

ENERGY AND CLIMATE: A POLICY PATHWAY FORWARD FOR PENNSYLVANIA

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Energy and Climate: A Policy Pathway Forward for Pennsylvania

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The Pennsylvania Environmental Council (PEC) protects and restores the natural and built environments through innovation, collaboration, education and advocacy. PEC believes in the value of partnerships with the private sector, government, communities and individuals to improve the quality of life for all Pennsylvanians.

Learn more about PEC's energy and climate work at www.pecpa.org/climate

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Introduction

The Pennsylvania Environmental Council (PEC) has been working on the issue of climate change for more than a decade. In 2007, we released a *Pennsylvania Climate Change Roadmap* that called for state and federal action. The *Roadmap* in turn inspired the Pennsylvania Climate Change Act of 2008, which directed the Commonwealth to perform ongoing development of both a Climate Action Plan and Climate Impacts Assessment.

Despite this important work, there has not been agreement on a comprehensive or coordinated approach to reducing emissions in our state – despite overwhelming evidence that failure to do so will only serve to magnify the most severe impacts of climate change and leave Pennsylvania further behind in terms of new energy technology and job growth.

In an effort to help build a workable framework, PEC held a conference in 2017 focused on deep decarbonization of Pennsylvania’s electricity sector. That event was followed by a summary report, stakeholder meetings, and participation in numerous policy hearings and associated efforts over the past two years. Our immediate recommendations from that work are now presented here.

The policies presented in this document represent a fundamental shift in state energy policy. Even so, they are only the first of many steps that will be needed to meaningfully reduce Pennsylvania’s emissions of greenhouse gases. Nonetheless, these recommendations are based on existing mechanisms that are proven, have been utilized in neighboring states, have been shown to generate economic benefits and job growth, can help advance new technologies and businesses, and still achieve significant emission reductions. Equally important, they allow multiple energy resources to be part of the long-term solution, so long as the focus and results remain centered on achieving deep reductions in emissions.

We present these recommendations with a readiness to work with all partners committed to meaningfully addressing the issue of climate change in Pennsylvania.

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Summary

Climate change is a defining issue of our time. It is occurring now and will have devastating consequences, but we have not done remotely enough to address it. Although climate change is a global issue, Pennsylvania has an essential role to play. Achieving deep reductions in greenhouse gas emissions requires consideration of alternative pathways for Pennsylvania's energy future.

2019 will be a pivotal year. Just this month, Governor Wolf announced a non-binding greenhouse gas reduction goal for the state and directed state agencies to pursue a set of emission-reducing strategies. Various state bodies were already in the process of considering efforts to address climate change and to head off the pending closure of zero-carbon nuclear plants. The nuclear issue has to be part of a bigger climate framework that achieves deep decarbonization while ensuring affordable and reliable energy supplies and a healthy economy for the Commonwealth.

The Pennsylvania Environmental Council (PEC) has been considering the challenges and opportunities associated with climate change for more than a decade. While addressing climate change in the Commonwealth will require a range of policy actions for years to come, PEC believes the following policy actions must occur within the next two years. Pennsylvania should:

- Join numerous other states in the Mid-Atlantic and Northeast in the **Regional Greenhouse Gas Initiative (RGGI)**, to begin providing a price signal and generating revenues that can reduce emissions in the electric power sector;
- Reform the Alternative Energy Portfolio Standard (AEPS) into a **Clean Energy Standard (CES)** to further drive zero-carbon electricity generation;
- Collaborate with neighboring states to ensure that the **Transportation and Climate Initiative (TCI)** results in a robust policy proposal (that is then implemented by the Commonwealth) to significantly reduce emissions from the transportation sector;
- Implement other measures and programs to support **energy efficiency, zero-carbon technologies, and carbon sequestration**; and
- Determine how to go beyond these measures to drive bigger, economy-wide reductions through an integrated **carbon pricing mechanism**.

After a brief overview of the need for deep emission reductions, this paper reviews each of these policy options in more detail.

