CHAPTER 11

Photo: Winter of 2018 at the Brunelle Marina in South Hadley, MA

LIVABILITY AND CLIMATE CHANGE

The Commonwealth of Massachusetts has re-affirmed its place as a leader in the country with respect to working actively to address our changing climate (https://www.mass.gov/topics/climate-action) both aggressively reducing GHG emissions to mitigate the damage caused by these pollutants and managing risk and facilitating adaptation to a 'new normal' of increasingly severe and unpredictable weather events while also promoting and facilitating livability--with MassDOT often leading the way. Regulations like the requirement to assess Green House Gas (GHG) emissions on all major transportation projects, and programs like the Complete Streets Initiative (https://www.mass.gov/complete-streets-funding-program) are helping Massachusetts become more livable and do our part to address the climate crisis.

The Pioneer Valley Planning Commission is a proud partner with the Commonwealth in leading the way to Livability and Climate Action, since 2008 when we completed the Commonwealth's first regional clean energy plan, committing the region to 80%

reductions in GHG emission by 2050. Just as the Commonwealth is realizing that we need to be even more aggressive in our commitment to climate action, so are we here in the Pioneer Valley. The same data and resulting conclusions that are summarized and explained in Volume II of the "Choices for Stewardship: Background Books – Facts, Trends, & Issues" report of the Commission on the Future of Transportation in the Commonwealth pp. 89-115, is guiding and informing the work of the PVPC.

We are a motivated partner with the MA EOEEA, promoting the Commonwealth's Municipal Vulnerability Preparedness (MVP) program to assist municipalities and regions to understand and manage risks to people, the environment and critical infrastructure. These risks are associated with the increasingly severe and unpredictable weather Massachusetts is experiencing and will continue to experience in the future. We also refer to and utilize the same data from the Northeast Climate Adaptation Science Center as cited by MassDOT in the recent products of the Commission on the Future of Transportation in the Commonwealth. Significant variations in the consequences of severe weather depend on how successful we can be in collectively reducing GHG emissions. Our region has been and continues to be a leader with respect to understanding the danger to municipalities caused by the climate crisis as demonstrated by our integration of climate change into our region's hazard mitigation plans in 2013.

PVPC promotes and provides technical assistance to advance Green Communities and Complete Streets certification in our region, two State initiatives that serve to help municipalities reduce energy use thereby reducing GHG emissions in the transportation sector. Green Communities requires municipalities to commit to purchase fuel efficient vehicles (in addition to many other building energy use reduction requirements) and Complete Streets promotes livability by requiring communities to adopt Complete Streets policies, requiring the addition of bike lanes (or other bike infrastructure) and sidewalks (or other pedestrian infrastructure) on all new and rehabilitated roadways. Each municipality must develop a Complete Streets Prioritization Plan to qualify for funding.

As the MassDOT "Choices for Stewardship" report Vol II highlights on p. 109, Massachusetts is unusual in the country with the high percentage of our GHG emissions that come from transportation—39%, compared to 28% for the USA. Our estimates of the magnitude of the problem here make our task slightly less onerous, with an estimated 32% of our GHG emissions coming from transportation. We are excited about the possibilities offered by the regional Transportation Climate Initiative (TCI) (https://www.transportationandclimate.org/) the regional collaboration of nine states, including Massachusetts that seeks to develop the clean energy economy and reduce oil dependence and GHG emissions from the transportation sector. As noted, the Pioneer Valley region is a leader with respect to Green

Communities and our communities have combined to reduce GHG emissions from municipal buildings using RGGI funds through the DOER by an estimated 20%.

We are very enthusiastic and optimistic about the possibilities to reduce GHG emissions from transportation if we had a comparable investment pool to fund collaborative work focused on the transportation sector. A public-private TCI funding stream could provide the spark needed to light the creative fires required to solve this emergency.

