

Pennsylvania's Regional Greenhouse Gas Initiative Relies on Faulty Data

Why RGGI is a "solution in search of a problem"



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Background

The CO2 Coalition is a national organization made up of nearly 70 top scientists bringing honesty to climate science.

This report is based principally on the work of **Gregory Wrightstone**, geologist, CO2 Coalition Executive Director and Expert Reviewer for the U.N. Intergovernmental Panel on Climate Change; **Dr. Patrick J. Michaels**, Senior Fellow for the CO2 Coalition and Competitive Enterprise Institute and Past President of the American Association of State Climatologists; and **David T. Stevenson**, Director, Center for Energy & Environment at the Delaware-based Caesar Rodney Institute and author of more than 100 analytic reports.

The analyses of Mr. Wrightstone and Dr. Michaels were presented June 22 to the Pennsylvania House Environmental Resources & Energy Committee. Mr. Stevenson previously published a peer-reviewed analysis of RGGI for the Cato Institute.

These and other contributors to this evaluation — listed at the end of the document — represent the fields of climatology, meteorology, physics, geology, agronomy and more.

Introduction

Pennsylvania Governor Tom Wolf, on October 3, 2019, signed an Executive Order¹ beginning the process to enroll Pennsylvania into the Regional Greenhouse Gas Initiative² (RGGI). RGGI is a mandatory carbon cap and trade program from states in the Northeast.

Electricity generation using coal and natural gas is targeted for reduction by this order and accounts for slightly more than 50% of the Commonwealth's needs according to the U.S. Energy Information Administration. Pennsylvania is an electricity generation powerhouse in the northeast and exports about one third of its total generation to other states. The increased costs of the electricity generated in Pennsylvania due to imposition of RGGI mandated increases will be borne, not only by our residents, but by those citizens in surrounding states that benefit from our energy exports.

According to the Governor and his executive order, the need for a RGGI-dictated carbon taxation/trading scheme is because the Commonwealth's carbon dioxide emissions are contributing to dangerous CO₂-driven warming.

The 2019 executive order directed the state's Department of Environmental Protection (DEP) to propose rules by September 15, 2020. The process is moving forward with recent approvals by four of DEP's advisory bodies, including the Air Quality Technical Advisory Committee, Small Business Compliance Advisory Committee, Citizens Advisory Council and Environmental Justice Board. Two CO2 Coalition scientists provide herein scientific refutations of Governor Wolf's justifications for imposing RGGI.

In addition, this document includes a June 2021 analysis by the Caesar Rodney Institute, which addresses the Wolf administration's flawed economic and environmental arguments for RGGI. Rather than confirming benefits from RGGI, the analysis predicts a great deal of harm for Pennsylvania's economy.

Executive Summary

RGGI's Flawed Climate Analysis

The Governor and other officials have relied heavily on the state's Climate Action Plans and specifically on the 2018 Pennsylvania Climate Action Plan³ in order to support their claims of current and future devastating impacts of continued CO_2 -driven warming. Assertions in the Climate Action Plan are refuted by the analysis of Gregory Wrightstone, Executive Director of the CO2 Coalition and an expert reviewer for the U.N. Intergovernmental Panel on Climate Change's 6th Assessment Report (IPCC – AR6).

Because of DEP's flawed climatic analysis, the agency's predictions of drought, flooding and other extreme weather events have no scientific basis.

Flooding

DEP's projection of increased flooding is contradicted by data from the Ohio, Allegheny and Susquehanna rivers that show a decline in the size of flood crests in the last 100 years even though the average precipitation has increased by four inches. Although Governor Wolf makes much of Susquehanna River flooding in 2018, that event ranks 31st in the list of greatest floods at Harrisburg and only slightly more than half of the magnitude of the 1972 flood from Tropical Storm Agnes. The IPCC says it "can discern no connection between a modest increase in temperature and any change in flooding worldwide."

Droughts

A DEP projection of more drought is unsubstantiated by data showing decreasing aridity in Pennsylvania over the last century while the climate warmed slightly during the period.

Heat Waves

A DEP projection of more heat waves is contrary to data showing a peak in the country's hot weather occurring in the 1920s and 1930s before CO_2 levels began increasing following World War II.

Health risks from pollution

DEP's projection of health risks from air and water pollution are inconsistent with data from the U.S. Environmental Protection Agency showing double-digit percentage decreases in pollution. Air and water today are cleaner than in more than 100 years and getting cleaner every year. According to the EPA, nationally, concentrations of air pollutants have dropped significantly since 1990.

Flooding in southeastern Pennsylvania from rising sea level

According to DEP's Climate Assessment, Delaware River Basin communities (including Philadelphia) can expect more frequent flooding and associated disruptions due to sea-level rise that presumably is caused by anthropogenic warming. Fortunately, historical data suggest that is unlikely.

Global sea levels have been rising for over 200 years, long before humans began adding prodigious amounts of CO_2 to the atmosphere in the mid-20th century, and oceans are likely to continue to rise whether RGGI is adopted or rejected. Having successfully already adapted to possibly as much as two feet of sea-level rise over the last two centuries, Philadelphia — with modern technology and capabilities — can expect to easily adapt to the projected six to eight inches of rise between now and 2100.

