2018 Pennsylvania Climate Action Plan

Energy Assessment and Adaptation Strategies Updates

October 24, 2017

Prepared for the Climate Change Advisory Committee Meeting

Bill Prindle (ICF)
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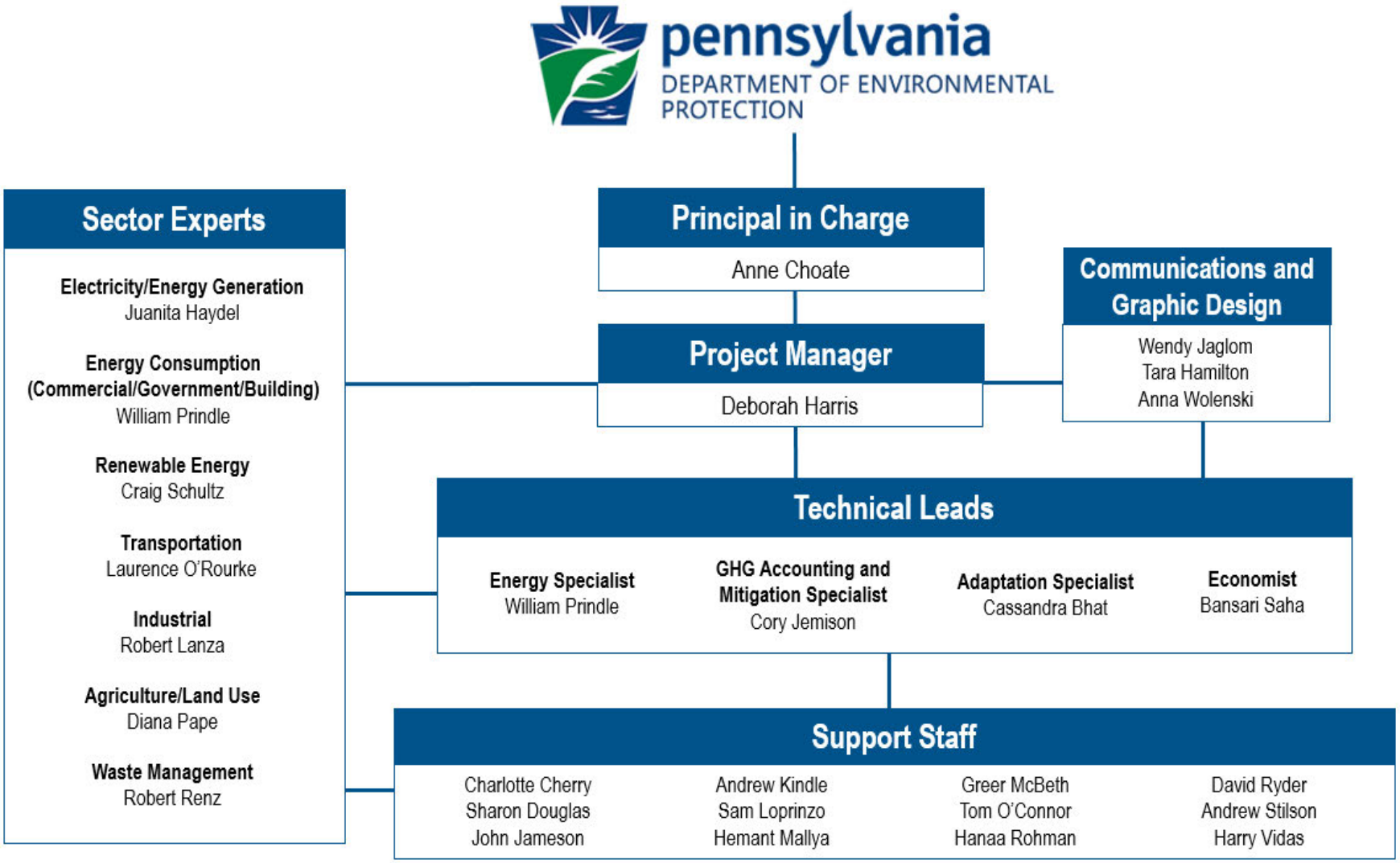
Agenda

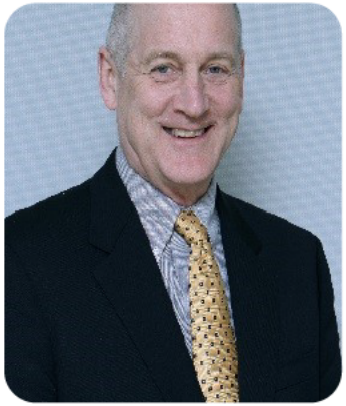
- **Introductions**
- **Reminder of Overall Project Approach (Bill Prindle)**
- **Energy Assessment/Resource Assessment Tasks (Bill Prindle)**
- **Interim Results from Adaptation Task (Cassie Bhat)**

ICF Introductions

Team Organization



ICF Energy and Adaptation Technical Leads



Bill Prindle—Energy Specialist

- 40+ years of experience in the energy field
- M.S. in Energy Management and Policy from Penn
- Philadelphia EMP, Kleinman, and MWCOG technical lead
- Works with DVRPC and numerous other cities, municipalities, states, and fed. agencies

Cassie Bhat—Adaptation Specialist

- 7+ years of experience in multi-sector adaptation planning at state, local, and regional levels
- Supports City of Philadelphia adaptation efforts
- Involved in Massachusetts Adaptation Plan

