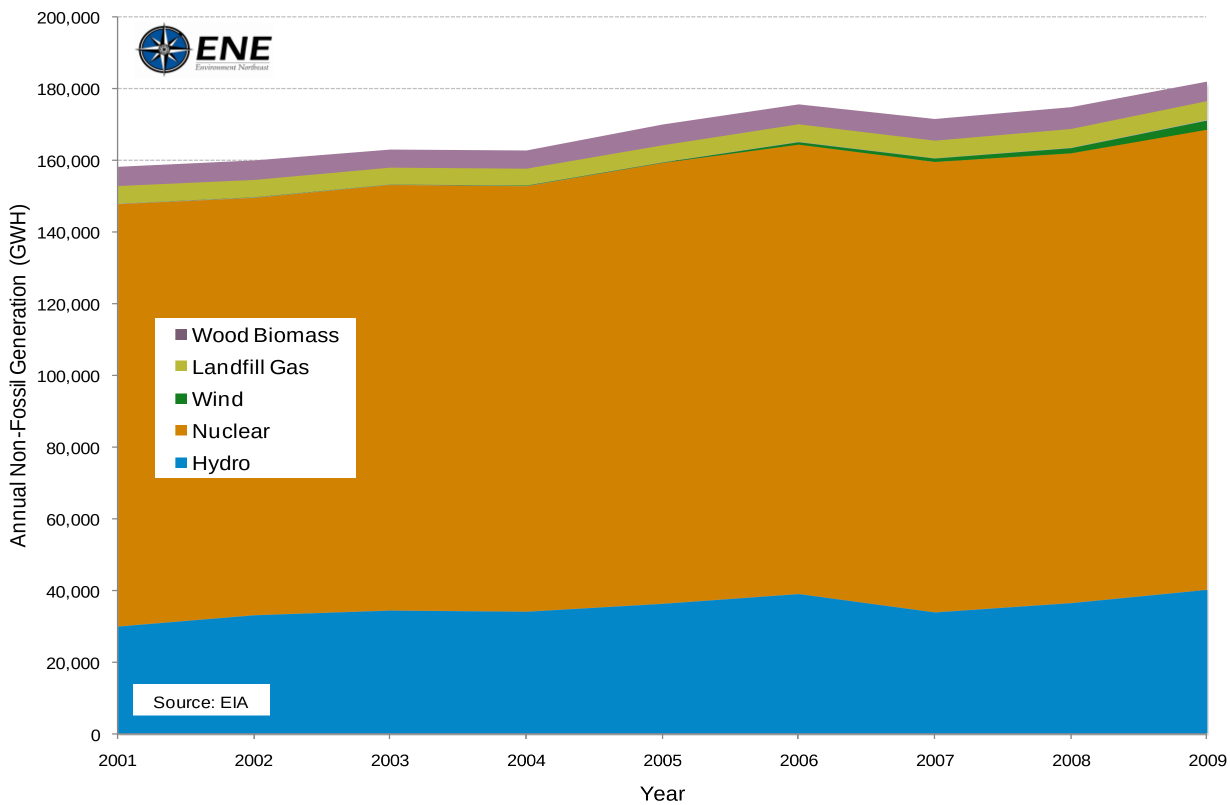
[1] Carbon emissions factors for natural gas (117.0 lbs $CO_2$/MMBtu), residual fuel oil (173.7 lbs $CO_2$/MMBtu) and coal (210.0 lbs $CO_2$/MMBtu) from EIA: www.eia.doe.gov/oiaf/1605/excel/Fuel%20Emission%20Factors.xls

[2] EIA average operating heat rate for natural gas (8,305 Btu/kWh), residual fuel (11,015 Btu/kWh) and coal (10,387 Btu/kWh) available at: http://www.eia.doe.gov/cneaf/electricity/epa/epat5p3.html

**Figure 5: RGGI Region Electricity Production from Non-Fossil Sources**




Between 2001 and 2009 annual non-fossil generation in the RGGI region has increased by over 23,800 GWh, with about 12,400 GWh of generation coming online since 2005. Of this 12,400 GWh of new non-fossil generation, 3,900 GWh came from hydroelectricity, 2,500 GWh came from wind, 5,500 GWh came from nuclear, and 500 GWh came from landfill gas. This non-emitting generation is displacing coal- and oil-based electricity, and is another significant driver behind emissions declines in the RGGI region.[3]

