



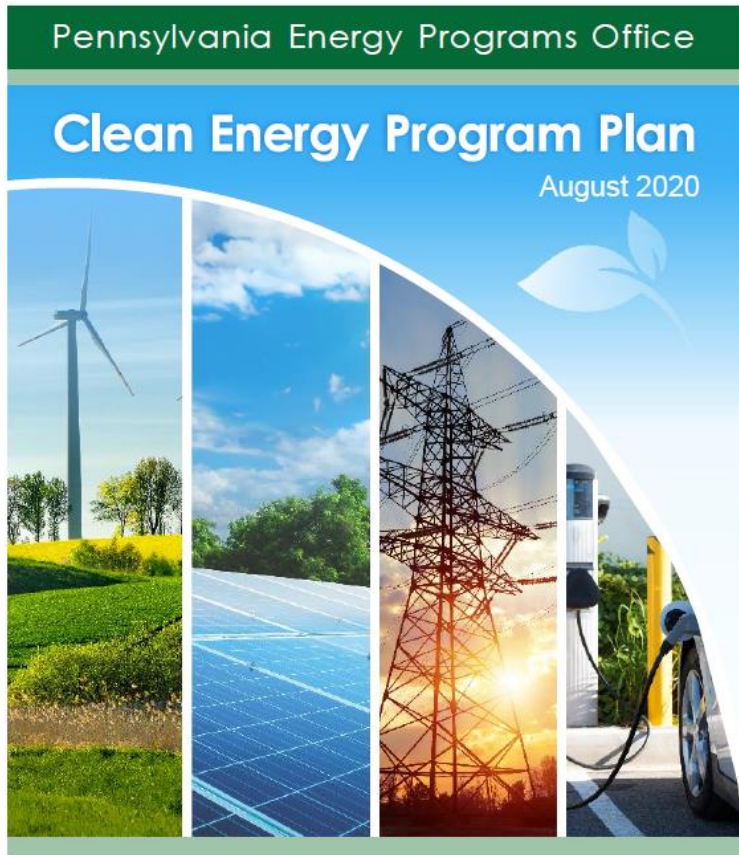
Pennsylvania Climate Impacts Assessment and Climate Action Plan 2021

**Air Quality Technical Advisory Committee
October 14, 2021**

Tom Wolf, Governor

Patrick McDonnell, Secretary

DEP Energy Programs Office (EPO)



- EPO is the primary agency responsible for implementing clean energy programs in Pennsylvania.
- EPO supports renewable energy, energy efficiency and conservation, climate change mitigation and adaptation, alternative transportation, energy assurance, and associated education, outreach and technical support efforts.
- EPO works with its partners to implement, coordinate, and facilitate clean energy programs

DEP Climate Program

Pennsylvania Climate Change Act (Act 70 of 2008) Requires DEP to:

- Develop a [climate impacts assessment](#) (3 yrs.)
- Prepare and update a [climate action plan](#) (3 yrs.)
- Develop an [inventory of greenhouse gases](#) (GHGs) (update annually)
- Administer a [climate change advisory committee](#) (CCAC) (bimonthly)
- Set up a voluntary registry of GHG emissions ([TCR](#))

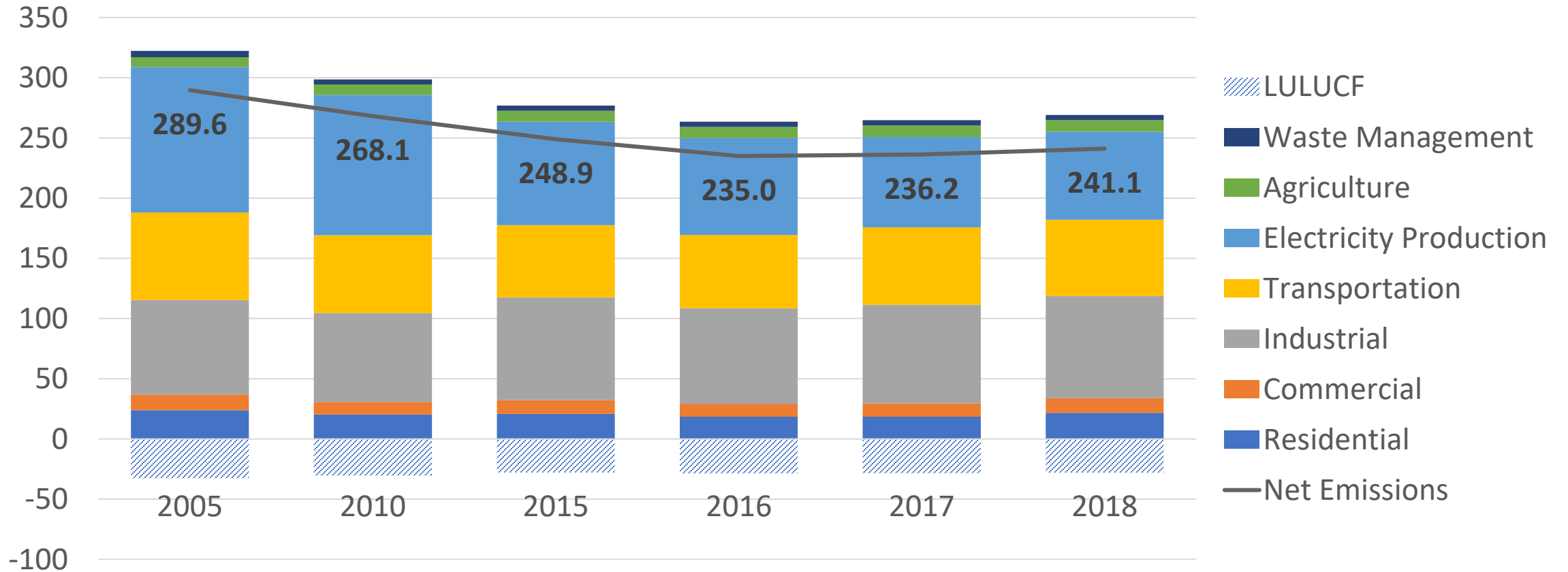
Why a Climate Program?

“Climate change is the most critical environmental threat confronting the world...Given the urgency of the climate crisis facing Pennsylvania and the entire planet, the commonwealth must continue to take concrete, economically sound and immediate steps to reduce emissions.”