Agricultural damage

DEP predicts damage to Pennsylvania agriculture, but actual data shows improvements in farm production. Pennsylvania is no different than most of the rest of the globe, which is benefiting from a moderate rise in atmospheric carbon dioxide and natural warming. Over the last 50 years there have been increases in the length of growing seasons and crop production and an overall greening of Earth.

RGGI's Flawed Use of Climate and CO₂-Emission Models

Dr. Patrick J. Michaels, Senior Fellow for the CO2 Coalition and Competitive Enterprise Institute and Past President of the American Association of State Climatologists, found that all but one of 102 computer models used in the Pennsylvania Department of Environmental Protection's (DEP's) Climate Action Plan "failed dramatically" in representing how the climate behaved in the past. He suggested that it would have been preferable for the state to have used the one model that more accurately reflected past climatic conditions than to have averaged the results of all 102 irrespective of their accuracy. In addition, the Pennsylvania analysis uses a CO₂-emission model that assumes an unrealistic increase in the use of coal that exceeds some estimates of the quantity of recoverable coal reserves. Correcting for the state's reliance on flawed analyses reduces the predicted warming by 2050 to less than two degrees Fahrenheit from the state's projection of 5.4 degrees.

Even if Pennsylvania were to reduce its emissions from electricity to zero, Dr. Michaels says any reduction in temperature or in sea-level rise would be too small to measure.

The Pennsylvania Climate Action Plan report, which serves as the basis for Governor Wolf's RGGI proposal, needs to be dramatically revised, and should no longer be used as the basis for any policy proposals in its present form, concludes Dr. Michaels.

RGGI's Flawed Economics

Pennsylvania Gov. Tom Wolf's proposal to enter RGGI will be economically damaging and provide no environmental benefits, according to a June 2021 analysis by David T. Stevenson, Director of the Center for Energy & Environment at the Delaware-based Caesar Rodney Institute. The findings are consistent with what Mr. Stevenson found in a 2018 peer-reviewed report published by the Cato Institute.

Mr. Stevenson's recent analysis says the Wolf administration's 2020 "Pennsylvania RGGI Modeling Report" predicts economic and environmental benefits on the basis of flawed assumptions. For example, emission reductions are likely overstated in the modeling report because Pennsylvania reductions in fossil fuel use will most likely be replaced by fossil fuel power plants in other states as electric generation and demand from energy-intensive manufacturing shift away from Pennsylvania.

"The assumptions used in the report are flawed as are the forecasted outcomes," said Mr. Stevenson, author of more than 100 analytic reports. "Using information learned from the decade-old RGGI program it is clear emissions will not be reduced globally, electric rates will rise, and there will be billions of dollars of economic damage if Pennsylvania joins RGGI."

Mr. Stevenson projects tax losses of \$282 million from the economic damage to exceed the \$261 million in estimated receipts from the sale of emission allowances. The losses break down as follows: \$92 million in corporate income taxes, \$102 million in personal income taxes and \$88 million in utility gross receipts taxes.

According to the 2018 Stevenson report, RGGI had no effect on carbon dioxide reductions — nor any supposed health benefits when other factors are considered: the effects of regulatory and market forces and the quantity of emissions exported to other states by the importation of power into RGGI states.

The conclusions of the Stevenson report include the following:

- RGGI does not lower global emissions. Any cuts in Pennsylvania will likely show up in other nearby states as electric demand is expected to remain constant across the region.
- Pennsylvania now a large exporter of electricity could lose as much as \$2 billion a year in electricity sales to other states at a cost of 1,400 jobs in electric generation.
- Lost coal and natural gas production could total \$1.1 billion a year at a cost of 3,500 jobs a year.
- Based on the experience of RGGI states, higher electricity prices from Gov. Wolf's carbon tax could result in a loss of approximately 17,000 jobs in the energy intensive manufacturing sector.
- Total loss to the Pennsylvania economy from the state's participation in RGGI could be as high as \$7.7 billion a year and more than 22,000 jobs, with the economic loss between 2022 and 2030 over \$50 billion.
- There would be a net loss in tax revenue as the estimated \$261 million generated by the sale of RGGI emission allowances would be more than offset by \$282 million lost in lower collections of the corporate income tax, personal income tax and utility gross receipts tax.

Analyses

Analysis of Wolf Administration's Predictions of Climate Catastrophe

Gregory Wrightstone Executive Director, CO2 Coalition

Governor Tom Wolf's proposal for Pennsylvania to join the Regional Greenhouse Gas Initiative (RGGI) is based primarily on dire warnings of existing and future CO_2 -driven catastrophes documented in the 2018 Pennsylvania Climate Action Plan (PACAP). In this document we will review and assess the primary claims of looming catastrophe that have been used by the Governor and his supporters to justify imposition of this plan. This review will document that the stated claims of current and future harm from continuing emissions of carbon dioxide (CO_2) are unsupported by the facts.

