Pennsylvania Environmental Council

Climate and Energy Policy Recommendations for the Pennsylvania Gubernatorial Candidates

October 2022

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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 https://pecpa.org/air/deep-decarbonization/

Background

In January 2019, the Pennsylvania Environmental Council (PEC) issued Energy and Climate: A Policy Pathway Forward for Pennsylvania, outlining recommendations for how the Commonwealth should accelerate the shift toward a 'net zero' greenhouse gas emissions profile. These recommendations were developed pursuant to stakeholder discussions, as well as examination of policies in other states. Two years later, PEC updated its recommendations in its Climate and Energy Policy Recommendations 2021 roadmap for policy action during the 2021-2022 state legislative session.

There has been some progress. In October 2019, Governor Wolf issued an Executive Order[1] directing the Department of Environmental Protection (DEP) to develop a rulemaking to reduce carbon dioxide emissions from the electric power generation sector by linking to the Regional Greenhouse Gas Initiative (RGGI). Participation in RGGI was the foremost recommendation in our 2019 Report. While the rulemaking has been finalized, it is now subject to legal review in the courts. Beyond this singular (though significant) step, however, the Commonwealth has remained at a standstill with respect to meaningful policy evolution on climate action and energy transitioning.

Since the last set of PEC recommendations, the landscape has continued to evolve. For example, the Intergovernmental Panel on Climate Change (IPCC) has released a new series of assessment reports laying out the impacts that climate change is already having, documenting the continued rise in emissions, and emphasizing the urgent need for rapid and deep greenhouse gas emission reductions in conjunction with enhanced carbon dioxide removal from the atmosphere[2]. In Congress, the bipartisan infrastructure law (the Infrastructure Investment and Jobs Act, IIJA) was enacted in November 2021, providing, among many other things, billions of dollars for efforts related to climate change and clean energy, including investments in clean transportation, clean energy transmission, carbon capture / hydrogen hubs, and large-scale pilots and demonstration programs for low-carbon energy technologies.[3] In August 2022, the Inflation Reduction Act (IRA) was enacted, providing hundreds of billions of dollars of incentives and funding for climate and clean energy efforts.[4] Both the IIJA and IRA provide an extraordinary acceleration toward decarbonization, particularly in those states that shape their policies to best leverage those investments.

Beyond Congress, other states, as well as businesses, energy producers, and utilities, have been making emission reduction commitments, which have been increasing both in number and in ambition. Eleven states plus DC and Puerto Rico have established binding 100% clean or renewable energy standards or net-zero requirements for electric utilities, while carbon reduction targets by individual utilities or utility parents have proliferated across the country. [5] At the same time, more than 2,000 companies around the world representing $38 trillion of global market capitalization have adopted science-based emission reduction targets or commitments.[6]

Given the shifts in science, technology, policy, and the economy, Pennsylvania needs to better capitalize on the state and local economic and work force development and employment potential of clean energy technologies. While Pennsylvania was often at the forefront and had an outsized role in every energy transition since the colonization of America, from wood/timber supplies in the 18th century to the fossil fuels that have made up most of U.S. energy consumption for more than a century, it cannot rely on history to guide its future. If the Commonwealth fails now to adapt and

develop a suite of policies that incent clean technology and investment, Pennsylvania will acquiesce its competitive advantage and be left behind in the transition to the net-zero clean energy economy of tomorrow, affecting every corner of the state's economy and infrastructure.

With this in mind, PEC is revisiting its climate and energy recommendations once again to provide an updated decarbonization roadmap for the Gubernatorial candidates.