The expansion of non-emitting generation appears likely to continue in years ahead. The Federal Energy Information Administration (EIA) predicts that renewable and nuclear generation will continue to increase nationwide in the near term.[4] Additionally, all 10 RGGI states have Renewable Portfolio Standards that require electric utilities to procure increasing quantities of renewable electricity, ensuring continuing growth of renewable generation in the region.[5]

## *Economic Conditions & Electricity Consumption*

Economic conditions and electricity consumption are significant drivers of RGGI region emissions, but stable electricity demand during recent periods of economic growth suggests that emissions may remain low even as the economy recovers from its recent downturn. Electricity demand has historically been tied to economic growth, with electricity consumption – and related emissions – increasing during

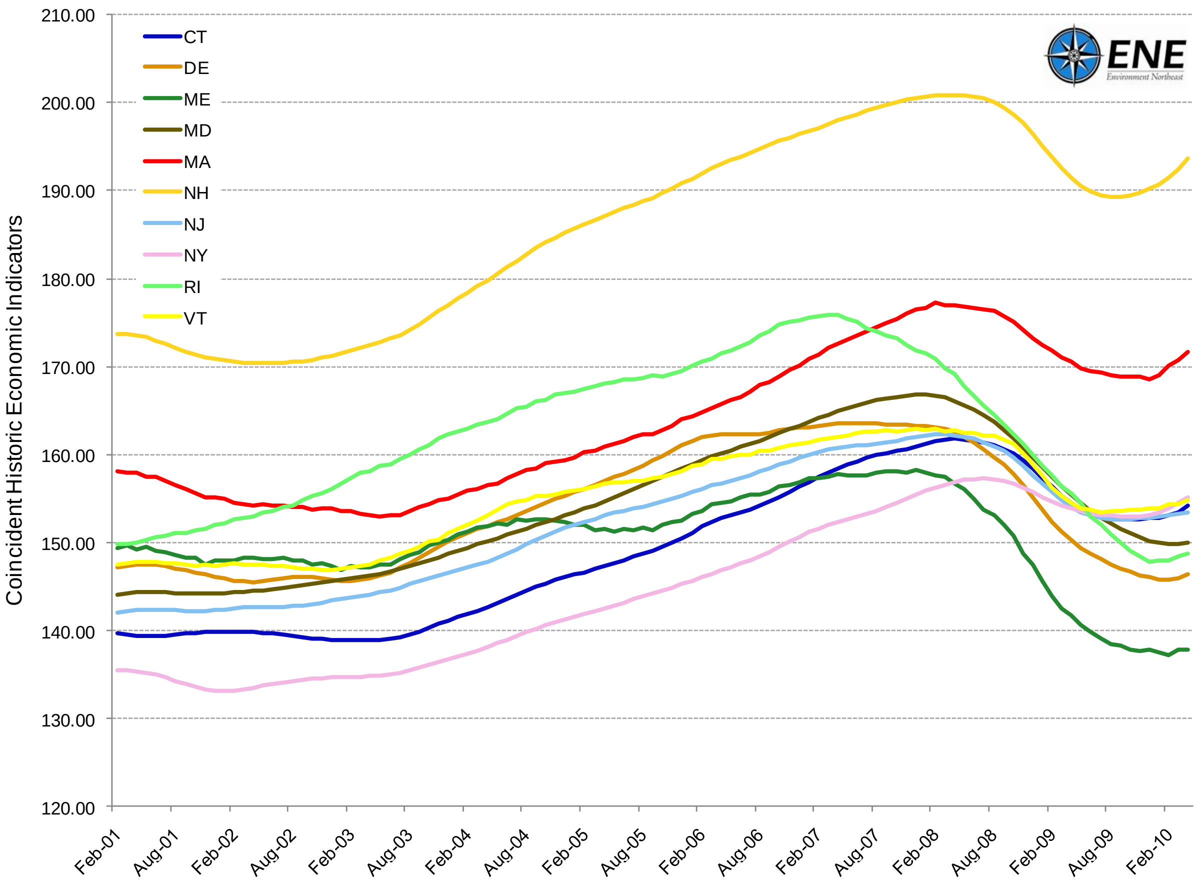
[3] Based a weighted average of emissions intensity for oil and coal generation coming off line since 2005, in 2009 this non-emitting generation avoided approximately 12 million tons of $CO_2$ that would have been emitted to produce an equivalent amount of electricity from oil and coal.