If the reasons presented to justify imposition of the Regional Greenhouse Gas Initiative are shown to be false, then the governmental bodies tasked with review of RGGI should "follow the science" and reject this economically crippling program. The justifications for imposing the carbon taxation scheme that is RGGI were included in the 2018 Climate Action Plan in the section titled "Why Does Pennsylvania Need a Climate Action Plan?" To quote from the action plan:

In recent years, extreme weather and catastrophic natural disasters have become more frequent and more intense. Like many parts of the United States, Pennsylvania is expected to experience higher temperatures, changes in precipitation, sea level rise, and more frequent extreme events and flooding because of climate change in the coming decades. Climate impacts in Pennsylvania are already occurring and put Pennsylvanians and local industries at risk. Key impacts include:

- Increasing precipitation leading to extreme weather events and flooding throughout the state
- Increase in drought and heat waves
- Increased health risks from worsening air and water pollution
- Sea-level rise to cause more frequent flooding in the Delaware River Basin
- Farming sector would be harmed

Are extreme weather events attributable to human-caused changes in climate?

The Intergovernmental Panel on Climate Change is the gold standard for climate science and disagrees, stating: "Many weather and climate extremes are the result of natural climate variability... Even if there were no anthropogenic changes in climate, a wide variety of natural weather and climate extremes would still occur."⁴

The World Meteorological Organization goes even further, saying: "... any single event... ... cannot be attributed to human-induced climate change, given the current status of scientific understanding."⁵

Do Pennsylvania's records of rainfall, drought, food production, flooding and the like support the allegations that the Commonwealth is experiencing any of these?

Claim #1 – Man-made climate change is leading to increased precipitation and flooding

Precipitation has increased slightly over the last 100-plus years. That increase amounts to about 4 inches of additional precipitation per year (figure 1).⁶



Figure 1 – NOAA Pennsylvania annual precipitation⁶

The slight increase in precipitation is already providing many benefits to the Commonwealth that were not addressed in the Climate Action Plan. These benefits include increased vegetation, crop-growth, silage for livestock, snow for ski resorts and a decrease in fire risk. The only downside to this increase in rainfall would be if it resulted in a documented increase in devastating floods.

According to the well-respected Intergovernmental Panel on Climate Change, their latest report (AR5)⁷ states that they have a "*low confidence that there is a sign of a trend globally in the magnitude or frequency of floods on a global scale.*" In other words, they can discern no connection between the modest 0.8-degree Celsius increase in temperature since 1900 and any change in flooding worldwide.

Governor Wolf seems fixated on his belief that flooding is being made worse by climate change and has referred repeatedly to several high-precipitation events that occurred in 2018, but here the governor makes the common mistake of conflating weather with climate. For example, Governor Wolf personally viewed flooding of the Susquehanna River in Harrisburg in July of that year when it crested at 17.3 feet. Much was made of the flooding at the time, but it ranks just 31st on the list of the greatest floods at Harrisburg — and only a bit more than half the record set by Tropical Storm Agnes in 1972.

Due to the large number of measuring stations across the state, it is difficult to assess flooding statewide. We have here sampled a handful of sites. Those from the Ohio⁸, Allegheny⁹ and Susquehanna¹⁰ rivers show a decline in the average crest of floods over the last century, while the data from Bucks County¹¹ show a similar decline in the number of floods (figure 2).



Figure 2 – Localized flooding data

According to the IPCC AR5 WGI report¹², they state that they have "...low confidence in trends in small-scale severe weather phenomena such as hail and thunderstorms..."

We shall find in a later section that Pennsylvania crops are thriving — likely helped by abundant and timely rainfall.

Fact check on increasing flooding: False and misleading

Claim #2 – Droughts are increasing

In order for drought to occur, two climate events are required: lack of rainfall and intense heat waves. We have seen in the previous section, that rainfall is increasing slightly, and we shall see in the next section that heat waves are not increasing. Neither of the two required elements for drought to occur are happening.

The most commonly used measurement of drought is the Palmer Drought Severity Index (PDSI)¹³. It estimates dryness by using both temperature and precipitation data. Figure 3 shows annual values of PDSI for Pennsylvania as accessed from NOAA. This chart clearly reveals a trend (blue line) of decreasing aridity.



Figure 3 – NOAA drought index¹³

According to the IPCC AR5 WGI report, they state that they have "...low confidence in a global-scale observed trend in drought or dryness (lack of rainfall) since the middle of the 20th century..."¹⁴

The data and the experts agree that droughts are NOT increasing.

Fact check on increasing drought: False and misleading

Claim #3 – Heat waves are increasing

There is little dispute that the longest and most intense heat waves in the United States occurred some 90 years ago in the 1920s and 1930s. Figure 4 is a chart created by Dr. John Christy, Professor of Atmospheric Science and Director of the Earth System Science Center at The University of Alabama in Huntsville and Alabama's State Climatologist. This chart¹⁵ shows that the percentage of U.S. stations measuring more than 100 degrees F peaked during that time frame and have been in decline since.

Confirming this are data from the EPA (figure 5) ¹⁶ once again showing peak heat waves occurring during the early 20^{th} century during a time when CO_2 was at levels too low to impact temperature significantly.



