Testimony of Roger Caiazza
Retired Air Pollution Meteorologist
Before the Pennsylvania House of Representatives
Environmental Resources & Energy Committee
August 24, 2020

Disclaimer: The opinions expressed in my testimony do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone. I have no affiliation with any company in Pennsylvania.

Roger Caiazza Background

- Air pollution meteorologist
  - Assessed impacts of emissions on air quality
  - BS Meteorology from State University College at Oneonta, NY (1974)
  - MS Meteorology from University of Alberta, Edmonton, Alberta (1976)
  - Certified Consulting Meteorologist (retired), American Meteorological Society
- Five years consulting with EPA contractors
  - Evaluated performance of air quality models used for regulatory compliance by EPA
- Joined Niagara Mohawk Power Corporation in 1981
  - Regulatory assessment of state and federal environmental initiatives
  - Provided analyses and reporting for ambient monitoring and continuous emissions monitoring systems for coal, oil, gas, and nuclear plants in New York
  - Compliance reporting for emissions trading programs (e.g., Acid Rain Program and Regional Greenhouse Gas Initiative (RGGI))
- Joined NRG Energy in 1999 when New York de-regulated the utility industry
  - Same responsibilities as with NMPC but added many more facilities across the country
- Semi-retired in 2010 and joined Environmental Energy Alliance of New York[1]
  - Regulatory assessment of environmental initiatives generation and transmission company members
- Retired in 2018 and author a blog Pragmatic Environmentalist of New York[2]
  - Goal is to explain the importance of balancing risks and benefits of both sides of environmental issues
  - Includes a dedicated page for RGGI[3] articles

[1] https://www.eeanyweb.org/wp/
[2] http://pragmaticenvironmentalistofnewyork.blog
[3] http://pragmaticenvironmentalistofnewyork.blog/**rggi-posts**/

RGGI 101 How it Works and How It Benefits Pennsylvanians

On August 6, 2020 I tuned into the Pennsylvania Department of Environmental Protection (DEP) webinar titled "RGGI 101 How it Works and How it Benefits Pennsylvanians". I penned a blog post[4] on it and Chairman Metcalfe invited to come to this hearing. My critique of the webinar is based on my experiences in my long-time involvement with RGGI which includes the original drafting of the initiative as an active stakeholder. In the following I occasionally reference slides from the webinar presentation that are available at DEP's RGGI website.[5]

Carbon Pricing

RGGI is a variation of carbon pricing using a type of emissions trading or "cap and trade" program. EPA does a good job describing the fundamentals of cap and trade. What you need to know about this pollution control approach is that there are three components: the cap, accurate measurements, and a tradable allowance for the pollutant covered. The cap sets a limit on the total regional emissions that must be met over a trading season such as a year or in the case of RGGI three years. The cap is set at a level such that the pollutant of interest will be reduced to levels that are determined by policy makers like you. Setting the cap level correctly is critically important: too high and the environmental objectives are not met and too low and the market mechanism fails. It is necessary to measure the emissions accurately and transparently because for every ton of pollution emitted affected sources have to create or purchase an allowance which is used for compliance. At the end of each compliance period, affected sources are required to surrender one allowance for each ton emitted.

There are different methods available to the regulator to distribute the allowances. EPA's Acid Rain program is the poster child for a successful cap and trade program because greater than required reductions occurred, earlier than expected and with much lower costs than projected. In the Acid Rain Program, they were distributed at no cost to all affected sources based on historical operations. I believe the success of the program occurred because the allowances were placed in the hands of the generators as a "currency". With this "currency" in hand, some generators retrofitted control technology, other switched fuels, and still others retired. The allowance "currency" was an incentive for those actions and the sold allowances were used at facilities that did not have these options available. RGGI, however, is a cap and tax proposal where the generators pay the allowance price as a tax and respond to market prices while the state governments collect the tax (allowance sales revenues) and spend it as they choose. According to RGGI, the states invest proceeds from the auctions "in energy efficiency, renewable energy, and other consumer benefit programs" and the programs are "spurring innovation in the clean energy economy and creating green jobs in the RGGI states".

---

[4] http://pragmaticenvironmentalistofnewyork.blog/2020/08/08/critique-of-rggi…s-pennsylvanians/

[5] https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx

Carbon pricing is a climate policy approach that works by charging emitting sources for the tons of emissions of carbon dioxide (CO_2) they emit but in some proposed plans there is no attempt to set a cap. The theory is that by setting a carbon price the market will devise the least-cost approach to reduce those emissions. Another aspect of the economist's theoretical carbon price approach is that the revenues are supposed to offset other taxes so there is no net cost to the public. RGGI is a variant of carbon pricing theory in that it sets a cap, specifies a range of auction prices, and, depending on the state, uses some of the proceeds to, in theory, reduce emissions.

The problem is that there is a large gap between the elegant theory of carbon pricing and the real world. In theory applying a carbon price across the globe on all sectors could work as advertised but the reality of a carbon price such as RGGI for one sector in one limited area is that it is a prescription for misapplied price signals and potential leakage. Pollution leakage refers to the situation where a pollution reduction policy simply moves the pollution around the globe rather than actually reducing it. RGGI claims in their annual RGGI electricity marketing report[6] that there is no leakage problem[7] but admits it is very difficult to calculate.

I described why I thought carbon pricing is a practical dead end[8] earlier this year. Proponents have convinced themselves that somehow this is different than a tax but, in my experience working with affected sources, the carbon price is treated just like a tax and very rarely is it used to offset other taxes. As a result, the over-riding problem with carbon pricing and RGGI is that it is a regressive tax. It is paid by all who consume electricity including those who can least afford it. In my article I described a number of other practical reasons that cap-and-invest carbon pricing or any variation thereof will not work as theorized: revenues over time decrease over time, market participants don't behave as expected by economic market theory,[9] the carbon price signal is inefficient, affected sources don't have many control options, the total costs of alternatives are high, and the logistics of a pricing program is a daunting problem. In addition, the Regulatory Analysis Project (RAP) recently completed a study for Vermont, Economic Benefits and Energy Savings through Low-Cost Carbon Management,[10] that raises additional relevant concerns about carbon pricing implementation, basically concluding that if you want to reduce carbon emissions it is more effective to target your financing to get the biggest reduction bang for the buck than to set a carbon price.