The Need for Deep Reductions in Greenhouse Gas Emissions

The science-based targets in the Paris Agreement — keeping the increase in global average temperature this century to well below 2°C above pre-industrial levels, with the aim of limiting the increase to 1.5°C — are generally recognized as reflecting what is necessary to significantly reduce the risks and impacts of climate change. The world is already experiencing impacts from the current warming of about 1°C, so the 1.5°C and 2°C targets do not necessarily represent what is “safe” — just what will give humanity a meaningful chance of avoiding the worst impacts of climate change.

In October, a special report from the Intergovernmental Panel on Climate Change (IPCC) underscored that unless urgent action is taken to curb greenhouse gas emissions, the most pronounced effects of climate change may be unavoidable.¹ In November, the U.S. Global Change Research Program released the fourth National Climate Assessment, which starkly warned that climate change could imperil U.S. public health, communities, and agriculture, harm the U.S. economy, and lead to hundreds of billions of dollars of costs and damages annually.² In December, the Global Carbon Project — representing scientists from more than 50 academic and research institutions — issued findings that emissions of greenhouse gases are rapidly accelerating globally, outpacing current decarbonization efforts.³ This month, the Rhodium Group released preliminary estimates showing that, after three years of decline, U.S. carbon dioxide (CO₂) emissions rose sharply in 2018 despite record coal plant closures — driven by increased use of natural gas in the power sector, increased demand for diesel and jet fuel in the transportation sector, increased fossil fuel demand in the buildings sector for heating, and increased industrial activity.⁴

Precipitous drops in greenhouse gas emissions need to start now. This means that the global energy system, which has evolved over more than 100 years, needs to fully transform over a matter of decades. (Decarbonization must also go beyond just the energy sector to encompass every facet of the economy.) This is an extremely challenging undertaking. For example, the International Energy Agency (IEA) suggested in 2017 that achieving a 70% reduction in global energy-related CO₂ emissions by midcentury would require: almost 95% of electricity to be low-carbon (compared to less than 33% today); 70% of new cars to be electric (compared to 1%

¹ Intergovernmental Panel on Climate Change, *Global Warming of 1.5°C*, 2018, <https://www.ipcc.ch/sr15/>

² U.S. Global Change Research Program, *Fourth National Climate Assessment: Volume II: Impacts, Risks, and Adaptation in the United States*, 2018, <https://nca2018.globalchange.gov/>

³ Global Carbon Project, *Carbon budget and trends 2018*, 2018, <http://www.globalcarbonproject.org/carbonbudget/>

⁴ Rhodium Group, *Preliminary US Emissions Estimates for 2018*, Jan. 8, 2019, <https://rhg.com/research/preliminary-us-emissions-estimates-for-2018/>

today); retrofitting the entire existing building stock; an 80% reduction in CO₂ intensity in the industrial sector; fossil fuels accounting for about half of the energy demand they are responsible for today; and annual energy-sector investments of \$3.5 trillion (twice today's levels), including increased investments in renewables, nuclear power, carbon capture and storage (CCS), and transmission and distribution grids. The IEA analysis also suggested that such a deep transformation of the energy sector requires serious policy support, including rapidly phasing out fossil fuel subsidies, increasing carbon prices, extensive electricity market reforms to integrate renewables, and strong low-carbon and energy efficiency mandates.⁵

Key Steps Pennsylvania Should Take

It is apparent that there will be little leadership at the federal level in the near term to address climate change. It is therefore up to states, cities, corporations, and individuals to get the work done. Particularly in the current national political environment, bottom-up action will be needed to show what is achievable, rebuild the political center, and change the political conversation on clean energy and climate change to enable the national-level policies that will ultimately be needed.

All actors – particularly major emitters – have to do their part. Among U.S. states, Pennsylvania was the fourth-largest carbon dioxide emitter in 2016,⁶ with more than 37% of the Commonwealth's energy-related emissions coming from the electric power sector, about 28% coming from the transportation sector, about 21% coming from the industrial sector, and smaller amounts coming from the residential and commercial sectors.⁷

PEC has been considering the challenges and opportunities associated with climate change for more than a decade, going back to our 2007 *Pennsylvania Climate Change Roadmap* that helped lead the state toward enacting its own planning efforts to understand the issue.⁸ In 2017, PEC held a conference on deep decarbonization of the state's electricity sector, leading to a report that highlighted a number of policy options.⁹ This was followed by a number of stakeholder meetings to vet these options and help formulate a path forward for Pennsylvania.