Figure 4 - % of U.S. stations >100°F 15



Figure 5 – EPA heatwave index¹⁶

Fact check on increasing heat waves: False and misleading

Claim #4 – Increasing health risks from worsening air and water pollution

Our air and water today are cleaner than in more than 100 years and getting cleaner every year. According to the EPA, the concentrations of air pollutants in the United States have dropped significantly since 1990 (figure 6)¹⁷:

Carbon Monoxide (CO) 8-Hour, down 73% Lead (Pb) 3-Month Average, down 86% (from 2010) Nitrogen Dioxide (NO2) Annual, down 61% Nitrogen Dioxide (NO2) 1-Hour, down 54% Ozone (O3) 8-Hour, down 25% Particulate Matter 10 microns (PM10) 24-Hour, down 26% Particulate Matter 2.5 microns (PM2.5) Annual, down 41% (from 2000) Particulate Matter 2.5 microns (PM2.5) 24-Hour, down 30% (from 2000) Sulfur Dioxide (SO2) 1-Hour, down 90%



Figure 6 – EPA National air pollution chart - Air Quality Trends Show Clean Air Progress¹⁷

Pennsylvania is home to five major rivers (Delaware, Susquehanna, Ohio, Allegheny, and Monongahela) and many thousands of tributaries that each have their own history of pollution and subsequent clean up. The good news is that nearly all of these waterways have seen tremendous water quality improvements over the last several decades. Once-polluted waters around the state are now home to fishing tournaments like the annual event in Pittsburgh that features fishing in all three of Pittsburgh's famous rivers — once infamously contaminated.

Some rivers and streams remain hopelessly polluted by acid mine drainage that thwarts remediation efforts, but the overarching story is one of steadily improving water quality that we should all be proud of.

The PA DEP shines the light of success on the Susquehanna River in their report¹⁸ titled *"The Susquehanna River Story: Pennsylvania's Chronicle."* This story details the successful efforts to clean up a polluted river that, as recently as 2005, led to disease-related deaths of young smallmouth bass.

The claim that Pennsylvania's air and water quality are declining is shown to be factually incorrect and divorced from reality.

Fact check on worsening air and water quality: False and misleading

Claim #5 – Rising sea level to cause more flooding in southeastern Pennsylvania

According to the 2018 Climate Assessment, the Delaware River Basin communities (including the city of Philadelphia) can expect more frequent flooding and associated disruptions due to sea level rise that presumably is caused by anthropogenic warming. Fortunately, we have very good data available that should be a relief to citizens of those communities.

Relative Sea Level (RSL) measures both sea-level rise and geologic down warping. RSL at the tide gauge in Philadelphia shows a rise of 12 inches over the last century¹⁹ (0.12 inches/year) at a remarkably even rate (figure 7).



Figure 7 – Relative sea level at Philadelphia harbor¹⁹

A small amount — about 2 inches of that sea level rise — is due to the long-term downward movement of the land mass in the Philadelphia area as measured by a station some six miles to the north of the tide gauge and anchored on bedrock. The downward movement measured here is likely due to well-documented isostatic rebound along the eastern seaboard responding to glacial melt at the end of the last ice advance.

The tide gauge itself is built on land that was created by filling in the waterfront. It is attached to a wooden sea wall of questionable stability (figure 8) at the local Coast Guard station. Both of these issues may lead to an additional 2 inches of subsidence due to compaction and settling of the fill used to create the waterfront.

Since long-term sea-level rise has been steady over the last 150 years, if we extrapolate the same trend back to the founding of the port it is likely that Philadelphia has seen between 24 and 30 inches of relative Sea Level Rise over the last 250 years.

Over that same 250 years, in spite of the over 2 feet of relative sea level rise, Philadelphia has not suffered any disaster from rising seas but rather Philadelphia has prospered, and the Delaware River port complex has become one of the largest shipping areas in the United States.



Figure 8 – Positioning of tide gauge at the port of Philadelphia located on wharf and subsiding land fill and location of elevation measuring station

When dealing with slowly occurring changes over long periods of time, such as has been the case with rising relative sea level at Philadelphia, adaptation is often the most appropriate response. Philadelphia has obviously successfully adapted to the last 150 years of relative sea level rise already.

Global sea levels have been rising for over 200 years, long before we began adding prodigious amounts of CO_2 to the atmosphere in the mid-20th century, and they are likely to continue to do so whether RGGI is adopted or rejected. Having successfully, if unwittingly, already adapted to >200 years of rising sea levels, Philadelphia, with modern technology and capabilities, can expect to easily adapt to the projected 6 to 8 inches of rise expected between now and 2100.

Claim #6 - Pennsylvania's farm sector will be harmed

The 2018 Pennsylvania Action Plan forecasts future harm to the agricultural and dairy sector because of man-made climate change and makes recommendations for how dairymen and farmers can adapt to their predicted crises. Is that the case? Are we seeing indications that this sector has been impacted negatively?

While focusing on perceived negative consequences and predictions of doom, the Climate Action Plan ignores the many benefits that are accruing to our ecosystems and agriculture from modestly rising temperatures, increase in precipitation and increasing CO₂. Contrary to predictions of looming famine in the Keystone State, facts on the ground present a story of agricultural bounty and steady increases in production.

Agricultural production in Pennsylvania and around the world continue to break records year after year. The increase in temperature results in longer growing seasons. Killing frosts end earlier in the spring and arrive later in the fall, leading to more plantings and harvests.

The benefits of warming are turbocharged by the CO_2 fertilization effect which enhances crop and foliage growth significantly. According to laboratory studies by Dr. Craig Idso, a 300 parts-per-million increase in atmospheric CO_2 will lead to an astounding average increase of 46% in crop biomass.