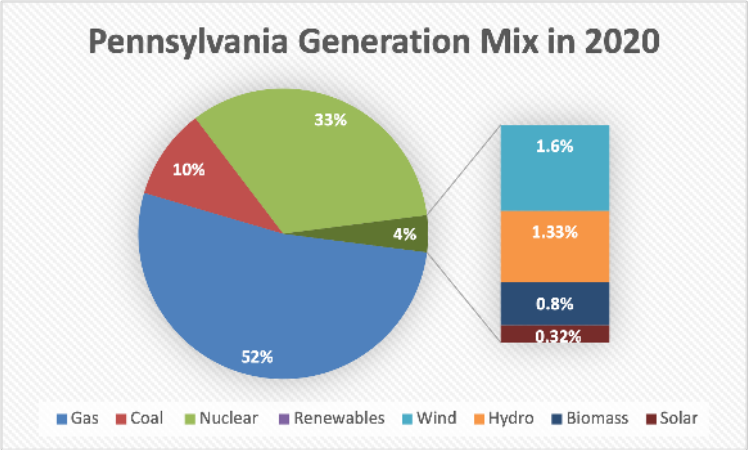
This roadmap includes:

- Establishing a cabinet-level Decarbonization Director, with supporting staff, to coordinate agency activity on emissions reductions, clean energy and materials procurement, and decarbonization-related community engagement and economic development;
- Designing and implementing a framework to strategically invest revenues from the Regional Greenhouse Gas Initiative;
- Reforming the Alternative Energy Portfolio Standards into a Clean Energy Standard;
- Creating or enhancing tax credits, grants, loans, or other financial incentives for energy efficiency and energy use reduction, as well as strengthening and expanding existing Act 129 energy efficiency programs and weatherization programs;
- Adopting measures to promote community solar and grid modernization;
- Adopting policies and incentives to support installation of distributed energy resources, including renewables and energy storage;
- Advancing measures to facilitate clean energy development, including with regard to contracting and siting;
- Considering programs and policies to help bring other zero-carbon technologies to commercial readiness in Pennsylvania, including carbon capture and clean hydrogen;
- Further addressing methane emissions; and
- Promoting electric vehicles, electric vehicle charging infrastructure, and other low-carbon fuels in the transportation sector.

Pennsylvania's Electricity Portfolio

In 2021, Pennsylvania's total electricity usage was more than 142,000 gigawatt-hours, an increase of more than 2.6% from the prior year. Total usage was expected to increase at an average annual rate of 0.6% through 2026.[7]

In 2020, Pennsylvania's generation mix was roughly 52% natural gas, 33% nuclear, 10% coal, and 4% renewable (with wind passing hydropower as the largest source of renewable electricity). That represents a marked decrease in use of coal and increase in natural gas since 2010, when they were at roughly 48% and 15% respectively.[8]



Data source: U.S. EIA (2021)

According to the state greenhouse gas inventory (which is based on 2018 data), electricity production was the second-largest contributor to Pennsylvania greenhouse gas emissions, just behind the industrial sector and just ahead of transportation. Of those electricity sector emissions, about 59% were due to coal combustion, with almost all the rest due to natural gas combustion.[9] Looking just at energy-related carbon dioxide (CO2) emissions, the U.S. Energy Information Administration suggests (based on 2019 data) that the electricity sector was by far the largest source in Pennsylvania, accounting for more than 34% of emissions (compared to about 28% for transportation and 23% for industrial).[10] Either way, electricity is a key sector if Pennsylvania is going to address its contributions to climate change. This becomes all the more important with increasing electrification of the transportation and building sectors. Between 2020 and 2021, CO2 emissions from the power sector in Pennsylvania increased by 9.6%, outpacing the national average.[11]

A Policy Agenda for Decarbonizing Pennsylvania's Electricity

While addressing climate change in the Commonwealth will require a range of policy actions for years to come, PEC believes the following opportunities should be considered by the incoming Governor and their transition team as they prepare for the 2022-2023 legislative session.

Pennsylvania should:

Appoint a cabinet-level Decarbonization Director, with supporting staff, to synchronize activities within the Administration related to emissions reductions, clean energy and materials procurement, and decarbonization-related community engagement and economic development.