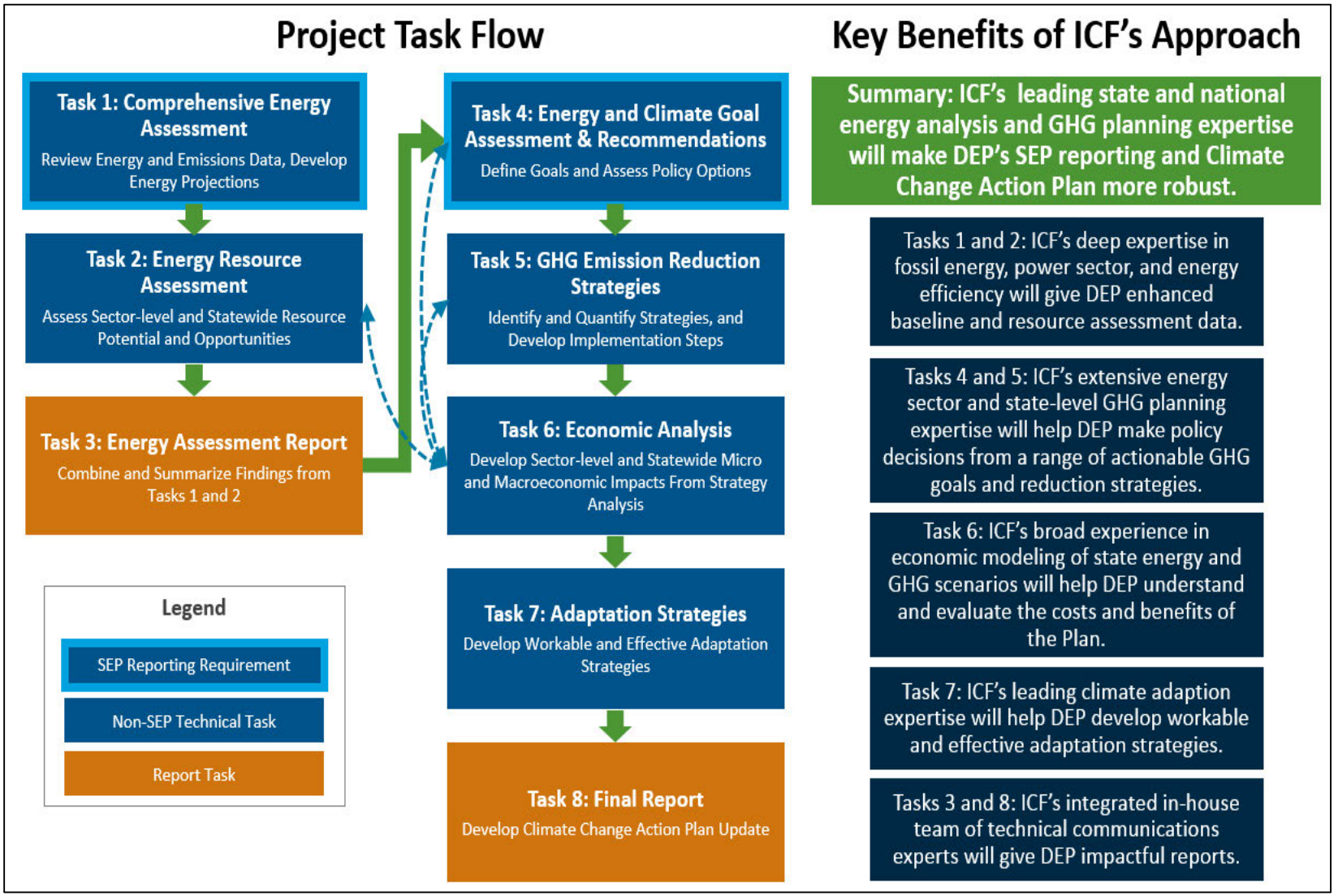
Reminder of Overall Project Approach

Overall Project Task Sequence

Integrated Task Approach:

- **Task 1. Comprehensive Energy Assessment**
- **Task 2. Energy Resource Assessment**
- **Task 3. Energy Assessment Report**
- **Task 4. Energy and Climate Goal Assessment and Recommendation**
- **Task 5. GHG Emission Reduction Strategies**
- **Task 6. Economic Analysis**
- **Task 7. Adaptation Strategies**
- **Task 8. Final Report**

ICF's Integrated Project Approach



Overview of Energy Assessment (Task 1) and Resource Assessment (Task 2)

Agenda

Task 1: Comprehensive Energy Analysis

Task 2: Energy Resource Assessment

Data Sources

Key Questions and Input

Next Steps

Task 1: Comprehensive Energy Analysis

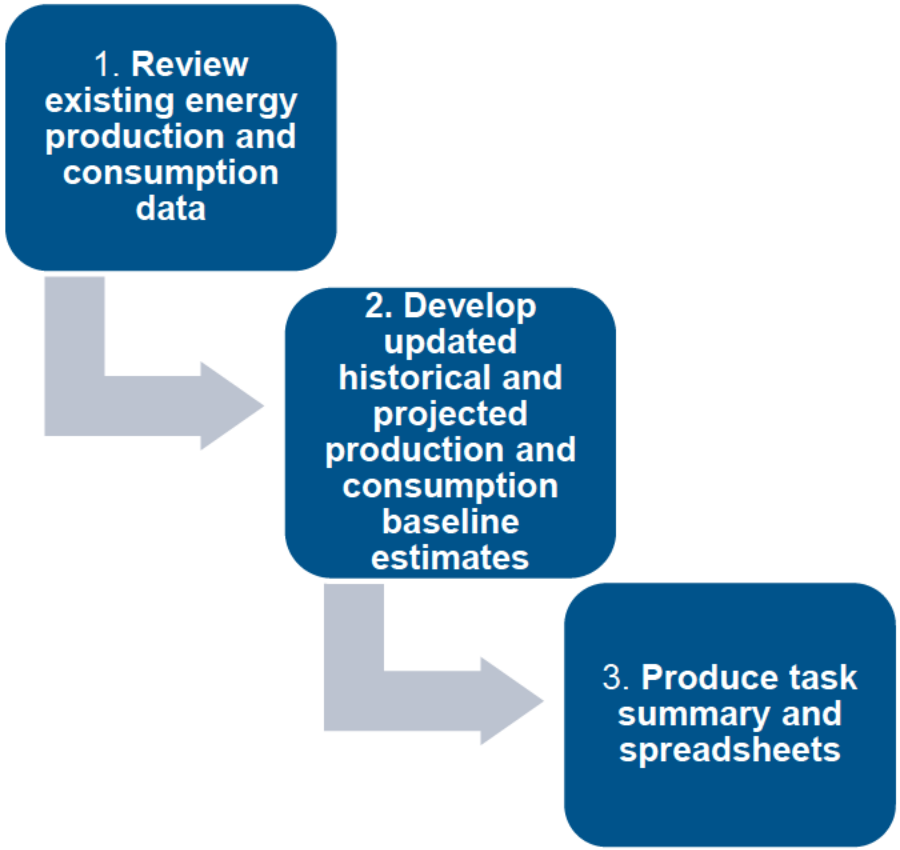
Task 1. Comprehensive Energy Analysis Objectives

- Summarize and present state-wide historical and projected (through 2050) energy production and consumption data by sector and fuel type.

