# Assessing the Health Impacts and Benefits of Regional Climate Action Plan Strategies in Western Massachusetts

**A COLLABORATIVE ASSESSMENT BY THE MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH, THE PIONEER VALLEY PLANNING COMMISSION, AND THE MUNICIPALITIES OF SPRINGFIELD AND WILLIAMSBURG**


Massachusetts Department of Public Health

*Bureau of Environmental Health*

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This publication was supported by funding by the Centers for Disease Control and Prevention (CDC) for the Massachusetts Health Impact Assessment to Foster Healthy Community Design (Cooperative Agreement 5UE1EH000913-03) and by funding by the Centers for Disease Control and Prevention (CDC) for the Development and Implementation of Building Resilience Against Climate Effects (BRACE) in Massachusetts (Cooperative Agreement Number 5UE1EH 001123-03 REVISED). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention or the Department of Health and Human Services.

# ACKNOWLEDGEMENTS

This Health Impact Assessment (HIA) was collaboration between the Massachusetts Department of Public Health (DPH) and the Pioneer Valley Planning Commission (PVPC) with oversight and guidance provided by representatives of two municipalities, the city of Springfield and the town of Williamsburg.

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We also thank the Springfield Green Committee; the Williamsburg Energy Committee; Helen Caulton Harris, Director of the Department of Health and Human Services, Springfield, MA; and Jan Denny, Director of Elder Affairs, Springfield, MA.

# EXECUTIVE SUMMARY

## Introduction

Health Impact Assessments (HIAs) use data, research, and stakeholder input to assess the likely positive and negative health impacts of a proposed policy, plan, or project before it is implemented. An HIA informs the decision-making process by providing recommendations for changes to a proposal that promote positive health outcomes and minimize negative consequences. A key feature of an HIA is to identify and reduce health inequalities that may arise from a proposal. This HIA — which focused on the communities of Springfield and Williamsburg — explored an overall approach for supplementing climate change action strategies with information on the public health impacts and benefits of these strategies. Due to limited resources and time constraints, this HIA should be viewed as a pilot project for demonstrating the feasibility of using HIAs to evaluate climate action strategies at the local level. A long-term goal of this initial effort is to provide a roadmap for other municipalities and regional agencies to consider health in their climate adaptation planning process.

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This HIA represents a collaborative effort by the Massachusetts Department of Public Health (DPH), the Pioneer Valley Planning Commission (PVPC), and the municipalities of Springfield and Williamsburg. The climate action strategies are based on the regional Pioneer Valley Climate Action and Clean Energy Plan (PV Climate Action Plan) completed by the PVPC in 2013. The aim of that plan was to promote greater understanding of the causes and consequences of climate change in PVPC's service region (which includes Springfield and Williamsburg) and to identify a set of actions that local governments and other partners could consider to mitigate and adapt to climate effects.

An Advisory Committee of stakeholders identified two climate action strategies from the PV Climate Action Plan to be evaluated in the HIA:

(1) Providing cooling centers and other approaches to assist vulnerable populations during heat-related events; and

(2) Implementing energy efficiency measures in municipal buildings.

A summary of the scientific literature, formulation of research questions, pathway diagrams, assessment of the distribution of health impacts and benefits, and the findings and recommendations for each strategy are summarized below.

## Highlights of the Literature Review

Below is a brief summary of the literature review for each of the strategies evaluated in this HIA. Additional information and references are provided in the report.

### Heat-related Events

According to the National Climate Assessment, the climate in the Northeast is experiencing noticeable changes that are expected to increase in the future. Between 1895 and 2011, temperatures rose by almost 2°F, and projections indicate temperature increases of 4.5°F to 10°F by 2080. As the global climate continues to change, extreme heat events are predicted to occur more frequently and heat-related morbidity and mortality is expected to rise. Extreme heat events account for more fatalities in the U.S. than any other weather hazard. Prolonged exposure to heat can cause dehydration, heat stress, heat exhaustion, and heat stroke. Chronic medical conditions (e.g., diabetes, renal disease, cardiovascular disease, respiratory disease) increase vulnerability to heat, especially among elderly people. Increases in outdoor temperature also influences outdoor air pollutants levels including ozone, aeroallergens, and fine particles.