---

[6] https://www.rggi.org/allowance-tracking/emissions
[7] https://pragmaticenvironmentalistofnewyork.blog/2020/04/28/rggi-leakage/
[8] https://wattsupwiththat.com/2020/04/21/carbon-pricing-is-a-practical-dead-end/
[9] https://pragmaticenvironmentalistofnewyork.blog/2017/07/21/academic-rggi-economic-theory-of-allowance-management/
[10] https://ljfo.vermont.gov/assets/Uploads/a5e545b014/rap-carbon-management-VT-JFO-february-2019-updated.pdf

RGGI Success??

Proponents of RGGI and the Pennsylvania DEP proposal believe that RGGI has been a success. However, my evaluation of the data indicates that success is in the eye of the beholder. In particular, the rationale given to join and stay in RGGI is that it is a way to do something about climate change by reducing CO_2 emissions from the electric sector. However, my evaluation of the results indicates that it is an inefficient tool to reduce CO_2 emissions.

The historical trend of CO_2 emissions is an important test for RGGI success. Slide 6 in the DEP webinar RGGI 101 How it Works and How It Benefits Pennsylvanians ("DEP webinar") describes Pennsylvania participation in RGGI. It graphically shows how five steps of RGGI participation will lead to "helping the state combat climate change". One of the steps says: "Since 2005, RGGI states have significantly reduced their power sector CO_2 pollution" beneath a graphic that indicates that there was a 45% reduction. On July 29, 2020 RGGI released their Investment of RGGI Proceeds in 2018[11] report that tracks the investment of the RGGI proceeds and the benefits of these investments throughout the region. That report contains a similar statement: "As a whole, the RGGI states have reduced power sector CO_2 pollution over 50% since 2005, while the region's gross domestic product has continued to grow". Both DEP and RGGI[12] make the observed reduction sound like the reductions are due to RGGI. RGGI did not start until 2009 so the reductions from 2005 until the start of the program could not be due to RGGI. Moreover, a detailed look at the data indicates RGGI has not been an unqualified success[13] despite proponent claims that it is.

In order to evaluate the claims of success I used emissions data for the period 2005 to 2019 from the Environmental Protection Agency's Air Markets Program Data website[14]. One of the key components of any pollution trading program is transparency of the emissions data and this website provides that data for the electric generating sector. The website includes a query tool that enables the user to select particular data. Because these claims started in 2005 before RGGI started I selected all the programs in the query tool to get every facility that provided data and selected emissions data at the unit level. For the time frame I requested annual data from 2005 to 2019. I filtered my emissions data to only include the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia. In order to determine fuel use, I chose to get the unit level data rather than have it aggregated. I chose to get the following data parameters: operating time,

[11] https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2018.pdf
[12] https://pragmaticenvironmentalistofnewyork.blog/2020/07/30/investment-of-rggi-proceeds-report-for-2018/
[13] https://pragmaticenvironmentalistofnewyork.blog/2019/11/05/rggi-lessons-to-date-november-2019-edition/
[14] https://ampd.epa.gov/ampd/

number of months reported, gross load, steam load, SO_2, NOx, and CO_2 mass, heat input, source category, unit type, primary fuel type and secondary fuel type. After I downloaded all these data, I put them in a spreadsheet[15] so that I could summarize totals sorted as necessary.

Table 1 lists the total CO_2 emissions summed for the 9-states those that have always been in RGGI, the total including PA, NJ and VA, as well as just the PA emissions totals from 2005 to 2019. The first year of the RGGI program was 2009, when the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont emitted 108,487,823 tons of CO_2. In 2005 emissions from those nine states equaled 147,032,069 tons. The RGGI investment report was for 2018 and those states emitted 75,177,614 tons of CO_2 so my estimate of the reduction since 2005 is 49%. But 19% of the reductions had occurred by 2008 before RGGI started so clearly some other factor was at play.

Table 1: State-Level CO_2 Emissions for Twelve RGGI States 2005 to 2019

Year	9-State Total	PA	12-State Total
2005	147,032,069	121,858,351	321,908,874
2006	128,402,332	119,193,505	295,374,145
2007	133,903,150	123,585,266	310,185,905
2008	119,577,750	119,393,275	287,267,461
2009	108,487,823	114,331,904	269,527,189
2010	118,444,437	125,655,768	299,647,928
2011	104,844,813	118,689,447	270,233,082
2012	95,595,518	111,175,907	249,110,371
2013	89,115,999	112,108,370	249,609,392
2014	89,554,562	104,303,446	244,555,455
2015	86,382,080	95,211,399	235,122,647
2016	82,650,554	89,188,551	229,818,881
2017	67,830,311	84,201,372	203,002,123
2018	75,177,614	81,411,494	209,998,758
2019	63,537,644	82,798,637	196,614,413

[15] Spreadsheets are available upon request.