- Reflect existing policies and identify key trends and patterns in state energy production and consumption, including assessing Pennsylvania's gap between production and consumption.

Task 1. Comprehensive Energy Analysis Methods

Task Steps



Key Task Components

- Use existing state and federal data sources (State Inventory Tool, EIA, USDA, BLM, NREL, etc.)
- Covers energy production and consumption, including transportation

Energy Assessment Data Elements: Consumption

Historical Energy Consumption/Expenditures

- Total Energy Consumption
- Energy Consumption by Sector: Residential/Commercial/Industrial/Transportation
- Electricity Consumption: Residential/Commercial/Industrial/Transportation
- Energy Prices (by fuel type)
- Total Energy Expenditures
- Energy Expenditures by Sector: Residential/Commercial/Industrial/Transportation
- Pennsylvania Gross Domestic Product and Energy Consumption (Btu/$ GSP)

Future Consumption/Expenditures Projections (through 2050)

- Total Consumption, and by Sector: Residential/Commercial/Industrial/Transportation
- Energy Prices (by fuel type)
- Total Expenditures, and by Sector: Residential/Commercial/Industrial/Transportation
- Pennsylvania Gross Domestic Product and Energy Consumption (Btu/$ GSP)

Energy Assessment Data Elements: Production

Historical and Future Production Energy Projections (through 2050)

- Fossil Fuels: Bituminous & Anthracite Coal, Natural Gas, Crude Oil
- Renewable and Alternative Fuels
  - Methane: Landfill Gas, Coal Mine, Digesters (wastewater & agricultural waste)
  - Biomass solids (wood waste)
  - Biodiesel
  - Ethanol (corn and cellulosic)
- Includes estimates of GHG and pollutant emissions and economic characteristics

Energy Assessment Data Elements: Electricity Generation

Historical and Future (through 2050) Electricity Generation

- Fossil Fuels: Coal, Natural Gas, Oil
- Renewable Electricity
  - Solar
  - Hydro
  - Wind
  - Biomass Solids
  - Biogas
- Nuclear
- CHP/Microgrids
- Includes estimates of GHG and pollutant emissions and economic characteristics

Energy Assessment Data Elements: Energy Imports and Exports

- Comparison of Total Energy Consumption and Production
- Comparison of Fossil Fuel Consumption and Production
  - Natural gas
  - Coal
- Comparison of Electricity Consumption and Production
- Comparison of Other Energy Consumption and Production
- Future Trends in Energy Imports and Exports

Task 2: Energy Resource Assessment

Task 2. Energy Resource Assessment

1. **Develop supplemental resource assessments**
   - Include energy efficiency, fossil fuels, renewable fuels, renewable power, transportation, and DER
2. **Define sectoral energy resource opportunities**
   - Map resource potential into policy and program strategies
   - Allocate estimates of resource potential by sector where applicable
3. **Develop environmental impact and economic benefit and cost estimates.**
   - Project environmental impacts and economic costs and benefits
4. **Produce task summary and spreadsheet(s)**

Task 2. Energy Resource Assessment – Resource Potential by Energy Resource Type

Demand-side

- Energy Efficiency (technology measures, including GHPs)
- Energy Conservation (behavioral/operational measures)

Supply-side

- Fossil fuels
  - Coal
  - Petroleum
  - Natural Gas
  - Propane
- Nuclear
- Renewables
  - Solar (PV)
  - Hydro

- Renewables Cont'd
  - Wind
  - Biogas (Methane from landfills, coal mines, wastewater ag waste) methane)
  - Biomass solids (wood waste)
  - Biodiesel
  - Ethanol (corn and cellulosic)

Task 2. Energy Resource Assessment – Enabling Technologies and Strategies

- CHP/Microgrids
- Heat Pumps (Ground and Air Source)
- Energy Storage (battery)
- Hydrogen (fuel cells)
- Electrification
- Connected devices/IoT

Task 2. Energy Resource Assessment – Mapping Resources Potential Data to Sectors

- **Map resource potential to sector-oriented policies and programs**
- **Identify policies and programs that can realize potential by sector**

Example format shown below—does not reflect final resource types or sector mapping

Energy Resource Type	Sector					
	Transpor-tation	Electricity Generation	Industrial	Commercial Buildings	Government Buildings	Residential Buildings
Energy Efficiency	X		X	X	X	X
Coal		X	X			
Petroleum	X					
Natural Gas	X	X	X	X	X	X
Propane				X		X
Biofuels (direct use)	X		X	X	X	X
Renewable Power (wind, solar, biofuels, hydro)		X	X	X	X	X

Energy Assessment Data Sources

Task 1 and 2 Data Sources

A Sample of Key Sources

- State Inventory Tool (SIT) module spreadsheets
- DOE EIA Annual Energy Outlook, Reference Case
- DOE EIA State Energy Profiles, Pennsylvania
- Specific EIA datasets for key fuels, electricity generation, etc.
- 2013 Pennsylvania Energy Analysis
- 2015 CAP update, including workplans and supporting data
- Act 129 baseline and efficiency potential studies
- PUC documents on Act 129, AEPS, electricity forecasts, DG, etc.
- Pennsylvania Solar Future data and assumptions

…and many others!

Key Questions and Input from the CCAC on the Energy Assessment

Energy Assessment Key Questions and Input from the CCAC

- **Task 1**
  - Are we developing baseline data in the right categories?
  - Are there new reports or data sources on energy use or production we should use?
- **Task 2**
  - Have we captured the right resource types for potential assessment?
  - Are there new or forthcoming reports or sources we should include?
  - Are there specific technology/policy/program priorities we should give special focus?
- **Audiences**
  - Who will most likely review/use the Energy Assessment and Resource assessment reports?
  - In that context, are there key sensitivities, priorities, other issues we should be aware of?