The ability to reduce exposure to heat during extreme events, especially for vulnerable populations, will be an increasingly important health determinant. Elderly people living alone are especially vulnerable. For example, vulnerability factors associated with mortality during the 1995 Chicago heat-related event were elderly living alone, not leaving home daily, lacking access to transportation, and not having an air conditioner. Cooling centers should be located in areas that are accessible to the most vulnerable populations and should be advertised in a way that targets those populations. Coordination between local police and fire departments, human services, the local public health department, emergency medical services, and local hospitals during heat-related events is essential for preventing morbidity and mortality among the most vulnerable populations.

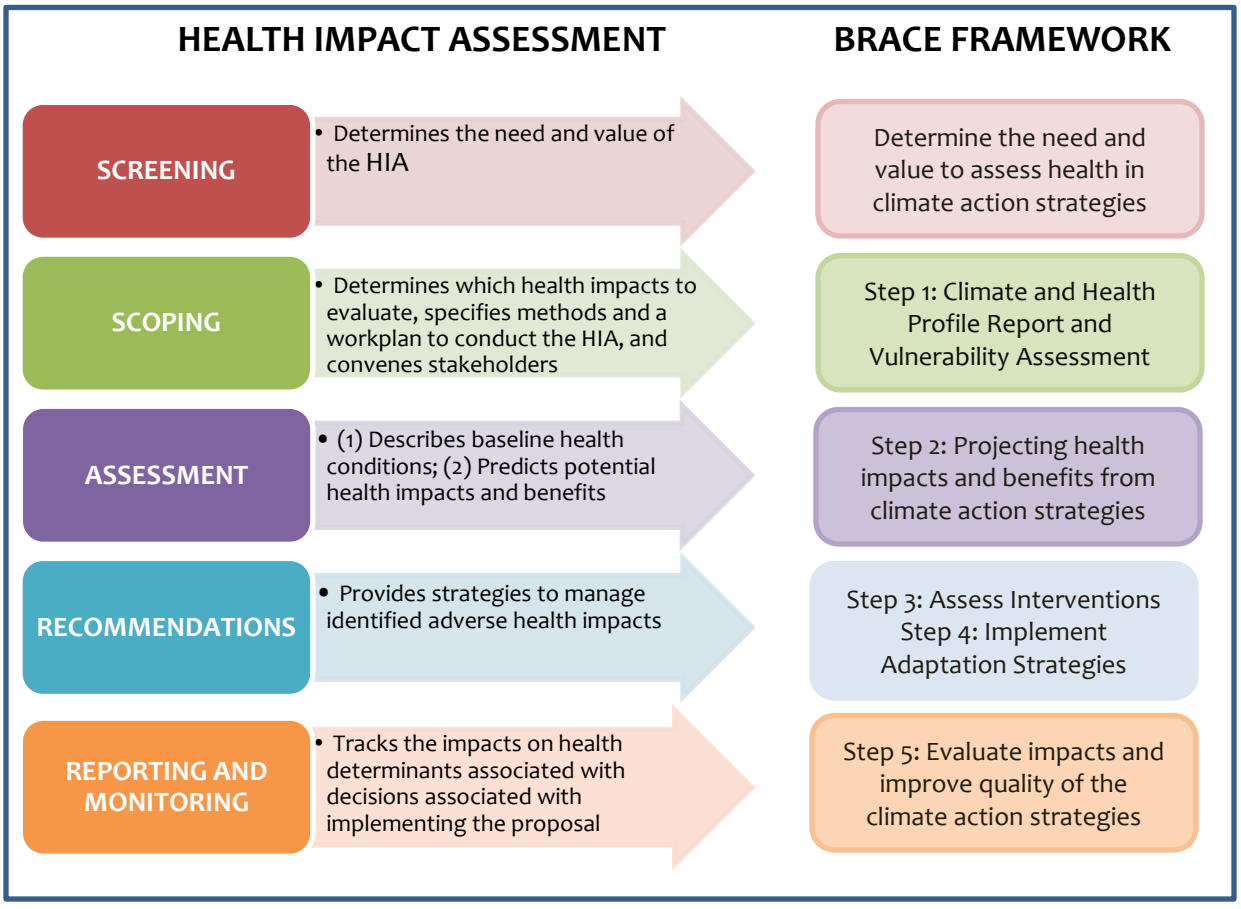
### Energy Efficiency

Energy efficiency measures reduce electricity demand by improving end-use technologies in residential, commercial, industrial and manufacturing sectors. In addition to reducing energy consumption and related costs, energy efficiency measures benefit public health by reducing emissions of greenhouse gases and air pollutants, and increasing the reliability of the energy grid. Energy efficiency measures also contribute to energy security by reducing dependence on foreign sources of fuel. According to the US Environmental Protection Agency (US EPA), state and local government agencies across the US spend more than $10

billion a year on energy to provide public services and meet constituent needs, but nearly one-third of the energy used by typical government buildings can be conserved. A 2007 expert report on energy efficiency concluded that strategies emphasizing energy efficiency are the most economically and environmentally sensible ways of providing energy for sustainable development and addressing climate change. Energy efficiency measures that tighten the building envelop also need to ensure adequate ventilation to maintain healthy indoor air quality.

The BRACE framework is a five-step process that allows health officials to develop strategies and programs to help communities prepare for the health effects of climate change. The 5-step process of the BRACE framework incorporates an assessment of climate change impacts and vulnerability (Step 1), assessment of projected health impacts (Step 2), evaluation of evidence-based public health intervention options (Step 3), development and implementation of a climate and health adaptation plan (Step 4), and evaluation of activities in an iterative framework (Step 5). The HIA framework complements the BRACE framework by providing a decision-support tool to assess a wide array of climate-related health impacts and develop health-based intervention and adaptation strategies. Figure 1 illustrates how each step of the BRACE framework was integrated into the assessment phase of this HIA.

**Figure 1: Integration of CDC BRACE Framework into HIA Process**



## Pathway Diagrams

A pathway diagram visually demonstrates the link between the proposal and potential health outcomes. Literature reviews and input from the Advisory Committee informed the development of the pathway diagrams for the climate action strategies evaluated in this HIA.

Figure 2 presents the potential health impacts associated with providing cooling centers and other approaches to assist vulnerable populations during heat-related events. The assessment of this pathway focused on projected increases in the frequency and intensity of heat-related events, characterization of vulnerable populations in each community, evaluation of existing heat response plans in each community, and mapping the location of existing cooling centers.

