**Should Virginia Join the Regional Greenhouse Gas Initiative?**

By Lena Lewis

**Abstract:** Climate change models predict that Virginia will face rising sea levels and increased flooding along the coast, as well as droughts and heat waves across the state. The damage caused by climate change will have negative economic and ecological impacts. In spite of this prognosis, Virginia has no statewide policy to reduce greenhouse gases that cause climate change. Virginia could effectively lower its carbon emissions by joining the nine other states that are currently members of the Regional Greenhouse Gas Initiative (RGGI). RGGI is a carbon cap-and-trade program that puts a price on carbon dioxide emitted by power plants.

States participating in RGGI have decreased their carbon emissions and generated new revenue to fund programs in energy efficiency and renewable energy. Virginia could save administrative costs by joining RGGI, because the program has already been carefully planned and successfully implemented elsewhere, instead of starting our own statewide initiative. Joining RGGI would not noticeably decrease the impacts of climate change for Virginia, but it would signal to other states and nations that Virginia is doing its part to reduce the severity of climate change. Virginia should be part of the collective worldwide action needed to achieve deep cuts in greenhouse gas emissions, so we can collectively benefit from diminished climate disruption.

**Introduction: Virginians Will Pay the Price for Climate Change**

Virginia is just beginning to experience the effects of the market failure that results from our fossil-fuel driven economy. Climate change will cause some regions of Virginia to experience drought, more severe storms, and heat waves (Nash, 2014). Alteration of our ecosystems will lead to the extinction of some species. A warmer climate will allow mosquitos, ticks, and other parasites to spread disease more easily in Virginia, increasing our healthcare costs and decreasing worker productivity. The Hampton Roads region is acutely aware of the cost of climate change caused by the "business-as-usual" burning of fossil fuels. Hampton Roads is ranked second in the country, beat only by New Orleans, as most vulnerable to sea level rise (Center for Sea Level Rise, n.d.). By the end of the century, sea levels in the Chesapeake Bay region are projected to rise anywhere from 1.3 to 5.5 feet (Nash, 2014). Neighborhoods, industry, and critical infrastructure are vulnerable to increased risk of damage from storms and rising sea level. Citizens affected by climate change will need a source of revenue to pay for repairs and relocation. To avoid the worst effects of climate disruption in Virginia, the worldwide rate of greenhouse gas emissions must be drastically reduced. Virginia can make a persuasive case to the rest of the world to reduce greenhouse gas emissions only if Virginia also takes steps to dramatically reduce our own.

The market failure of a fossil-fuel-based economy lies in the negative externalities of producing and burning fossil fuels. This paper focuses on the externalized damages of carbon emissions. Though these remarks address only carbon emissions, efforts to reduce carbon emissions are likely to reduce other negative externalities of fossil fuel use, such as polluted water, leveled mountains, deforestation, and acid rain. Virginians pay a steep price for fossil fuels that is not reflected in the dollars spent.

Virginians cannot conquer climate change alone, nor can we expect others to take the steps we ourselves are

unwilling to take. Virginia must show leadership in mitigating climate change so that others will join. So far, Virginia has made the decision not to substantively reduce greenhouse gas emissions. The opportunity to change our approach is still available. We can accept the impacts of accelerating climate change on our communities and our economy, or we can take action to slow climate change down.

Virginia needs to alter our pricing of fossil fuels to reflect the true social cost of carbon emissions. One way to achieve this is to incorporate the cost of carbon emissions into the price of electricity. Virginia could join the Regional Greenhouse Gas Initiative (RGGI) as a way to put a price on carbon pollution. RGGI is a voluntary agreement among nine northeastern states to limit carbon emissions from power plants using the proven cap and trade approach. Now in its seventh year, RGGI has successfully decreased the participating states' power sector carbon emissions by 45 percent from 2005 levels without inhibiting economic growth in those states. This paper evaluates the efficacy of RGGI and its potential as a mechanism for Virginia to cost-effectively reduce its carbon pollution.