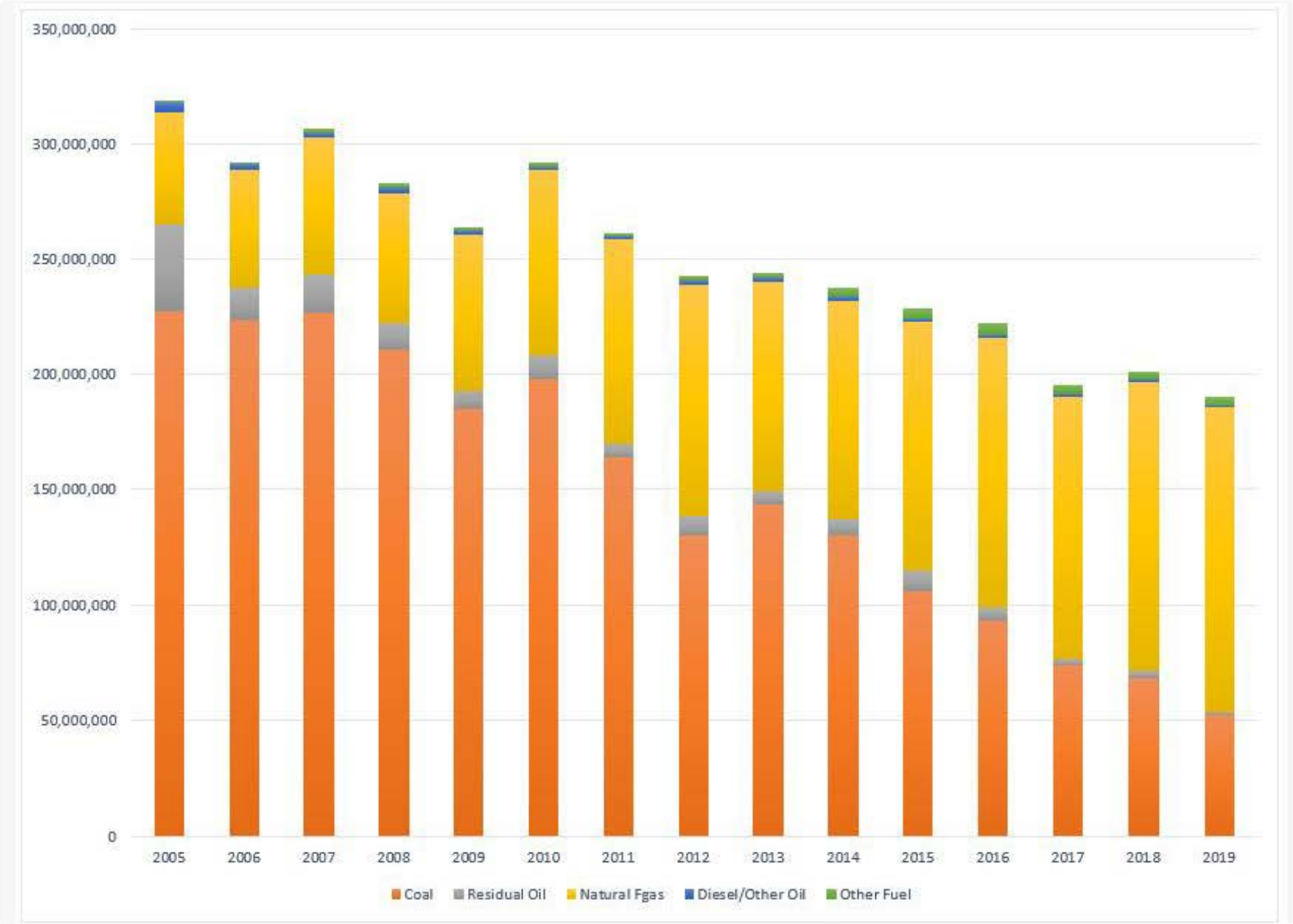
In order to investigate the reason for the reductions I summed data for each year by primary fuel type[16] for all 12 RGGI states as shown in Figure 1 and Table 2, RGGI 12-State Annual Emissions Data by Primary Fuel Type[17]. Because RGGI uses a three-year compliance period to reduce the impact of economic and weather impacts on load and CO_2 emissions I use a comparison baseline of the three-year average of the years before the start of RGGI. It is obvious that emissions reductions from coal and oil generating are the primary reason why the emissions decreased. CO_2 emissions have dropped by a third for the last three years as compared to the baseline. However, both coal and oil emissions have dropped over 78% since that baseline over all 12 states accounting for most of the overall reduction. In the nine RGGI states CO_2 emissions[18] from coal and residual oil have gone down by 81,203,339 tons from the baseline to the last 3 years and natural gas CO_2 is up 12,734,322 tons. The fuel switch from coal and oil to natural gas occurred because natural gas was the cheaper fuel and had very little to do with RGGI because the CO_2 allowance cost adder to the plant's operating costs was relatively small and that small increase is passed through in the power bid price to the customer.

There are only a few other ways than fuel switching that power plants can reduce CO_2 emissions and RGGI was not a factor in those options either. There are no cost-effective add-on pollution controls for CO_2. Another option to reduce CO_2 emissions at a power plant is to become more efficient and burn less fuel. However, because, as shown above, fuel costs are the biggest driver for operational costs that means efficiency projects to reduce fuel use are routinely done as an economic decision and not because of RGGI. Another option to reduce CO_2 emissions is to limit operations and a binding cap of allowances relative to emissions would mean that plants would simply operate until they used up their allowances. Concurrently, other state programs subsidizing renewable generation have lowered the operating periods of the affected sources and reduced total emissions.

This is not to say, however, that RGGI did not have an effect on emissions. Reductions caused directly by RGGI are limited to reductions due to the investments made with the auction proceeds. RGGI prepares an annual Investments of Proceeds[19] report that I used to calculate the annual emission reductions accumulated since the beginning of the program through 2018. Table 3, Accumulated Annual Regional Greenhouse Gas Initiative Benefits, lists the annual avoided CO_2 emissions generated by the RGGI investments from five reports. The claimed "accumulated" total of the annual reductions from RGGI investments is 3,091,992 tons while

[16] Note that sorting by primary fuel type is only an approximation because sources combined fuels for this label.
[17] https://pragmaticenvironmentalistofnewyork.files.wordpress.com/2020/08/table-2-rggi-12-state-annual-emissions-data-by-primary-fuel-type.pdf
[18] https://pragmaticenvironmentalistofnewyork.files.wordpress.com/2020/08/rggi-9-state-2005-2019-emissions-by-fuel-type.pdf
[19] https://www.rggi.org/investments/proceeds-investments

Figure 1: 12-State RGGI Annual CO_2 Mass (tons) by Primary Fuel Type



the difference between total annual 2005 and 2018 emissions is 71,854,455 tons. The RGGI investments appear to be only directly responsible for 4% of the total observed annual reductions over the 2005 to 2018 timeframe! While future emission reductions will accrue from these subsidies, the totals are very uncertain.

