Pennsylvania Climate Action Plan

2021

Strategies for government, business, agriculture, and community leaders—and all Pennsylvanians

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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This update is a plan that was prepared in response to the Pennsylvania Climate Change Act (Act 70 of 2008), which requires the Department of Environmental Protection (DEP) to prepare a climate action plan regularly. The Pennsylvania Climate Change Advisory Committee provided input and feedback to the DEP and ICF for the preparation of this assessment. The Climate Change Advisory Committee has 18 members plus 3 ex officio members. The 2021 Climate Action Plan is the fifth iteration of the Pennsylvania Climate Action Plan and builds on the previous action plans. This plan and the analyses contained in it were prepared by the Pennsylvania DEP with support from ICF, Penn State University and Hamel Environmental Consulting.

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Cover Photos:

Top: Center for Sustainable Landscapes at Phipps Conservancy and Botanical Gardens (photo credit: Denmarsh Photography, Inc.)

Bottom, Left to Right: Electric car charging; Benjamin Rush State Park tree planting, Philadelphia, PA; Wind farm in central Pennsylvania (photo credit: Andy Fogelsonger); Solar panels at the Tom Ridge Environmental Center, Presque Isle, PA

PENNSYLVANIA CLIMATE ACTION PLAN 2021

Strategies for government, business, agriculture, and community leaders—and all Pennsylvanians

September 2021

MESSAGE FROM GOVERNOR WOLF

The Climate Imperative

As I've seen firsthand in communities statewide, Pennsylvania is undergoing more extreme weather events, from flooding and tornadoes this month in Philadelphia and across southeast and southcentral counties, to record water levels in Lake Erie in 2019, to flooding that led to U.S. Department of Agriculture disaster declarations in 33 counties in 2018.

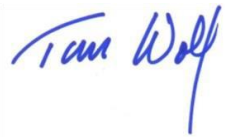
Increasingly frequent, these events are buffeting Pennsylvania with deep recurring socioeconomic costs: public health stresses; evacuations and closings; flooded, buckled, and washed-out roads and bridges; downed trees and power outages; large-scale cleanups; and destroyed homes, businesses, and harvests.

We must move now out of reactive mode on climate change. Leadership across sectors requires knowledge, tools, and proactive approaches to climate change to protect Pennsylvanians' health and safety, economy, infrastructure, farms, businesses, recreation, and environmental resources. In addition to preparing for and adapting to the level of impacts we're already experiencing, we must significantly lower greenhouse gas emissions to prevent worsening impacts.

In 2019, I set the first ever statewide goals to reduce greenhouse gas emissions: 26 percent lower by 2025 and 80 percent lower by 2050, compared to 2005, which is the standard baseline. I've charted a course for Pennsylvania to join 10 Northeast states in the Regional Greenhouse Gas Initiative, the cap-and-invest program that reduces carbon dioxide emissions from electric power plants. Revenue from carbon allowance auctions will be targeted to traditional energy-based communities and Environmental Justice areas across Pennsylvania and to further reduce carbon emissions statewide.

I also mandated that state agencies lead by example, increasing sustainability while saving taxpayers money and creating jobs in Pennsylvania's clean energy economy. In addition to aggressively stepping up energy efficiency measures, we launched an initiative in 2021 to get nearly 50 percent of state agencies' electricity from seven new solar energy arrays to be built around the state by January 2023.

I urge leaders across government, business, agriculture, academia, and community organizations—and all Pennsylvanians—to join in making climate change a top priority. It is only with your commitment, collaboration, and action, large scale or small, that Pennsylvania will meet the climate imperative. Throughout history, Pennsylvania has led the nation in every era of energy innovation. We can and must lead now. Pennsylvania Climate Action Plan 2021 tells us how.



September 22, 2021

MESSAGE FROM SECRETARY PATRICK MCDONNELL

Tools to Lead on Climate Action

Slowing down future climate change and adapting to changes that are already happening present a challenge on a scale that can seem overwhelming. Where to start?

Pennsylvania Climate Action Plan 2021 is where to start. Here you'll find statewide data on and trends in greenhouse gas emissions from every sector: electricity generation, transportation, industry, agriculture, residential and commercial buildings, and more.

A suite of 18 strategies is recommended that—if started now—will meet our statewide greenhouse gas emissions goals for 2025 and 2050. For each strategy, the emission reductions, costs, and benefits in jobs and economic growth are quantified, and health and social benefits are analyzed. Supplemental strategies are also recommended to bolster efforts toward greenhouse gas reductions.

In addition, Pennsylvania Climate Action Plan 2021 identifies priority areas to focus our preparation and adaptation: public health, overburdened and vulnerable populations, agriculture, recreation and tourism, infrastructure, and forests, ecosystems, and wildlife.

Pathways to adaptation are mapped out that will enable us to lessen negative impacts and capitalize on any potential opportunities created by climate change.

After getting an overview from this booklet, head to www.dep.pa.gov/climate. There you can review the complete Pennsylvania Climate Action Plan 2021 in depth to inform your policy, planning, and program decision making. You'll also find helpful related resources, including Pennsylvania Climate Impacts Assessment 2021, the Local Climate Action Program, statewide data on greenhouse gas emissions, as well as on job growth and workforce development needs in clean energy industries, and many more tools to lead on climate action in Pennsylvania.

