Emissions from power plants in the Regional Greenhouse Gas Initiative (RGGI) increased slightly in 2010, but remained well below the regional emissions cap. The 2010 increase was due primarily to a hotter summer and higher electricity demand for air conditioning. The persistence of low 2010 emissions in relation to the cap was a consequence primarily of fuel-switching to natural gas, increased generation from non-emitting sources, stable electricity consumption, and weak economic conditions in the region.

Summary of Key Findings:

- Between 2009 and 2010 emissions increased 10.9%, but total 2010 emissions remain 27% below the RGGI cap.

- Emissions declines are primarily driven by low prices for natural gas, which emits less carbon dioxide (CO₂) 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-CO₂ generation from coal and oil, and increases in non-emitting generation will continue to reduce emissions in the years ahead.

- While the economic downturn, along with expanding energy efficiency program investments, have 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 the economic rebound may not increase emissions significantly.

Emissions Data
Carbon dioxide emissions from RGGI power plants in 2010 totaled 137,174,260 tons, a 10.9% increase from 2009 levels (123,718,594 tons) but remained 27.1% 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 through the CO₂ Allowance Tracking System (RGGI-COATS), formed the basis for the analysis.¹

¹ Emissions data available at: [https://rggi-coats.org/eats/rggi/](https://rggi-coats.org/eats/rggi/), “Public Reports”. Three facilities listed incomplete data for 2010: Devon (CT), AES Greenidge (NY), and Project Orange Facility (NY). Devon and AES Greenidge list higher emissions in the incomplete 2010 quarter than in corresponding 2009 quarter, and the incomplete 2010 data was used to provide a conservatively high estimate of 2010 emissions. In the absence of any data from Project Orange Facility in
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.

2010 q4, 2009 q4 data was used. In total, emissions from these three plants comprised 0.5% of RGGI emissions in 2009, and as such inconsistencies should not affect final 2010 emissions significantly.
**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 5 years natural gas has been significantly lower priced (Figure 2).

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

![Figure 2: National Spot Prices for Residual Fuel and Natural Gas](image_url)
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 2010 was down 46% from 2009 levels and 95% from 2005 levels, while coal generation increased 2% from 2009 levels, yet decreased 30% from 2005 levels (Figure 3). Meanwhile, natural gas generation continued to increase in 2010, up 18% from 2009 levels and up 35% from 2005.

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

Fuel switching from coal and oil to lower-carbon natural gas has had a significant impact on regional emissions. To produce the same amount of heat, natural gas emits 44% less carbon than coal and 33% less carbon than fuel oil, and natural gas plants are typically more efficient. Using the average efficiency of each type of generation, it can be estimated that since 2005 (when the RGGI cap was established), emissions from residual fuel and coal generation have decreased by approximately 67.2 million tons, while emissions from natural gas generation have increased by approximately 17.4 million tons, for a net decrease of 49.8 million tons.

2 Carbon emissions factors for natural gas (117.0 lbs CO₂/MBtu), residual fuel oil (173.7 lbs CO₂/MMBtu) and coal (210.0 lbs CO₂/MMBtu) from EIA: www.eia.doe.gov/oiaf/1605/excel/Fuel%20Emission%20Factors.xls
3 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
**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).

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

Between 2001 and 2010 annual non-fossil generation in the RGGI region has increased by over 18,500 GWh, with about 6,700 GWh of generation coming online since 2005. Of this 6,700 GWh of new non-fossil generation, 3,240 GWh came from wind, 3,890 GWh came from nuclear, and 700 GWh came from landfill gas. Some of the increase in non-emitting generation was offset by a 3,850 GWh decline in hydro output in from 2009 to 2010, which contributed to higher 2010 emissions. However, overall trends in recent years show that non-emitting generation is generally displacing fossil-based electricity, and is another driver behind emissions declines in the RGGI region.4

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, in addition to natural gas generation.5 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.6

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4 Based a weighted average of emissions intensity for oil and coal generation coming off line since 2005, in 2010 this non-emitting generation avoided approximately 6.8 million tons of CO₂ that would have been emitted to produce an equivalent amount of electricity from oil and coal.


6 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](http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm)
**Overall Generation Trends**

Electric generation in the RGGI region has reduced in carbon intensity over the last 5 years, due to increased generation from natural gas, nuclear, and renewable sources and decreased output from higher-carbon coal and residual fuel plants (Figure 6). With the exception of steady, incremental growth in wind capacity, this decline in electric sector emissions has occurred without the addition of significant new capacity or capital expenditures. This low-cost transition to lower regional emissions suggests that decreasing emissions may be far more cost-effective than commonly assumed.

**Figure 6: RGGI Generation by Fuel Type**
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 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 7).

Figure 7: RGGI Region Economic Conditions

See: http://www.philadelphiafed.org/research-and-data/regional-economy/indexes/coincident/
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 8). 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.

Figure 8: RGGI Electricity Consumption

![Figure 8: RGGI Electricity Consumption](image-url)
**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.

The summer of 2010 was more hot and humid than the last several years (Figure 9).\(^8\) Hotter, more humid weather increased demand for air conditioning, thus increasing electricity demand and emissions.

**Figure 9: RGGI Weighted Temperature-Humidity Index**

\(^8\) 2010 weather data from Delaware was unavailable at the time of publication.
Emissions Leakage

The addition of RGGI allowance costs to electric generation prices does not appear to be causing significant 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 increased by 0.2%, while generation decreased by only 0.7%. In 2009 – when RGGI allowance prices were higher – sales were down 4.4% from 2008 levels while generation was down 3.5%, indicating a modest decrease in imports before the modest increase in 2010 (Figure 10).

Figure 10: RGGI Region Electricity Trends

![Figure 10: RGGI Region Electricity Trends](image)

Conclusion

Due primarily to a hot and humid summer, 2010 RGGI emissions increased from 2009, but remain well below the regional cap due to low cost 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 lower emissions are here to stay for the foreseeable future.

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