**Current Renewable Energy Policies in Virginia**

Virginia currently has no substantive policy to reduce carbon emissions. Unlike many states, Virginia lacks a renewable portfolio standard, mandating that a certain percent of the Commonwealth's electricity be generated using renewable energy (Richardson, Baille, & Cleetus, 2016). Virginia's policies to make renewable energy projects more affordable for residents and small businesses include tax breaks for materials, a Property Assessed Clean Energy Loans program (PACE), and subsidies to cover interest on renewable energy project loans (§ 58.1-3661; § 58.1-3508.6; "Law Amends" 2015; "Sustainable Energy," n.d.). All told, these incentives make small projects more affordable for individual homeowners, but do not significantly change the energy portfolio of the state. Joining RGGI's carbon cap-and-trade program would be the first comprehensive industry-wide step towards reducing Virginia's carbon emissions.

**How the Regional Greenhouse Gas Initiative Works**

The nine states of the cooperative RGGI are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. They have set a cap on carbon emissions from power plants with capacities of at least 25 Megawatts. RGGI states sell one allowance for each short ton of carbon emissions through a quarterly auction. At the end of a three-year control period, power plants must turn in one allowance for each ton of CO2 emitted, or pay a penalty. The auction is a "sealed-bid uniform price format" in which participating power plants submit confidential bids for a certain number of allowances (Ramseur, 2013). The price of the second highest bid becomes the clearing price that all bidders must pay. In a simplified example, if RGGI had 100 allowances to sell to 3 firms, suppose Firm A put in a bid of $5 per allowance for 50 allowances, Firm B bid $3 each for 30 allowances, and Firm C bid of $2 for 40 allowances. The clearing price would be set to $3 for all buyers. Firm A would buy 50 allowances, Firm B would buy 30, and Firm C would only be able to buy the 20 remaining balances.

RGGI decreases carbon emissions below established levels by lowering the cap over time. Special provisions have been built into RGGI to prevent prices from going too low or too high and to insure the program does decrease carbon emissions. Firms can buy allowances and bank them for the future. RGGI also allows carefully defined and monitored offset programs to account for a small percent of carbon allowances. These offset programs include afforestation, reduction of landfill gas leakage, and projects that either sequester or limit emissions of greenhouse gases (RGGI, Inc., 2016). No offsets have been used to date (W. Shobe,

personal communication, Feb 12, 2017).

According to the fundamental principles of environmental economics, the most efficient way to reduce emissions from multiple sources is to have firms reduce their emissions until they all achieve equal marginal cost of abatement (MCA). A functioning cap-and-trade system allows firms to reach this point through the bidding process. A firm that has an MCA below the cost of one allowance will reduce its emissions rather than buy more allowances. As it reduces its emissions, its MCA increases. The firm will cease further emissions reductions once the MCA equals the price of allowances. A second firm that has a very high MCA will buy allowances until the MCA of its allowed emissions equals the price of allowances. This firm will have an incentive to find cheaper ways to reduce its emissions so that it can spend less money buying allowances.

Another principle of environmental economics states that maximum efficiency is achieved when the marginal cost of abatement equals the marginal cost of benefits to society. In other words, the marginal cost of abatement should not exceed the marginal societal value of the benefits resulting from the abatement. The federal government has placed the current working value of the social cost of carbon at approximately $40 per short ton of carbon emissions (EPA, 2017). At the time of this writing, the RGGI auction clearing price was $4.54 per short ton of carbon emissions, with the highest price reaching $7.50 in December, 2015 (RGGI, Inc., 2016). The price of allowances is substantially lower than the social cost of carbon, which means that emitters are still paying less than is needed to make the deep cuts in emissions needed to reach globally optimal levels. The cap is being lowered slowly at 2.5 percent a year, giving electricity producers time to adjust their methods and avoid a price shock. The slow pace of cap reduction also means that polluters are not paying enough to counteract the full social cost of carbon. This essentially means that RGGI states are still externalizing part of the social cost of fossil-fuel generated electricity.