September 22, 2021

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EXECUTIVE SUMMARY

Introduction

Pennsylvania established its first statewide policy on climate change in the Pennsylvania Climate Change Act of 2008 (Act 70). The Act requires the Department of Environmental Protection (DEP) to compile an annual greenhouse gas (GHG) inventory, develop a voluntary GHG registry, and develop a climate action plan (CAP) and impacts assessment and update them every three years. Act 70 also establishes the Climate Change Advisory Committee (CCAC) to advise DEP during CAP and Impacts Assessment development. Working with the committee, DEP has issued several climate action plans and impacts assessments in the intervening years.

Act 70 Requirements

- Compile annual GHG inventory
- Develop a voluntary registry of GHG emissions
- Develop a Climate Action Plan and Impact Assessment
- Establish a Climate Change Advisory Committee

Executive Order 2019-01

- Recognized the risks of climate change for Pennsylvanians
- Set net GHG reduction targets of 26% by 2025 and 80% by 2050 (from 2005 levels)
- Reestablished the GreenGov Council

Governor Tom Wolf issued an executive order in 2019 that established a Pennsylvania climate goal of a 26% reduction in net GHG emissions statewide by 2025 and an 80% reduction by 2050, from 2005 levels. It also reestablished the GreenGov Council to assist state agencies in incorporating environmentally sustainable practices into policy and planning decisions.

This 2021 Climate Action Plan presents GHG reduction strategies that could realize the executive order's emission reduction goals. It also maps out strategies for adapting to the impacts of climate change, based on the 2021 Pennsylvania Climate Impacts Assessment[1].

Within the last two decades, the Commonwealth has created energy policy and program actions that have complemented and supported Act 70's overall goals. For example, the Alternative Energy Portfolio Standard (AEPS) that increased electric utilities' purchases of renewable power, and Act 129 that continue to require electric utilities to meet customer energy savings targets, were in place when the first CAP was published. Given the many efforts which can be undertaken across state government, local governments, and in the private sector and other organizations, the CAP process allows DEP to identify, coordinate, integrate, and leverage a

[1] PA Department of Environmental Protection (2021). Pennsylvania Climate Impacts Assessment 2021. www.depgreenport.state.pa.us/elibrary/GetDocument?docId=3667348&DocName=PENNSYLVANIA CLIMATE IMPACTS ASSESSMENT 2021.PDF <span style%3D"color:green%3b"> <span style%3D"color:blue%3b">%28NEW%29 4/30/2023

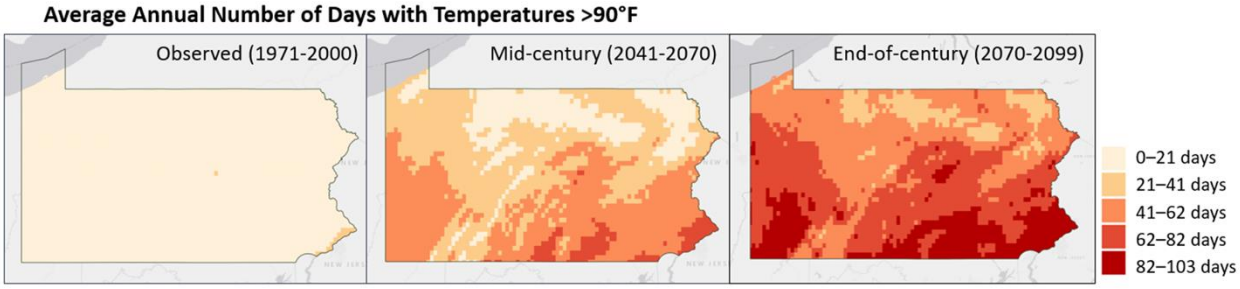
range of strategies that could be employed meet the Commonwealth's GHG reduction goals, while also increasing resilience and adapting to the risks from climate impacts.

This 2021 plan is the CAP's fifth iteration. Building on previous plans and the latest science on the impacts of climate change, it lays out strategies to help Pennsylvania meet the Governor's 2025 and 2050 emission reduction goals, while also helping to prepare for future climate change impacts, and giving added consideration to the plan's effects on public health and equity.

Climate change is already impacting Pennsylvania; worsening heat waves, increased flooding, and other impacts are affecting the state economy and public health. The 2021 Impacts Assessment, published in May 2021, summarizes expected impacts and risks over the next 30 years and beyond, such as:

- The average annual temperature statewide is expected to increase by about 6 degrees Fahrenheit. Extreme heat events will also increase: 90+-degree temperatures are expected to occur approximately 37 days per year, up from 5 days historically; such impacts will, for example, alter the growing season, increase cooling energy use, and decrease heating energy use (Figure ES-1).
- Total average rainfall will increase, coming in less frequent but heavier rain events, but drought conditions are also expected to occur more frequently.
- Tidally influenced flooding is expected to increase in the Delaware Estuary coastal zone. Lake Erie is expected to see lower water levels, increased coastal erosion, and higher water temperatures.

Figure ES-1. Observed and projected annual days with temperatures above 90°F



Rising temperatures and heavy precipitation with inland flooding are identified in the Impacts Assessment as the two highest-risk hazards by mid-century. Increasing temperatures will have major consequences for human health and environmental justice and equity, especially in urban areas. Heavy precipitation and flooding could severely affect human health, agriculture, and built infrastructure, with those in or near floodplains at greatest risk.