– *Governor Tom Wolf, October 3, 2019*

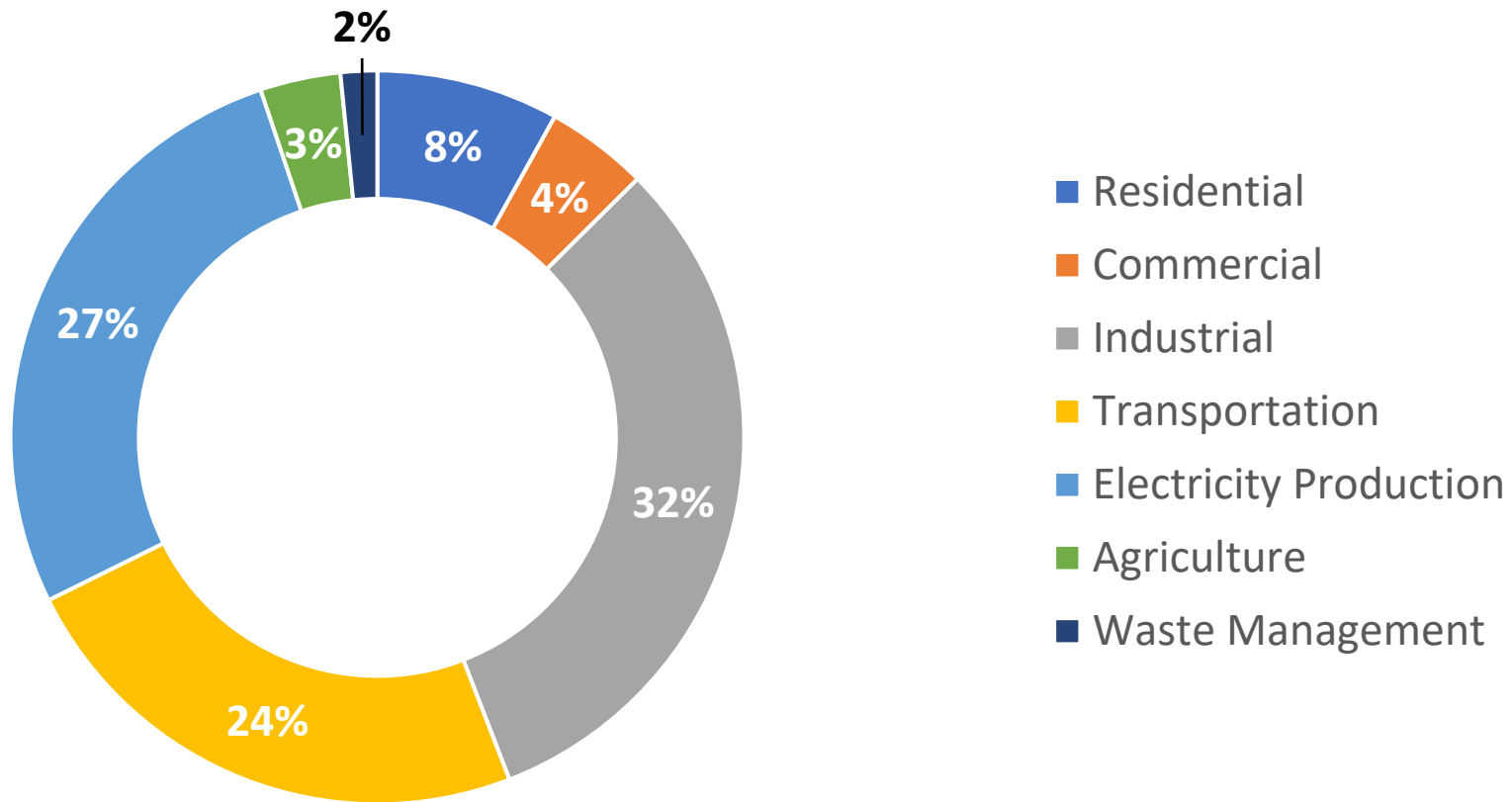
GHG Emissions Inventory

GHG Emissions (MMT_{CO₂e}) by Sector



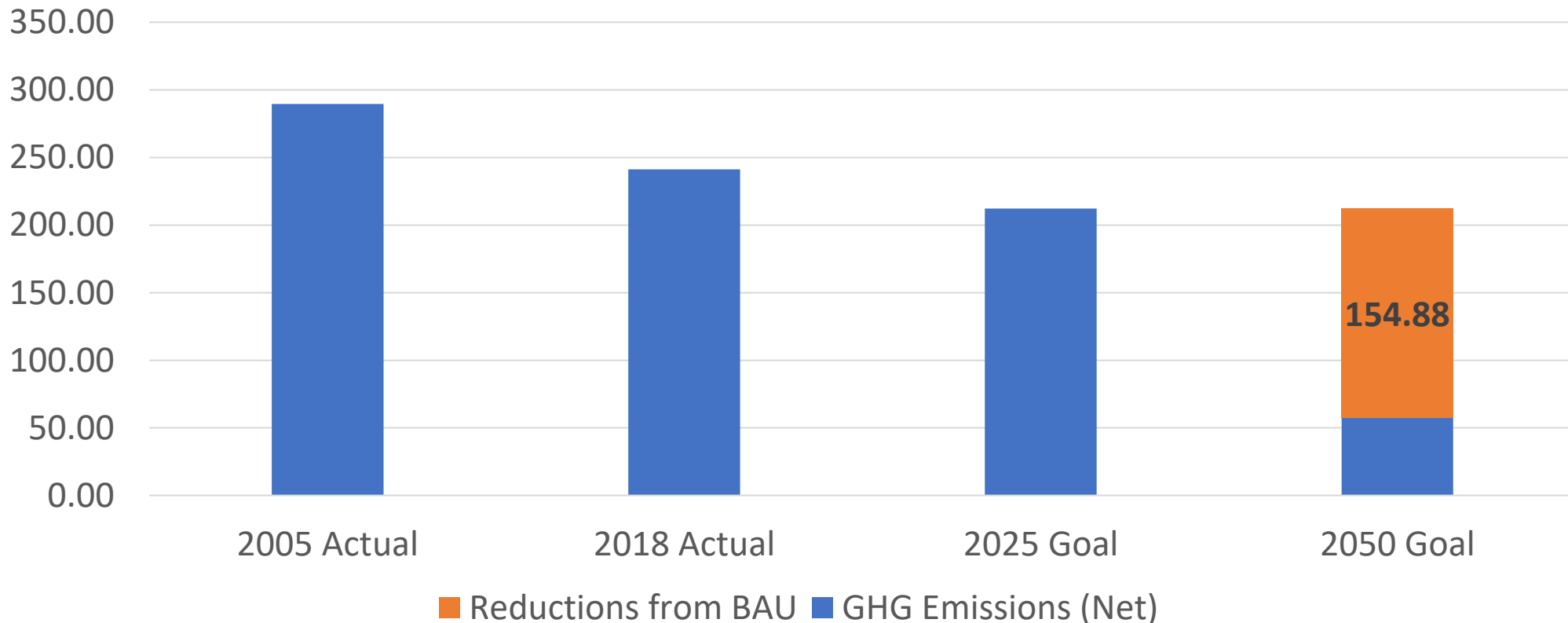
GHG Emissions Inventory

Pennsylvania 2018 GHG Emissions
% of Total by Sector

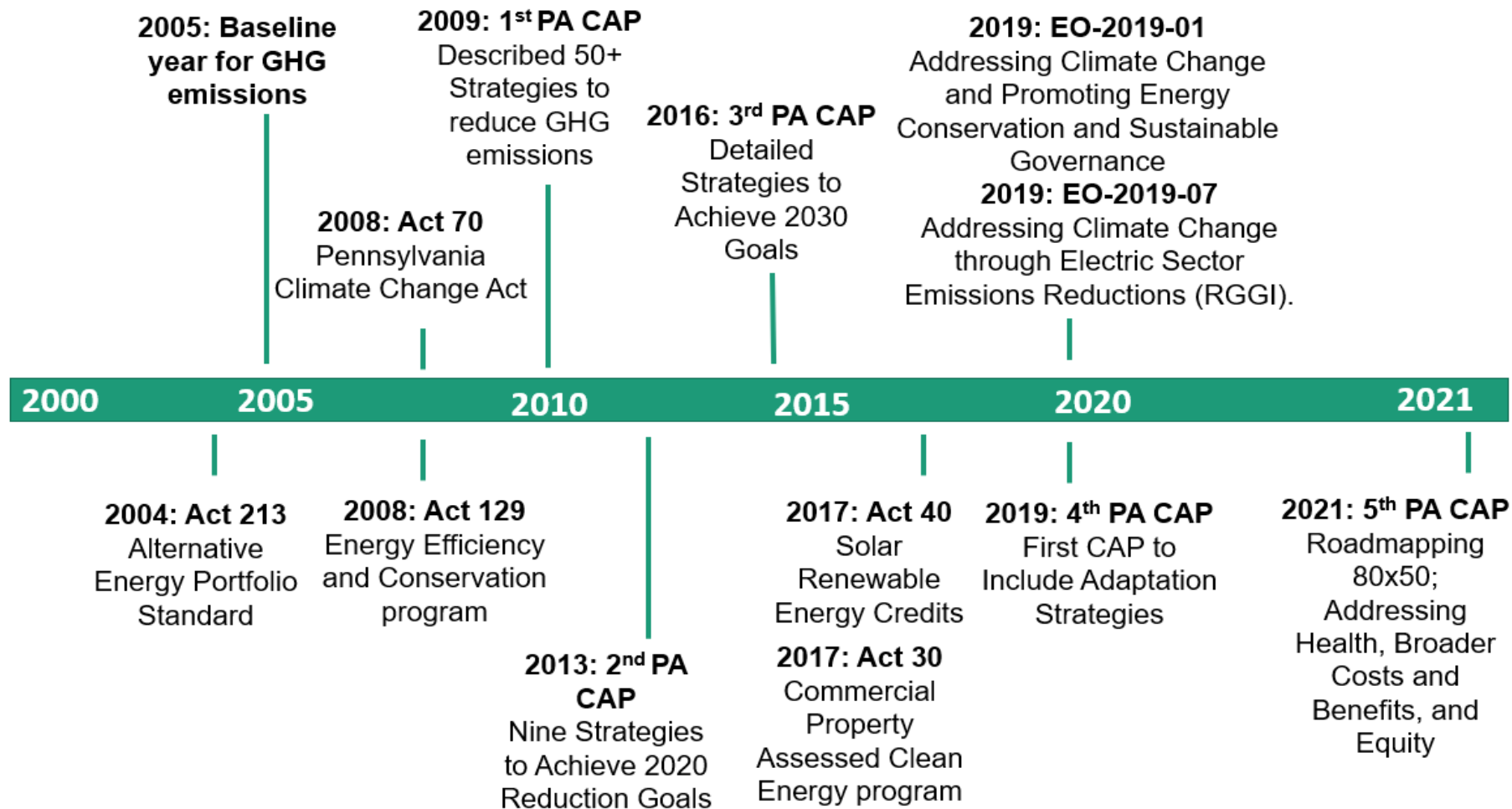


Greenhouse Gas Reduction Goals

GHG Reductions Needed to Meet 2025 and 2050 Goals (MMT_{CO2e})



PA's Energy and Climate Planning Efforts



2021 Climate Impacts Assessment and Action Plan



PennState



HAMEL
ENVIRONMENTAL
CONSULTING

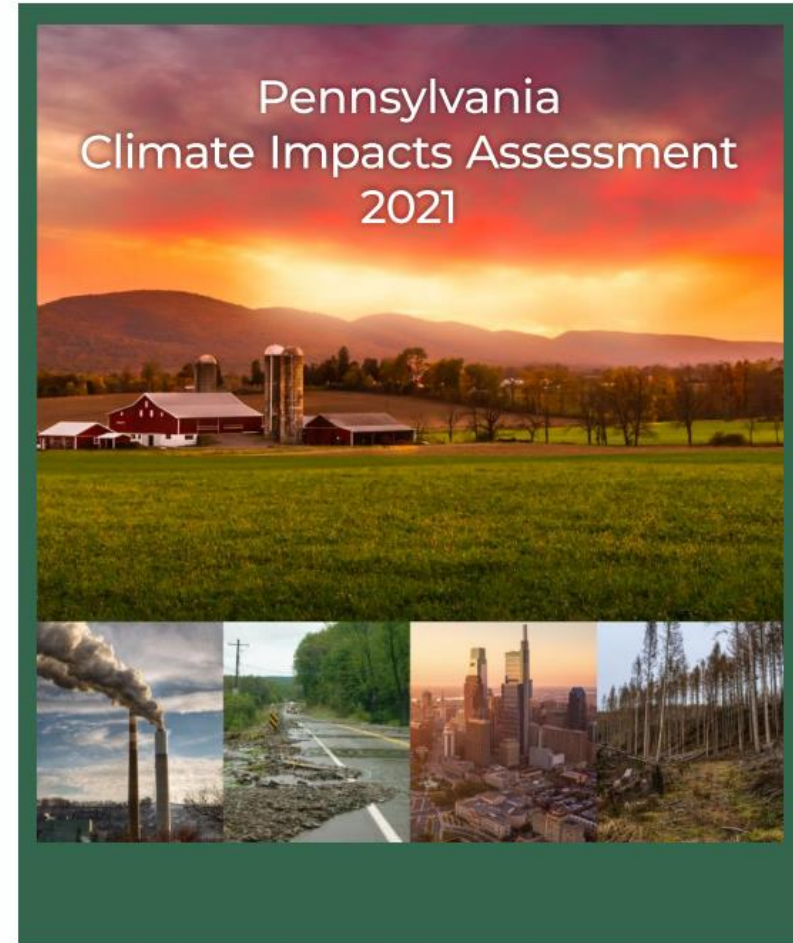
The Impacts Assessment and Climate Action Plan team includes experts in:

- Buildings
- Transportation
- Energy Production, Supply and Electricity
- CHP