**Advantages of RGGI**

RGGI generates a new source of revenue for participating states. Projections suggest that Virginia could generate $2.8 billion through 2030 by joining RGGI (Acadia Center, 2015). Under the Memorandum of Understanding among participating states, the original participating states agreed to spend at least 25 percent of the new revenues on "consumer benefit or strategic energy purpose[s]" (MoU, 2005, p. 12). This portion of allowance revenues is invested in projects that improve energy efficiency, increase clean energy, or otherwise reduce emissions. Since the beginning of RGGI, states have exceeded the 25 percent goal, using 65 percent of their revenues for energy efficiency (Ramseur, 2013). Investing revenues in projects that reduce carbon emissions make further cuts in carbon emissions possible in the future. RGGI, Inc., the nonprofit organization that runs the auctions, asserts that the benefits of energy efficiency do not only help those people who have more energy-efficient homes. These homes reduce the demand for electricity, which causes prices to decrease for all electricity customers. Homeowners spending less money on electricity will have more money to spend on other sectors of the economy ("Fact Sheet" 2016.). New York State's renewable energy returns on investment were $3-4 dollars per dollar invested (RGGI, Inc., 2016). As new types of efficiency and clean energy programs are developed, they potentially create more jobs. The Renewable Energy Policy Project calculated that investing $1 million in renewable energy creates around 6 full-time manufacturing jobs plus other jobs in construction and maintenance (RGGI, Inc., 2016).

By joining RGGI, Virginia would not have to start a new emissions reduction program from scratch. Other states have already done considerable work in creating the program and demonstrating its proof of concept.

Virginia can save a lot of time and administrative costs by joining this successful program.

**The Environmental Benefit of Virginia Joining RGGI Alone is Negligible**

From Virginia's perspective, the direct climate benefits of joining RGGI will be very small. The reduction in Virginia's emissions will be evenly distributed over the planet because carbon emissions mix uniformly into the global atmosphere. The direct environmental benefit to Virginia of our own reduced carbon emissions will be negligible. The rationale for action by a single state must arise from the power of numbers; Virginia is not alone in RGGI, but will be joining 9 other states, whose aggregate emissions rank among the top 20 nations (Ramseur, 2013). At the time of this writing, 134 countries have ratified the Paris Agreement ("Paris Agreement - Status of Ratification," n.d.). If countries stick to their commitments, we may reach the goal of holding climate change to only a 2ºC increase in the planet's average temperature by the end of the century. This would limit sea level rise in the Hampton Roads region. It would reduce the chance of ecological disturbances throughout Virginia, and reduce the severity of climate disruption to our local agricultural and fishing industries. Taken together, and only taken together, worldwide reduction of carbon emissions will benefit Virginians. If we want those benefits, we need to take part in the worldwide efforts. Expanding RGGI is one substantive method to reduce climate change.

**How VA Could Join RGGI**

Changes to Virginia law would be required to authorize joining RGGI. Virginia's cap would initially be set at the level of expected emissions for the first year of participation, and decrease by 2.5 percent for each subsequent year. This cap would be added to the current RGGI cap to create a combined emissions cap for all RGGI states. Virginia would then be a partner to the multi-state Memorandum of Understanding and would participate in and be subject to the results of future program reviews.

Virginia's Department of Environmental Quality or Department of Energy would need to add administrative staff positions to oversee RGGI within the state and to manage the revenue brought in through allowance sales. The Department of Energy's primary goal is to "advance sustainable energy practices and behaviors" (Division of Energy, n.d.). Virginia's Department of Environmental Quality would provide allowance verification, and a third party would need to provide allowance verification as well (Center for Climate, n. d.). Virginia would also need to pay dues to RGGI, Inc. to run the auction. Maryland's FY 2015 data can provide an example of budget expectations. Maryland spent $5.7 million of its RGGI revenues on administrative costs of the Energy Administration. This may sound sizeable, but it is small in comparison to the to the almost $78 million Maryland raised in RGGI allowance auctions in 2015. Maryland paid approximately $457,000 in RGGI dues in 2015 (Maryland Energy Administration, 2016).

**Monitoring**

One of the strengths of joining RGGI is that the EPA already collects data on the carbon emissions from power plants for RGGI (EPA FLIGHT, 2016). RGGI COATS is the RGGI CO2 Allowance Tracking System platform that records data for each state's carbon allowances and compliance (RGGI, Inc., n. d.).