Pennsylvania Greenhouse Gas Inventory, Forecast, and Reduction Efforts

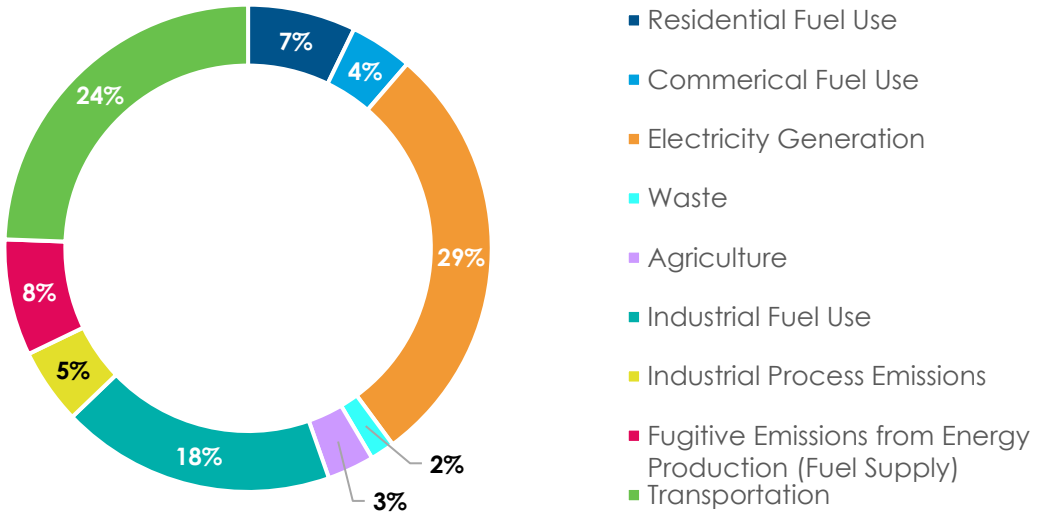
Pennsylvania's latest greenhouse gas inventory reports historical GHG emissions in the Commonwealth from 2000 to 2017. This inventory provides a baseline for tracking progress in reducing GHG emissions over time; it also forms the basis of the business as usual (BAU) emissions forecast through 2050, which is the projected emission levels without any new policy or program changes after 2020. 2017 is the most recent year for Pennsylvania's GHG inventory due to the lag in data availability from the U.S. Environmental Protection Agency (EPA). Pennsylvania is currently working on the 2018 GHG Inventory, but it was not available in time for analysis in the 2021 Impacts Assessment or CAP.

Figure ES-2 below sums up Pennsylvania's 2017 GHG emissions by major sector, totaling 263.2 million metric tons of carbon dioxide or its equivalent ($MMTCO_2e$). More than 10% of that amount is captured each year in soils or vegetation, or "sequestered," resulting in "net" emissions of 233.7 $MMTCO_2e$. 2017 net emissions are almost 20% lower than 2005 levels (289.1 $MMTCO_2e$), which puts Pennsylvania about three-quarters of the way to its 26% reduction goal by 2025.

Emissions have declined since 2005 in most sectors, with the exception of industrial and agricultural emissions. In 2017, the following sectors were the three largest sources of emissions:

- Electricity generation (29%)
- Transportation (24%)
- Industrial fuel use (18%)

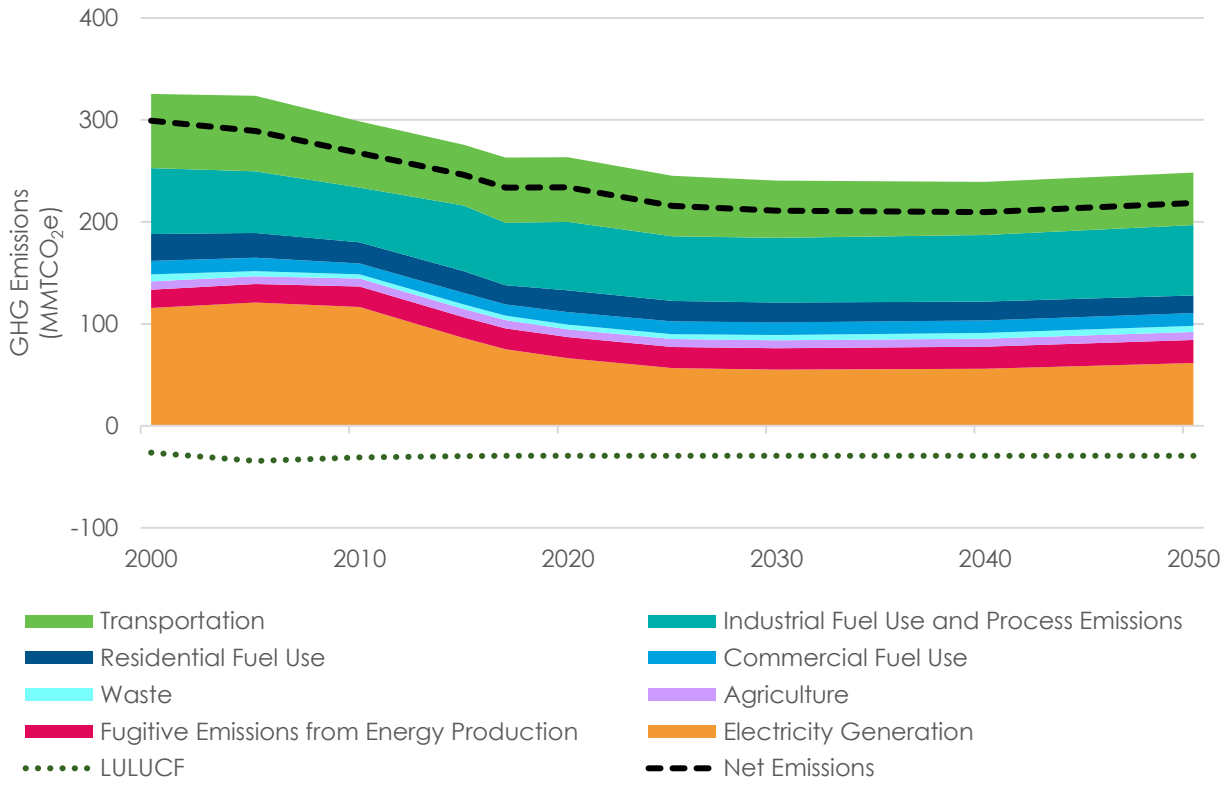
Figure ES-2. Pennsylvania 2017 GHG emissions by sector