- While agencies are performing good work on these fronts, there should be enhanced coordination and clear priority-setting by the incoming Administration toward making Pennsylvania a leader in clean energy deployment, development, and community benefit.

- The Director's office should focus on the following:
  - Maximizing deployment of federal clean energy funding in the Commonwealth.
  - Coordinating efforts of the Departments of Environmental Protection, Community and Economic Development, Conservation and Natural Resources, Labor and Industry, Transportation, Agriculture, and others to help advance:
    - Greenhouse gas emission reductions;
    - Attraction of clean energy businesses and manufacturing to the Commonwealth;
    - Consistent and transparent community engagement principles, particularly for frontline and environmental justice areas;
    - Establishment of meaningful Just Transition principles for workers and communities; and
    - Clean energy and materials procurement.
  - Working with the state Treasurer and agencies on development of a Green Bank for Pennsylvania, leveraging federal funding opportunities in alignment with the incentives and policies included in these recommendations.
  - Working with the Public Utility Commission to identify and further advance measures and metrics on consumer cost reduction through clean energy and efficiency.
  - Developing an Annual Benchmark Report that tracks progress on these issues within the Commonwealth and in comparison to other states and that provides recommendations for legislative and regulatory action.
  - Other recommendations as highlighted in this document, as appropriate.

Design and implement a framework to invest revenues from the Regional Greenhouse Gas Initiative (RGGI) allowance auctions.

- Our earlier recommendation reports highlighted why linking to RGGI was an effective and flexible mechanism for Pennsylvania to reduce CO2 emissions from the electric generation sector. With the rulemaking now final, attention must shift toward how our state crafts an investment framework that will drive clean energy innovation and business growth, help all energy consumers (from residential to industrial) reduce energy consumption and costs, and provide support to communities impacted by energy development and generation, including those affected by the energy transition. The investment framework should leverage and maximize Pennsylvania's competitiveness towards securing the significant funding available under the federal IIJA and IRA.
- States can direct their RGGI investments to suit their unique needs. Based on the RGGI investment frameworks in other states,[12] a RGGI proceeds investment framework for Pennsylvania should include significant investments in:
  - *Energy efficiency* – Most RGGI states direct the majority of investment toward energy

efficiency across all types of end users, including residential and commercial.

- ◎ *Clean and renewable energy* – Many RGGI states direct some portion of investment toward fostering development of clean energy. New York, for instance, has directed significant funds toward residential solar incentives, and Rhode Island has invested proceeds in supporting solar development on brownfields.

- ◎ *Beneficial electrification* – RGGI states are increasingly directing proceeds towards advancing the electrification of other sectors (e.g., transportation, buildings) to displace the use of highly emitting fuels. Delaware, Massachusetts, and New Jersey, for instance, invest some (or in New Jersey's case, most) of the RGGI proceeds in their clean transportation / electric vehicle programs, while New York has directed some investments to support building decarbonization, including on campuses.

- ◎ *Bill assistance* – A few RGGI states direct a portion of the proceeds to bill assistance for consumers (i.e., rebates on energy bills), either for low-income consumers only or for all consumers. The proportion of proceeds going to bill assistance varies widely, with New Hampshire directing most of its proceeds that way.

- ◎ *Workforce development & just transition* – Some participating states, such as New Jersey and New York, have directed funding to bolster clean energy and/or clean transportation workforce development and job creation. In addition, looking beyond RGGI states, Pennsylvania should adapt the approach taken by other coal states (such as Colorado)[13] by developing programs to help communities and workers impacted by plant closures, or to address current and legacy pollution issues.

- ◎ *Green manufacturing* – In recent months, Mid-Atlantic and Midwest states have had success in attracting significant clean energy and transportation investment and manufacturing. Pennsylvania could use proceeds to not only reduce emissions, but also ensure that the means to do so are built here.