Energy Assessment Next Steps

Energy Assessment Next Steps

- **Currently building out baseline dataset within overall project analysis spreadsheet tool**
- **Reviewing data sources and beginning Task 1 quantification steps**

Material/Deliverable	Draft due to DEP
Task 1 Analysis Spreadsheets	November 2017
Task 1 Summary Report	November 2017
Task 2 Analysis Spreadsheets	December 2017
Task 2 Summary Report	December 2017
Task 3 Report	February 2018

Adaptation Strategies Interim Results (Task 7)

Agenda

Objectives

Methods

Findings

Feedback

Next Steps

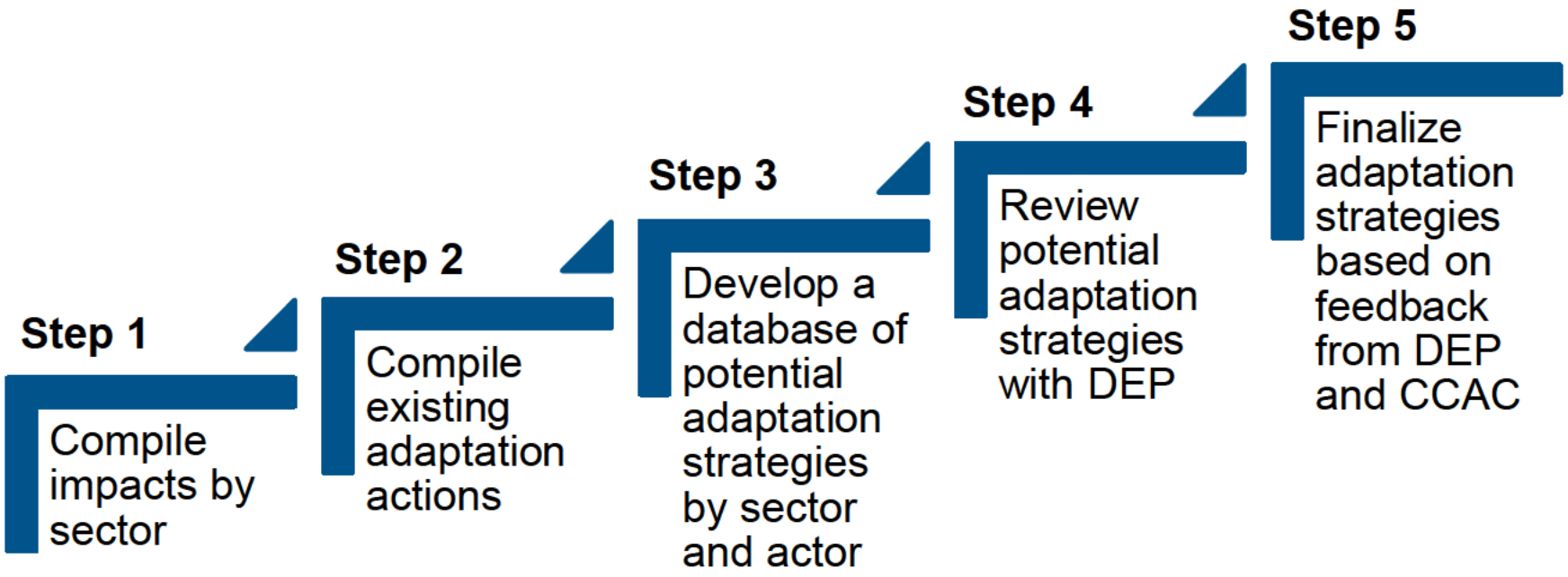
Adaptation Strategies Objectives

Objectives

- **Identify actions that citizens, businesses, and state leadership can take to reduce vulnerabilities**
  - Focus on near-term practical steps
  - Organize actions into the following sectors:
    - Water (including water supply, water quality, flooding, aquatic ecosystems, and coastal resources)
    - Human health
    - Agriculture (including forestry)
    - Infrastructure (including energy, transportation, and buildings)
    - Outdoor recreation and tourism
- **Compile adaptation strategies database, prioritizing citizen actions**