- Waste
- Agriculture, Land Use, Forestry
- Climate Science and Risk
- Adaptation
- Economics
- GHG Accounting
- Health and Air Quality
- Equity
- Policy

2021 Impacts Assessment Focus Areas and Updates

Purpose of this Report:

- Update: Reflect latest available information on climate science and impacts
- Risk-based approach: Understand relative timing and severity of impacts to inform overall risk ratings and priorities for adaptation
- Make it actionable: Directly inform priority adaptation actions in the Climate Action Plan (CAP)



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Impacts Assessment – Climate Projections

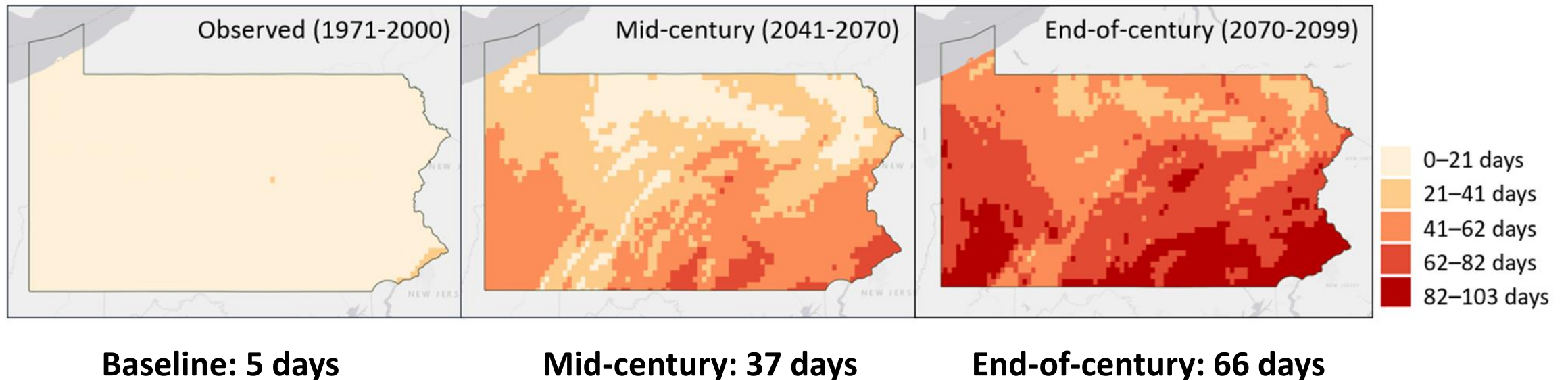
Climate Projections - PA is getting warmer and wetter.