Looking forward, Pennsylvania's BAU scenario projects a baseline of GHG emissions through 2050, assuming that current policies and programs, or those significantly underway in

development, are implemented, and thus serving as a benchmark for projecting the impacts of potential GHG reduction strategies. The graphic below shows BAU emissions through 2050: it projects net emissions falling by 24% from 2005 levels. This means that while current policies and actions are expected to almost hit the state goal of reducing GHG emissions 26% by 2025, they fall far short of the 80% emission reductions by 2050 goal. The rest of the required 2050 reductions can be achieved through implementing the CAP's strategies.

Figure ES-3. Business as usual net emissions by sector 2000-2050 ($MMTCO_2e$)



It is important in the context of the BAU assessment to recognize Pennsylvania's energy policies and programs, and key features of its energy economy, that shape both today's energy and environmental agenda and tomorrow's policy and program solutions. Pennsylvania is a leading energy producer and supplier, which has historically and significantly contributed to local economies and wealth. Pennsylvania's energy profile has become increasingly dynamic in recent decades, as both fossil fuel and clean energy generation have grown. These changes, however, have resulted in both challenges and opportunities for reducing GHG emissions. Additional opportunities remain for both improving resilience in Pennsylvania's energy infrastructure and deploying new and diverse energy resources to result in assured energy supply and to mitigate the impacts of climate change. The Commonwealth is the nation's second leading natural gas producer (after Texas) and the largest electricity generator in its

region.[2] In 2019, there were more than 269,000 total energy and motor vehicle sector jobs in Pennsylvania; of those, more than 97,000 were clean energy jobs. [3]

Falling costs for renewable energy, and policies such as the AEPS, have boosted the role of renewable power in the energy mix. However, zero emission energy generation in Pennsylvania is heavily reliant on nuclear power; the Commonwealth is the nation's second largest nuclear power producer. To further reduce power plant emissions, DEP is currently undertaking a rulemaking process to enable Pennsylvania to join the Regional Greenhouse Gas Initiative (RGGI), an 11-state power sector carbon dioxide cap-and-trade program. Participation in RGGI, in addition to driving down emissions, could also create funding to be used in supporting further reductions in GHG emissions.

Energy efficiency has also become a significant source of emissions reductions through more than 10 years of Act 129 implementation, in which the seven largest electric companies meet savings targets by reducing customers' electricity consumption. Act 129 does not cover fuel oil or natural gas use, and fuel oil use is relatively high in rural areas. Cleaner fuels like ethanol and biofuels are mostly used in the transportation sector. To further address transportation fuel emissions, Pennsylvania has been participating in discussions which have helped to develop the Transportation Climate Initiative (TCI), which aims to reduce emissions from the transportation sector. While PA has not committed at this time to joining the TCI Program (TCI-P), which would require fuel suppliers to purchase "allowances" for the GHG emissions resulting from the combustion of fuels sold in participating jurisdictions using cap-and-trade mechanisms, TCI-P is designed such that Pennsylvania may consider participation in the future.

PA Policies Informing the BAU Scenario

- **Act 129.** Act 129 requires PA's seven largest electric distribution companies (EDCs) to reduce customer energy use.
- **Alternative Energy Portfolio Standard.** AEPS sets targets for renewable electricity supplied by PA's EDCs. AEPS 2020 rules are projected to remain constant through 2050.
- **Regional Greenhouse Gas Initiative.** By joining RGGI, Pennsylvania would commit to reducing powerplant emissions along with 11 other states. RGGI 2020 rules are projected to remain in place through 2050. RGGI will not take effect in Pennsylvania until 2022.
- **Hydrofluorocarbon (HFC) Phaseout.** HFC chemicals are found in air conditioning refrigerants. PA will phase out HFCs in accordance with the Federal AIM Act.

[2] U.S. Energy Information Administration (2020). Pennsylvania State Energy Profile. https://www.eia.gov/state/print.php?sid=PA

[3] PA Department of Environmental Protection (2020). Workforce Development. https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/EnergyEfficiency_Environment_and_EconomicsInitiative/Pages/Workforce-Development.aspx

Pennsylvania has undertaken numerous energy and environmental programs and policies since the early 1990s. Some of the most notable and ongoing examples include:

- Act 213: Alternative Energy Portfolio Standards (AEPS) (2004),
- Act 70: Pennsylvania Climate Change Act (2008),
- Act 129: Energy Efficiency and Conservation Program (2008),
- Act 30: Commercial Property Assessed Clean Energy Program (C-PACE) (2017),
- Act 40: Solar Renewable Energy Credits (2017),
- The Medium- and Heavy-Duty Zero Emission Vehicle MOU,
- Governor's Executive Order 2019-01, which set GHG reduction goals for Pennsylvania and sustainability goals for Commonwealth agencies (2019), and
- Governor's Executive Order 2019-07, which enabled Pennsylvania to join RGGI (2019).