Just as PVPC has been catalyzing regional progress with respect to regional economic development, clean energy and transportation planning, PVPC has also been a leader in the Commonwealth with a regional smart growth plan. This plan is designed to help our member municipalities grow sustainably, channeling new development where there is existing supporting infrastructure. Livable communities are safe and convenient for people to walk, scoot, bus, stroll, drive, jog, ride, and/or bicycle to their destinations. Valley Vision, our regional Livability plan is now 21 years old and in its fourth iteration. (hyperlink)

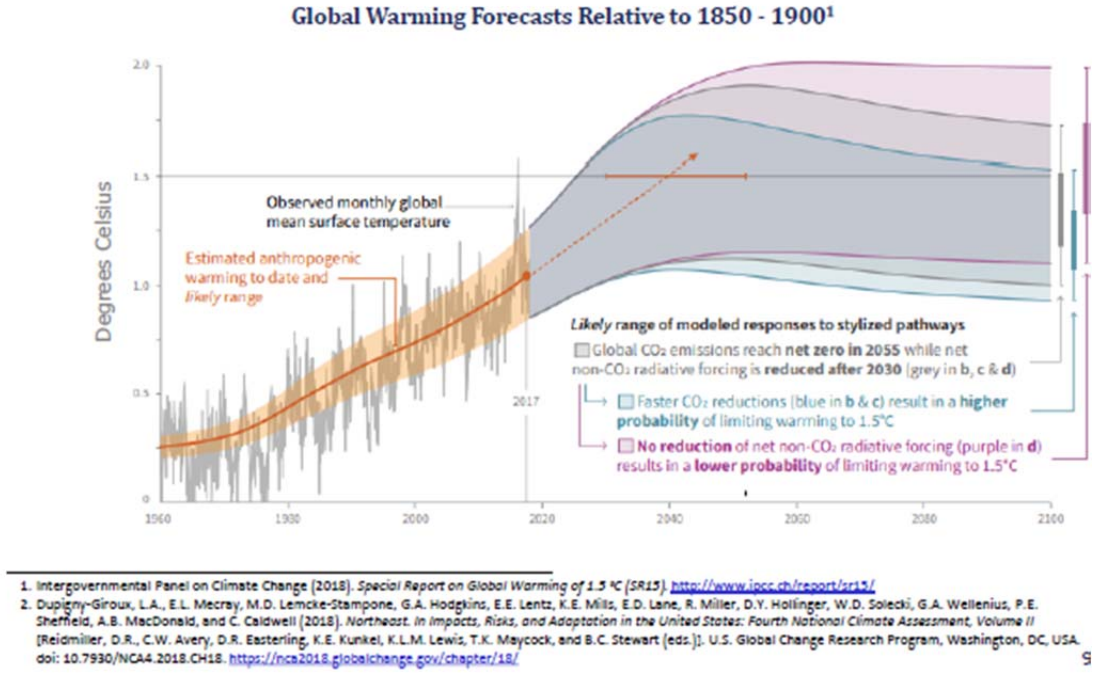
A. REGIONAL WEATHER TRENDS AND ANTICIPATED CHANGES

The transportation sector is a significant source of greenhouse gases (GHG), accounting for almost 1/3 of the Pioneer Valleys GHG emissions and almost 40% of the Commonwealth's emissions. Our regional transportation plan includes the goal of reducing driving in single occupant vehicles and accelerating the transition to electric vehicles as we work to green the grid. At the same time we are also very aware of how vulnerable the existing transportation network is to the effects of our changing climate and we are simultaneously working to reduce municipal vulnerability.

1. Temperature

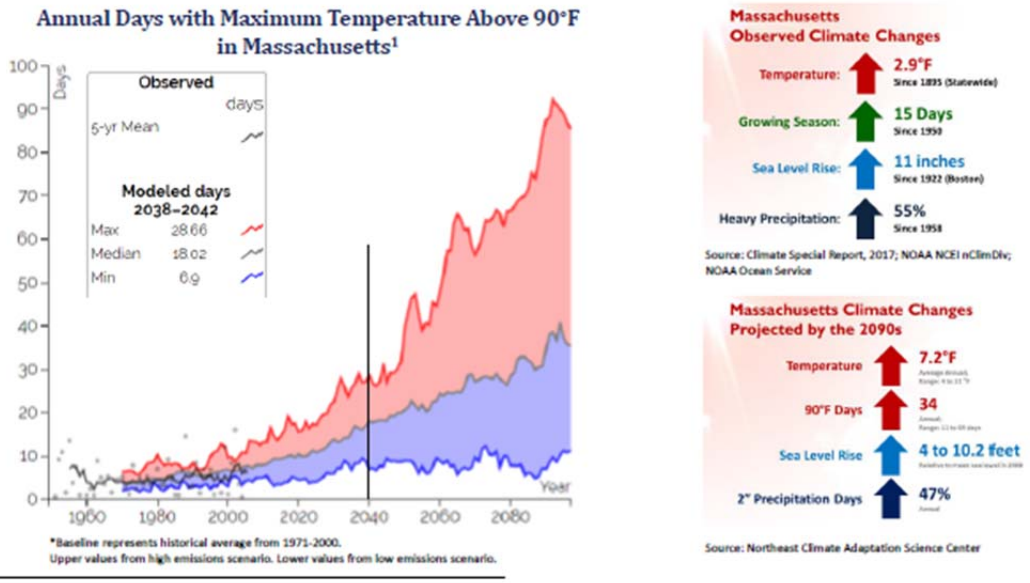
Depending on how successful we collectively are at reducing GHG emissions; our region stands to experience a wide range of temperature changes. The International Panel on Climate Change (IPCC) has documented a trend of warming temperatures caused by human use of fossil fuels. Both the Commonwealth and the Pioneer Valley region have committed to reduce GHG emissions by 80% of 1990 levels by 2050. As summarized in the following figures, temperature increases could be as bad as 34 days over 90 degrees by the end of this century with a 7.2 degree increase in average temperature.