[4] EIA, 2010, *Annual Energy Outlook 2009 with Projections to 2030*, Available at: www.eia.doe.gov/oiaf/aeo/overview.html

[5] For additional information on State Renewable Energy Portfolios see the Department of Energy's EERE State Activities & Partnerships, Available at: http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm

periods of economic expansion, and decreasing in economic downturns. RGGI region economies expanded for the majority of the last decade, with the economic downturn reversing this trend in 2008-2009, as evidenced by coincident indexes from the Federal Reserve Bank of Philadelphia (Figure 6).[6]

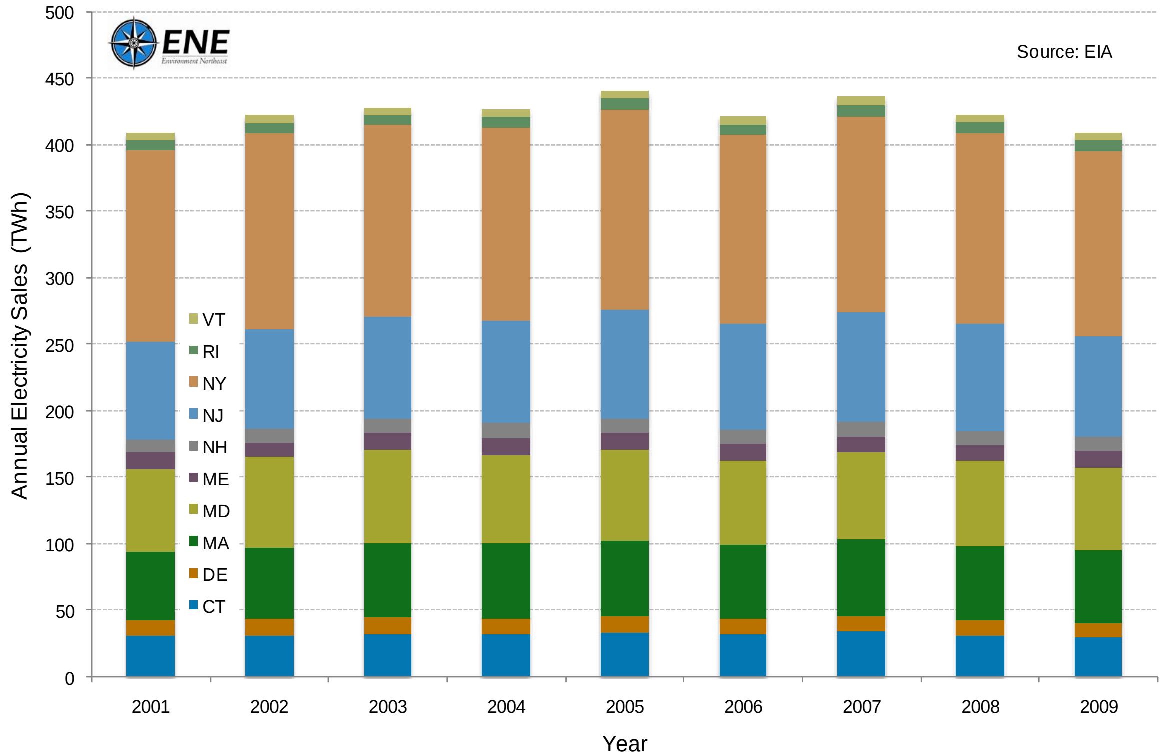
**Figure 6: RGGI Region Economic Conditions**




While the economic downturn (and attendant decrease in electricity consumption) likely contributed to emissions declines, the direct link between economic growth and increases in electricity consumption and emissions appears to be weakening. Electricity consumption increased only slightly in the early part of the decade, and remained stable during the economic growth period from 2003-2007 (Figure 7). This suggests that improved energy efficiency and successful energy savings programs may have broken the link between economic growth and emissions growth. While the extent of this trend remains unclear, emissions may remain low when the economy recovers, as efficiency investments increase and low- or non-emitting generation supplies an increasing portion of the regional energy mix.