These and other efforts have evolved to support a broader transition to a cleaner and more resilient energy future, encompassing a wide range of organizational, regulatory, and program initiatives. Examples include:

- Regulating volatile organic compounds (VOCs), which reduces co-pollutants like methane emissions from natural gas,
- Planning for climate adaptation,
- Incentives for clean vehicles, and
- Clean energy financing.

The list of efforts underway in state and local governments and the private sector grows ever longer. For more information on these and other ongoing efforts, visit DEP's website: https://www.dep.pa.gov.

Opportunities to Significantly Reduce GHG Emissions in Pennsylvania

DEP worked with the CCAC and other agencies, in addition to gathering public input via a public survey and best-practice information from around the country, to identify, prioritize, and model the impacts of a wide range of strategies for reducing GHG emissions across Pennsylvania's buildings, industry, transportation, power, fuels, agricultural, other land use, and waste sectors. These are summarized in Table ES-1. Considerable deliberation went into identifying, prioritizing, describing, and modeling these strategies; the methods and process for those efforts are described in the body of the plan. Strategies with quantified GHG reductions, costs, and benefits are assigned A-R for ease of reference throughout this plan.

Table ES-1. Summary of GHG reduction strategies by sector

Sector	GHG Reduction Strategy	Expected Implementation Timeframe	Quantified GHG Reductions, Costs and Benefits
Residential and Commercial (R&C) Buildings	A. Support energy efficiency through building codes	Near-term	Yes
	B. Improve residential and commercial energy efficiency (electricity)	Near term	Yes
	C. Improve residential and commercial energy efficiency (gas)	Near term	Yes
	D. Incentivize building electrification	Midterm	Yes
	Introduce state appliance efficiency standards	Midterm	No
	E. Increase distributed on-site solar	Near term	Yes
	Take actions to promote and advance C-PACE financing and other tools for Net Zero Buildings and high-performance buildings	Near term	No
Transportation	F. Increase fuel efficiency of all light duty vehicles and reduce vehicle miles traveled for single occupancy vehicles	Midterm	Yes
	G. Implement the multi-state medium-and heavy-duty zero-emission vehicle memorandum of understanding	Long term	Yes
	H. Increase adoption of light-duty electric vehicles	Midterm	Yes
	I. Implement a Low Carbon Fuel Standard	Midterm	Yes
Industry	J. Increase industrial energy efficiency and fuel switching	Near term	Yes
Fuel Supply	K. Increase production and use of biogas/renewable gas	Midterm	Yes
	L. Incentivize and increase use of distributed Combined Heat and Power	Near term	Yes
	M. Reduce methane emissions across oil and natural gas systems	Midterm	Yes
Electricity Generation	N. Maintain nuclear generation at current levels	Near term	Yes
	O. Create a carbon emissions free grid	Long term	Yes
Agriculture	P. Use programs, tools, and incentives to increase energy efficiency for agriculture	Near term	Yes
	Q. Provide trainings and tools to implement agricultural best practices	Midterm	Yes
LULUCF	R. Increase land and forest management for natural sequestration	Midterm	Yes
Waste	Reduce food waste	Near term	No
	Reduce waste generated by citizens and businesses and expand beneficial use of waste	Near term	No

Highlights of Key Results

The following are highlights of key results of modeled GHG reduction strategies, which include GHG emission reductions and different measures of cost-effectiveness (i.e., costs, jobs, economic growth). Health and social benefits were also analyzed outside of modeling efforts, and are discussed in the body of the plan.

Pennsylvania will likely exceed the 26% GHG emission reduction target by 2025, if all the modeled strategies are implemented and expected impacts are realized. The success of strategies in the fuel supply and industrial sectors will be especially important from now to 2025.

Reaching the 80% reduction target by 2050 will require successful implementation of all recommended strategies. Electricity generation strategies show the greatest potential for reductions through 2050, followed by the transportation, industrial, and buildings sectors. The electricity sector sheds its GHG emissions by producing almost all of its power from nuclear and renewable sources, which is one potential scenario for a future clean grid.

The strategies outlined in the CAP create jobs through cost-effective strategies while sustaining economic growth. Insights from the modeling results show that the CAP strategies:

- **Create over one million job-years[4] by 2050**, with an annual average close to 42,000 supported jobs per year, an increase of about 0.5% per year on average.
- **Result in little effect on economic growth while promoting a more environmentally sustainable future for Pennsylvania**. The average annual gross state product (GSP) decreases marginally by 0.01% overall, but rises in later years with an equivalent GSP increase of about 0.1% annually by 2050. Thus, the Pennsylvania economy continues to grow robustly with CAP strategies in place and the changes in GSP being on the margin, without affecting the overall growth path of the state economy. Similar patterns are expected for personal income changes as well, with slight annual decreases in early years, followed by slight annual increases in later years. The Commonwealth economy continues to grow with these strategies in place, but at a slightly slower rate than without any action to reduce emissions to mitigate the impacts of climate change.
- **Are cost-effective.** Taken together, the CAP strategies cost less per ton of GHG emissions reduced than the cost of inaction**.** Most strategies also create co-benefits such as improved air and water quality, improved health outcomes, increased energy security, and improved equity and environmental justice outcomes.