Corn is, by far, the largest agricultural product in Pennsylvania, with more than 15,000 farms growing it to use as a grain and for silage. Figure 9^{20, 21} reveals a stunning relationship between corn yield per acre and increasing global carbon emissions.



Figure 9 – Corn yield and carbon emissions^{20, 21}

In Pennsylvania, both corn yields in tons per acre (figure 10)²² and milk yields in pounds per cow (figure 11)²³ are improving year after year.



Figure 10 – Corn silage is steadily increasing in yield per acre



Figure 11 – Milk yield is steadily increasing in pounds per cow

The facts from down on the farm paint an entirely different picture than that presented by the Climate Action Plan. By every metric, the dairy and agricultural sectors are thriving and improving with no end in sight.

Summary – There is no climate crisis and no need for RGGI

The Wolf administration relies on factually incorrect assertions of ongoing and future harm from CO₂-driven warming. Historical data show predictions of increased flooding, drought, heat waves, health risks and more to be blatant fearmongering meant to advance a destructive anti-science agenda. Instead of relying on climate misinformation to support the imposition of a program that would destroy Pennsylvania's billion-dollar fossil fuel industry and tens of thousands of associated jobs, the government bodies tasked with review of RGGI should "follow the science" and reject this economically crippling program.

Analysis of Wolf Administration's Flawed Use of Climate and CO,-Emission Models

Dr. Patrick J. Michaels Senior Fellow, CO2 Coalition and Competitive Enterprise Institute

Governor Wolf's Executive Order 2019-7 on addressing climate change in Pennsylvania is largely based upon the 2018 Pennsylvania Climate Action Plan. Therefore, my analysis is about that plan. It suffers from serious problems that call into question the basis for the Governor's Order.

The 2018 Pennsylvania Climate Action Plan [PCAP] is a document that theoretically is based on the best available science and is being used as the basis for sweeping and extensive regulation of the emissions of greenhouse gases—mainly carbon dioxide and methane—from the Commonwealth of Pennsylvania.

My comments on it are largely along three lines;

- 1. The validity of the climate models that serve as its basis, and
- 2. The validity of the emission assumptions that underpin the plan, and
- 3. The amount of warming and sea level rise mitigated if Pennsylvania emissions from electricity generation were completely curtailed in the beginning of this century.

It will be demonstrated that, in general, these models simply do not work when simulating climate changes in recent decades, and that the emission assumption, known as "RCP 8.5" is now recognized to be a gross exaggeration of changes in the atmosphere of the future. In combination, use of the only working climate model (see below) and

a more likely emissions scenario *negates the credibility of the Pennsylvania Climate Action Plan report*. (RCP means "representative concentration pathway" and the 8.5 is the change of downwelling energy, in this case 8.5 watts per square meter, that pathway would produce.)

I'll begin with the observed behavior of the atmosphere versus model predictions in recent decades. The underlying data and the enclosed illustration were readily available at the time PCAP was published. The fact that they were ignored casts substantial doubt on the scientific credibility of the PCAP document.

Figure 12 shows the predicted and observed average tropospheric temperature over the tropics. Predictions are the U.S. Department of Energy's fifth Coupled Model Intercomparison Project (CMIP-5) model suite data that was readily available at the KNMI Climate Explorer site.²⁴

A careful look at Figure 12 reveals that only one of the 102 model runs correctly simulates what has been observed. This is the Russian climate model INM-CM4, which also has the least prospective warming of all of them, with an equilibrium climate sensitivity (ECS) of 2.05°C, compared to the CMIP-5 average of 3.2°C.

If PCAP followed best scientific practice, it would use this model along with a more realistic projection of future emissions than it used (see below). This is similar to what operational meteorologists do every day. They generally *don't* take all the available daily forecast models and average them up, as some perform better or worse depending upon the daily weather situation. Instead, they rely on the one(s) that perform the best.

Had PCAP followed this best practice, its projected 2000-2050 statewide average warming would drop from 5.4° F to 3.3° , a reduction of 40%.

Christy and McNider (2017)²⁵, in a paper readily available to the PCAP writing team, further demonstrated that the models are predicting several *times* more warming at altitude in the tropics than is being observed.



Figure 12. Solid red line—average of all the CMIP-5 climate models available at the time PCAP was written; Thin colored lines—individual CMIP-5 models; solid figures—weather balloon, satellite, and reanalysis data for the tropical troposphere. Source: Christy, J.R.: 2017, [in "State of the Climate 2016"], Bull. Amer. Meteor. Soc. 98, (8), S16-S17. DOI:1-.1175/2017BAMSStateoftheClimate.I.

The implications of this error are manifold, as a substantial amount of moisture that falls as precipitation over Pennsylvania originates in the tropics. The amount that enters the air is determined by the temperature contrast between the surface and the upper reaches of the lower atmosphere. Getting this wrong (with too little contrast) means that precipitation forecasts for Pennsylvania are systematically underestimated in the PCAP.

In summary, on this point, it is clear that had PCAP used the working climate model and a realistic emissions scenario (see below) that it would have forecast less than half the warming that it did, likely rendering the issue much less frightening, with adaptation (which is already occurring) the most likely response, rather than a wholesale re-ordering of the lives of the Commonwealth's citizens.