Table 3: Accumulated Annual Regional Greenhouse Gas Initiative "Benefits" from RGGI Annual Investment Reports

Time Period	RGGI Investments ($)	Avoided CO_2 (Short tons)	Electric Energy Savings (MWhr)	Energy Savings (mmBtu)
Cumulative (2008-2014)	$ 1,365,479,614.73	1,700,000	2,400,000	5,300,000
2015	$ 410,158,329.31	298,410	505,761	1,500,000
2016	$ 436,397,470.69	382,266	409,630	1,600,000
2017	$ 315,600,000.00	438,099	699,019	1,424,199
2018	$ 248,000,000.00	273,217	699,019	1,424,199
Annual Totals	$ 2,775,635,414.73	3,091,992	4,713,429	11,248,398

Cost Efficiency	($/ton)	($/MWhr)	($/mmBtu)
Cumulative (2008-2014)	$ 803.22	$ 568.95	$ 257.64
2015	$ 1,374.48	$ 810.97	$ 273.44
2016	$ 1,141.61	$ 1,065.35	$ 272.75
2017	$ 720.39	$ 451.49	$ 221.60
2018	$ 907.70	$ 354.78	$ 174.13
Annual Total	$ 897.69	$ 588.88	$ 246.76

Using the average of the three years before the program as the baseline, there was a 52,116,796 annual ton reduction (41%) in the nine RGGI states compared to 2018 and reported RGGI investments accounted for only 6% of the reduction. Fuel switching to Marcellus Shale gas created by Pennsylvania's fracking revolution was the primary cause of the observed decreases in emissions. Clearly, Pennsylvania has done more to reduce CO_2 in the RGGI states than the RGGI program has accomplished.

RGGI as a factor in air quality changes

The improvements to healthcare costs and quality of life projected by RGGI and described in the DEP webinar assume that that is a linear, no-threshold relationship between health impacts and air pollution. I have looked at the PM2.5 relationship in New York City[20] using that assumption and am unimpressed with the purported benefits.

The DEP webinar CO_2 limit slide includes a bullet that states: "Analyzing emissions impacts in environmental justice (EJ) areas and developing EJ principles". It is currently fashionable amongst progressive environmentalists to incorporate consideration of EJ communities. I evaluated the potential effects of peaking plants in New York City[21] on neighboring communities and found that concern about emissions from power plants directly affecting health in neighboring communities is mis-placed because they usually claim health impacts from ozone and inhalable particulates which are secondary pollutants. That means that formation of both pollutants takes time and by the time the reactions occur the pollution has been transported away from the immediate neighborhood. There are health benefits associated with the observed lower SO_2 and NOx emissions but they primarily occur further away than adjacent communities. That is not to say that there are not nuisance impacts to adjacent communities from nearby power plants.

[20] https://pragmaticenvironmentalistofnewyork.blog/2020/05/12/pm2-5-health-impacts-in-new-york-city/
[21] https://pragmaticenvironmentalistofnewyork.blog/2020/06/30/new-york-peaking-power-plants-and-environmental-justice-summary/

RGGI as a Factor in Reducing Global warming

According to DEP's RGGI website[22]: "Governor Wolf states that climate change is the most critical environmental threat confronting the world, and given that power generation is one of the largest contributors to greenhouse gas emissions, it is time to take concrete, economically sound and immediate steps to reduce emissions". If Pennsylvania joins RGGI what effect will it have on climate change? I could not find an estimate by DEP so I made my own.

I simply adapted the calculations in Analysis of US and State-By-State Carbon Dioxide Emissions and Potential "Savings" In Future Global Temperature and Global Sea Level Rise[23] to estimate the potential effect. This analysis of U.S. and state by state carbon dioxide 2010 emissions relative to global emissions quantifies the relative numbers and the potential "savings" in future global temperature and global sea level rise. These estimates are based on MAGICC: Model for the Assessment of Greenhouse-gas Induced Climate Change[24] so they represent projected changes based on the Intergovernmental Panel on Climate Change estimates. All I did in my calculation was to pro-rate the United States impacts by the ratio of Pennsylvania electric sector emissions in 2019 divided by United States emissions to determine the effects of a complete cessation of all CO_2 Pennsylvania electric sector emissions to estimate the best-case for joining RGGI.

As shown in the Table 4 I found there would be a reduction, or a "savings," of approximately 0.0011°C by the year 2050 and 0.0023°C by the year 2100. To give you an idea of how small this temperature change is consider changes with elevation and latitude[25]. Generally, temperature decreases three (3) degrees Fahrenheit for every 1,000-foot increase in elevation above sea level. The projected temperature difference is the same as going down 9 inches. The general rule is that temperature changes three (3) degrees Fahrenheit for every 300-mile change in latitude at an elevation of sea level. The projected temperature change is the same as going south two tenths of a mile.

---

[22] https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx

[23] http://scienceandpublicpolicy.org/images/stories/papers/originals/state_by_state.pdf

[24] http://www.magicc.org/

[25] http://landterms.com/Articles_and_FAQ_s/Conservation_and_Ecology_Articles_and_FAQ_s/Latitude__Elevation_and_Temperature/

Table 4: Analysis of Carbon Dioxide Emissions and Potential "Savings" in Future Global Temperature and Global Sea Level Rise from a Complete Cessation of 2019 Pennsylvania Electric Sector CO_2 Emissions 82.8 million short tons of 75.1 million metric tons
http://scienceandpublicpolicy.org/images/stories/papers/originals/state_by_state.pdf

Scenario	CO_2 Emissions Million Metric Tons	Percentage of Global Total	Time (Days) Until Total Emissions Subsumed by Chinese Coal		Temperature "Savings" Deg C		Sea-Level "Savings" (cm)	
			Completed in 2019 & Under Construction	Completed in 2019	2050	2100	2050	2100
US Observed 2010	5631.3	17.88%	11,474	29,126	0.0830	0.1720	0.6000	1.8000
Scenario GHG Reduction	75.11	0.2385%	153	389	0.00111	0.00229	0.00800	0.02401

Temperature Reduction Impact in 2100 Relative to Elevation or Latitude Change
http://landterms.com/Articles_and_FAQ_s/Conservation_and_Ecology_Articles_and_FAQ_s/Latitude__Elevation_and_Temperature/
Generally, temperature decreases three (3) degrees Fahrenheit for every 1,000 foot increase in elevation above sea level.
This emissions reduction will cause a change in temperature equivalent to a change in elevation of 9 inches.