⁵ International Energy Agency, *Deep energy transformation needed by 2050 to limit rise in global temperature*, Mar. 20, 2017, <https://www.iea.org/newsroom/news/2017/march/deep-energy-transformation-needed-by-2050-to-limit-rise-in-global-temperature.html>

⁶ U.S. Energy Information Administration, *Rankings: Total Carbon Dioxide Emissions, 2016*, <https://www.eia.gov/state/rankings/?sid=PA#series/226>

⁷ U.S. Energy Information Administration, *Pennsylvania Carbon Dioxide Emissions from Fossil Fuel Consumption (1980-2016)*, <https://www.eia.gov/environment/emissions/state/excel/pennsylvania.xlsx>

⁸ Pennsylvania Environmental Council, *Pennsylvania Climate Change Roadmap*, June 2007, <https://pecpa.org/resources/climate-change-roadmap/>

⁹ Pennsylvania Environmental Council, *Achieving Deep Carbon Reductions: Paths for Pennsylvania's Electricity Future*, June 2017, <http://www.pec-climate.org/s/PEC-Deep-Carbon-Reductions-Report-FINAL-June-2017.pdf>

While deep decarbonization will be a decades-long effort, the key is to do what is achievable now that gets humanity at least on the right trajectory towards that end goal. There is no need to over-commit to any particular policy or technology now; politics and technologies will change, but the end goal and commitment must be clear. Pennsylvania has redefined its role in the energy world before. At various times in its history, Pennsylvania's economy, and many of its communities, have centered around oil, coal, or natural gas. There is no reason Pennsylvania could not redefine itself again to be a leader in zero-carbon energy, if it can muster the political will and vision. Pennsylvania (and the United States) can help lead the new world economy – or can fall further behind.

The good news is that there is a lot that can be done – and done in a way that will have benefits far beyond the singular objective of avoiding the worst of future climate impacts. For Pennsylvania and the United States as a whole, deep decarbonization is an environmental issue, a jobs issue, an economic issue, and an energy security issue.

This month, Governor Wolf announced a non-binding greenhouse gas reduction goal for the state and directed state agencies to pursue a set of emission-reducing strategies. This is an excellent beginning, but much more is needed. PEC believes the following suite of state policy actions – setting a firm commitment to carbon reductions and targeting the largest sources of emissions in the Commonwealth – must occur within the next two years (within the timeframe of the 2019-2020 legislative session):

(1) Join numerous other states in the Mid-Atlantic and Northeast in the Regional Greenhouse Gas Initiative (RGGI), to begin providing a price signal and generating revenues that can reduce emissions in the electric power sector.

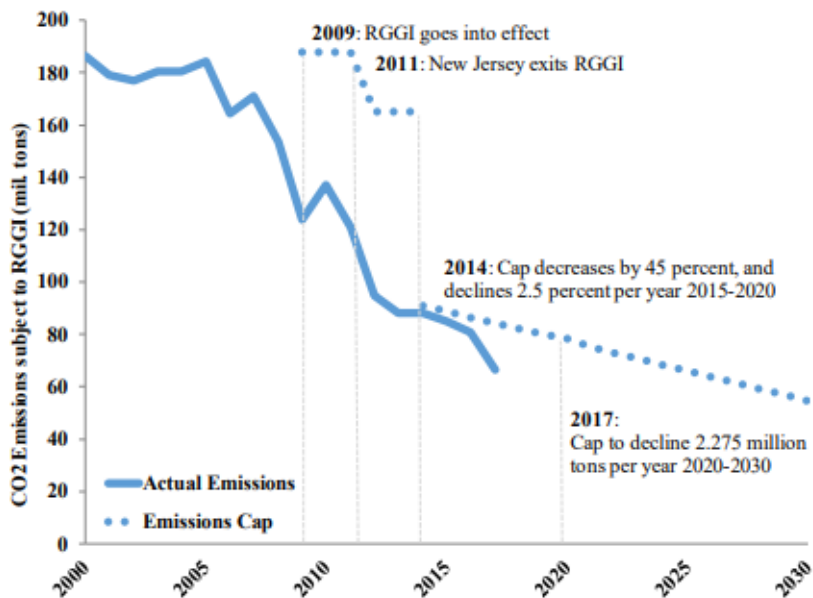
RGGI is a multi-state, market-driven program to reduce carbon emissions in the electric power sector.¹⁰ It is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO₂ emissions in the sector, and both Virginia and New Jersey have begun the process of joining RGGI. Fossil-fuel-fired power generators with a capacity of 25 megawatts or more in RGGI states are required to hold allowances equal to their CO₂ emissions. Regulated power plants can use an allowance issued by any participating RGGI state to show compliance, and they can acquire allowances from regular regional auctions or through secondary markets.