The RGGI cooperative has a periodic review to make adjustments as necessary, and has already used it to good effect. In 2012, after several years in which states' emissions were below the cap level and allowances were being sold at the floor price, members of RGGI lowered their 2014 cap from an initial level of 165

million tons $CO_2$ down to 91 million tons $CO_2$ (Ramseur, 2013). They decided to keep their original plan of decreasing the cap by 2.5 percent each year until 2020. RGGI states also decided not to save the unsold allowances from previous years. A 45 percent cap reduction in a single year sent a strong signal that RGGI states were serious about making sure that RGGI functions as intended. These adjustments show that RGGI has the ability to be responsive to market conditions.

**Addressing Stakeholder Concerns**

RGGI's design has many elements to address the concerns of stakeholders. Some of the major stakeholders in climate change policy are power companies, consumer advocacy groups, environmentalists, social justice groups, and fiscal conservatives. Virginia power company executives can look to the experience of power companies in the RGGI region, who were able to recover the cost of allowances in the 2012-2014 period (Hibbard, Okie, Tierney, & Darling, 2015). A Cost Containment Reserve of allowances is available for purchase if the clearance price rises to a predetermined level (Ramsuer, 2013). This trigger price increases each year so power plants can adjust to the slowly increasing price of emission allowances. Utility companies will not be able to avoid the loss of revenue as customers' energy efficiency improves, and power plants dependent on coal will lose money.

Consumer advocacy groups can take heart that additional electricity costs to consumers will be minimal. In Maine, electricity customers pay an extra $0.0024 per kilowatt hour, which translates to an extra $1.27 per month for the average residential consumer (Griset, 2015). Overall, consumers have benefitted from reinvestment of some of the RGGI revenue into energy efficiency programs. Though electricity prices increased at first, consumers in the RGGI region collectively saved $459 million by the end of 2014 (Hibbard, et al., 2015). Hibbard, et al. explain that these savings occurred through reinvestment of RGGI revenue into energy efficiency.

Environmental advocates and social justice groups will appreciate the RGGI requirement that states use at least 25 percent of revenues to support energy efficiency or clean energy projects. Those projects can include assistance to low-income households to make their homes more energy efficient and can make renewable energy installments more affordable to residents and small business owners. RGGI funds have also been used to cover energy costs for low-income residents. Most of all, environmental advocates will support a program that decreases carbon emissions from the power sector by 45 percent in just seven years.

RGGI states have developed a variety of creative clean energy and energy efficiency programs to address the particular needs of their residents. As previously mentioned, states chose to exceed the minimum requirement for use of RGGI funds for clean energy projects. Economic modeling for Maryland indicates that the state would benefit from the reinvestment of up to 100 percent of RGGI revenue into emission reduction programs (Paul, et al., 2010). Investment in emission reduction programs causes further decrease in emissions, but it would benefit the Maryland economy and create jobs. By 2014, RGGI states had invested over $1.3 billion of auction proceeds in energy efficiency, clean energy, greenhouse gas abatement, and other measures that would further reduce emissions (RGGI, Inc., 2016). RGGI, Inc. estimates a return of $4.67 billion on investments in emissions reductions, which benefits both the economy and the environment.

Fiscal conservatives will object to RGGI as a new form of revenue for Virginia. Though a new form of revenue will be created, it could be used to offset the cost to consumers through reduction in income taxes or a return of a dividend to tax payers, making the RGGI revenue-neutral (Burtraw, Sweeny, and Rawls, 2009).

One criticism of a cap-and trade system is that the resulting increased energy costs will have a greater negative effect on low-income consumers because a higher percent of their income is spent on energy. A dividend split evenly among all Virginians would ensure that the impact of RGGI is progressive, because the dividend returned to low-income consumers will offset a larger percent of their energy costs than for high-income consumers. (Boyce & Riddle, 2007). Making revenue recycling part of the proposal to join RGGI could make the proposal more attractive to "small-government" conservatives while also appealing to low-income voters.