It is also important to note that these emission reduction strategies will likely reduce need for adaptation investments, and those benefits are not calculated in the CAP modeling process. In

[4] A job-year is defined as one year of work for one person. For example, a new construction job that lasts five years is five job-years.

addition, some of the CAP's emission reduction strategies provide adaptation co-benefits, and vice versa; while not modeled quantitatively, the body of the plan identifies these synergies.

GHG Reduction Modeling Results Highlights

The CAP modeling process showed that Pennsylvania's 2025 and 2050 GHG reduction targets can be met by implementing strategies across all sectors. The "wedge graph" (Figure ES-4) below illustrates a possible pathway to 80% reductions by 2050. The 2025 reduction target could be exceeded through successful implementation of the modeled strategies; beyond that point, sustained impacts are needed from all strategies for the next 25 years. **Figure ES-5** shows annual reductions by sector compared to the BAU for select years.

Figure ES-4. GHG reductions by strategy, through 2050 ($MMTCO_2e$)

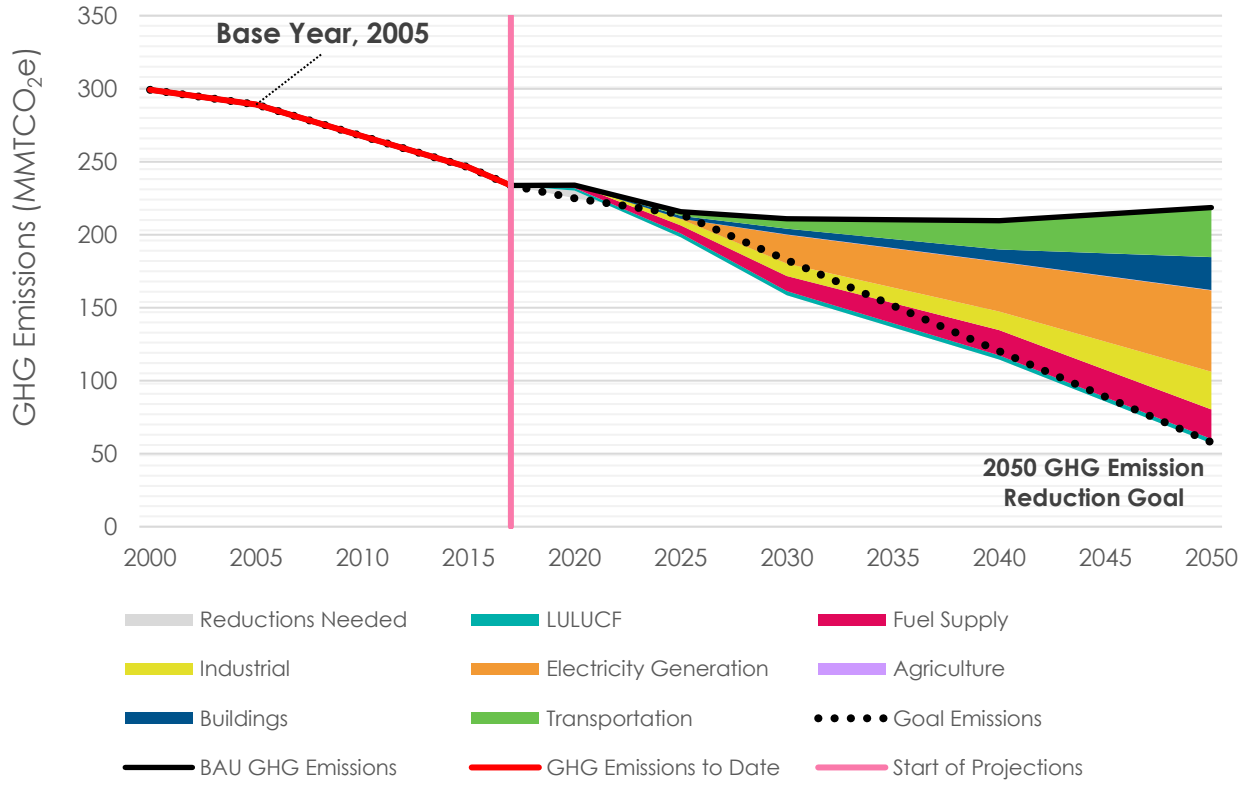
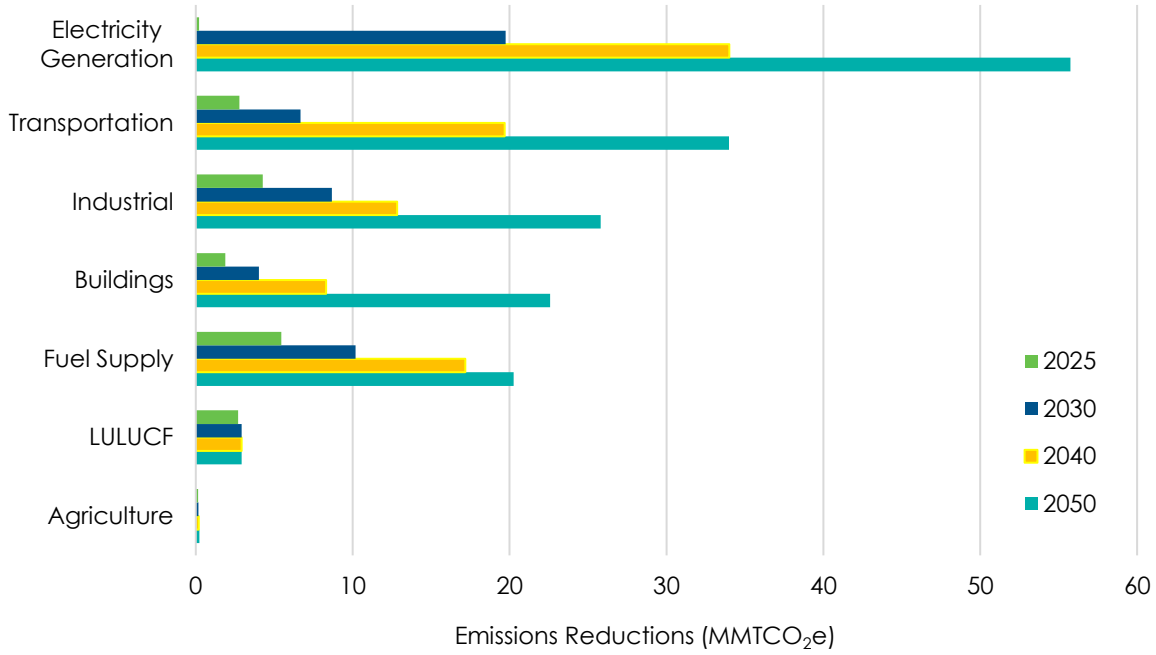