Assisted by low natural gas and renewable energy prices, RGGI has helped spur emission reductions and provided significant economic revenues for participating states. Annual emissions from the sector in the RGGI states have dropped by more than half since RGGI launched in 2009 (due both to RGGI and broader economic and

¹⁰ Regional Greenhouse Gas Initiative, <https://www.rggi.org/>

energy industry factors), and the RGGI cap will continue declining through 2030. Since RGGI’s launch in 2009, almost all of the nearly \$3 billion in proceeds from allowance auctions has gone back into state coffers to be used for energy efficiency programs, renewable energy projects, consumer bill assistance, job training, and more. From 2015-17, RGGI caused \$1.4 billion of net positive economic activity in the participating states, with net benefits for each state’s consumers and economy, as well as thousands of new jobs.¹¹

Actual CO₂ Emissions in the RGGI States and Evolution of the RGGI CO₂ Emissions Cap



Source: The Analysis Group (2018), based on data from RGGI, Inc.

Particularly once Virginia and New Jersey join RGGI, there will be a Pennsylvania-shaped hole in the RGGI map. Pennsylvania has been an observer of the RGGI program, but it has yet to become a member state. Joining RGGI would allow the Commonwealth to begin providing a price signal and generating revenues that can reduce emissions in the electric power sector, while boosting the local economy, helping consumers, and creating jobs.

While RGGI is a proven mechanism, careful consideration will be required as to how Pennsylvania would join – given the state’s considerable role as an energy producer, adjustments might need to be made to the regional program. In addition, to help address emissions leakage, Pennsylvania should pursue creating a carbon border adjustment – or pushing for a regional one throughout PJM. This kind of regulatory pricing mechanism would ensure that electricity used and/or generated in Pennsylvania and neighboring states is priced equally despite differing (or a lack of) carbon

¹¹ Analysis Group, *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States*, Apr. 17, 2018, https://www.analysisgroup.com/globalassets/uploadedfiles/content/insights/publishing/analysis_group_rggi_report_april_2018.pdf

regulations, thereby helping to ensure that reduced fossil generation in Pennsylvania would not simply be offset by associated increases in other states.

The Commonwealth will also need to prudently utilize revenues derived from participation in RGGI to help address potential consumer impacts, job transitioning, and expanded investment in renewables deployment, grid modernization, efficiency measures, and other beneficial programs.

(2) Reform the Alternative Energy Portfolio Standard (AEPS) into a Clean Energy Standard (CES) to further drive zero-carbon electricity generation.

Pennsylvania has to grapple with changes to the AEPS soon one way or another, given debates about solar power, nuclear power, and more. The Commonwealth should take this opportunity to reform the AEPS into a Clean Energy Standard to further drive zero-carbon generation.

Unlike the current AEPS in Pennsylvania, a CES would be focused on achieving zero-carbon energy. Unlike other states' Renewable Energy Standards (or Renewable Portfolio Standards), a CES would also be more technology-inclusive. In addition to renewables, this could include technologies such as existing and new nuclear plants, as well as fossil-fuel-fired plants with carbon capture and storage.