The general rule is that temperature changes three (3) degrees Fahrenheit for every 300 mile change in latitude at an elevation of sea level.
This emissions reduction will cause a change in temperature equivalent to a change in latitude of 0.2 miles

Pennsylvania's action should also be considered relative to the rest of the world. According to the China Electricity Council[26], about 29.9 gigawatts of new coal power capacity was added in 2019 and a further 46 GW of coal-fired power plants are under construction. If you assume that the new coal plants are super-critical units with an efficiency of 44% and have a capacity factor of 80%, the reductions provided by this program will be replaced by the added 2019 Chinese capacity in 389 days or 153 days if the 2019 capacity and the units under construction are combined. Clearly, in the absence of worldwide commitments Pennsylvania joining RGGI will have no tangible benefits relative to global warming.

RGGI Investment Recommendation

The DEP webinar listed three potential reinvestment scenarios while emphasizing that they do not reflect funding commitments:

1. Balanced approach,
2. Ratepayer assistance, and
3. General fund.

These scenarios varied by the percentage of investments in five broad categories: energy efficiency; clean and renewable energy; greenhouse gas abatement; general fund and bill assistance. Table 5 summarizes the RGGI investment for the nine states in RGGI in 2018 from the latest Investments of Proceeds report. There is a wide range of investments for each category. Although there are no investments to the general fund in 2018 there have been years when there were contributions.

[26] https://www.bnnbloomberg.ca/china-seen-adding-new-wave-of-coal-plants-after-lifting-curbs-1.1448154?utm_source=CCNet+Newsletter&utm_campaign=9afd780483-EMAIL_CAMPAIGN_2020_06_18_12_02&utm_medium=email&utm_term=0_fe4b2f45ef-9afd780483-36423245&mc_cid=9afd780483&mc_eid=1afdc1d1a3

Table 5: 2018 RGGI Investments (%) by Category

State	Energy Efficiency	Clean & Renewable Energy	GHG Abatement	General Fund	Bill Assistance	Administration	RGGI
RGGI	38%	19%	20%		16%	5%	0.9%
CT	72%	21%					7%
DE	71%	8%	11%		2%	7%	0.4%
ME	67%				26%	6%	1%
MD	26%	9%	17%		41%	6%	1%
MA	45%		47%			7%	1%
NH	20%				77%	2%	1%
NY	31.2%	42.3%	21.1%			4.5%	1%
RI	37%	43%	7%			12%	1%
VT	95.3%					3.7%	1%

Energy Efficiency	Insulation and Weatherization, system improvements, and Appliance Recycling etc.
Clean & renewable energy	Biogas, solar, wind, hydropower etc.
GHG abatement	R&D, Workforce Development, Well Plugging, Electric Vehicles (EVs) and EV Infrastructure
General fund	Service public debt or other non energy investments
Bill Assistance	Credits on electric bills for struggling households

The results RGGI reported in the latest Investments of Proceeds[27] report suggest that investments in clean and renewable energy and greenhouse gas abatement would be a poor choice for Pennsylvania. As noted previously the accumulated total of the annual reductions from RGGI investments is 3,091,992 tons. In Table 3: 2018 RGGI All-Time Benefits of RGGI Investments I list the accumulated total annual RGGI investments as $2,578,305,737. The RGGI CO_2 reduction cost per ton based on those numbers is $898 dollars per ton of CO_2 reduced.

One way to determine if the GHG emission reduction costs are an effective tool is to compare the cost per ton reduced against a damage metric. The social cost of carbon[28] (SCC) is the metric used by Federal agencies for this purpose. I recently posted an overview summary of the SCC[29] but for the purposes of this post you need to know that the values range widely depending on assumptions. The most widely used value at this time is from the Obama-era

[27] https://www.rggi.org/investments/proceeds-investments
[28] https://media.rff.org/documents/SCC_Explainer.pdf
[29] https://pragmaticenvironmentalistofnewyork.blog/2020/07/22/climate-leadership-and-community-protection-act-value-of-carbon/

Interagency Working group. They use a discount rate of 3% and consider global benefits to estimate the 2020 SCC value is $50. The RGGI investments exceed that metric by over an order of magnitude so they cannot be considered cost-effective relative to the alleged negative impacts of CO_2 emissions.

During the webinar presentation it was noted that energy efficiency investments can be targeted to those who are having trouble paying their energy costs and other than direct bill assistance this is the only category that has that advantage. Personally, because the RGGI fee is regressive I believe that the ratepayer assistance reinvestment scenario is the best choice.

Pennsylvania vs. RGGI Emission Reductions

The September 15, 2020 Environmental Quality Board[30] agenda includes an Executive Summary[31] of Proposed Rulemaking: CO_2 Budget Trading Program (25 Pa. Code Chapter 145, Subchapter E) regulation that would establish the Commonwealth's participation in RGGI. It claims that "The declining CO_2 Emissions Budget in this proposed rulemaking directly results in CO_2 emission reductions of around 20 million short tons in this Commonwealth as well as emission reductions across the broader PJM regional electric grid" and "This proposed rulemaking would effectuate least cost CO_2 emission reductions for the years 2022 through 2030".