- Over past 110 years, temperatures in PA increased by more than 1.8°F and are expected to increase by an additional 5.9°F by 2050
- Cities are expected to see increased frequency of 100+ degree days
- Annual precipitation in PA has increased by 10% since early 20th century and is expected to increase by another 8% by 2050, with a winter increase of 14%

Impacts Assessment – Climate Projections

Observed and projected annual days with temperatures above 90°F

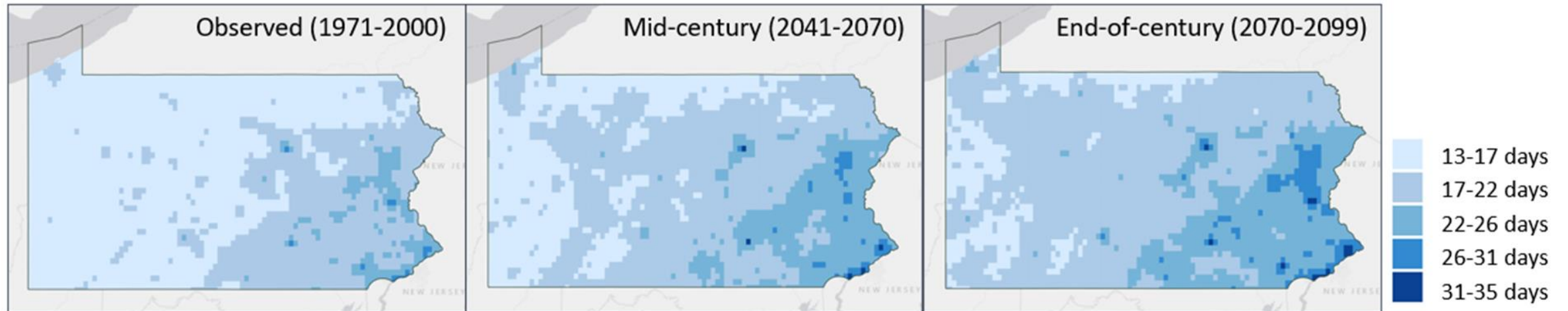
Average Annual Number of Days with Temperatures >90°F



Impacts Assessment – Climate Projections

Observed and projected annual days with “very heavy” precipitation

Number of Days with Very Heavy Precipitation

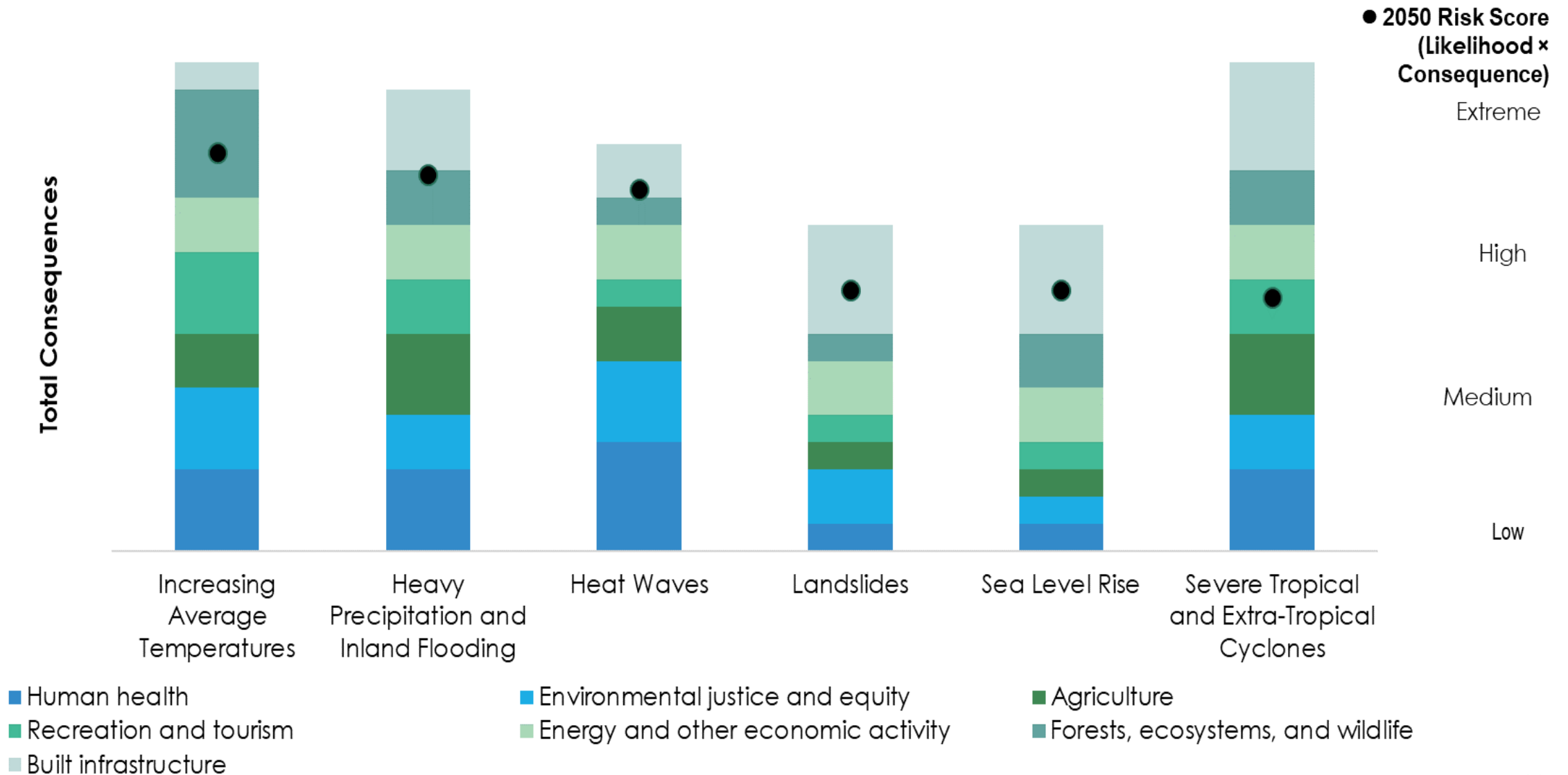


Baseline: 12.4 days

Mid-century: 15.4 days

End-of-century: 16.8 days

2050 Risk Assessment Results



2050 Risk Assessment Results

Consequence Category → Hazard	Human health	Environmental justice and equity	Agriculture	Recreation and tourism	Energy and other economic activity	Forests, ecosystems, and wildlife	Built infrastructure	Overall Risk Rating
Increasing average temperatures	12	12	8	12	8	16	4	10.7
Heavy precipitation and inland flooding	12	8	12	8	8	8	12	9.9
Heat waves	16	12	8	4	8	4	8	9.3
Landslides	3	6	3	3	6	3	12	5.6
Sea level rise	3	3	3	3	6	6	12	5.6
Severe tropical and extra-tropical cyclones	6	4	6	4	4	4	8	5.3