**FIGURE 2: PATHWAY DIAGRAM FOR PROVIDING COOLING CENTERS AND OTHER APPROACHES TO ASSIST VULNERABLE POPULATIONS**

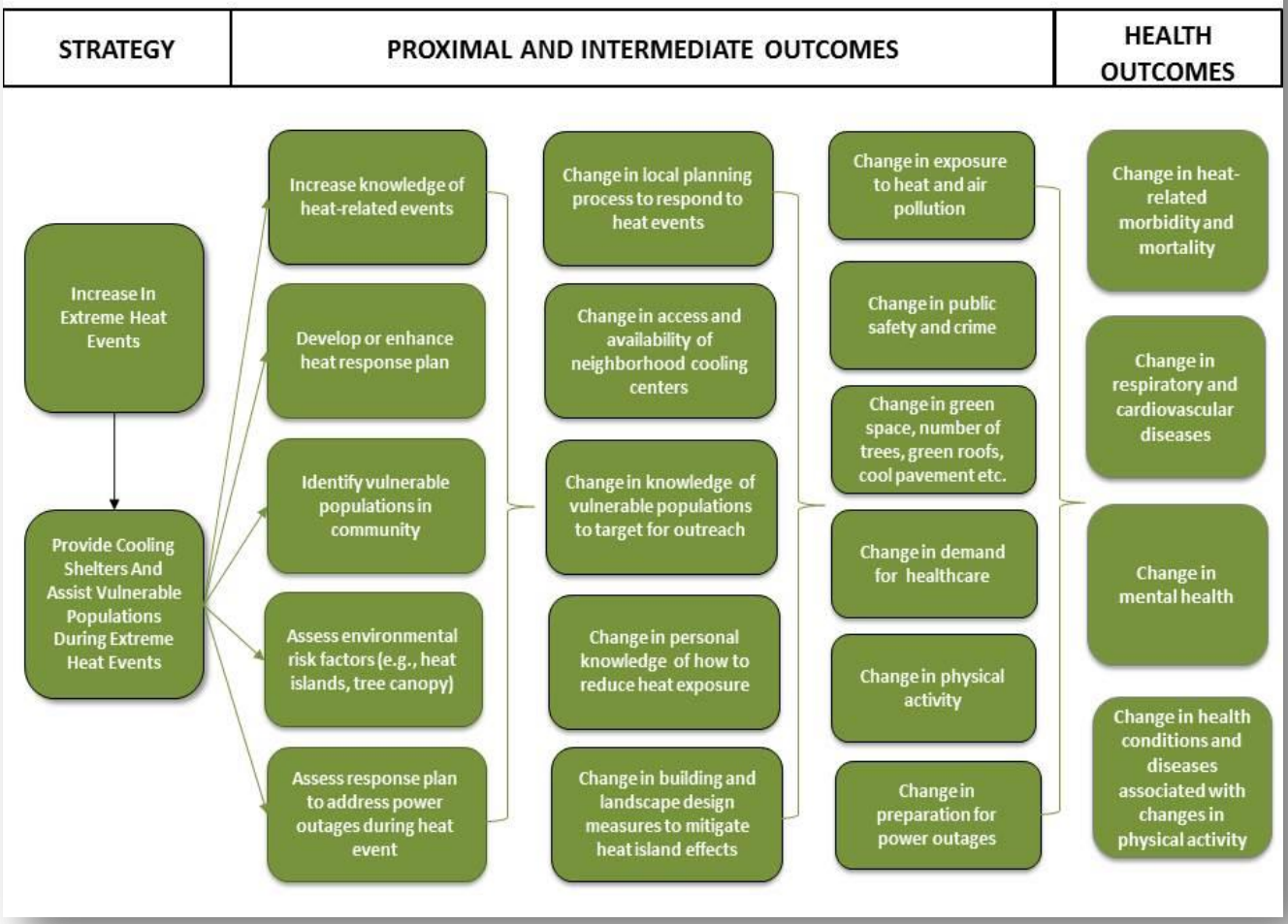


Figure 3 presents the potential health impacts of implementing energy efficiency measures in municipal buildings. In addition to assessing potential climate and vulnerability impacts, the assessment included semi-quantitative analysis of changes in local and regional air pollution emissions from reductions in electricity associated with energy efficiency measures implemented in each community.