As shown in Table 6, Pennsylvania has accomplished nearly as much without joining RGGI as the nine states that have been members from 2009 to 2019 in terms of maintaining fossil generation levels while reducing emissions, improving efficiency, and switching to cleaner fuels. The fact is that the 91.7% reduction in Pennsylvania CO_2 emissions represents a reduction of 31,533,267 tons that is far greater than the rulemaking's projection of a 20 million-ton reduction. In 2019, there were a total of 77,918,301 tons of CO_2 emitted in the electric sector and 37,804,961 tons were emitted from coal generation. It is very likely that the continued switch to cleaner fuels enabled by Pennsylvania's natural gas industry will reduce emissions further even if Pennsylvania does not join RGGI and will account for most of the reductions if it does join.

[30] https://www.dep.pa.gov/PublicParticipation/EnvironmentalQuality/Pages/2020-Meetings.aspx

[31] http://files.dep.state.pa.us/PublicParticipation/Public%20Participation%20Center/PubPartCenterPortalFiles/Environmental%20Quality%20Board/2020/September%2015/01-7-559-CO2%20Budget%20Trading-Proposed_Executive%20Summary.pdf

Table 6: Comparison of 2009 to 2019

	Fossil Generation	SO_2	NOx	CO_2	Heat Rate	Fuel Carbon Intensity
RGGI 9 States	**-22.8%**	**-97.4%**	**-79.8%**	**-41.8%**	**-9.7%**	**-16.5%**
Pennsylvania	**-0.8%**	**-91.7%**	**-72.6%**	**-27.6%**	**-14.7%**	**-15.1%**

Conclusion

Despite the claims made by its proponents, upon close examination RGGI is an inefficient method for reducing CO_2 emissions. The affected sources will treat it simply as a tax. As a result, that means that the primary impact to the public is a regressive tax.

This analysis shows that the primary cause for the observed emission reductions in RGGI has been fuel switching enabled by the abundant supplies of Pennsylvania's low-cost natural gas delivered by Pennsylvania's fracking industry. The reductions directly attributable to RGGI are a small fraction of the total observed reduction so Pennsylvania has already done more to reduce CO_2 than RGGI. We should all rationally conclude that over time Pennsylvania CO_2 emissions will continue to decrease while electric energy production totals remain stable even if the Commonwealth decides not to join RGGI. Regardless of the policy chosen, the CO_2 reductions will not have any measurable effect on global warming or benefit to its residents.

Pennsylvania House of Representatives
Environmental Resources & Energy Committee
Public Hearing August 24, 2020

Testimony of Roger Caiazza
Retired Air Pollution Meteorologist

Roger Caiazza Background

- Air pollution meteorologist in electric sector since 1981
- Responsible for pollution monitoring reports and pollution trading reports for electric generating companies
- Performed regulatory analysis of numerous emissions trading programs including RGGI
- Since retirement I blog at Pragmatic Environmentalist of New York
- The opinions expressed in my testimony do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone.

Carbon Pricing

- Attractive theory to let market decide how to make reductions
- RGGI is a carbon pricing variation called “cap and dividend” but I call it “cap and tax”
- Practical problems reduce attractiveness
  - Pollution leakage
  - Lack of power plant control options
  - Ultimately it is a regressive tax

RGGI's so called "Success" Story

- PA DEP webinar: "Since 2005, RGGI states have significantly reduced their power sector CO2 pollution" beneath a graphic that indicates that there was a 45% reduction
- RGGI Investment Proceeds report: "As a whole, the RGGI states have reduced power sector CO2 pollution over 50% since 2005, while the region's gross domestic product has continued to grow".
- How much did RGGI actually contribute to those reductions?