Other states have begun to expand their RPSs into CESs, including in the region. Massachusetts, for instance, recently promulgated regulations creating a CES that requires retail sellers to have a specified percentage of clean generation, starting at 16% in 2018 and rising to 80% by 2050. Massachusetts allows the CES to be met by renewables or by any generation unit that has net lifecycle greenhouse gas emissions 50% lower than those of a new combined cycle natural gas plant (as long as that generation unit was put into operation after 2010 – which excludes its existing nuclear plant).¹² Ohio's AEPS allows for up to half of the overall goal (25% by 2024) to be met with "advanced energy resources", including advanced (but not existing) nuclear.¹³ New York has a CES of sorts, combining a 50% by 2030 renewables standard with a zero-emissions credit (ZEC) requirement to support existing nuclear plants.¹⁴ Governor Cuomo in New York recently announced his proposal to raise the renewables standard to 70% by 2030 and to require that the state's electricity be 100% zero-carbon by 2040.¹⁵ Outside the region, California in 2018 enacted a law raising the RPS target to

¹² Code of Massachusetts Regulations, 310 CMR 7.75, <https://www.mass.gov/files/documents/2019/01/02/310cmr07.pdf>

¹³ Ohio Administrative Code, Chapter 4901:1-40, <http://codes.ohio.gov/oac/4901%3A1-40>

¹⁴ New York State Energy Research and Development Authority, *Clean Energy Standard* website, <https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard>

¹⁵ Governor Andrew M. Cuomo, State of New York, *Governor Cuomo Announces Green New Deal Included in 2019 Executive Budget*, Press Release, Jan. 17, 2019, <https://www.governor.ny.gov/news/governor-cuomo-announces-green-new-deal-included-2019-executive-budget>

60% by 2030 and establishing a state policy goal of getting 100% of the state's electricity from "eligible renewable energy resources and zero-carbon resources" by 2045.¹⁶

Pennsylvania should pair targeted emission reductions in the electric power sector (i.e., from joining RGGI) with a CES, replacing and improving the current AEPS to more effectively promote investments in low-carbon energy technologies. This Clean Energy Standard should be centered on a target to achieve a 100% zero-carbon electricity supply before 2050. Specifically, the Pennsylvania CES should include the following components:

- **Tier I: Zero-Carbon Renewables** – Expand the minimum Tier I market requirements for renewables, with greater targets for both in-state solar and PJM-region wind. These requirements should be ambitious, but also based on realistic projections given technology and capacity. The targets should steadily increase over time.
- **Tier II: All Zero-Carbon** – Create a revised Tier II requirement that can be met by any zero-carbon sources, including renewables, existing nuclear, advanced nuclear, and fossil-fuel-fired plants with 100% CCS. These sources should be allowed to help meet Tier I requirements in the event there is insufficient renewable generation capacity available.
- **Tier III: Lower-Carbon** – As a transitional measure, create a new Tier III that includes any generation sources that have emissions per MWh below a regularly tightening maximum rate. The tightening rate means that qualification for Tier III gets increasingly stringent over time, and before 2050, Tier III should be completely eliminated.

Waste coal generation does not need to be included in a Clean Energy Standard. Dealing with waste coal in Pennsylvania is an important issue with real environmental ramifications, and it should be addressed, but not as a preferred generation source.

(3) Collaborate with neighboring states to ensure that the Transportation and Climate Initiative (TCI) results in a robust policy proposal (that is then implemented by the Commonwealth) to significantly reduce emissions from the transportation sector.

Pennsylvania is a member of the Transportation and Climate Initiative, a regional collaboration of Northeast and Mid-Atlantic states and the District of Columbia that seeks to improve transportation, develop the clean energy economy, and reduce carbon emissions from the transportation sector. In December, the TCI coalition of

¹⁶ California SB100, 2018, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

states announced their intent to design a new regional low-carbon transportation policy proposal that would cap and reduce carbon emissions from the combustion of transportation fuels and invest proceeds from the program into low-carbon and more resilient transportation infrastructure. The participating TCI jurisdictions plan to complete the regional policy design process by the end of 2019, after which each jurisdiction will decide whether and how to adopt and implement the policy.¹⁷

As the second-largest source of greenhouse gas emissions in the Commonwealth (and the largest source in the country), it is imperative to have a robust policy to tackle emissions from the transportation sector. Pennsylvania DOT and DEP must work this year to ensure that the TCI policy design proposal is capable of achieving significant emission reductions. If the key driver of reductions will be a cap, that cap must be sufficiently stringent. If the key driver will be investment in transportation infrastructure, then the policy must be designed to ensure generation of sufficient revenues for reinvestment. Once the regional policy design process is complete, the Commonwealth must then expeditiously initiate and complete the process of adopting and implementing the agreed upon mechanism.