Finally, environmentalists may object that RGGI does not go far enough to capture all sources of greenhouse gas emissions. Only 22 percent of greenhouse gas emissions in RGGI states are covered by the RGGI cap (Ramseur, 2013). If high auction prices cause an increase in electricity prices, Virginians will find substitutes to heat their homes that may cause emissions of their own, such as natural gas. Requiring allowances only for large power plants will cause residents to purchase more appliances that use natural gas instead of electricity. Fortunately, the design of RGGI gives it the capacity to expand to cover more sources of carbon emissions. The Progress Review of 2012 demonstrated states' abilities to make major revisions to caps and safety valves. Over time, RGGI could be used to cover not only all power suppliers, but all sources of greenhouse gas emissions, including transportation fuel, home heating fuel, and landfills.

**Emissions Leakage**

The power grid is set up across state boundaries, allowing power distributors to make use of the most cost effective sources of electricity. PJM is a power distributor that covers much of the current RGGI territory, but also covers non-RGGI states. One weakness of RGGI is that utility companies can shift their power sources to states outside of RGGI boundaries to avoid purchasing allowances. While this gives the appearance that carbon emissions have decreased in RGGI states, those carbon emissions have still been produced, but in other states instead. The migration of power production to carbon-emitting power plants outside of RGGI boundaries is called "emissions leakage". A major and still unresolved question is whether emissions leakage has occurred, and to what degree. Chen (2009) predicted that emissions leakage would occur once states implemented RGGI in 2009. Chen defined leakage as the change in emissions of non-RGGI states compared to a baseline year prior to RGGI implementation. Chen also defined relative leakage:

$$\text{Relative leakage} = \left| \frac{\text{Change in emissions of non-RGGI states}}{\text{Change in emissions of RGGI states}} \right| \times 100$$

Thus, if the emissions increased by 80 short tons in a non-RGGI state, but decreased by 100 short tons in a neighboring RGGI state, the relative leakage would be 80 percent. Chen's models of PJM power distribution predict a relative leakage of over 90 percent when the emissions allowance is less that $7 per short ton. If these models are correct, then the environmental benefits of RGGI are minimal. Murray and Maniloff (2015) counter that if leakage is happening, the neighboring regions to which it is most likely shifting have energy portfolios that are lower in carbon emissions than those of the RGGI states. Chen (2009) also predicted that RGGI-induced leakage would increase electricity prices in the states from which the electricity is leaking, due to the increased demand for the electricity. If this prediction is correct, demand for electricity in those states would decrease. Therefore, leakage would still result in overall carbon emission reductions, though not as much as if no electricity were imported to RGGI states. The difficulty of measuring leakage leads to an

essential question to answer if Virginia is to join RGGI: How can we tell that a change in carbon emissions is caused by RGGI and not by other factors, such as leakage or economic recession?

**The Impact of RGGI**

RGGI was introduced at roughly the same time as a major economic upheaval and an unexpected increase in the supply of natural gas. The decrease in emissions in RGGI states could have been caused by the Recession of 2008 leading to decreased energy usage. The rapid implementation of directional drilling and hydraulic fracking caused an unanticipated decrease in natural gas prices. Because natural gas emits only 48 percent of the carbon dioxide of an energetically equivalent quantity of coal, as power companies switch to natural gas, total carbon emissions will decrease (Murray & Maniloff, 2015). Murray and Maniloff analyzed economic models to determine the effect of different factors on the decline in emissions in RGGI states. They found that 24 percent of the change in RGGI emissions between 2009 and 2012 was caused by RGGI. Lower gas prices accounted for 14 percent and the recession accounted for another 14 percent. All RGGI states also have renewable portfolio standards which require a certain amount of the state's energy portfolio to come from renewable energy sources. Murray and Maniloff found that renewable portfolio standards accounted for another 12 percent of emission reductions in RGGI states. Their research suggests that RGGI is an effective method of emissions reduction.