- ◎ *Emissions reduction* – There are sectors of our economy that will require solutions other than electrification for decarbonization, including steel, cement, chemicals, and heavy-duty transportation. Investments to incent clean hydrogen, carbon capture, and other options should be considered where it is projected that they will result in quantifiable and meaningful emission reductions.

- ○ Pennsylvania should continue efforts to push for a regional policy adjustment mechanism throughout PJM. PJM has a carbon pricing task force to examine this issue and review analyses, but the task force has not moved forward with developing a common set of rules to integrate carbon pricing and manage leakage. The fact that a growing number of states in PJM are participants in RGGI should add urgency to this process — particularly as the EPA readies a national policy[14] in early 2023 that will address a number of the issues noted above and could look to accommodate existing state and regional programs.

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

- ○ While RGGI will help promote measured emission reductions in the electricity sector, a

congruent and more precisely targeted policy action to increase emission free electricity generation, potentially funded by RGGI proceeds, is also needed to ensure that Pennsylvania achieves a net-zero generation profile by 2050.

- With fuel and energy costs rising rapidly, the importance of supply diversification is greater than ever. A CES can help ensure that Pennsylvania's generation portfolio does not become over-reliant on natural gas, while still preserving reliable dispatch and preventing curtailment. If natural gas displaces existing nuclear or crowds out renewable generation, Pennsylvania's carbon dioxide and methane emissions will markedly increase.

- Unlike the current AEPS in Pennsylvania, a CES would be focused on achieving zero-carbon energy, albeit in a more technology-inclusive way than most states' Renewable Portfolio Standards (RPSs). In addition to renewables, a CES could include technologies such as existing and new nuclear plants, emerging technologies such as hydrogen and geothermal, as well as natural gas plants with carbon capture, utilization, and storage (CCUS), and energy storage. A CES can help propel public and private investment in these technologies.

- A CES framework could also be designed to allow utilities to implement a range of options — including efficiency — to help drive utility- and distributed-scale programs for clean energy deployment.

- As noted earlier, 11 states plus DC and Puerto Rico have established binding 100% clean or renewable energy standards or net-zero requirements for electric utilities, while carbon reduction targets by individual utilities or utility parents have proliferated across the country[15]. Some states have begun to expand their RPSs into CESs (often retaining an RPS element within the broader CES), including states in the region (e.g., Illinois, Massachusetts, New Jersey, New York).

- Pennsylvania's CES should be centered on a target to achieve a 100% zero-carbon electricity supply before 2050.

- Given that the state recently enacted tax credits to directly assist the waste coal industry, waste coal generation should be phased out of any energy portfolio standard unless it is coupled with carbon capture — particularly since there has been an increase in waste coal generation use for private, energy-intensive cryptocurrency operations.

- As part of, or in parallel to, the CES, Pennsylvania should fully account for lifecycle greenhouse gas emissions from all sources and should develop policies to reduce and eventually eliminate or offset those emissions.

Build on existing financial incentives for energy efficiency and energy use reduction, as well as strengthen and expand existing Act 129 energy efficiency programs and weatherization programs.

- Achieving CES and RGGI targets will be easier, and more advantageous for consumers, with enhanced programs targeting energy efficiency and energy conservation. Energy efficiency and conservation reduce energy use and therefore greenhouse gases (and other pollution), while also reducing the amount of zero-carbon energy that has to be brought

online to meet demand. Energy efficiency and conservation initiatives also reduce consumer bills and create local jobs.