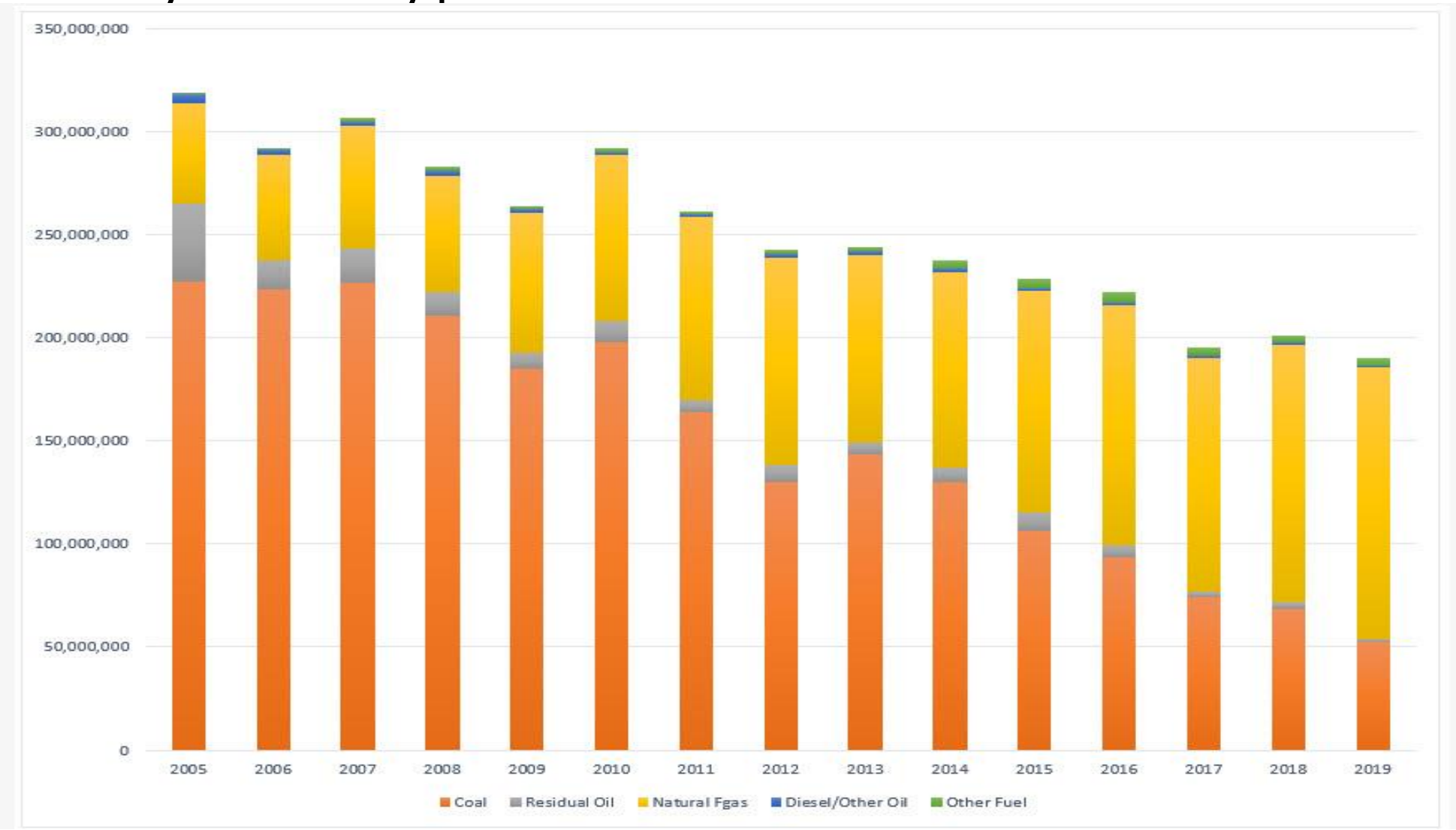
RGGI Emissions Analysis

- Used emissions data for the period 2005 to 2019 from the Environmental Protection Agency's Air Markets Program Data website
- Data from all RGGI states and Pennsylvania
- Unit-level data for operating time, number of months reported, gross load, steam load, SO2, NOx, and CO2 mass, heat input, source category, unit type, primary fuel type and secondary fuel type.
- Summarized data by category totals

RGGI & PA Emission Reduction Summary

- Emission reductions against 3-year baseline 2006-2008 against last three years 2017-2019
  - CO2 Mass (tons) down 33% or 98,247,343 tons
  - SO2 Mass (tons) down 95% or 1,483,165 tons
  - NOx Mass (tons) down 82% or 306,997 tons
  - Gross Load (MWh) down 12% or 45,032,054 MWh
  - Heat Input (mmBtu) down 23% or 856,239,177 mmBtu

Annual CO2 Emissions from RGGI States & PA by Primary Fuel Type



Possible Reasons for Reductions

- Supported by data
  - Fuel Switching
  - Older coal units displaced by new efficient natural gas combined cycles
- Not supported by data
  - Add-on controls
  - Efficiency projects

RGGI Effect on Emissions

- RGGI publishes an annual investment proceeds report
  - Cumulative annual amount invested per year: $ 2,775,635,414
  - Avoided CO2 emissions from the investments 3,091,992 tons
- Pre-RGGI baseline to last 3 years reduction 98,247,343 tons
- That means that for this comparison RGGI is only responsible for 3.3% of the observed reduction
- Cost per ton removed is $898

What effect will PA joining RGGI have on global warming?

- MAGICC projections for the United States can be pro-rated for PA electric sector emissions (82,798,637 CO2 tons in 2019)
- Assume all electric sector emissions are eliminated
- Temperature “savings,” of approximately 0.0011°C by the year 2050 and 0.0023°C by the year 2100
- The projected temperature difference is the same as going down 9 inches
- The projected temperature change is the same as going south 0.2 miles
- The reductions will be replaced by added 2019 Chinese capacity in 389 days or 153 days if the 2019 capacity and the units under construction are combined.

Pennsylvania vs. Nine RGGI States 2009-2019

	Fossil Generation	SO_2	NOx	CO_2	Heat Rate	Fuel Carbon Intensity
RGGI States	-22.8%	-97.4%	-79.8%	-41.8%	-9.7%	-16.5%
Pennsylvania	-0.8%	-91.7%	-72.6%	-27.6%	-14.7%	-15.1%

- Pennsylvania without RGGI has accomplished nearly as much as the nine RGGI states in terms of maintaining fossil generation levels while reducing emissions, improving efficiency, and switching to cleaner fuels.

Pennsylvania House of Representatives
Environmental Resources & Energy Committee
Public Hearing August 24, 2020

Testimony of Roger Caiazza
Retired Air Pollution Meteorologist

Roger Caiazza Background

- Air pollution meteorologist in electric sector since 1981
- Responsible for pollution monitoring reports and pollution trading reports for electric generating companies
- Performed regulatory analysis of numerous emissions trading programs including RGGI
- Since retirement I blog at Pragmatic Environmentalist of New York
- The opinions expressed in my testimony do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone.

Carbon Pricing

- Attractive theory to let market decide how to make reductions
- RGGI is a carbon pricing variation called “cap and dividend” but I call it “cap and tax”
- Practical problems reduce attractiveness
  - Pollution leakage
  - Lack of power plant control options
  - Ultimately it is a regressive tax

RGGI's so called "Success" Story

- PA DEP webinar: "Since 2005, RGGI states have significantly reduced their power sector CO2 pollution" beneath a graphic that indicates that there was a 45% reduction
- RGGI Investment Proceeds report: "As a whole, the RGGI states have reduced power sector CO2 pollution over 50% since 2005, while the region's gross domestic product has continued to grow".
- How much did RGGI actually contribute to those reductions?