**FIGURE 3: PATHWAY DIAGRAM FOR IMPLEMENTING ENERGY EFFICIENCY IN MUNICIPAL BUILDINGS**

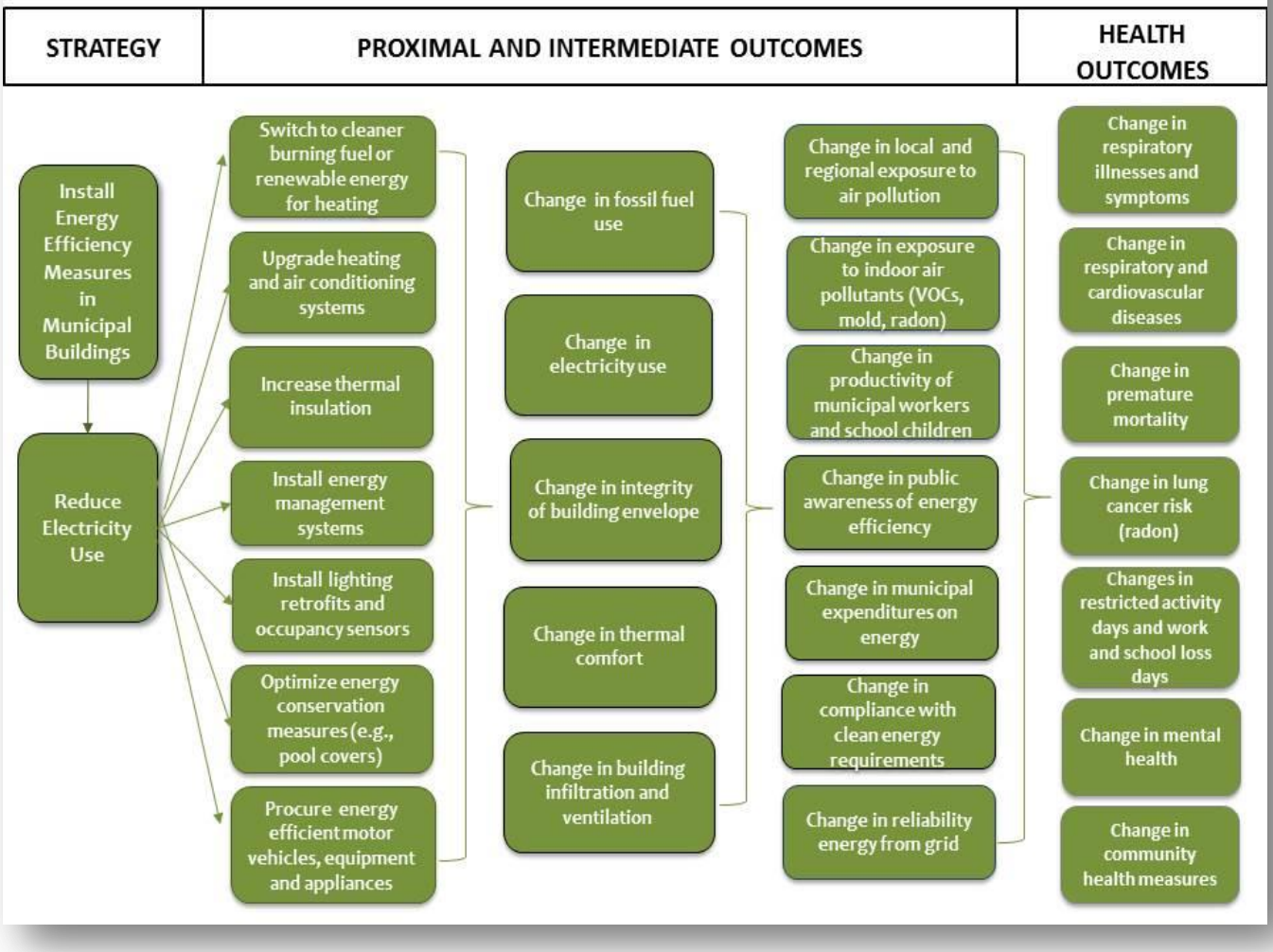



Table 3 and Table 4 provide the overall summary of major impacts, magnitude, severity, strength of causal evidence, assumptions, and limitations/uncertainties of the assessment of climate action strategies evaluated in this HIA using the following criteria:

**TABLE 3: OVERALL HEALTH ASSESSMENT FOR PROVIDING COOLING CENTERS AND OTHER APPROACHES TO ASSIST VULNERABLE POPULATIONS DURING HEAT-RELATED EVENTS**

| PROVIDING COOLING CENTERS AND OTHER APPROACHES TO ASSIST VULNERABLE POPULATION | | | | | | |
|---|---|---|---|---|---|---|
| **HEALTH OUTCOMES** | Impact | Magnitude | Severity | Strength of Causal Evidence | Assumptions | Limitations / Uncertainties |
| Change in heat-related morbidity and mortality | + | Moderate | High | ♦♦♦ | Municipalities will develop/enhance and implement a heat response plan that includes planning for vulnerable residents; and expand education and outreach plans on reducing heat exposure during heat events. | Information on existing use of centers is needed; Impact of power outages during heat-related events is unknown. |
| Change in respiratory and cardiovascular diseases | + | Major | High | ♦♦♦ | | |
| Change in mental health | + | Unknown | Unknown | ♦♦ | Municipalities will begin a dialogue about how to address environmental risk factors (e.g., heat island, tree canopy) through changes in building and landscape design measures. Planning and implementation of design measures is required. Increased physical activity is a co-benefit of these actions. | Insufficient data on mental health effects and future study is recommended. Insufficient data on changes in physical activity. |
| Change in health conditions and diseases from increased physical activity | + | Unknown | Unknown | ♦♦♦ | | |

***Impact*** refers to whether the alternative will improve (+), harm (-), or unknown (+/-).

***Magnitude*** reflects a qualitative judgment of the size of the anticipated change in health effect (e.g., the increase in the number of cases of disease). Negligible, Minor, Moderate, and Major.

***Severity*** reflects the nature of the effect on function and life-expectancy and its permanence: High = Intense/severe; Mod = Moderate; Low = Not intense or severe.

***Strength of Causal Evidence*** refers to the strength of the research/evidence showing causal relationship between strategies and the health outcome: ♦ = plausible but insufficient evidence; ♦♦ = likely but more evidence needed; ♦♦♦ = high degree of confidence in causal relationship.

**TABLE 4: OVERALL HEALTH ASSESSMENT OF IMPLEMENTING ENERGY EFFICIENCY MEASURES IN MUNICIPAL BUILDINGS**

| IMPLEMENT ENERGY EFFICIENCY MEASURES IN MUNICIPAL BUILDINGS | | | | | | |
|---|---|---|---|---|---|---|
| **HEALTH OUTCOMES** | Impact | Magnitude | Severity | Strength of Causal Evidence | Assumptions | Limitations / Uncertainties |
| Respiratory illnesses and symptoms | + | Moderate | High | ♦♦♦ | Improved indoor air quality in schools and municipal buildings including compliance with ventilation guidelines. | The magnitude of the outdoor air quality impact from reduced use of heating oil is uncertain. |
| Respiratory and cardiovascular diseases | + | Moderate | High | ♦♦♦ | Reductions in regional air pollution from displaced electricity at electric generating units (EGUs) occur at specified units. | A major limitation of US EPA's model for quantifying benefits of air pollution reductions is that it underestimates total benefits because it only includes secondary formation of $PM_{2.5}$ from NOx and SOx emissions. |
| Change in premature mortality | + | Major | High | ♦♦♦ | | |
| Change in lung cancer risk | +/- | Unknown | Unknown | ♦♦♦ | Indoor radon levels vary across municipalities. | Pre- and post-monitoring is needed. Energy efficiency measures may increase or decrease indoor radon levels. |
| Restricted activity days and work/school loss days | + | Major | Moderate | ♦♦ | Increased productivity of workers and students from improvements from energy efficiency measures including improved indoor air quality and lighting. | Surveys are needed. Limited studies from California of post-retrofit benefits in school children; no data on municipal workers. |
| Change in mental health | + | Unknown | Unknown | ♦♦ | Improved work/school environment. Public awareness and empowerment to address energy issues and climate change at the local level | Stakeholders provided evidence of positive responses from residents. Further assessment is recommended. |
| Change in community health measures | + | Unknown | Unknown | ♦ | Shift in municipal expenditures from energy to other uses; increase market value of municipal buildings | Impact of energy efficient buildings on market value of municipal assets is unknown. |

## Major Findings of the HIA

- Overall, the HIA found that while designing appropriate research methods for evaluating specific climate action strategies can be challenging, HIAs can be an effective tool to convene municipal stakeholders, evaluate baseline health conditions, and qualitatively assess the health implications of mitigation and adaptation strategies at the local level.