Adaptation Strategies Methods

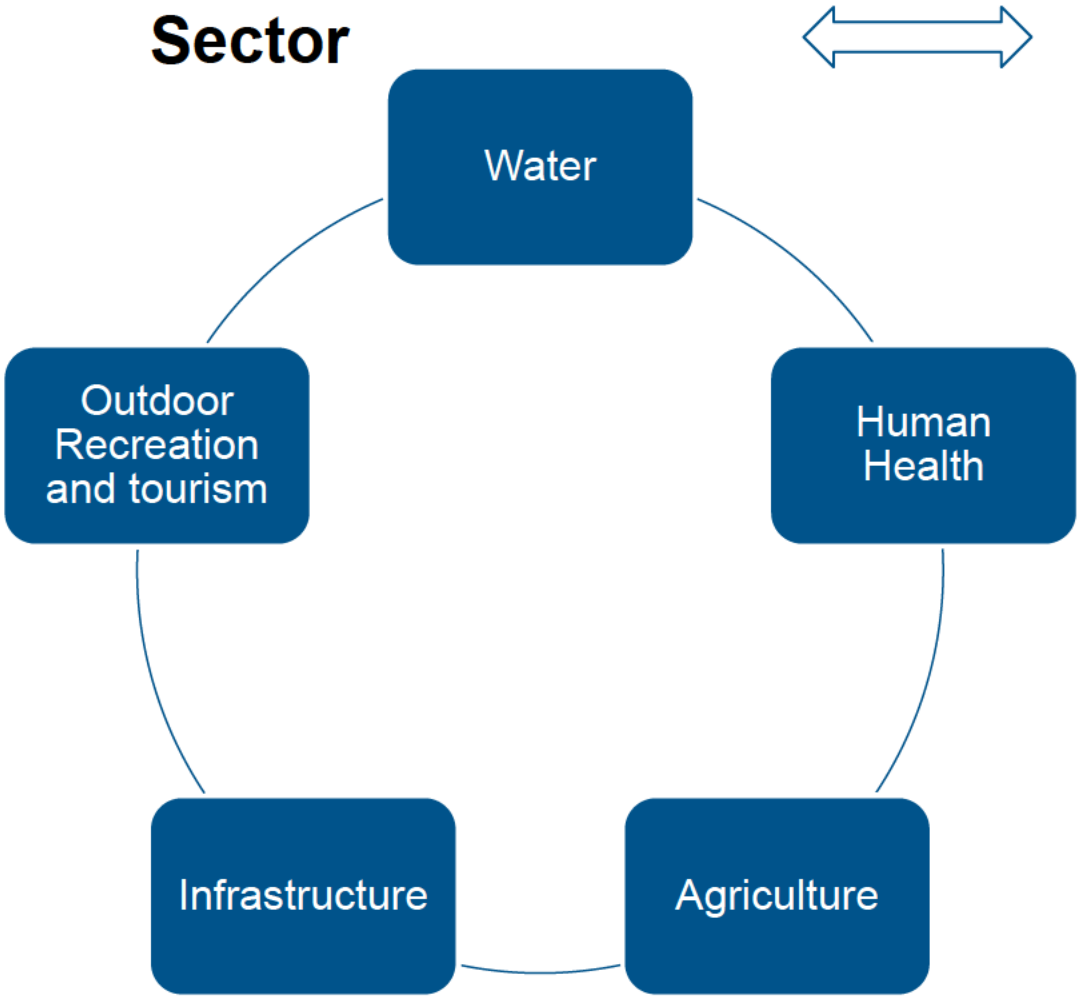
Methods


Step 1
Compile impacts by sector
Step 2
Compile existing adaptation actions
Step 3
Develop a database of potential adaptation strategies by sector and actor
Step 4
Review potential adaptation strategies with DEP
Step 5
Finalize adaptation strategies based on feedback from DEP and CCAC

Methods

- **Step 1 – Compile impacts by sector**
  - Draw on:
    - 2015 Pennsylvania Climate Impacts Assessment Update
    - 2010/2014 Pennsylvania Climate Adaptation Planning Report
  - Categorize into the sectors above
- **Step 2 – Compile adaptation actions already underway**
  - Compile state-level actions already researched and catalogued (e.g., States at Risk)
  - Research recent state-level actions taken from August 2015 to present
  - Compile sub-state-level actions (Georgetown Climate Center)
- **Step 3 – Develop a database of potential adaptation strategies by sector, actor, and timeframe**
  - Existing state adaptation plans (PA, MD, NJ, etc.)
  - Assess gaps in sectors/actors covered from existing activities and adaptation strategies
  - Conduct targeted desk research to fill gaps in adaptation strategies

Organization

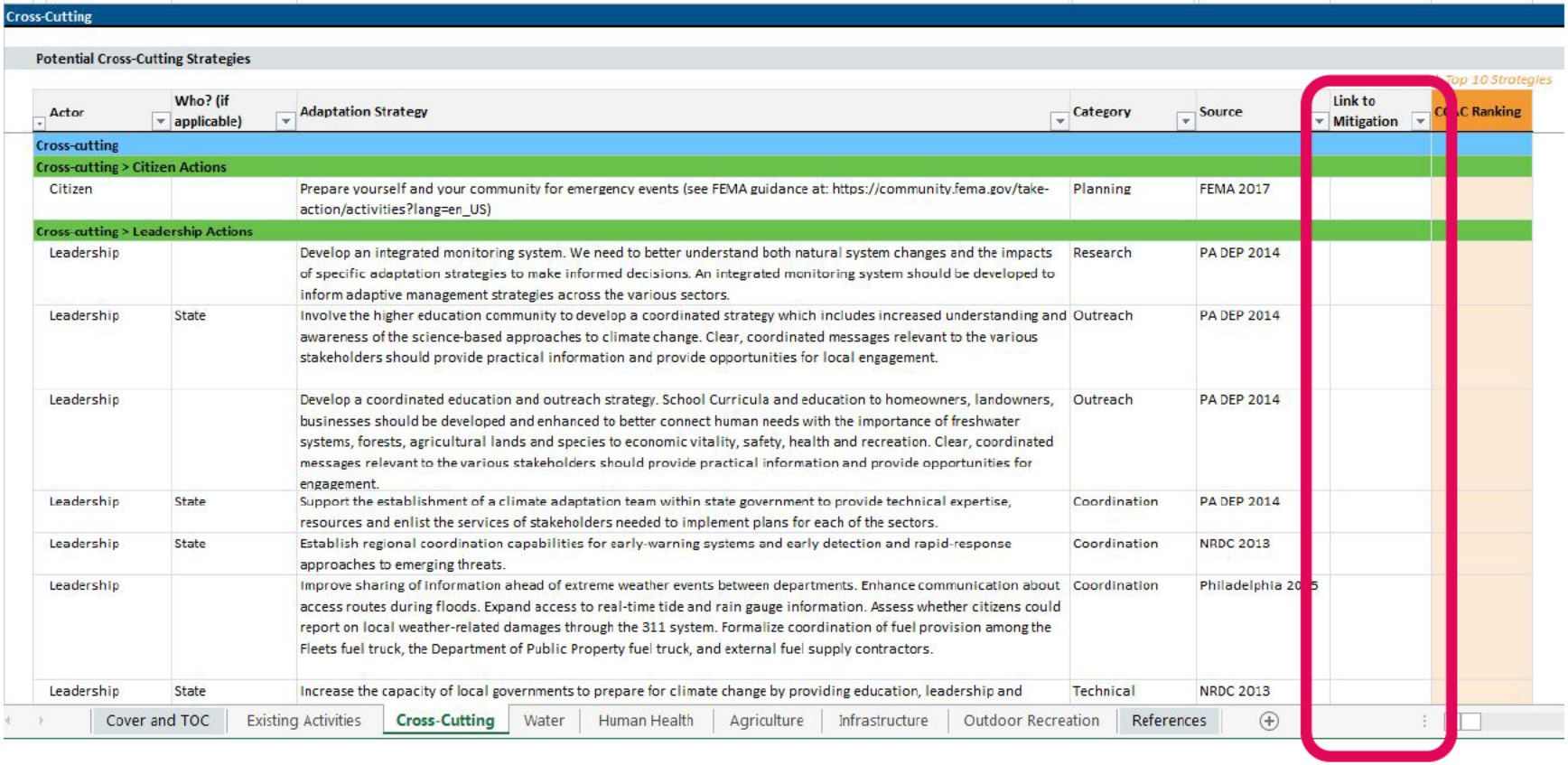


Actors

- Citizens
- Businesses
- Leadership

Cross-cutting Strategies

- **Co-benefits across multiple sectors**
- **Flagged links between adaptation and mitigation (positive links are indicated in the "Link to Mitigation" column**