As important as it is to follow best scientific practice in modeling and forecasting tomorrow's weather, it is even more vitally important to use the best assumed future emissions pathway when basing important policy decisions on that model. -On page 5, PCAP states:

"This report adopts the Representative Concentration Pathway 8.5 (RCP 8.5). This pathway is the one that the world is currently on and is one of two emissions pathways adopted by a large number of climate modeling groups."

RCP 8.5 is the most extreme emissions scenario employed in the most recent (2013) comprehensive report of the United Nations' Intergovernmental Panel on Climate Change (IPCC). Since the publication of PCAP in 2018, the use of RCP 8.5 has been roundly criticized.

In 2020, Zeke Hausfather and Glen Peters published an article²⁶ in the prestigious journal *Nature* which began with the blunt statement, "Stop using the worst-case scenario for climate warming as the most likely outcome — more realistic baselines make for better policy."

According to Hausfather and Peters, RCP 8.5 "paints a dystopian future that is fossilfuel intensive and excludes any climate mitigation policies, leading to nearly 5°C of warming by the end of the century."

Sole reliance on RCP 8.5 invites strong criticism because of its unreality. Hausfather and Peters note that "Emission pathways to get to RCP 8.5 generally require an unprecedented fivefold increase in coal use by the end of the century, an amount larger than some estimates of recoverable coal reserves."

They conclude that "We must all — from physical scientists and climate-impact modelers to communicators and policymakers — stop presenting the worst-case scenario as the most likely one." This includes the authors of the PCAP.

A sidebar, shown below, in the Hausfather and Peters article intercompares the various emissions scenarios, finding that the latest version of RCP 8.5 (called here "SSP5-8.5) in the upcoming (2022) IPCC Sixth Assessment report to be **Highly unlikely** and often wrongly used as 'business as usual' [emphasis in original].



Figure 13. Sidebar showing various emissions pathways that accompanied the 2020 Nature article by Hausfather and Peters. Source: Hausfather, Z., and M. Peters, Nature, Vol 577, 618-620.

This strong language applies to the PCAP. As Hausfather told the BBC concerning his work, RCP 8.5 is "exceedingly unlikely."

As shown in Figure 13, the likely scenario, given policies that already exist, is an RCP value of between 4 and 6, instead of 8.5. This would reduce prospective warming by between 30 and 50%, as warming rises linearly with the RCP value. Using the most conservative version of the correct RCP value reduces warming another 1.6°F, leaving a remainder from 2000-2050 of 1.7°F, a far cry from the original PCAP value of 5.4°.

As a thought experiment, suppose that Pennsylvania ceased any carbon dioxide emissions from electricity generation a decade ago. The EPA's Model for the Assessment of Greenhouse-Gas Induced Climate Change²⁷ (the acronym *is* MAGICC) is the standard tool used to assess the climate impacts of any emissions reductions. Using its standard assumption of an equilibrium climate sensitivity of 3.0°C, the amount of warming that zero electricity generation emissions from Pennsylvania would mitigate by 2050 is 0.04°F and the amount of sea-level rise mitigated is 0.002 (two-thousandths) of an inch. Both are well below our ability to even measure.

Summary of Comments

Using the model that works, the Russian INM-CM4, reduces prospective warming by 60%. Using the likely emissions pathway reduces this further by 30%, ultimately reducing the 2000-2050 warming from 5.4° to 1.7°F, or approximately one degree Celsius. The amount of warming and sea-level rise mitigated by Pennsylvania under any circumstance could not be measured by 2050 (or 2100, for that matter). The Pennsylvania Climate Action Plan report, which serves as the basis for Governor Wolf's Executive Order 2019-07, needs to be dramatically revised, and should no longer be used as the basis for any policy proposals in its present form.

Analysis of Economic and Environmental Impact of Wolf Administration's RGGI Proposal

David T. Stevenson Director of the Center for Energy & Environment, Caesar Rodney Institute

Governor Wolf is dragging Pennsylvania into a regional carbon cap tax and trade scheme without legislative approval. In fact, for a second time the legislature is likely to pass a bill banning participation in the Regional Greenhouse Gas Initiative (RGGI).

Eleven Mid-Atlantic and New England states participate, and every state joined through legislative approval, not executive action that doesn't reflect the will of the people. To justify his action a report titled, "Pennsylvania RGGI Modeling Report"²⁸ was prepared to demonstrate RGGI would reduce carbon dioxide emissions while boosting the economy and lowering electric rates. The assumptions used in the report are flawed as are the forecasted outcomes. Using information learned from the decade old RGGI program it is clear emissions will not be reduced globally, electric rates will rise, and there will be billions of dollars of economic damage if Pennsylvania joins RGGI.

RGGI hasn't worked

My peer reviewed study, "A Review of the Regional Greenhouse Gas Initiative,"²⁹ came to the same conclusion as the Congressional Research Service, "The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress."³⁰ Emissions from electric generation have been falling for a decade because of the switch from coal to lower emitting natural gas that is less expensive, EPA regulations that led to coal plant closures, and the addition of non-emitting wind and solar power. RGGI and non-RGGI states had similar reductions in emissions, after adjusting for RGGI state exporting of emissions through generating less power in-state³¹ and exporting energy intense manufacturing jobs³² to other states. Table 1 shows the changes.