- A key feature of this HIA is the integration of an evidence-based framework developed by CDCs Climate and Health Program (i.e., BRACE framework) to support the advancement of health-based climate change adaptation strategies. Evaluation of the approach for integrating the BRACE framework into the appropriate phases of the HIA found that: (1) the approach addressed one of the goals of the HIA to collect and analyze evidence between climate change planning and health; (2) the approach informed the assessment phase of the HIA by providing evidence-based data on climate impacts, health outcomes of greatest concern, and populations potentially vulnerable to climate impacts; and (3) the findings of the HIA can inform the adaptation planning process.

## Heat-related Events

- The climate action strategy to provide cooling centers and other approaches to assist vulnerable populations was found to likely reduce heat-related morbidity and mortality.

- For heat-related impacts, baseline health conditions in Springfield (e.g., higher prevalence of respiratory disease and diabetes in adults, and pediatric asthma) indicate that the health co-benefits of this strategy may be substantial.

- While there are significant differences in the baseline health profile of Springfield compared to Williamsburg in terms of the number of people in poverty, the number of people of race/ethnicity other than white, and population density, the percent of one category of vulnerable residents — elderly living alone (i.e., 1 in 3) — is the same in both communities.

- The common issues and resource constraints shared by both a large urban city and a small rural town in developing and activating a heat response plan, including education and outreach to vulnerable populations, as well as taking steps to mitigate environmental risk factors (e.g., lack of trees and green space, impervious surfaces) through changes in building and landscape design measures may be more effectively addressed through regional efforts.

- Although there is a need to create incentives for people to use their air conditioning during heat waves, this study also identified the need to promote multiple

approaches to reduce heat exposure in addition to the use of air conditioning including improving circulation of indoor air using fans, shading windows, applying a cold cloth to neck and wrists, shutting off lights, and staying in cool areas of the home (e.g., basement).

- A key issue raised by stakeholders is the potential loss of power at cooling centers during an extreme heat-related event. Given the regional nature of the electrical grid, this issue should also be considered in future regional planning efforts.

## Energy Efficiency

- In addition to cost-savings, energy efficiency programs provide a wide range of health, environmental, and social co-benefits that enhance community resilience.

- Energy efficiency improvements to buildings have positive co-benefits with respect to improving the indoor environment for occupants and reducing outdoor air pollution from emission reductions across the electrical power grid and fuel switching. The monetized regional health benefits from energy efficiency measures implemented in Springfield that reduced air pollution emissions across the Northeast electrical power grid ranged from $760,000-$1,700,000.

- While the overall health impacts from implementing energy efficiency measures in municipal buildings are positive, the need to achieve and maintain adequate ventilation for optimal indoor air quality must also be considered. It is also important to consider the potential increase in indoor radon levels from energy efficiency measures that tighten the building envelope.

- The assessment suggests that energy efficiency measures can increase the productivity of building occupants (e.g., municipal workers and students).

- Energy efficiency activities at the municipal level may also increase public awareness and empowerment to address energy issues and climate change at the local level.

- This HIA demonstrated that although the co-benefits of energy efficiency measures at the municipal level may be relatively small, the total benefits regionally and statewide of such actions are likely to be significant and need to be further assessed.

## Recommendations

### General Recommendations

- Regions and municipalities statewide without climate action plans should take steps to prepare such plans.

- State, regional, and local agencies should coordinate data and resources to support research and other related activities to improve the understanding of the relationship between climate and health.

- Other climate action strategies recommended in the PV Climate Action Plan should be examined to better understand health impacts and benefits of climate action strategies.

- Tools, innovative methods, and approaches to conduct comprehensive HIAs should be identified to more fully explore health impacts and benefits of adaptation strategies.