Risk Assessment Key Findings

- **Flooding is currently the highest-risk hazard** facing Pennsylvania, and flood risks are projected to increase; at the same time, risks from **increasing average temperatures and heat waves** could rise to be as high as flooding is today by mid-century
 - Flooding from heavy rain events affects built infrastructure, human health, and agriculture, with ripple effects throughout the economy
 - Increasing average temperatures could affect nearly every aspect of life
- **Heat waves will become increasingly common** and will create particular health and economic risks for vulnerable populations
- **All hazards could affect public health negatively**—especially heat waves, increasing temperatures, and flooding
- **Climate change will not affect all Pennsylvanians equally.** Some may be more at risk because of their location (and inability to relocate), income, housing, health, or other factors
- **Landslides and sea level rise can cause severe impacts in the locations where they occur**, but pose relatively low risks statewide
- **Severe tropical storms, flooding, and landslides already pose risks**, and these could become more likely or severe in the future

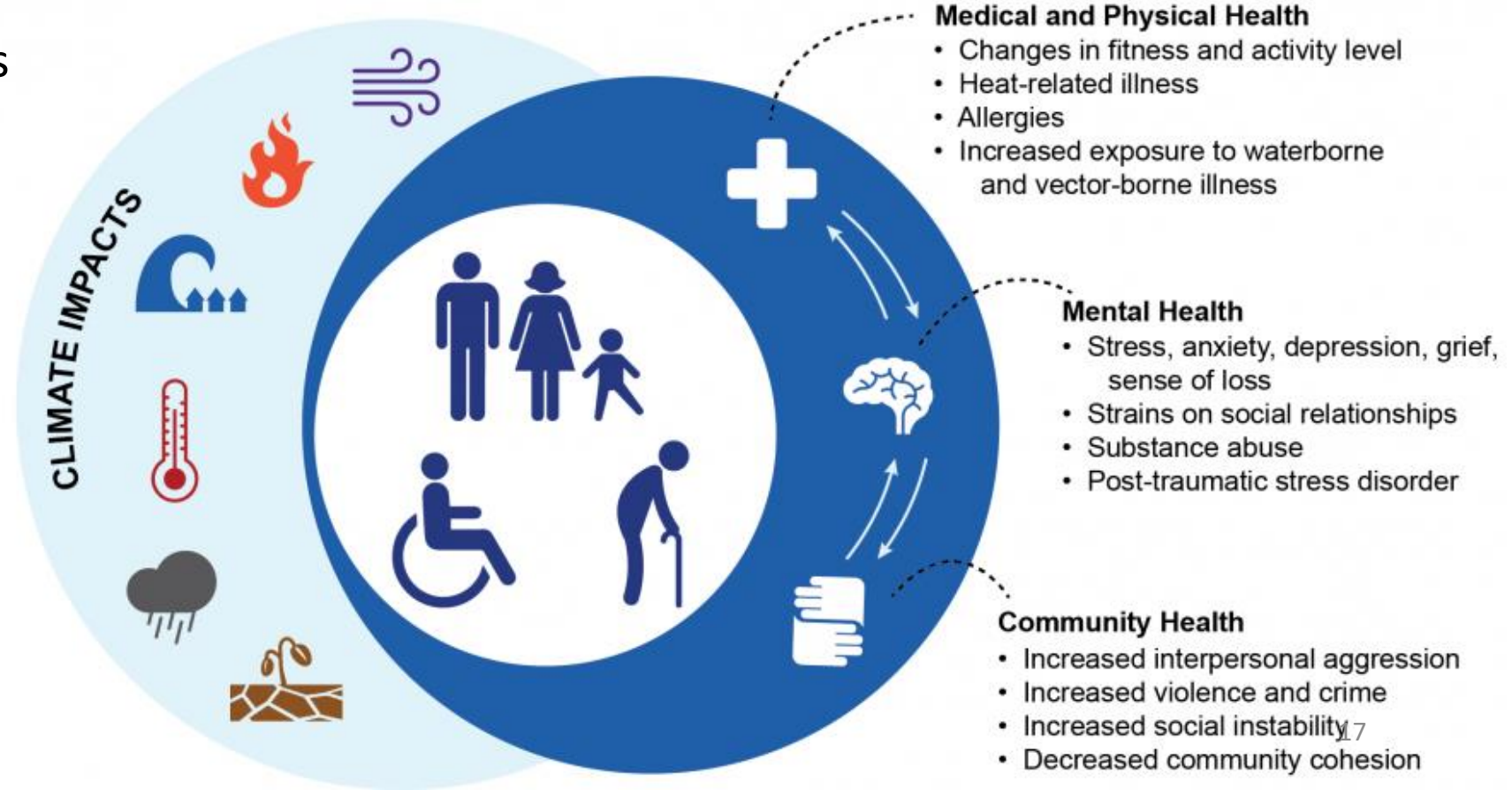
Impacts to Human Health

Increasing average temperatures and heat waves are projected to increase:

- heat-related illnesses or deaths
- allergies
- violence and crimes
- anxiety and mood disorders

Flooding and severe cyclones can also have severe health impacts such as:

- disrupting critical services
- making conditions are more hazardous



Impacts to Human Health

Impacts to human health will not affect Pennsylvanians equally

Underlying health conditions, age, race, limited access to air conditioning, outdoor employment (e.g., farm labor or logging), and living in urban areas can all increase risk to heat-related health conditions

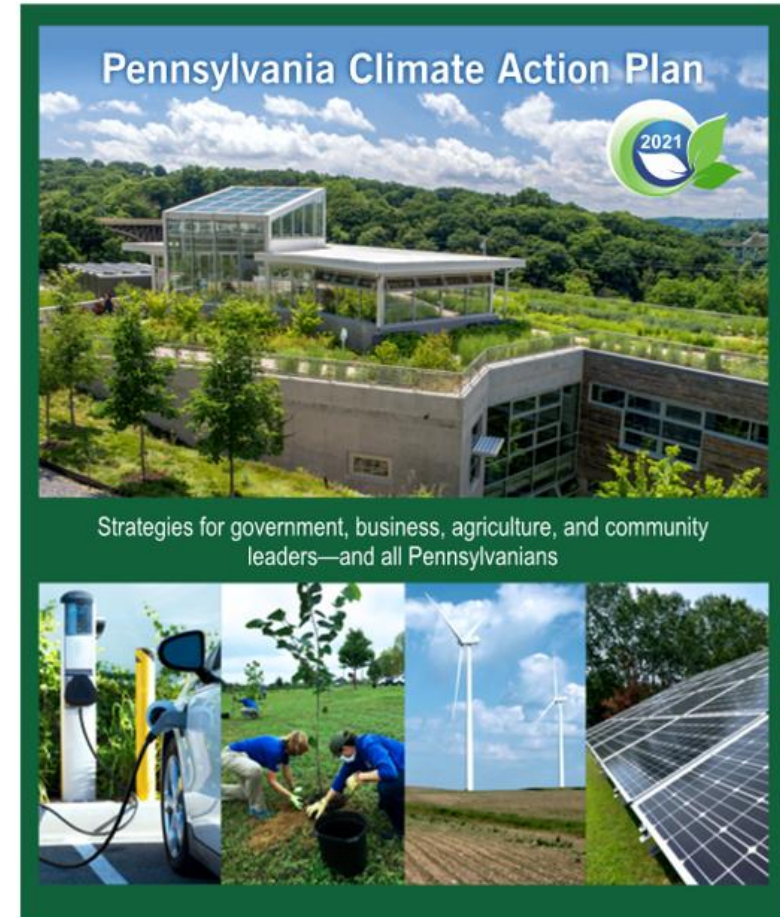
Populations at greater risk from heat include:

- The elderly
- Low-income communities
- Pregnant people
- Individuals with cardio-vascular disease
- Outdoor workers

Pennsylvania Climate Action Plan 2021

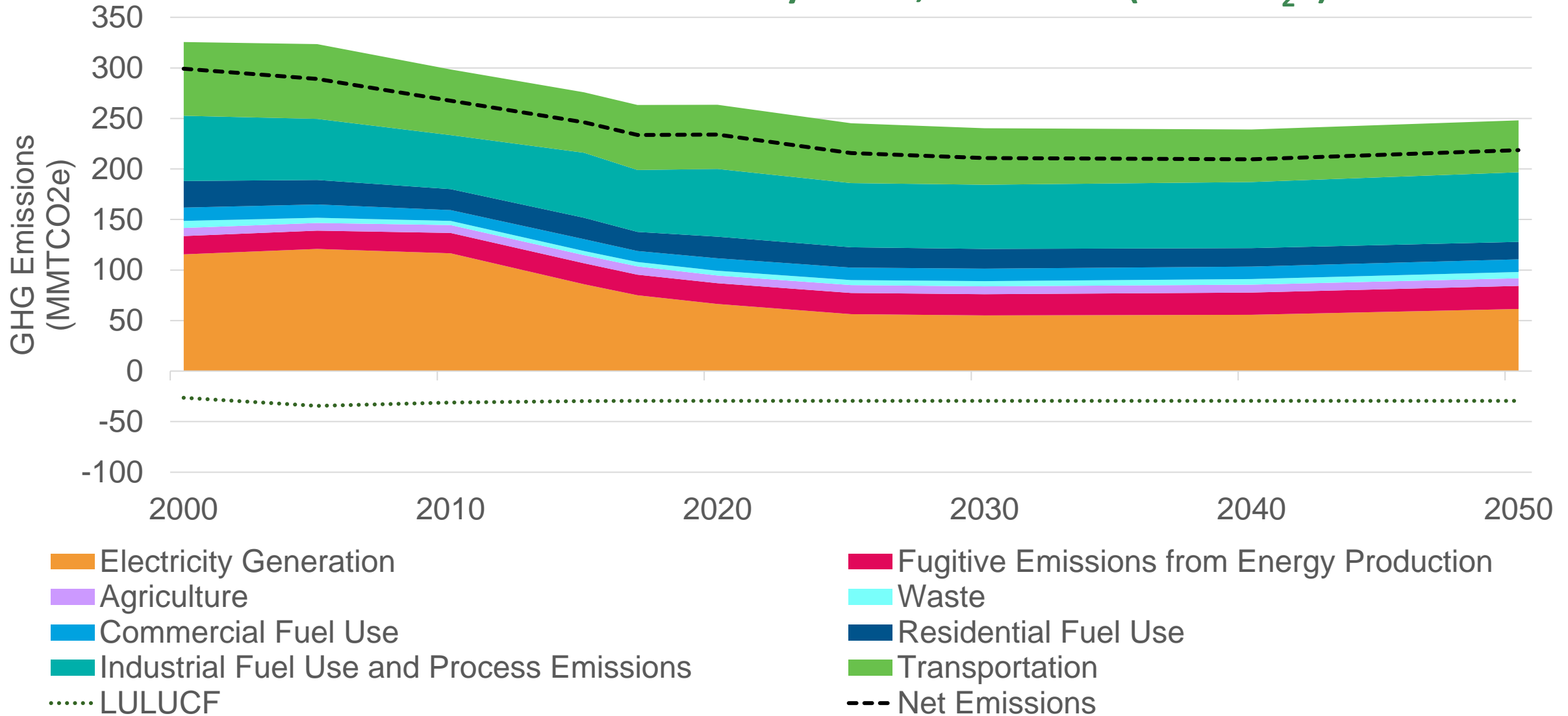
Purpose of this Report:

- Updated BAU Emissions Scenario Projections
- Outlines a pathway to reaching PA's GHG reduction goals: 26% by 2025 and 80% by 2050 from 2005 levels
- Quantifies GHG reduction and economic costs/benefits of climate action
- Includes discussion on the role of “enabling technologies” in meeting PA's GHG reduction goals
- Priority adaptation actions directly informed by the Pennsylvania Climate Impacts Assessment 2021
- Focus on equity throughout



Pennsylvania Climate Action Plan – Business As Usual

Business-as-usual net emissions by sector, 2000-2050 (MMT_{CO₂e})



Pennsylvania Climate Action Plan – Strategies

Start Now and Implement in 5 years:

- Institute the most up-to-date building codes for energy efficiency.
- Improve residential and commercial energy efficiency.
- Increase distributed on-site solar energy.
- Increase Industrial energy efficiency and fuel switching.
- Use programs and incentives to increase energy efficiency for agriculture.
- Incentivize use of distributed combined heat and power.
- Keep nuclear energy generation at current levels.

Pennsylvania Climate Action Plan – Strategies

Start Now and Implement in 10 years:

- Incentivize building electrification.
- Increase fuel efficiency of light-duty vehicles and reduce vehicle miles traveled for single-occupied vehicles.
- Increase use of light-duty electric vehicles.
- Institute a low-carbon fuel standard to reduce the carbon intensity of transportation fuels.
- Increase capture of biogenic methane from non-fossil sources, including animal manure, food waste, and landfill gas, for use in by commercial and industrial properties.
- Reduce fugitive methane emissions from fossil fuel extraction industries such as oil and natural gas operations.
- Provide training and tools for agricultural best practices.
- Increase land and forest management to increase carbon absorption.