- In the 2020 ranking of states by the American Council for an Energy-Efficient Economy (ACEEE), Pennsylvania came in 19th and received only 4 out of 20 possible points regarding utility efficiency.[16] The Commonwealth can do better. Pennsylvania needs to ramp up its efficiency programs and spending and should set more ambitious energy savings targets. ACEEE estimates that, in 2020[17]:
  - Pennsylvania achieved electricity savings equivalent to about 0.69% of retail sales, compared to savings above or close to 2% in Massachusetts (2.34%), Rhode Island (2.14%), Maryland (1.99%), and Vermont (1.97%).
  - Natural gas and fuel efficiency program savings were low in Pennsylvania (0.04% of commercial and residential retail sales) compared to leaders in the region, such as Massachusetts (0.77%), DC (0.74%), Rhode Island (0.66%), and Illinois (0.52%).
  - Spending in Pennsylvania on electricity efficiency programs was very low compared to leaders in the region — at 1.4% of statewide electricity revenues, compared to 7.6% in Vermont, 6.5% in Rhode Island, 6.4% in Massachusetts, and 3.9% in Maryland.
  - Spending in Pennsylvania on natural gas efficiency programs was very low compared to leaders in the region — at $4.15 per residential customer, compared to $135.38 in Massachusetts, $99.42 in Rhode Island, $95.23 in New Hampshire, $80.94 in Connecticut, $71.22 in Vermont, $48.37 in DC, $39.01 in New Jersey, $36.98 in Delaware, and $28.63 in New York.
- The federal bipartisan infrastructure law included billions in funding for weatherization, building energy codes, building audits and upgrades, and more, including through the State Energy Program. (For the latest on IIJA funding opportunities from the US Department of Energy, see https://www.energy.gov/bil/bipartisan-infrastructure-law-homepage.) The Inflation Reduction Act likewise included incentives to promote building efficiency, such as tax credits for households that install heat pumps. Pennsylvania should leverage these federal opportunities, including by continuing to update its building energy and construction codes to require implementation of energy efficiency measures. Programs should also help ensuring local workforce development.
- If Pennsylvania enacts a tax credit program to advance energy efficiency, it should be structured so as to make the credits attractive to a wide range of target audiences, including those with limited tax liability.
- Pennsylvania should also be careful to structure its efficiency policies so as to drive decarbonization and avoid penalizing people and facilities for taking steps to reduce emissions that end up increasing their electricity consumption (e.g., purchasing an electric vehicle). Instead, the Public Utility Commission (PUC) should work with the power sector to advance overall carbon efficiency, preparing for and facilitating beneficial electrification of other sectors.

Adopt measures to promote community solar and grid modernization, both of which can

boost resilience and consumer choice while 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)[18]. Bipartisan legislation already introduced in the General Assembly to accomplish this should be enacted.

- 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.[19] This will be critical as electrification of homes, buildings, and transportation take hold.

Create tax or other financial incentives and policies to support installation of distributed energy resources (DERs), including renewables and energy storage, in Pennsylvania.

- Zero- or low-carbon DERs, including distributed solar, battery storage, and demand response, can reduce greenhouse gas emissions while also increasing grid flexibility and resilience.

- Other states are spurring adoption of energy storage. Maryland, for instance, in 2018 became the first state to launch an energy storage tax credit,[20] and several states have adopted energy storage rebates or other forms of incentives.[21] In addition, at least nine states have statewide targets for energy storage deployment, including Connecticut, Massachusetts, New Jersey, New York, and Virginia.[22]

  - As noted above, any tax credit program should be structured so as to make the credits attractive to a wide range of target audiences, including those with limited tax liability.

- Net metering limits could be raised to allow for bigger distributed installations. Pennsylvania could also adopt a Value of Distributed Energy Resources (VDER) approach, as New York has done, to provide further forward revenue certainty to distributed clean energy project developers.

- Pennsylvania should promote low-impact micro-hydro opportunities through retrofit of existing impoundments throughout the state. This can be accomplished by offering funding or tax credits for projects, as well as by developing uniform permitting guidance. There is renewed partnership between the environmental and hydropower industry on guiding principles for such development.[23]

Advance other measures to facilitate clean energy development, including with regard to contracting and siting.