Figure ES-5. GHG reductions by sector for select years, compared to business as usual



The CAP provides extensive additional details on the modeling process, the strategies that were modeled, the modeling results, as well as detailed descriptions of each strategy. It also explores implementation considerations for these strategies, such as cost, political, and environmental justice considerations, and examines enabling technologies that will likely be needed to facilitate full realization of strategy impacts.

Opportunities to Adapt to the Impacts of Climate Change

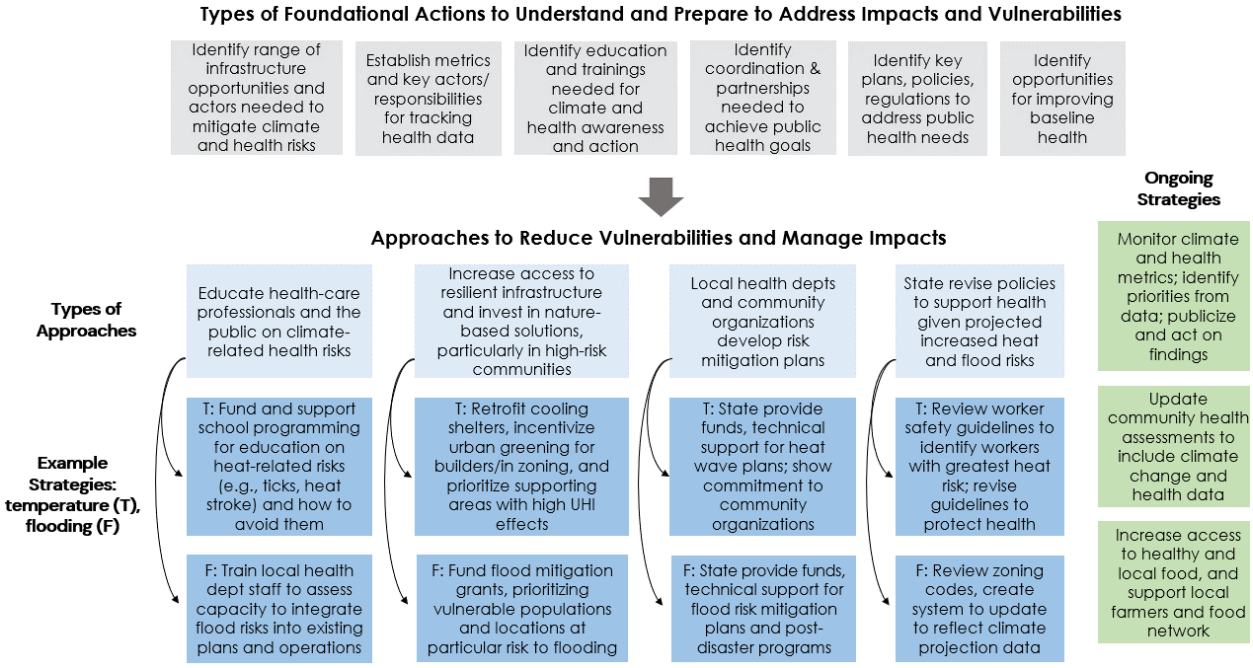
Climate risks and related impacts in Pennsylvania could be severe, potentially causing increased infrastructure disruptions, higher risks to public health, economic impacts, and other changes, unless actions are taken by the Commonwealth to avoid and reduce the consequences of climate change. Taking adaptation action also presents an opportunity for Pennsylvania to strengthen its economy, reduce inequities, and build resilience.

As a result of the 2021 Impacts Assessment, seven priority areas were identified for climate adaptation:

- Increasing heat and flooding on health
- Increasing heat and flooding on overburdened and vulnerable populations
- Increasing average temperatures on forests, ecosystems, and wildlife
- Warmer and wetter climate on agriculture
- Increasing average temperatures on recreation and tourism
- Flooding on built infrastructure
- Landslides on built infrastructure.