	2007	2019	Change	% Change
RGGI State Electricity Imports Million Megawatt-hours	16.5	56	39.5	239%
PA Electricity Exports Million Megawatt-hours	74.5	83.4	8.9	12%
RGGI State Industrial Electric Demand Million Megawatt-hours	52.4	39.5	-12.8	-24.50%
PA Industrial Electric Demand Million Megawatt-hours	48.6	50.4	1.8	3.80%
RGGI State Real GDP Goods Manufacturing \$ Billions	211.9	193.7	-18.2	-8.60%
PA Real GDP Goods Manufacturing \$ Billions	87	86.2	-0.8	-0.90%

Table 1: PA v. RGGI change in imports/exports, industrial demand

RGGI electricity imports from nine states that have been in the program since 2008 increased from 5% in 2007 to 17% in 2019 essentially exporting their CO_2 emissions. Since imports were primarily from the PJM regional grid we can use the increased electricity imports of 39.5 million megawatt-hours (MWh) times the PJM average Systems Mix³³ for 2019 of 0.39 metric tons of CO_2 /MWh to add 15.4 metric tons to RGGI emissions. Also, high RGGI state electric rates shifted energy intensive businesses out of state with the same effect of exporting CO_2 . The loss of 12.8 million MWh of industrial electric demand times 0.39 tons resulted in shifting 5 million metric tons of CO_2 out of state. Table 2 summarizes the changes showing Pennsylvania reduced emissions 40% compared to RGGI's real reduction of 37%. In short, RGGI didn't work.

State	2007	2019	Change	% Change
РА	129.3	77.4	-51.9	-40%
RGGI	165	84.2	-80.8	-49%
RGGI Adjusted	165	104.6	-60.6	-37.00%

Table 2: PA v. RGGI changes in CO, emissions 2007 to 2019 – millions of metric tons

Pennsylvania electric generation will fall faster than forecast

The state report sets an emission reduction target of 20 million metric tons spread roughly equally by year from 2022 to 2030 (78 million to 58 million). In reality emissions may fall by 46 million tons very rapidly. Pennsylvania participates in the 13 state PJM regional electric grid. Generators bid wholesale power prices in day ahead and hour ahead auctions. The bid that meets the last MWh needed sets the price for all suppliers in that hour of production. Since the cost of the RGGI allowances need to be added to the bids in RGGI states their bids are accepted less often.

Coal-fired power plants emit about a ton of CO₂ for each MWh, while natural gasfired plants emit about 0.38 tons and so are impacted less. Coal-fired power plants in Delaware and Maryland saw operating hours drop 89% with RGGI allowance prices of about \$5.50/ton³⁴, and Delaware natural gas-fired power plants saw a 30% reduction in operating hours. Translating that to Pennsylvania we might expect coal-fired generation to fall from 38 terawatt-hours (TWh) to 5 reducing CO₂ emissions by 33 million tons, and natural gas-fired generation to fall from 98 TWh to 68 reducing emissions by 13 million tons for a total reduction of 46 million tons. Since the latest RGGI auction was priced at \$7.60/ton³⁵ it is expected the loss of 63 TWh of Pennsylvania electric generation would come almost immediately in 2022. Increasing emissions reduction might seem like a good thing. However, the U.S. Energy Information Agency³⁶ expects electric demand to remain stable through 2050 with perhaps a 1% growth. A reduction in generation in Pennsylvania will be met by generation in other non-RGGI PJM states with similar emissions. In fact, the state report discloses the expected 20 million metric ton reduction will be offset by 11 million metric tons of emissions by other PJM states. It is more likely the entire 46 million tons of Pennsylvania reductions will be matched by increases elsewhere.

The cost of lost power generation

The state report shows PJM wholesale electric rates have been averaging \$32/MWh. The loss of 63 TWh of electric generation will cost the state economy \$2 billion a year, or \$18 billion over the 2022 to 2030 period. In addition, using information from the "2020 Pennsylvania Energy Employment Report"³⁷ we can calculate the loss of 515 jobs at coal-fired power plants, and 890 at natural gas-fired power plants, or about 1,400 lost jobs in total.

Less power generation means less fuel consumed. Coal mining may fall 27% (\$800 million, 2795 jobs), and natural gas drilling may fall 3% (\$300 million, 712 jobs). The total loss in fuel production could be \$1.1 billion a year, \$10 billion from 2022 to 2030, and 3500 jobs.

The state report estimates the state economy will grow by 0.02% by 2030 because of RGGI, an amount too small to measure. Lost electric generation, drilling and mining could actually reduce Pennsylvania's \$726 billion economy by 0.4%.

Higher electric rates likely

RGGI allowance cost will be passed along to Pennsylvania electric customers. The state report estimates allowance prices will average about \$5/ton falling to \$4/ton by 2030. RGGI, Inc. itself forecast allowances will gradually rise from about \$8/ton now to \$12 to \$22 by 2030 in nominal dollars³⁸. At \$10/ton and an expected 32 million tons annual emissions, allowance revenue should total \$320 million a year. At \$22/ton the cost would be \$704 million a year. The average cost might be \$500 million a year or almost \$4.5 billion between 2022 and 2030.