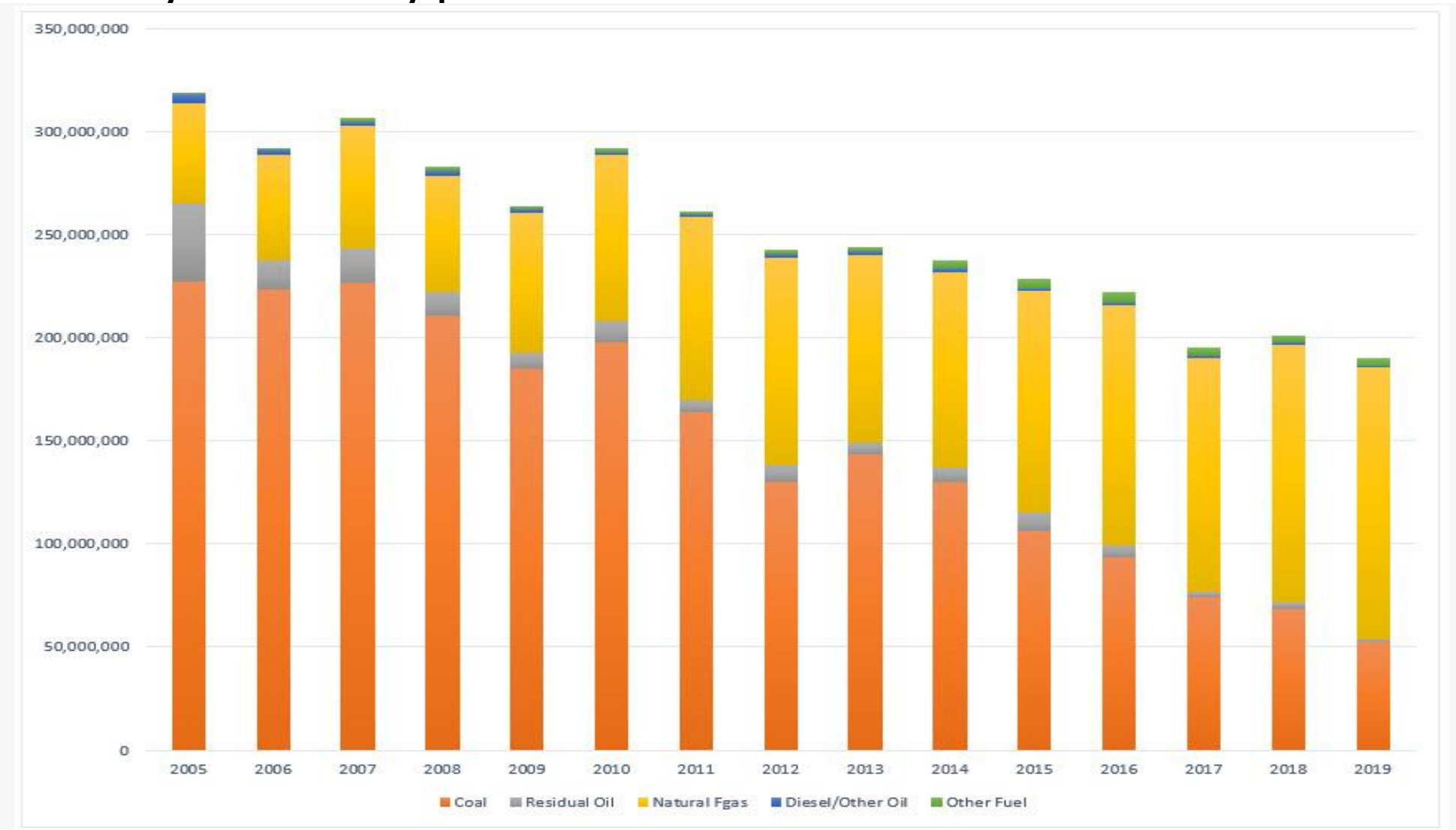
RGGI Emissions Analysis

- Used emissions data for the period 2005 to 2019 from the Environmental Protection Agency's Air Markets Program Data website
- Data from all RGGI states and Pennsylvania
- Unit-level data for operating time, number of months reported, gross load, steam load, SO2, NOx, and CO2 mass, heat input, source category, unit type, primary fuel type and secondary fuel type.
- Summarized data by category totals

RGGI & PA Emission Reduction Summary

- Emission reductions against 3-year baseline 2006-2008 against last three years 2017-2019
  - CO2 Mass (tons) down 33% or 98,247,343 tons
  - SO2 Mass (tons) down 95% or 1,483,165 tons
  - NOx Mass (tons) down 82% or 306,997 tons
  - Gross Load (MWh) down 12% or 45,032,054 MWh
  - Heat Input (mmBtu) down 23% or 856,239,177 mmBtu

Annual CO2 Emissions from RGGI States & PA by Primary Fuel Type



Possible Reasons for Reductions

- Supported by data
  - Fuel Switching
  - Older coal units displaced by new efficient natural gas combined cycles
- Not supported by data
  - Add-on controls
  - Efficiency projects

RGGI Effect on Emissions

- RGGI publishes an annual investment proceeds report
  - Cumulative annual amount invested per year: $ 2,775,635,414
  - Avoided CO2 emissions from the investments 3,091,992 tons
- Pre-RGGI baseline to last 3 years reduction 98,247,343 tons
- That means that for this comparison RGGI is only responsible for 3.3% of the observed reduction
- Cost per ton removed is $898

What effect will PA joining RGGI have on global warming?

- MAGICC projections for the United States can be pro-rated for PA electric sector emissions (82,798,637 CO2 tons in 2019)
- Assume all electric sector emissions are eliminated
- Temperature “savings,” of approximately 0.0011°C by the year 2050 and 0.0023°C by the year 2100
- The projected temperature difference is the same as going down 9 inches
- The projected temperature change is the same as going south 0.2 miles
- The reductions will be replaced by added 2019 Chinese capacity in 389 days or 153 days if the 2019 capacity and the units under construction are combined.

Pennsylvania vs. Nine RGGI States 2009-2019

	Fossil Generation	SO_2	NOx	CO_2	Heat Rate	Fuel Carbon Intensity
RGGI States	-22.8%	-97.4%	-79.8%	-41.8%	-9.7%	-16.5%
Pennsylvania	-0.8%	-91.7%	-72.6%	-27.6%	-14.7%	-15.1%

- Pennsylvania without RGGI has accomplished nearly as much as the nine RGGI states in terms of maintaining fossil generation levels while reducing emissions, improving efficiency, and switching to cleaner fuels.