Cross-Cutting

Potential Cross-Cutting Strategies

Top 10 Strategies

Actor	Who? (if applicable)	Adaptation Strategy	Category	Source	Link to Mitigation	C Ranking
Cross-cutting						
Cross-cutting > Citizen Actions						
Citizen		Prepare yourself and your community for emergency events (see FEMA guidance at: https://community.fema.gov/take-action/activities?lang=en_US)	Planning	FEMA 2017		
Cross-cutting > Leadership Actions						
Leadership		Develop an integrated monitoring system. We need to better understand both natural system changes and the impacts of specific adaptation strategies to make informed decisions. An integrated monitoring system should be developed to inform adaptive management strategies across the various sectors.	Research	PA DEP 2014		
Leadership	State	Involve the higher education community to develop a coordinated strategy which includes increased understanding and awareness of the science-based approaches to climate change. Clear, coordinated messages relevant to the various stakeholders should provide practical information and provide opportunities for local engagement.	Outreach	PA DEP 2014		
Leadership		Develop a coordinated education and outreach strategy. School Curricula and education to homeowners, landowners, businesses should be developed and enhanced to better connect human needs with the importance of freshwater systems, forests, agricultural lands and species to economic vitality, safety, health and recreation. Clear, coordinated messages relevant to the various stakeholders should provide practical information and provide opportunities for engagement.	Outreach	PA DEP 2014		
Leadership	State	Support the establishment of a climate adaptation team within state government to provide technical expertise, resources and enlist the services of stakeholders needed to implement plans for each of the sectors.	Coordination	PA DEP 2014		
Leadership	State	Establish regional coordination capabilities for early-warning systems and early detection and rapid-response approaches to emerging threats.	Coordination	NRDC 2013		
Leadership		Improve sharing of information ahead of extreme weather events between departments. Enhance communication about access routes during floods. Expand access to real-time tide and rain gauge information. Assess whether citizens could report on local weather-related damages through the 311 system. Formalize coordination of fuel provision among the Fleets fuel truck, the Department of Public Property fuel truck, and external fuel supply contractors.	Coordination	Philadelphia 20 5		
Leadership	State	Increase the capacity of local governments to prepare for climate change by providing education, leadership and	Technical	NRDC 2013		

Cover and TOC | Existing Activities | Cross-Cutting | Water | Human Health | Agriculture | Infrastructure | Outdoor Recreation | References

Adaptation Strategies Findings

Pennsylvania Climate Impacts Assessment Update

May 2015

James Shortle[1] (PI), Professor

David Abler[1] (Co-PI), Professor
Seth Blumsack[2] Assistant Professor
Aliana Britson[5] Post Doctoral Scholar
Kuai Fang[5] Graduate Student
Armen Kemanian[7] Assistant Professor
Paul Knight[4] Sr. Lecturer
Marc McDill[3] (Co-PI), Associate Professor
Raymond Najjar[4] Professor
Michael Nassry[6] Post Doctoral Scholar
Richard Ready[1] (Co-PI), Associate Professor
Andrew Ross[4] Graduate Student
Matthew Rydzik[4] Graduate Student
Chaopeng Shen[5] Assistant Professor
Shilong Wang[5] Graduate Student
Denice Wardrop[8] Senior Scientist
Susan Yetter[8] Research Assistant

[1]Agricultural Economics, Sociology, and Education
[2]Energy and Mineral Engineering
[3]School of Forest Resources
[4]Meteorology
[5]Civil and Environmental Engineering
[6]Geography
[7]Plant Science
[8]Riparia

The Pennsylvania State University, University Park

For correspondence about this report, contact James Shortle at 814-865-8270, or jshortle@psu.edu

Water Impacts

- **Water quality –** Increase in saltwater intrusion (in estuaries) due to rising sea levels; impaired water quality due to flashier runoff, urbanization, and increasing water temperature, and reduced functionality of wetlands.
- **Flooding –** Increased flood potential due to more extreme precipitation, and associated infrastructure impacts.
- **Aquatic ecosystems and fisheries –** Overall reduced health of stream and wetland biological communities due to temperature, water quantity, and water quality. Animals and plants living in lakes and rivers would be negatively affected by reduction in water quality. More sedimentation and increased scouring of stream banks and floodplains would decrease survival and success for fish and macroinvertebrates. Humans who depended on these resources for recreation, fishing, and drinking water would also be negatively affected.

Water Impacts

- **Water supply –** Amplified risks to water resources associated with decreased snowpack, decreased water quality, urban flooding, and irrigation. Overall, expected increase in winter runoff outweighs expected decrease in summer runoff due to higher evaporation.
- **Oceans and coastal resources –** Threats to fauna in the tidal freshwater portion of the Delaware estuary, reduced dissolved oxygen concentration, salinity intrusion into coastal wetlands.

Human Health Impacts

- **Heat** – Increased heat-related illness and mortality.
- **Vector-borne diseases** – Increased distribution and prevalence of ticks and mosquitoes carrying Lyme Disease and West Nile Virus.
- **Air quality** – Declining air quality, increased respiratory and cardiac issues, heart disease.
- **Water quality** – Reduced drinking water quality and increased human contact with polluted water through outdoor recreation.
- **Increased allergens**

Agriculture Impacts

- **Potential change in crop production** – Potential for both positive and negative impacts: Higher winter and summer temperatures affect crop production systems, but the main shift may be caused by milder winters and earlier warming during spring. Field crops may have negative impacts on yields and crop quality.
- **Livestock** – Heat stress to livestock and losses in productivity.
- **Food prices** – Indirect effects on food prices and increased demand by farmers for risk management products.
- **Pests and diseases** – Possible change in the prevalence and spread of different types of pests and diseases.

Infrastructure Impacts

- **Energy Supply** – Impact the ability of the energy sector to produce reliable supplies under some scenarios, particularly those requiring cooling water.
- **Energy Reliability** – Extreme weather events may reduce energy delivery reliability, increase cooling demand, damage infrastructure, or cause equipment failures.
- **Energy Demand** – Increased demand for energy, particularly electric power.
- **Energy Prices** – Declining energy commodity prices, particularly for electricity and natural gas, will present challenges to some technology options that could contribute to CC mitigation. This will probably have a negative impact on renewable energy.
- **Transportation Demand** – Minimal impact. Overall demand for transportation is likely to be affected more by overall economic conditions.
- **Transportation Reliability** – Extreme weather can have negative impacts on air travel and on shipping.

Infrastructure Impacts

- **Infrastructure Maintenance Costs** – Reductions in freeze-thaw cycles that may accompany a warming climate in PA would suggest lower costs to maintain highways, bridges, and transportation infrastructure.
- **Infrastructure Damage** – Higher risk of flooding and erosion to infrastructure.