The same RGGI analysis indicates the direct higher wholesale costs of electricity in RGGI states in PJM will leak into non-RGGI PJM states with region wide prices rising between \$0.44/MWh to \$2.64/MWh on top of the direct cost of RGGI allowances. With Pennsylvania still producing possibly 163 TWh of electricity a year the added cost might be \$72 million to \$430 million a year, or \$0.6 to \$3.9 billion between 2022 and 2030.

Worst case costs could be as high as \$8.4 billion between 2022 and 2030. With electric demand at about 146 TWh a year the electric bill premium might be \$57.50/ MWh. Residential use is about 10 MW a year so cost to households could be \$575 between 2022 and 2030. However, it is not unusual for a manufacturing business to use 75,000 MWh a year, for a cost between 2022 and 2030 over \$400,000.

Lost manufacturing

The state report suggests the spending of RGGI revenue on wind & solar power generation, energy efficiency, and other emission reduction strategies will add 3,083 jobs. Those allocations of funds can only happen with supporting legislation; otherwise the revenue will probably wind up in the General Fund. Not only is legislative approval unlikely, pending legislation may successfully ban RGGI in Pennsylvania.

As shown in Table 1 RGGI states have experienced an 8.6 % drop in goods manufacturing between 2007 and 2019, compared to only a 0.9% loss of such jobs in Pennsylvania. The 7.7% net loss represents a \$6.6 billion a year loss in Real GDP in Pennsylvania, and 46,600 lost jobs should the Commonwealth face the same experience as the RGGI states. There are a lot of factors that go into the loss of manufacturing jobs including labor, and tax policies. However, energy costs are a big piece of the puzzles especially for highly energy intense industries, such as primary metals, food processing, paper products, petroleum refining, chemicals, and plastics and rubber products. Even limiting the 7.7% potential loss to those energy intense industries the resulting decline would still be \$3.8 billion a year, or \$17 billion between 2022 and 2030 assuming a prorated loss each year, and 17,460 jobs.

Allowance Revenue

The modeling report estimates allowance sale revenue will average \$261 million a year. Using the economic analysis details above in Table 3 below we see the expected allowance revenue will be erased by lost Corporate Income Tax, Personal Income Tax, and Utility Gross Receipts Tax income. Tax revenue will be redistributed with less revenue going to the General Fund. Instead money will be spent subsidizing wind and solar projects which have come down in cost so much that state subsidies are no longer needed, subsidies to the wealthy to buy overpriced electric vehicles, and electric bill offsets for the poor that wouldn't be needed if RGGI didn't exist.

Tax Name	Tax Basis	Annual Tax Revenue
RGGI Allowance		\$261 Million
Corporate Income Tax	\$7.7 billion sales X 6% earnings X 9.99% tax rate X 2 for indirect and induced losses	- \$92 million
Personal Income Tax	22,000 jobs @\$75,000/year X 3.07% tax rate X 2 for indirect and induced losses	- \$102 million
Utility Gross Receipts Tax	\$2 billion sales X 4.4% tax rate	- \$88 million
Total tax losses		- \$282 million

Table 3: Net Tax Revenue average 2022-2030

Summation

Taken together the negative impacts could be:

- RGGI does not lower global emissions, any cut in PA will likely show up in other PJM states as electric demand is expected to remain constant
- Lost electricity sales to other states may total \$2 billion a year, and cost 1,400 electric generation jobs
- Lost coal & natural gas production may total \$1.1 billion a year and cost 3,500 jobs a year
- Electric rates may rise \$0.75 million a year
- Lost energy intense manufacturing jobs from higher electric rates may cost up to \$3.8 billion and 17,460 jobs (7.7%) as happened in RGGI states
- Total loss to the economy could be as high as \$7.7 billion a year, and over 22,000 jobs, with total cost between 2022 and 2030 over \$50 billion
- No net gain in tax revenue

Conclusion

The administration of Governor Wolf attempts to justify Pennsylvania's participation in RGGI with exaggerated predictions of climatic catastrophes resulting from its similarly exaggerated predictions of carbon dioxide emissions and supposedly damaging atmospheric warming. RGGI, the administration claims without regard to past performance, will reduce emissions while boosting the economy and lowering electric rates.

However, analyses of the Wolf proposal by widely respected professionals show that:

- The administration's predictions of floods, droughts, heat waves, pollution risks, destructive sea-level rise and agricultural damage are contradicted by historical data and what science and common sense suggests for the future.
- The administration overestimates future carbon dioxide emissions and atmospheric warming because more than 99 percent of its climate models are flawed and because its assumptions for coal use likely exceed what is even possible.
- The administration's claims of economic benefits ignore RGGI's poor performance in other states over the past decade. A more realistic forecast for Pennsylvania's proposed participation in RGGI is one of billions of dollars in lost gross domestic product, hundreds of millions in tax losses, tens of thousands in job losses, higher electric bills and no environmental benefits.

In short, the administration's economic and environmental justifications for entering RGGI are invalid and its claims of environmental and economic benefits are fiction. RGGI is a purported solution in search of a problem. Even if there were a problem — which there isn't — RGGI's theoretical effects on the environment would be too small to measure, much less solve it.

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