[6] See: http://www.philadelphiafed.org/research-and-data/regional-economy/indexes/coincident/

**Figure 7: RGGI Electricity Consumption**



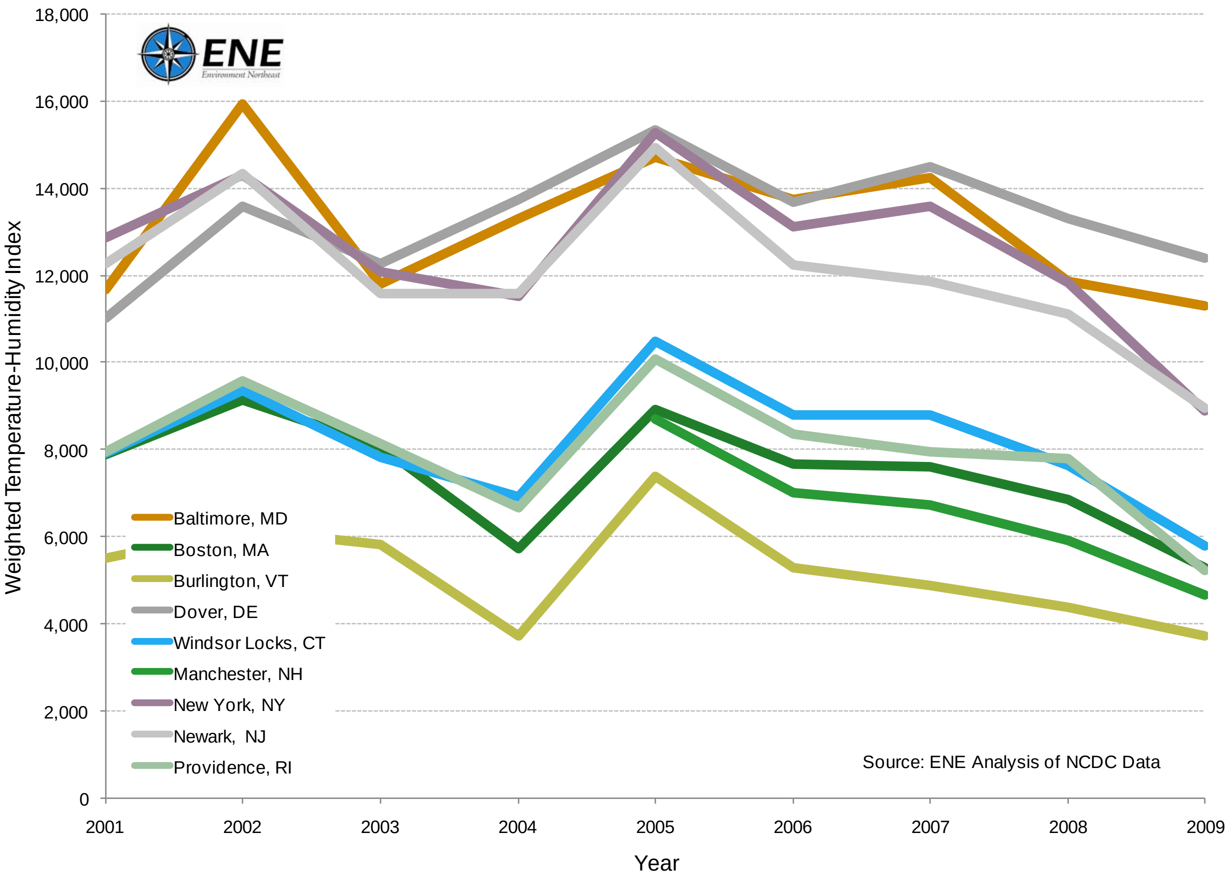

### *Weather*

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 (THI) to gauge the impacts of weather on electricity consumption and emissions. Over the past three years the THI has decreased across the RGGI region (Figure 8).

Milder summers have decreased demand for air conditioning, thus reducing electricity demand and emissions. An increase in hot, humid summer weather could increase emissions, but the expansion of successful demand-response programs[7] suggests that the impact of hot weather on emissions may be declining.

[7] Demand-response programs pay customers (usually large commercial and industrial electricity consumers) to reduce energy consumption when demand peaks (typically during heat waves), thus avoiding the need to switch on expensive, inefficient "peaker" units. For additional information on demand-response programs see: http://www.oe.energy.gov/demand.htm

**Figure 8: RGGI Weighted Temperature-Humidity Index**




## Conclusion

RGGI emissions have decreased significantly due to cheap natural gas, increased non-emitting generation, more efficient use of electricity, and – to a lesser extent – economic trends and mild summer weather. The significant emissions decline in the RGGI region suggests that fundamental shifts in the power sector may mean low emissions are here to stay for the foreseeable future.

***For Further Information:***

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