As previously mentioned, Murray and Maniloff are not concerned about the impact of leakage in their analysis because the states neighboring the RGGI region fortuitously have lower carbon intensity energy portfolios. Maniloff elaborates on this idea by describing "beneficial leakage" caused by RGGI (Maniloff & Fell, 2016). The notion of "beneficial leakage" is that, though leakage is occurring, overall carbon emissions are still decreasing. Less electricity is generated by carbon-intensive sources within the RGGI region and is being replaced by electricity from natural-gas fired power plants in neighboring states. Maniloff and Fell estimate that ¼ of the apparent emissions reductions in the RGGI states was due to leakage, yet that leakage resulted in an additional one percent in emissions reduction. Combining this result with the results of Murray and Maniloff's analysis, the apparent 12 percent in emissions reductions credited to RGGI would only be nine percent, with the remaining three percent caused by leakage. RGGI is not designed to depend on "beneficial leakage," nor should it. In the short term, beneficial leakage may cause a net reduction in carbon emissions, but it cannot lead to the deep carbon emissions reductions needed to significantly mitigate climate change.

Leakage is difficult to measure and difficult to prevent, but methods are available to combat it. Border adjustment policies alter the price of electricity entering or leaving a state. An import adjustment charges out-of-state electricity providers for selling their electricity to a cap-and-trade state. Economic models combining anti-leakage policies with a domestic carbon tax show that an import adjustment policy would increase domestic energy production and decrease imported energy (Fischer & Fox, 2012). Enacting a border adjustment policy in RGGI would not guarantee a reduction in emissions. Because electrons in the grid cannot be traced to back to their source, power companies could make adjustments to their energy portfolio on paper only. A non-RGGI power company could tweak its paperwork to indicate it sent that electricity generated by low-emission sources into an RGGI state, while it sent electricity generated by high-emission sources to in-state customers. The most foolproof way to prevent leakage is to expand the RGGI to encompass the whole power grid.

## Conclusion

Joining RGGI would be a relatively easy way for Virginia to put a price on carbon and reduce carbon emissions. The structure is already in place, thanks to careful work done by the original RGGI states. While other emission reduction policies are worth analyzing, joining RGGI is a simple, politically feasible way in which Virginia can reduce emissions at a low-cost.
I do not recommend that Virginia also require a renewable portfolio standard as the rest of the RGGI states have done. When a cap-and-trade system is working correctly, utility companies and individuals will move toward using more renewable energy sources without further regulation. A renewable portfolio standard would be unnecessary and over-regulatory because increasing the price of carbon emissions would provide the incentive needed to add renewables.

Virginia can further negotiate an import adjustment for all electricity entering the state from non-RGGI states, and encourage other RGGI states to do the same. Finally, Virginia should negotiate that it not be required to spend a minimum percent of the RGGI revenue on clean or efficient energy programs. Virginia should be free to determine the highest priorities for its revenue and make the best investments for its own citizens. Some RGGI revenue could be used to retrain workers who lose their jobs in the transition to a low-carbon economy; the funds could also be used to provide an energy rebate to customers (W. Shobe, personal communication, Dec 7, 2016). Since emissions allowances are a new expense for utility companies, they could initially increase their electricity rates to cover the costs, which will disproportionately hurt low-income customers. A flat rebate to all customers would disproportionately help those low-income customers by covering a higher percent of their electricity bill than for high-income customers. The new RGGI revenue could also be used to offset reductions of other taxes. Removing restrictions to Virginia's spending of this revenue would make RGGI more politically viable. As Virginia leaders see the success of reinvesting RGGI revenues into improving the energy sector in other states, they may be convinced to make such investments in Virginia.

In spite of the careful comprehensive planning of RGGI and the significant emissions reductions it has achieved, it still regulates less than ¼ of all carbon emissions in RGGI states (Ramseur, 2013). The economic efficiency of equal marginal costs of abatements for all firms is not being fully achieved if ¾ of carbon emissions are unregulated. Thus, large power plants are paying more to abate carbon emissions than other sectors of the economy. Power plants with capacity less than 25 MW do not have to buy allowances, nor do facilities that use at least 10 percent of the electricity they generate on-site. Small facilities and individuals can buy allowances, which they could trade to large power plants on a secondary market (RGGI, Inc. 2016).

RGGI's real promise lies in its potential to scale up to cover all carbon-emitting sectors of society, including transportation, landfills, and residential natural gas. The true success of the RGGI program will be when no more emission allowances are bought, indicating society's transition to a fossil-fuel-free economy. Virginia should be a part of this success story.

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