- Increasing developers' ability to secure quantifiable, long-term off-take commitments could boost in-state clean energy deployment. Developers with guaranteed long-term backing will have investment-grade secured revenue that de-risks the business case, enables them to get financing for building projects, and allows them to offer lower prices to buyers. The long-term contracting barrier has been overcome in some states (e.g., New York, Connecticut, Illinois), but Pennsylvania has nothing similar that provides developers with the long-term certainty they need to secure financing. Utilities do have authority to enter into long-term

contracts under §2807(e) of Act 129, but that authority has rarely been exercised. One solution could be to amend Act 129 to make clearer that a portion of utility energy should be sourced through long-term contracts of at least a certain length (e.g., 15-20 years). Alternatively, the locus of action for change in long-term contracting could lie at the PUC, through proceedings related to default service.[24]

- Pennsylvania could try to guide clean energy development to where it is most desirable, such as brownfields or retired coal plants. Incentives to reuse old mine lands or other previously developed sites could be an economic development approach that also requires less civil engineering (and thus less cost) for clean energy developers, and some sites, such as retired coal plants, already have transmission infrastructure in place. Massachusetts, for instance, incentivizes development in brownfields to focus development in spaces not otherwise being used; the state actually penalizes greenfield development.[25] Illinois in 2021 enacted the Climate and Equitable Jobs Act, which included, among many other provisions, programs to support the transition of coal plants to renewable electricity and energy storage facilities.[26] Montana passed a joint resolution in 2021 requesting a study of the feasibility of replacing coal-fired facilities with advanced nuclear.[27]
    - Relatedly, some states have created economic development zones through public policy that streamline the renewables siting process and/or provide real estate tax abatement. Siting measures could also include creating designated, pre-approved areas for development, testing, and operation of prototypes and pilots for zero-carbon technologies that are currently in relatively early stages, such as advanced nuclear. [28]

Consider adopting financial incentives and other programs to help bring zero-carbon technologies to commercial readiness, including facilitating research and infrastructure assessments in Pennsylvania related to carbon capture and storage (CCS), hydrogen, enhanced geothermal, advanced nuclear, advanced renewables, and other technologies.

- While Pennsylvania should unquestionably accelerate deployment of traditional renewable generation technologies such as wind and solar to achieve zero-carbon targets, the Commonwealth does not have particularly robust wind and solar resource potential. To maximize in-state energy generation and economic development opportunities, Pennsylvania should support efforts to bring other zero-carbon technologies to commercialization — recognizing that the state's role in advancing some technologies may inherently be somewhat limited.

- Pennsylvania should develop state procurement standards that help build demand for zero- and low-emission products and materials. This will directly benefit in-state efforts to attract and grow homegrown green manufacturing and businesses.

- Piggybacking on the recent suite of energy research, development, and demonstration (RD&D) programs funded by Congress in the bipartisan IIJA, the Commonwealth should fund an investment program in RD&D for advanced renewables (e.g., enhanced or super-hot-rock geothermal), advanced nuclear, hydrogen, carbon capture, carbon utilization, and/or other zero-carbon technologies that could support businesses and job creation in Pennsylvania. (For the latest on IIJA funding opportunities from the US Department of Energy, see https://www.energy.gov/bil/bipartisan-infrastructure-law-homepage.)

- ◎ Maryland, for instance, enacted in 2017 a law creating the Maryland Energy Innovation Institute (at the University of Maryland) designed to promote innovation and commercialization of clean energy technologies as part of the state's economic development strategy.[29]

- ◎ The Commonwealth does not necessarily need to create a standalone energy RD&D agency, but the Governor's office should at least convene a working group to make recommendations for how best to formulate and direct a state-sponsored zero-carbon RD&D program that complements federal initiatives, perhaps with targeted grants to Pennsylvania university research centers.