In addition, the Commonwealth should pursue additional complementary policies – such as promoting electric vehicle infrastructure and the development of alternative low-carbon fuels – to achieve emission reductions in the transportation sector.

(4) Implement other measures and programs to support energy efficiency, zero-carbon technologies, and carbon sequestration.

In addition to these regulatory approaches to achieving emission reductions in the electric power and transportation sectors, the Commonwealth should pursue measures to incentivize additional actions and technological developments in these sectors and beyond, including the following:

- Pennsylvania should create or enhance tax credits or other financial incentives for energy efficiency and energy reduction, as well as expand existing Act 129 energy efficiency programs and weatherization programs. In the 2018 ranking of states by the American Council for an Energy-Efficient Economy (ACEEE), Pennsylvania came in 18th and received only 3.5 out of 20 possible points regarding utility efficiency.¹⁸ The Commonwealth can do better.
- Pennsylvania should adopt measures to promote community solar and grid modernization, both of which can boost resilience and consumer choice while

¹⁷ Transportation & Climate Initiative of the Northeast and Mid-Atlantic States, *Transportation & Climate Initiative Statement*, Dec. 18, 2018, https://www.georgetownclimate.org/files/Final_TCI-statement_20181218_formatted.pdf

¹⁸ American Council for an Energy-Efficient Economy, *State and Local Policy Database: Pennsylvania*, last updated July 2018, <https://database.aceee.org/state/pennsylvania>

enabling emission reductions. Many states have adopted policies promoting community solar – local solar facilities shared by several subscribers who receive credit on their electricity bills – as a way to create access to solar for more people (e.g., renters, those without suitable roof space).¹⁹ As of Q3 2018, almost 1.3 GW of community solar had been installed in the United States.²⁰ Several states, including Ohio, New York, and Rhode Island, are also pursuing initiatives to modernize their grids and utility regulations in light of new technologies and consumer demands.²¹ The Commonwealth should join them.

- The Commonwealth should create or enhance tax credits or other financial incentives for installation of distributed renewables, distributed energy storage, and quantifiable carbon capture technologies (whether paired with sequestration or utilization) at industrial and commercial facilities in Pennsylvania. Maryland, for instance, in 2018 became the first state to launch an energy storage tax credit.²² Regarding CCS, the federal 45Q tax credit for carbon capture, utilization, and storage was extended and expanded by Congress in February 2018.²³ Pennsylvania should enact complementary incentives to attract greater private investment in carbon capture and other emission-reducing projects in the state.
- Pennsylvania should consider promoting retrofits at one of the state’s biomass plants to convert it into a bioenergy with carbon capture and storage (BECCS) plant. Most deep decarbonization pathways recognize the need for “negative emissions”, such as using biomass power or biofuels (the feedstocks for which absorb CO₂ while growing) and then capturing and sequestering the emissions.²⁴ There is currently one biofuels BECCS plant in the United States – an Archer Daniels Midland plant in Illinois.²⁵ Pennsylvania has both available biomass for use in bioenergy and suitable geologic storage sites for CO₂, which means it

¹⁹ National Conference of State Legislatures, *State Policies for Shared Renewable Energy*, Nov. 21, 2017, <http://www.ncsl.org/research/energy/state-policies-for-shared-renewable-energy.aspx>

²⁰ Solar Energy Industries Association, *Community Solar* website, updated Q3 2018, <https://www.seia.org/initiatives/community-solar>

²¹ GridWise Alliance, *Grid Modernization Index 4*, Nov. 2017, <https://cleandedge.com/reports/4th-Grid-Modernization-Index>