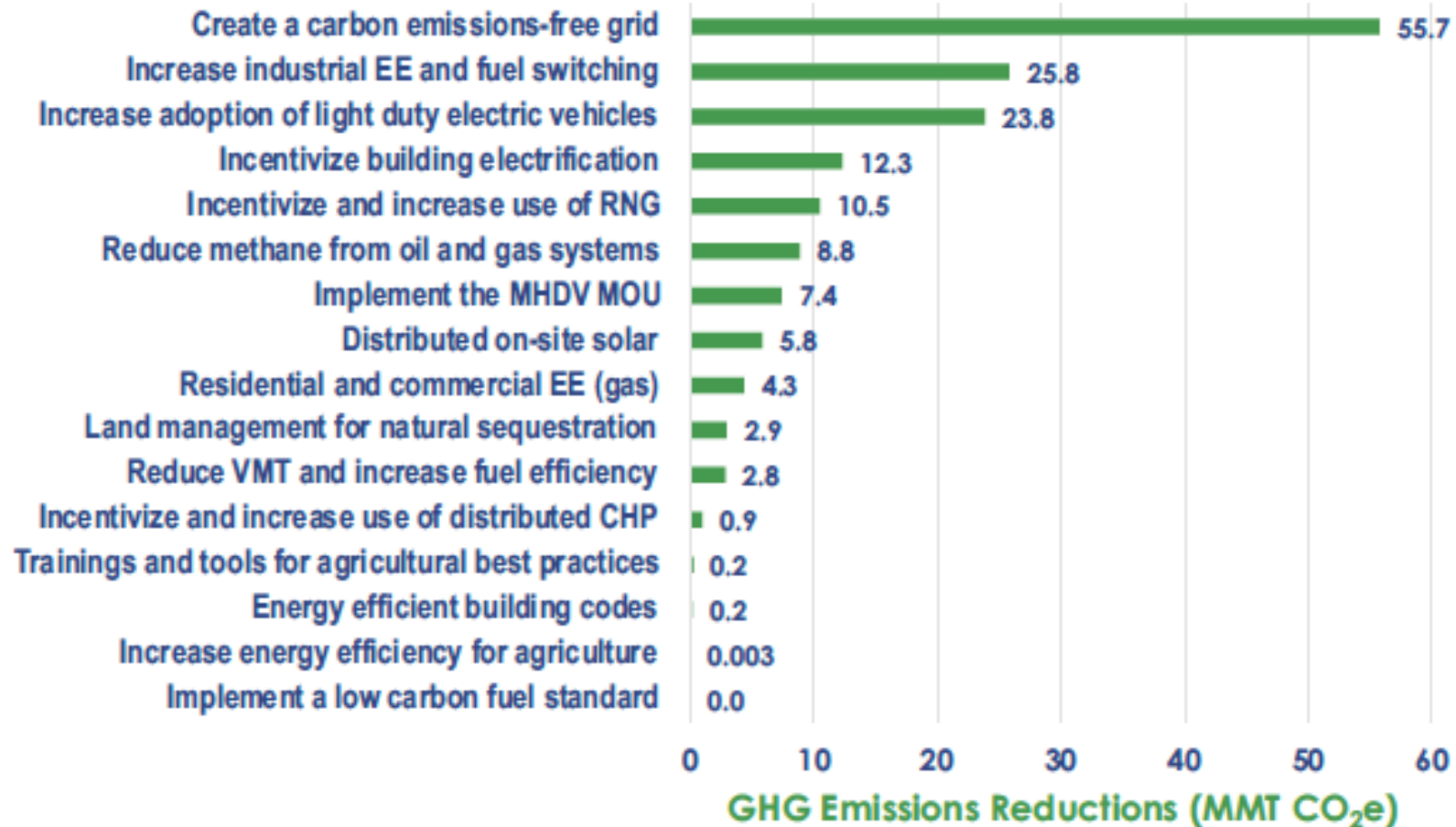
Pennsylvania Climate Action Plan – Strategies

Start Now and Implement in 10+ years:

- Implement a multi-state Memorandum of Understanding to make all medium- and heavy-duty vehicle sales zero emissions vehicles by 2050.
- Establish a carbon emissions-free grid.

▶ Pennsylvania Climate Action Plan – Strategies

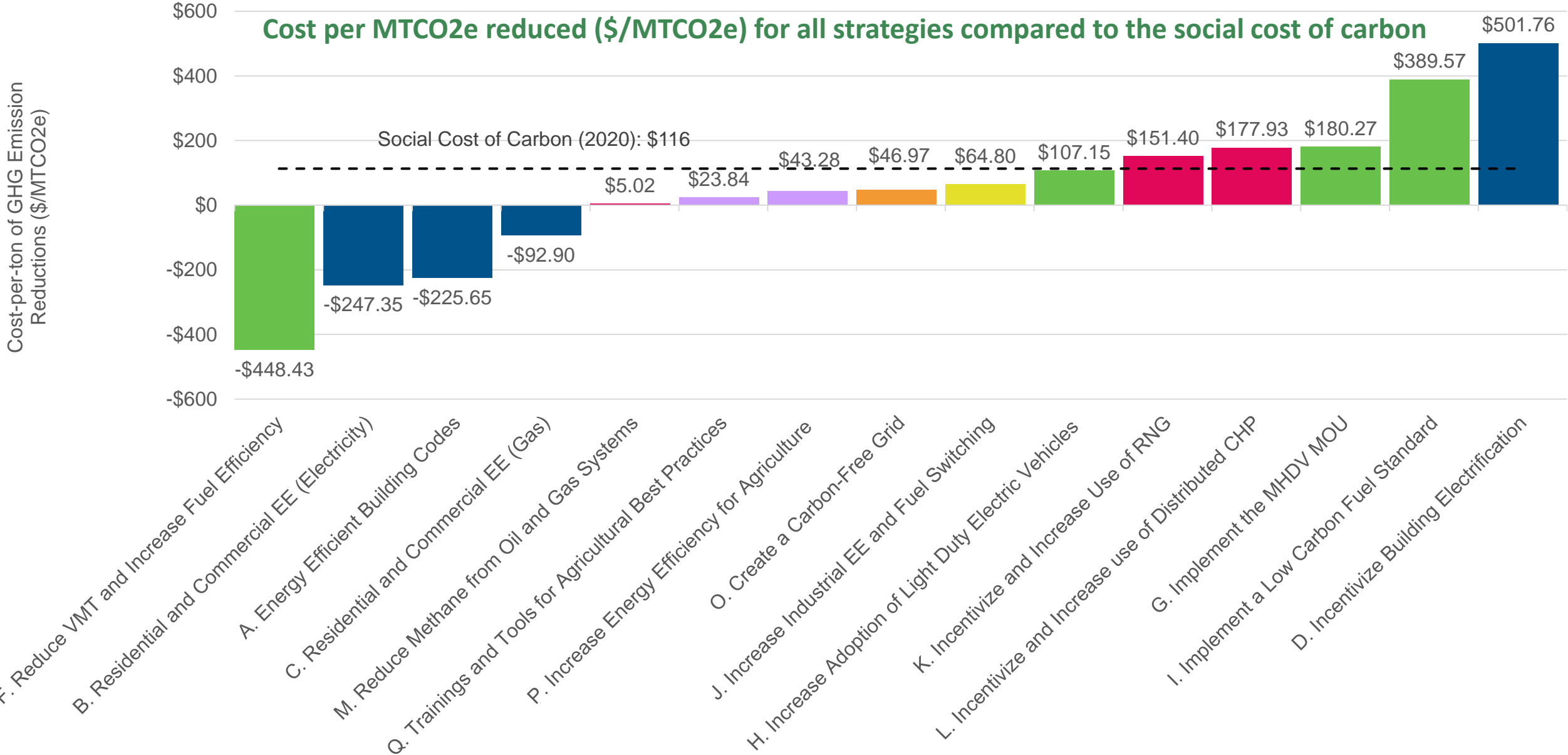
Greenhouse gas reductions achieved by 2050 from recommended strategies



EE: energy efficiency; RNG: renewable natural gas; MHDV MOU: Medium and Heavy-Duty Vehicle Memorandum of Understanding; VMT: vehicle miles traveled; CHP: combined heat and power; C-PACE: Commercial Property Assessed Clean Energy.

Pennsylvania Climate Action Plan – Strategies

Cost per MTCO2e reduced (\$/MTCO2e) for all strategies compared to the social cost of carbon



Pennsylvania Climate Action Plan – Enabling Tech

Enabling Technologies

- Incentivizing grid-level battery storage;
- Power-to-gas and blue and green hydrogen;
- Carbon capture, utilization, and storage (CCUS);
- Direct Air Capture (DAC);
- Peak energy load and balancing strategies;
- Carbon offsets; and
- Disruptive digital technologies.