Figure 11-1 – Global Warming Temperature Forecasts



1. Intergovernmental Panel on Climate Change (2018). *Special Report on Global Warming of 1.5 °C (SR15).* http://www.ipcc.ch/report/sr15/
2. Dupigny-Giroux, L.A., E.L. Mecray, M.D. Lemcke-Stampone, G.A. Hodgkins, E.E. Lentz, K.E. Mills, E.D. Lane, R. Miller, D.Y. Hollinger, W.D. Solecki, G.A. Wellenius, P.E. Sheffield, A.B. MacDonald, and C. Caldwell (2018). *Northeast. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA. doi: 10.7930/NCA4.2018.CH18. https://nca2018.globalchange.gov/chapter/18/

Figure 11-2 – Annual Days With Maximum Temperature Above 90° F



1. Resilient MA. (2018). *Climate Data Grapher.* http://www.resilientma.org/datagrapher/?c=Temp/state/maxt/ANN/MA/
2. National Academies Press. (2016). *Attribution of Particular Types of Extreme Events.* https://www.nap.edu/read/21852/chapter/6#113

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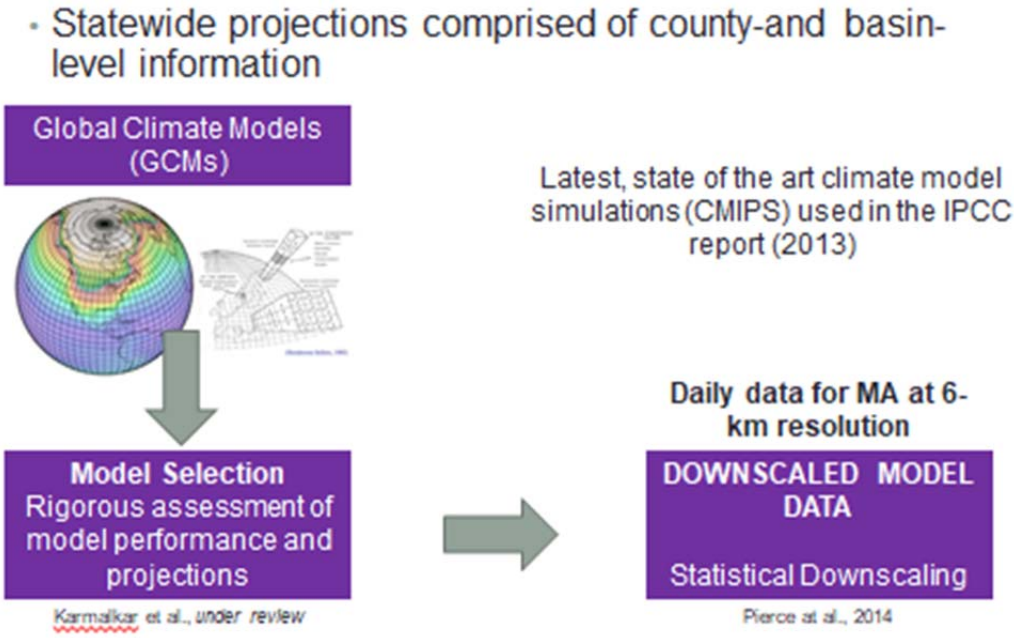
After Governor Baker signed Executive Order 569, committing the administration to work across the state to plan and prepare for the impacts of climate change, EOEEA funded the Northeast Climate Adaptation Science Center to develop down scaled

projections for changes in temperature, precipitation, and sea level rise for the Commonwealth of Massachusetts. The down-scaled, or localized, temperature and precipitation projections are based on simulations from the latest generation of climate models from the International Panel on Climate Change and scenarios of future greenhouse gas emissions. The models were carefully selected from a larger ensemble of climate models based on their ability to provide reliable climate information for the Northeast U.S., while maintaining diversity in future projections that capture some of the inherent uncertainty in modeling climate variables like precipitation. Both annual and seasonal projections are available at the statewide and major drainage basin geographic scales. The charts following highlight some of their findings. (insert website).