²² Robert Walton, *Maryland is first state to launch energy storage tax credit*, Utility Dive, Feb. 13, 2018, <https://www.utilitydive.com/news/maryland-is-first-state-to-launch-energy-storage-tax-credit/517011/>

²³ 26 USC 45Q,

<http://uscode.house.gov/view.xhtml?req=%28title:26%20section:45Q%20edition:prelim%29>

²⁴ E.g., The White House, *United States Mid-Century Strategy for Deep Decarbonization*, Nov. 2016, https://obamawhitehouse.archives.gov/sites/default/files/docs/mid_century_strategy_report-final.pdf

²⁵ Chris Mooney, *The world needs to store billions of tons of carbon. It could start in a surprising place.*, The Washington Post, Apr. 23, 2018, <https://www.washingtonpost.com/news/energy-environment/wp/2018/04/23/the-world-needs-to-store-billions-of-tons-of-carbon-it-could-start-off-in-a-surprising-place/>

could be a good location for jumpstarting deployment of the technology.²⁶

- Pennsylvania should enhance the use of its procurement authority to buy materials with low-carbon footprints. The Commonwealth already has a Green Procurement policy that encourages state procurement of products or services that, among other things, minimize greenhouse gases.²⁷ Gov. Wolf’s recent executive order directs the GreenGov Council to “encourage the incorporation of environmentally sustainable practices into the Commonwealth government’s ... procurement” and directs the Department of General Services to “[c]oordinate with all agencies to include green building, energy conservation, and energy efficiency practices as part of any new construction and renovation projects.” The state should go beyond this. For example, the Buy Clean California legislation (enacted in 2017) directs the establishment of maximum global warming potential standards for construction materials such as steel and glass to be used in public works projects.²⁸ Pennsylvania could pursue a similar approach, with a potentially broader list of materials (e.g., cement and concrete).
- The state should consider leveraging its resources to help bring zero-carbon technologies to commercial readiness, such as with an investment program in research and development for renewable, advanced nuclear, carbon capture, and carbon utilization technologies,²⁹ which will support businesses and job creation in Pennsylvania. Pennsylvania is especially well-situated to serve as an innovation and commercial hub for the use of gas with CCS to produce low-carbon electricity and zero-carbon fuels for transport and industry, considering the state’s substantial low-cost natural gas endowment. The Commonwealth does not need to create a standalone energy R&D agency (much less one on the scale of NYSERDA in New York), but the Governor’s office should convene a working group to make recommendations for how best to formulate and direct a state-sponsored zero-carbon R&D program, perhaps with targeted grants to Pennsylvania university research centers.

²⁶ *New maps pinpoint the potential for BECCS across the US*, Carbon Brief, Mar. 12, 2018, <https://www.carbonbrief.org/new-maps-pinpoint-potential-beccs-across-us>

²⁷ Part I, Chapter 22: “Green” Procurement, Sept. 2011, <https://www.dgs.pa.gov/Documents/Procurement%20Forms/Handbook/Pt1/Pt%20I%20Ch%2022%20Green%20Procurement.pdf>

²⁸ Buy Clean California Act, Public Contract Code § 3500-3505, 2017, https://leginfo.ca.gov/faces/codes_displayText.xhtml?division=2.&chapter=3.&part=1.&lawCode=PCC&article=5.

²⁹ For example, in October, the National Academies of Sciences, Engineering, and Medicine outlined a research agenda for improving the commercial viability of carbon utilization technologies. The National Academies of Sciences, Engineering, and Medicine, *‘Carbon Utilization’ Technologies Could Reduce Emissions by Turning Greenhouse Gases Into Useful Products; New Report Identifies R&D to Make Technologies More Commercially Viable*, Press Release, Oct. 18, 2018, <http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=25232>

- Pennsylvania should explore increasing its efforts to promote the use of biochar and other practices (e.g., cover crops) that can enhance soil carbon sequestration and improve agricultural productivity in the Commonwealth. In 2018, Hawaii enacted a law establishing a Greenhouse Gas Sequestration Task Force within the Office of Planning that, among other things, will seek to identify and develop incentives and funding mechanisms to promote practices and policies that increase greenhouse gas sequestration and build healthy soils.³⁰ Similarly, in 2017, Maryland enacted a law establishing the Maryland Healthy Soils Program to promote practices and provide incentives to farmers to increase biological activity and carbon sequestration in the state's soils.³¹ Pennsylvania should explore similar measures to support both its climate goals and its farmers, such as through the newly announced High Performance Farms Initiative.