- ◎ Pennsylvania could make nascent zero-carbon technologies eligible for state loan programs. Such loan programs could be tailored to have rates and terms appropriate for when a technology is expected to start producing energy and revenues. Wisconsin, for instance, adopted Act 344 in 2016 adding advanced nuclear reactors to the state's energy policy priorities list (e.g., when awarding loans and grants), behind energy efficiency and renewables.[30]

- ○ The IIJA also included wide-ranging support for CCS and clean hydrogen, including funding from DOE for a network of regional hydrogen hubs,[31] direct air capture (DAC) hubs,[32] carbon storage testing,[33] and more. Hydrogen and carbon capture can be key pieces of the decarbonization puzzle if done correctly, and Pennsylvania should position itself to be a leader in clean and equitable CCS and clean hydrogen deployment. CCS / hydrogen hubs could involve several industrial manufacturing sectors that use hydrogen to some extent, have carbon capture retrofitted on, produce clean hydrogen (using carbon capture and zero-carbon electricity), and utilize DAC and other CO2 removal (which goes into permanent geologic storage).

  - ◎ The western part of Pennsylvania (plus nearby Ohio and West Virginia) could be a good hub location. There is a concentration of industrial fuel use in the region, as well as an abundance of natural gas and associated infrastructure. Western Pennsylvania also has a substantial amount of CO2 that is relatively easy to capture from a technical standpoint.

  - ◎ The Commonwealth should develop and implement a strategic plan for industrial sector decarbonization — including repurposing of existing natural gas infrastructure to enable transport of hydrogen and captured CO2 from sources to locations where it can be utilized or stored.

  - ◎ The Commonwealth should support hub development efforts that meet clear and strong metrics for emission reductions and community benefit.

  - ◎ Pennsylvania should adopt robust emission performance standards that include frequent, accurate (i.e., not simply based on projections) monitoring and repair requirements for the full life cycle of any hydrogen production, transport, and use. Hydrogen is an indirect greenhouse gas that can lead to the formation of ozone and methane, and the process of hydrogen production and delivery poses significant leakage risks if not actively managed.

  - ◎ Pennsylvania should also continue to take steps to ensure that methane and CO2

emissions from natural gas extraction, processing, and transport are substantially reduced or eliminated, so that gas with CCS or hydrogen produced from natural gas (with CCS) is actually low- or zero-carbon. For hydrogen that is produced from natural gas, the state should establish a minimum emissions performance standard that requires that emissions remain below a certain level per kilogram of hydrogen produced. This concept has already been identified by the U.S. Department of Energy as a priority for funding eligibility under the Infrastructure Investment and Jobs Act, underscored further by tax incentives in the recent Inflation Reduction Act. If interests in Pennsylvania want to successfully pursue federal funding, it is in our collective best interest to set a nation-leading life cycle standard that is no less stringent than 2.5 kilograms of carbon dioxide equivalent per kilogram of hydrogen production (2.5 kgCO2e/kgH2) — including both upstream emissions and emissions at the site of production.

◎ Pennsylvania should prioritize deployment of low-carbon hydrogen toward applications that are hardest to electrify — such as heavy industry and heavy transportation — and where there is greatest potential for proximate location between production and use. Any policy or other financial incentives for hydrogen should include clear metrics with respect to cost efficiency and emission reductions, favoring production and deployment that can occur in close proximity where other (and cheaper) options are not available.

◎ Hawaii created a Hydrogen Investment Capital Special Fund to provide seed capital and venture capital investments in renewable hydrogen research, development, and demonstration projects.[34] Utah has an oil and gas severance tax credit for production of hydrogen fuel from natural gas for zero-emission vehicles.[35] Pennsylvania could do something similar for hydrogen produced from natural gas with carbon capture and storage, with a focus that includes not only hydrogen as a fuel but also hydrogen as a form of energy storage. (Pennsylvania already has a range of grant and rebate programs related to hydrogen fuel cell vehicles and fueling infrastructure.)