Outdoor Recreation Impacts

- **Changing Recreation Seasons**
  - Lengthening season and increase in participation in **indoor recreation.**
  - Negative impact on **winter recreation** – ski resorts will experience shorter seasons, higher snowmaking costs, and lower profits.
  - Potentially increased demand for **water-based recreation** due to higher summer temperatures.
  - Leisure activity will increase when temperatures rise, until a threshold at which they decrease.
- **Fishing** – Reduced suitable habitat for fish.
- **Habitats (Hunting, Hiking)** – Possible change in the prevalence and spread of different types of pests and diseases.

Strategy Breakdown

Existing Actions

Existing	Leadership
Water	17
Human Health	19
Agriculture	1
Infrastructure	34
Outdoor Recreation	3

- **Assessment has identified 74 existing actions and 830 possible strategies**

Possible Strategies

	Citizen	Business	Leadership
Water	16	39	289
Human Health	14	3	52
Agriculture	0	23	59
Infrastructure	12	34	174
Outdoor Recreation	6	12	76
Cross-Cutting	1	0	20

ICF

Example – Human Health

Health Sector Impacts

- Increased heat-related illness and mortality.
- Increased distribution and prevalence of Lyme Disease, West Nile Virus, and Zika Virus. Uncertain impacts on vectors and tick-borne diseases and life cycles of factors.
- Declining air quality, increased respiratory and cardiac issues, heart disease.
- Reduced drinking water quality and contact with polluted water through outdoor recreation.
- Increased allergens.

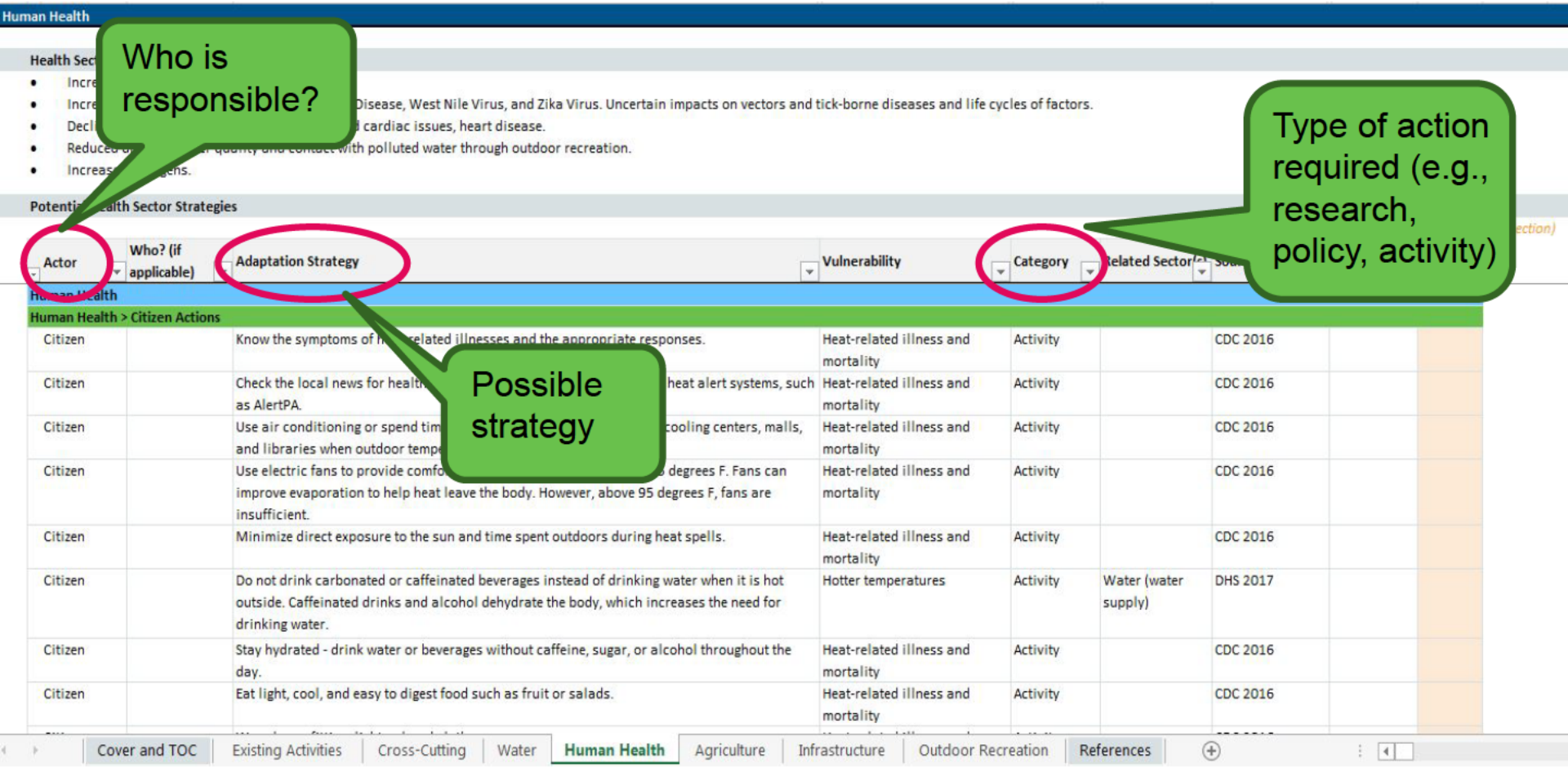
Potential Health Sector Strategies

Climate Change Impacts

Actor	Who? (if applicable)	Adaptation Strategy	Vulnerability	Category	Related Sector(s)	Source
Human Health						
Human Health > Citizen Actions						
Citizen		Know the symptoms of heat-related illnesses and the appropriate responses.	Heat-related illness and mortality	Activity		CDC 2016
Citizen		Check the local news for health and safety updates. Subscribe to local heat alert systems, such as AlertPA.	Heat-related illness and mortality	Activity		CDC 2016
Citizen		Use air conditioning or spend time in air-conditioned places, such as cooling centers, malls, and libraries when outdoor temperatures are high.	Heat-related illness and mortality	Activity		CDC 2016
Citizen		Use electric fans to provide comfort when the temperature is below 95 degrees F. Fans can improve evaporation to help heat leave the body. However, above 95 degrees F, fans are insufficient.	Heat-related illness and mortality	Activity		CDC 2016
Citizen		Minimize direct exposure to the sun and time spent outdoors during heat spells.	Heat-related illness and mortality	Activity		CDC 2016
Citizen		Do not drink carbonated or caffeinated beverages instead of drinking water when it is hot outside. Caffeinated drinks and alcohol dehydrate the body, which increases the need for drinking water.	Hotter temperatures	Activity	Water (water supply)	DHS 2017
Citizen		Stay hydrated - drink water or beverages without caffeine, sugar, or alcohol throughout the day.	Heat-related illness and mortality	Activity		CDC 2016
Citizen		Eat light, cool, and easy to digest food such as fruit or salads.	Heat-related illness and mortality	Activity		CDC 2016