Additional regulatory measures will also be needed, such as regulating existing sources of methane. Gov. Wolf has launched an effort to reduce methane emissions from the oil and gas sector in the Commonwealth, including regulations last year for new wells. PEC encourages the Governor to issue the rules for existing wells soon.

(5) Determine how to go beyond these measures to drive bigger, economy-wide reductions through an integrated carbon pricing mechanism.

The measures above will begin to make real strides in reducing emissions, particularly from the electricity and transportation sectors – the two sectors contributing the most greenhouse gas emissions.

Modeling commissioned by PEC suggests, for example, that even a low carbon price combined with a Clean Energy Standard could help push Pennsylvania's power sector carbon emissions down more than 30% from business-as-usual levels by 2030 and generate more than \$200 million in annual revenue, with a small rate impact on residential customers. More will be needed, though, to further reduce emissions in Pennsylvania and the region.

Many experts agree that carbon pricing is a key part of a deep decarbonization policy portfolio.³² The market tends to treat things that are priceless as valueless; markets

³⁰ State of Hawaii, Office of Planning, *Greenhouse Gas Sequestration Task Force* website, <http://planning.hawaii.gov/carbon-farming-task-force/>

³¹ Maryland HB 1063, 2017, <http://mgaleg.maryland.gov/webmga/frmMain.aspx?pid=billpage&tab=subject3&id=hb1063&stab=01&ys=2017RS>

³² Brad Plumer, *Scientists made a detailed "roadmap" for meeting the Paris climate goals. It's eye-opening.*, Vox, Mar. 24, 2017, <https://www.vox.com/energy-and-environment/2017/3/23/15028480/roadmap-paris-climate-goals>; Institute for Policy Integrity, New York University School of Law, *Expert Consensus on the Economics of Climate Change*, Dec. 2015, <https://policyintegrity.org/files/publications/ExpertConsensusReport.pdf>

generally only care about things that have a price. Pricing emissions creates a flexible, business-oriented incentive for reducing emissions. It also creates revenues for offsetting impacts to energy consumers (particularly low-income consumers), supporting further emission reductions and new and existing zero-carbon technologies in the major-emitting sectors, and supporting job transition programs for workers displaced by changes to the state's energy generation mix.

RGGI is a form of carbon pricing (and TCI presumably will be), but RGGI's carbon prices have generally been quite low – far below calculations of the social cost of carbon – and only apply to one sector. Pennsylvania should therefore convene experts and stakeholders to assess the need for and design of an economy-wide price on carbon emissions in Pennsylvania. This assessment will have to explore how a carbon pricing mechanism would interact with and not duplicate or contravene the various measures above, as well as how it would prevent leakage of emissions to other states (e.g., through a carbon border adjustment).

This expert consultation and review could be conducted as part of the consideration of the rulemaking petition filed with the Pennsylvania Environmental Quality Board on November 27, 2018, by a coalition of Pennsylvania organizations, businesses, and individuals seeking to compel the state to regulate greenhouse gas emissions, based on principles of state constitutional and statutory law.³³ Pennsylvania should proceed with consideration of the rulemaking petition.

³³ *Petition Pursuant to 25 Pa. Code §§23.1-23.5, Article I, §27 of the Pennsylvania Constitution, and the Pennsylvania Air Pollution Control Act to Adopt the Attached Regulation Establishing a Comprehensive Program to Limit Greenhouse Gas Emissions to Conserve and Maintain a Stable Climate and Other Public Resources for Which the Commonwealth is a Trustee*, filed with the Pennsylvania Environmental Quality Board, Nov. 27, 2018, <https://drive.google.com/file/d/1j9L0eU81py6tujMSm4kFcTRjFxD67Zlq/view>