Adaptation Planning – Climate Action Plan

- For each adaptation priority, develop an “adaptation pathway” – a recommended sequence of strategies to adapt to and prepare for climate change impacts
- Environmental justice and equity focus areas prioritize reducing impacts on already overburdened and vulnerable populations
- Adaptation priority areas by hazard and consequence category:
 - Primary focuses: health, environmental justice and equity, and built infrastructure
 - Primary hazards: increasing average temperature, heat waves, and flooding

1. Impacts of Increasing Average Temperatures and Heat Waves on Health

2. Impacts of Flooding and Storms on Health

3. Impacts of Increasing Average Temperatures on Environmental Justice and Equity

4. Impacts of Flooding on Environmental Justice and Equity

5. Impacts of Increasing Average Temperatures on Forests, Ecosystems, and Wildlife

6. Impacts of a Warmer and Wetter Climate on Agriculture

7. Impacts of Increasing Average Temperatures on Recreation and Tourism

8. Impacts of a Changing Climate on Built Infrastructure

9. Impacts of Landslides on Built Infrastructure

Adaptation Planning – Climate Action Plan

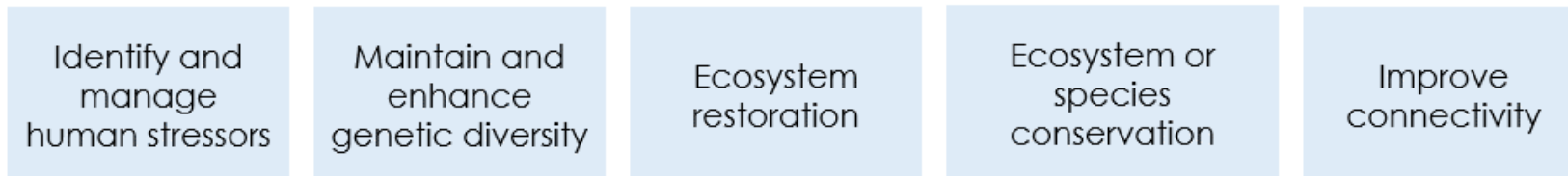
Example: Adaptation strategy pathway to reduce increased average temperatures impact on forests, ecosystems, and wildlife

Types of Foundational Strategies to Understand Impacts and Vulnerabilities



Approaches to Reduce Vulnerabilities and Manage Impacts

Types of Approaches



Example Strategies



Ongoing Strategies

Continuously monitor vulnerable species and ecosystem changes

Adaptation Planning – Climate Action Plan

Example set of strategies to support forests vulnerable to increasing average temperatures.

<p>Foundational Strategy Type: Identify vulnerable species, habitats, and ecosystems</p>
<p>Strategy: Conduct a more detailed risk assessment across key species, habitats, and ecosystems in the state</p>
<p>Actor: State Agencies, most likely DCNR</p>
<p>Timing: As soon as possible</p>



<p>Ongoing Strategy Type: Monitor vulnerable species and ecosystem changes</p>
<p>Strategy: Establish a statewide monitoring and research network to establish baseline conditions and monitor ecosystem factors.</p>
<p>Actor: State agencies, most likely DCNR and/or DEP</p>
<p>Timing: Ongoing beginning after vulnerable species and ecosystems are identified</p>



<p>Approach: Improve connectivity</p>
<p>Strategy: Promote connectivity by using land exchanges and conservation easements to allow species to migrate to suitable habitats</p>
<p>Actor: State agencies, most likely DCNR</p>
<p>Timing: As vulnerable areas are prioritized, and funding becomes available. Significant lead time may be needed to implement.</p>

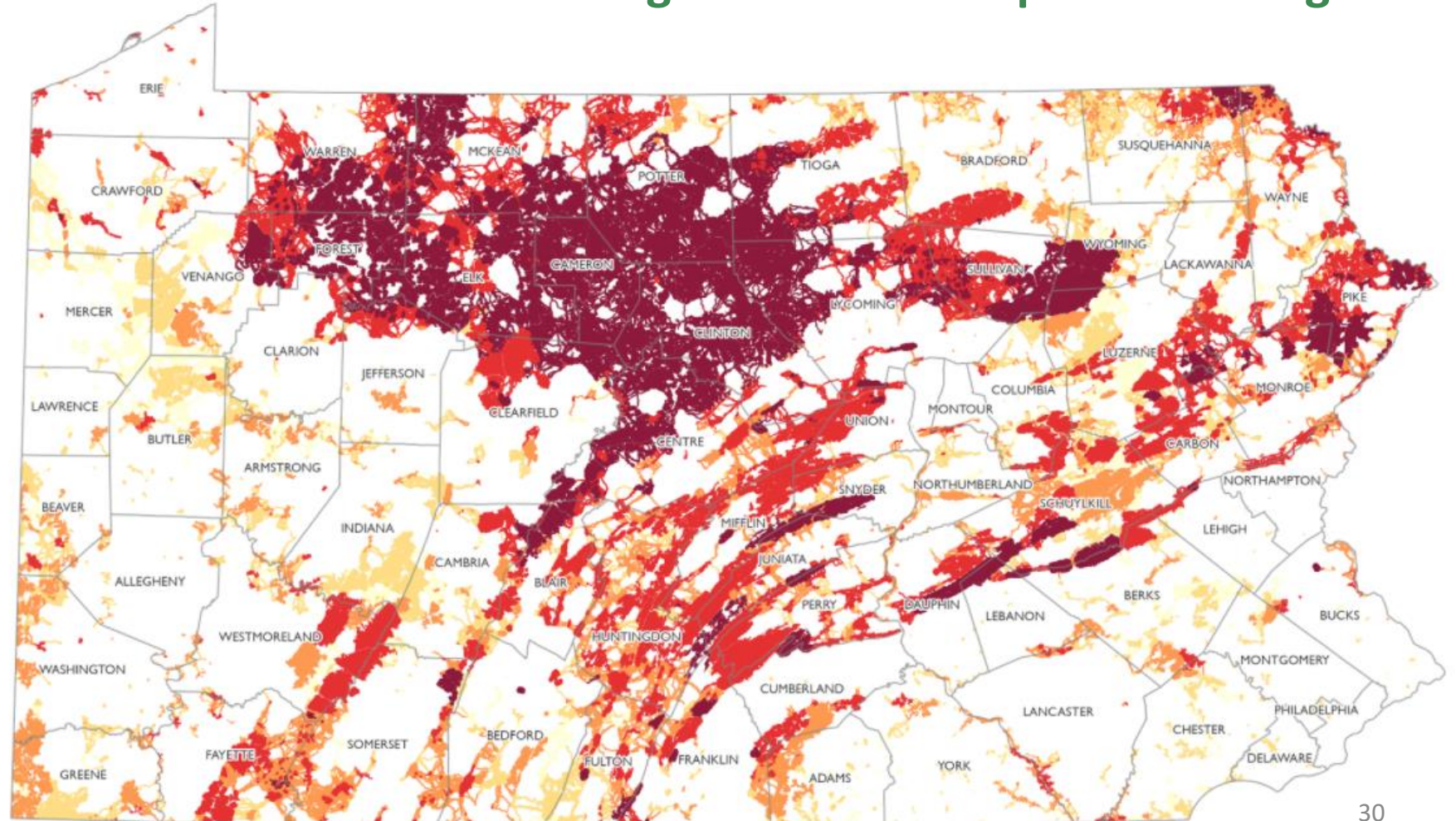
<p>Approach: Ecosystem restoration and conservation</p>
<p>Strategy: Promote forest conservation, reforestation and urban tree canopy expansion on private and public lands</p>
<p>Actor: State agencies, most likely DCNR and/or DEP</p>
<p>Timing: After vulnerable areas are identified and prioritized</p>

Adaptation Planning – Climate Action Plan

Case Study

Identifying Species Vulnerable to Climate Change to Inform Adaptive Planning

**Climate Change
Connectivity Priority
Scores identified in
the PNHP study.**





Thank you!

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DEP Climate Website: www.dep.pa.gov/climate

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