◎ Pennsylvania could consider means to facilitate inter-state cooperation on CO2 infrastructure (e.g., pipelines, storage site assessment), as a CO2 transport system could attract new industrial projects to the state and maximize emission reduction. Pennsylvania's participation in a multistate memorandum of understanding (MOU) committing to establish a regional CO2 transport infrastructure is a promising step, but it is important that the MOU collaboration lead to action.[36]

◎ Pennsylvania should address issues concerning ownership of pore space rights. West Virginia, for instance, enacted a law in March 2022 to clarify pore space ownership issues related to CO2 sequestration. [37]

◎ Pennsylvania should determine if it wants to pursue primacy on Class VI (carbon sequestration) wells, as North Dakota and Wyoming have done, in order to accelerate the permitting and development of CCS. State standards with respect to well siting, integrity, and financial assurance should be improved.

◎ Pennsylvania should take this opportunity to review and bolster the authority granted to the Public Utility Commission and the Department of Environmental Protection with respect to safety, siting, and integrity of CO2 and hydrogen pipelines and related

infrastructure. The state should also increase investments in state personnel in order to build the necessary human capacity to stand up effective CCS and hydrogen permitting and regulatory programs, including funding for both the Department of Environmental Protection and Department of Conservation & Natural Resources for administrative capacity, analysis, and oversight.

- With respect to CCS, the state should establish flexible and adequate authority for an oversight and management program that addresses:
  - Induced seismicity;
  - Emission performance standards and monitoring;
  - Groundwater protection;
  - Storage integrity issues, including preventing hazards created by nearby active or abandoned wells;
  - Site closure; and
  - Long-term liability and ownership issues post-closure.
    - The state should not absolve operators of financial or legal responsibility for issues caused by the actions (or omissions) of that operator. In addition, the state should establish a long-term stewardship fund, paid for through permitting fees, to support ongoing state monitoring or to address emergencies or threats to public safety.

◎ Pennsylvania policy should also promote stakeholder engagement and the development of community consent and benefit agreements, in line with the guidance provided by the Department of Energy.

Measures to Address Methane Emissions

Methane is an extremely potent greenhouse gas that, in the short term, is more damaging as a heat-trapping gas than carbon dioxide. At the time of this report's publication, the Department of Environmental Protection is finalizing regulations to address emissions of volatile organic compounds (VOCs) and methane from the oil and gas sector, pursuant to 2016 U.S. EPA guidelines. EPA is expected to release new draft methane requirements in late 2022 or early 2023, and Pennsylvania should diligently strengthen its own regulations accordingly.

Methane emissions, however, occur outside of the oil and gas sector as well, including from mining activities, wastewater treatment, and agriculture.

Pennsylvania should:

- **Develop regulations to require control and reduction of methane emissions from dormant and active mining operations;**
- **Advance opportunities and controls for emissions from wastewater treatment and agriculture operations, including potential capture and beneficial reuse options.**

Measures to Decarbonize Pennsylvania's Transportation

As one of the largest sources 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 state's automotive, truck, and bus fleets.

Pennsylvania should:

- **Promote electric vehicles (EVs), electric vehicle charging infrastructure, and other low-carbon fuels to achieve emission reductions in the transportation sector.**
    - The IIJA includes billions of dollars to build out EV charging networks nationwide, as well as investments to accelerate the transition to electric school buses and transit buses. Pennsylvania is already pursuing a range of incentives and programs to advance clean transportation, including through the Drive PA Forward initiative funded largely by the Volkswagen mitigation plan. [38]The Commonwealth developed an EV strategy roadmap in 2019,[39] and PennDOT has drafted a State Plan for Electric Vehicle Infrastructure Deployment to direct the millions of dollars the state will receive under the IIJA.[40] This work should be continued.
    - Grid modernization will be a critical factor. Pennsylvania should examine and policies that better align planning of, and support for, deployment of charging infrastructure and improvement of transmission systems.
    - PennDOT should examine where clean hydrogen and other low-carbon fuels may play a role where electrification options are not feasible.

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