Cover and TOC | Existing Activities | Cross-Cutting | Water | **Human Health** | Agriculture | Infrastructure | Outdoor Recreation | References

Example – Human Health



Human Health

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Cover and TOC | Existing Activities | Cross-Cutting | Water | **Human Health** | Agriculture | Infrastructure | Outdoor Recreation | References

Adaptation Strategies Feedback – DEP and CCAC

Requested Feedback

- **Existing Activities**
  - Are there ongoing activities we should be sure to include?
- **Potential Strategies**
  - Are there any strategies to be sure to include?
  - Which adaptation strategies to prioritize?

Requested Feedback

- **Existing Activities**
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  - Which adaptation strategies to prioritize?

Existing Activities

- State-level (expressly adaptation)
  - PennDOT
  - DNCR
- Sub-state level (expressly adaptation)
  - Philadelphia
  - Pittsburgh
  - DVRPC
  - York MPO
  - SEDA-COG
  - LeTort Spring Watershed Planning Study

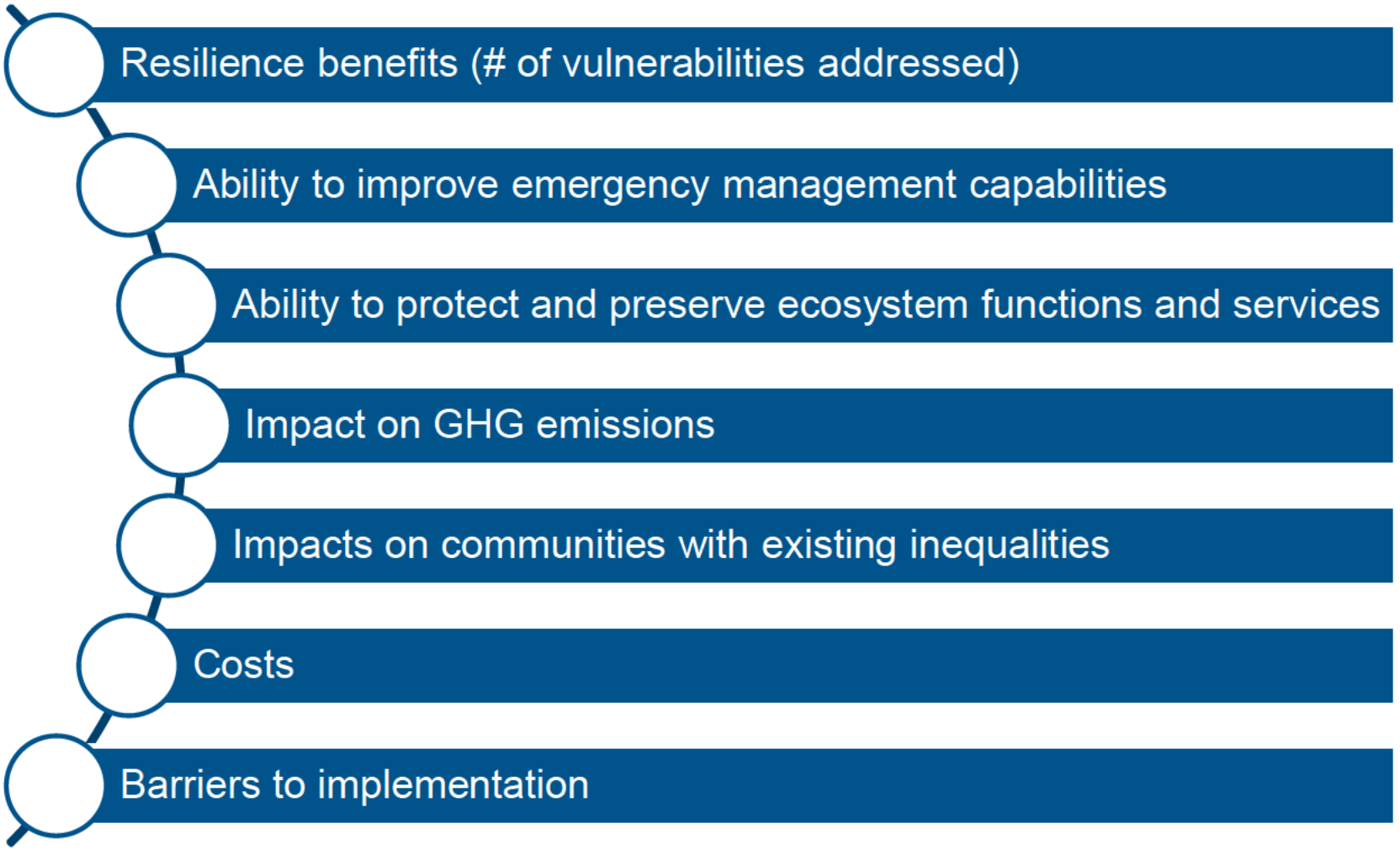
CCAC – are there any other existing activities we should be sure to include?

Ongoing Efforts with DEP to ID and Prioritize Strategies

- **Existing Activities**
  - Are there ongoing activities we should be sure to include?
- **Potential Strategies**
  - Are there any strategies to be sure to include?
  - Which adaptation strategies to prioritize?

Prioritize Strategies

Potential Prioritization Factors



Adaptation Strategies Next Steps

Adaptation Strategies Next Steps

- ✓ **ICF and DEP: Rank adaptation strategies**
- ✓ **Finalize adaptation strategies and seek feedback from CCAC**
- ✓ **Conduct additional research and analysis as needed to develop a final set of adaptation strategies**
- ✓ **Develop a Task Summary Report summarizing recommended adaptation strategies and those to prioritize based on the results of the evaluation with the CCAC**
- ✓ **Incorporate into broader Climate Action Report being prepared under Task 8**

Thank You

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