### Recommendations for Providing Cooling Centers and Other Approaches to Assist Vulnerable Populations During Heat-Related Events

- Develop municipal or regional heat response plans that include information about vulnerable populations (e.g., elderly, elderly living alone, socially isolated, children, people without a car, economically disadvantaged); approaches for locating cooling centers that are accessible to vulnerable populations; and personal strategies and solutions for cooling at home during a heat-related event, especially where air conditioning is not available or when the power goes out.

- Implement community-wide mitigation efforts, such as improving building and landscape design standards, promoting an adequate tree canopy, and minimizing pavement to reduce urban heat islands.

- Promote regional planning efforts that support consistent educational and outreach materials for vulnerable populations, address environmental risk factors (e.g., heat islands, tree canopy), identify critical infrastructure needs, and identify solutions for the potential loss of power at cooling centers during extreme heat-related events.

## Recommendations for Implementing Energy Efficiency Measures in Municipal Buildings

- Given that energy efficiency is one of the most practical policy options to mitigate and adapt to climate change impacts, it is important to promote the health co-benefits of energy efficiency at all levels (i.e., individual, municipal, regional and statewide).

- The stakeholder process identified the need to better understand and measure community awareness around climate action and how municipal actions can spur empowerment. Changes in public awareness about the value of municipal energy efficiency programs are the cornerstone of state and local government initiatives such as "Leading By Example." Empowerment is nurtured by a sense of belonging that can occur when energy efficiency measures are implemented across government, businesses, and residences. One option is to encourage such efforts by increasing resources to support additional energy efficiency programs. This recommendation is supported by a large body of work demonstrating the benefits of incentivizing energy efficiency programs.

- Ensure that ventilation systems maintain optimal indoor air quality. Consideration of the Massachusetts Department of Public Health's guideline for indoor air quality will ensure optimal indoor environmental conditions. Specifically, the guideline recommends a ventilation rate of 20 cubic feet per minute (cfm) of fresh air to provide optimal air exchange resulting in carbon dioxide levels at or below 800 ppm.

- Radon testing should occur prior to and before completing the renovation of a building to determine if mitigation measures are warranted and can be incorporated during the renovation. Post-renovation testing should also be conducted to ensure mitigation measures were successful.

- Support municipal efforts to apply for Massachusetts Department of Energy Resources (DOER) Resiliency funding to ensure hospitals and other essential facilities have power during outages.

- Support continued state funding of energy efficiency measures at the local level.

## Areas of Future Research

- There was insufficient information to assess the change in physical activity during heat-related events or long-term changes in the community from instituting environmental mitigation measures (e.g., increase in tree canopy) to mitigate rising temperatures. For example, the Michigan Department of Community Health's Climate and Health Adaptation Program conducted a comprehensive HIA

"Expanding the Urban Tree Canopy as a Community Health Climate Adaptation Strategy" in Ann Arbor. The HIA found epidemiological evidence that reduction of heat from an adequate tree canopy has multiple benefits associated decreased heat exposure, decreased air pollution exposure, increase in physical activity. These findings directly benefit the general population and specifically those individuals with pre-existing diseases including diabetes, hypertension, and obesity. Similar methods could be applied to subsequent HIAs to more fully evaluate mitigation measures in Massachusetts.

- Improve the understanding of community awareness around climate actions and how municipal actions can spur empowerment for more system-wide change. This may include strategies that educate residents about the problem, provide information on necessary behavioral changes to address the problem, promote transparency about sustainability issues, and facilitate consumer's individual choices toward sustainable consumption patterns.

- Poverty and crime are correlated with excessive morbidity and mortality during heat waves. The percentage and number of people living in poverty are much higher in Springfield than in Williamsburg, indicating that the vulnerable population in Springfield is larger. There is also a significant difference in the number of violent crimes in the two communities. Further examination of the relationship between poverty, crime and successful climate adaptation strategies is needed.

- Power outages were identified as a major concern by municipal officials in Springfield and Williamsburg. Analysis of power outages is conducted by the utility industry and consultants. Given that this information would be useful in the planning process, requests should be made for this information at the regional level.