The CAP describes a wide range of strategies to help Pennsylvanians adapt to these priority unavoidable impacts of climate change, even as the GHG reduction strategies work to reduce these impacts. Figure ES-6 below illustrates the CAP's approach to adaptation for reducing impacts of heat and flooding on health (one of the seven priority areas); Section 4 provides greater detail across a wide range of impacts and adaptation strategies.

Figure ES-6. Adaptation strategy pathway to reduce public health impacts from heat and flooding



This diagram provides illustrative examples of the primary types of strategies but does not capture the full universe of possible strategies that could be deployed.

Pennsylvania can use a combination of strategies to manage climate risks and can plan and implement strategies over time as conditions and information change. This approach is referred to as "adaptive management" (see Section 4). The Commonwealth can draw on strategies in this CAP as well as other resources.

Below are two examples (Figure ES-7, Figure ES-8) that visualize how adaptive management could be used to manage flood and heat risks in Pennsylvania. They show how new information about future climate risks (e.g., the 2021 Impacts Assessment) and the occurrence of events that will become more frequent (e.g., severe flooding) can guide the Commonwealth in selecting and implementing adaptation strategies. In particular, they illustrate how extreme events—such as a flood that causes devastating infrastructure damage, or a heat wave with a heightened death toll—harm people and places and thereby motivate society to both reconsider what risks are acceptable and take action to reduce risks by implementing additional adaptation strategies.

Figure ES-7. Example adaptive management approaches to flood risk

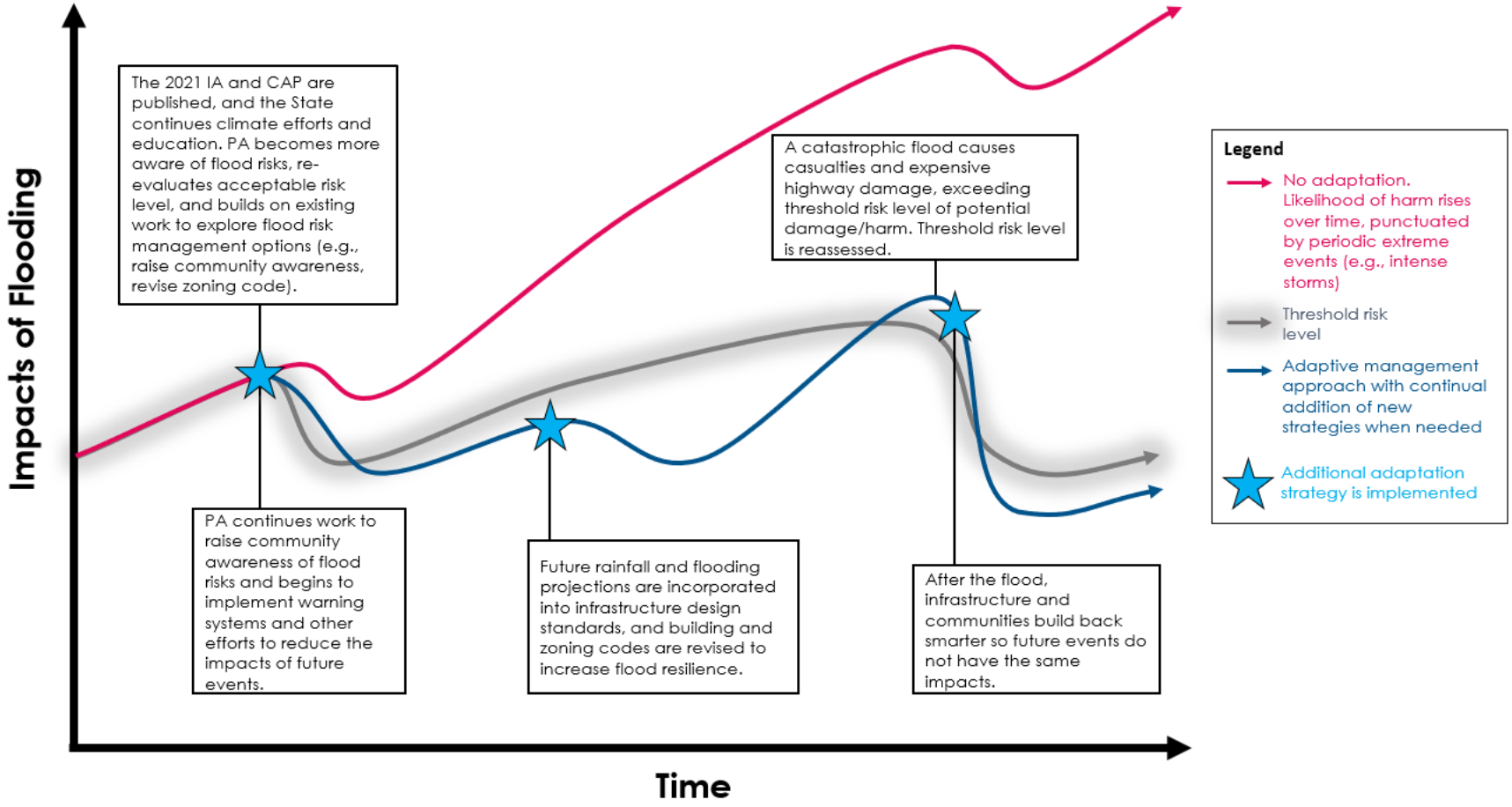


Figure ES-8. Example adaptive management approaches to heat risk