Figure 11-3 – Massachusetts Climate Projections



The Commonwealth could experience a dramatic variability depending on whether or not we are able to collectively reduce our GHG emissions.

Figure 11-4 – Massachusetts Emissions Scenarios

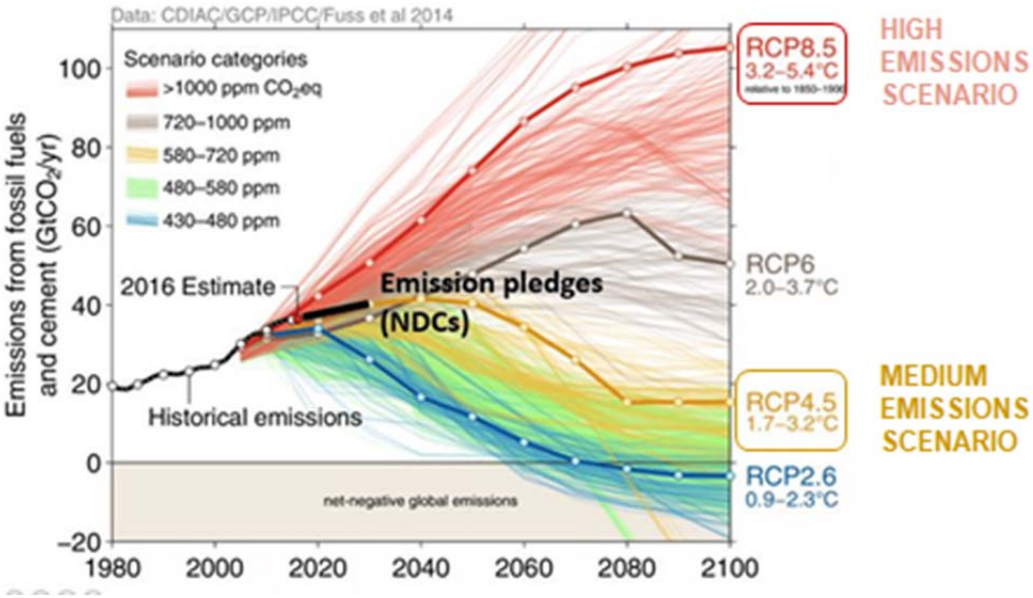


Figure 11-5 – Average Temperatures in Chicopee, MA

- ↑ in annual and seasonal average, max., and min. temps
- Summer highs may ↑ 9% by 2050, up to 17% 2100
- Fall highs may ↑ 12% by 2050, up to 20% 2100

Impacts

- Rain v. snow
- Ecosystem viability
- Consecutive dry days
- Drought and fire

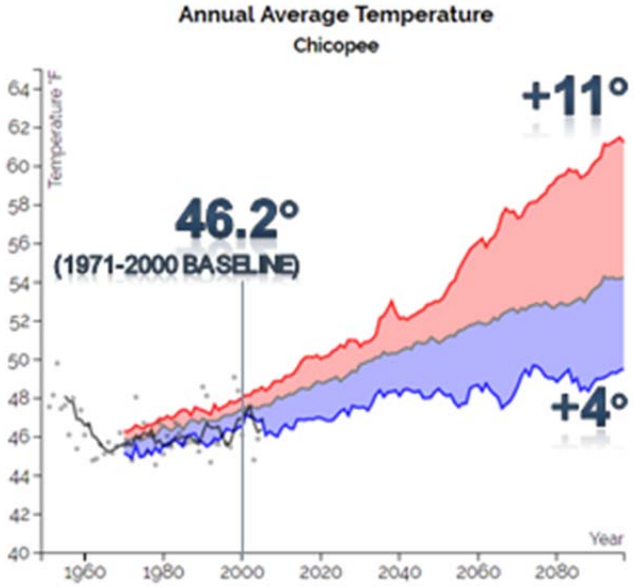
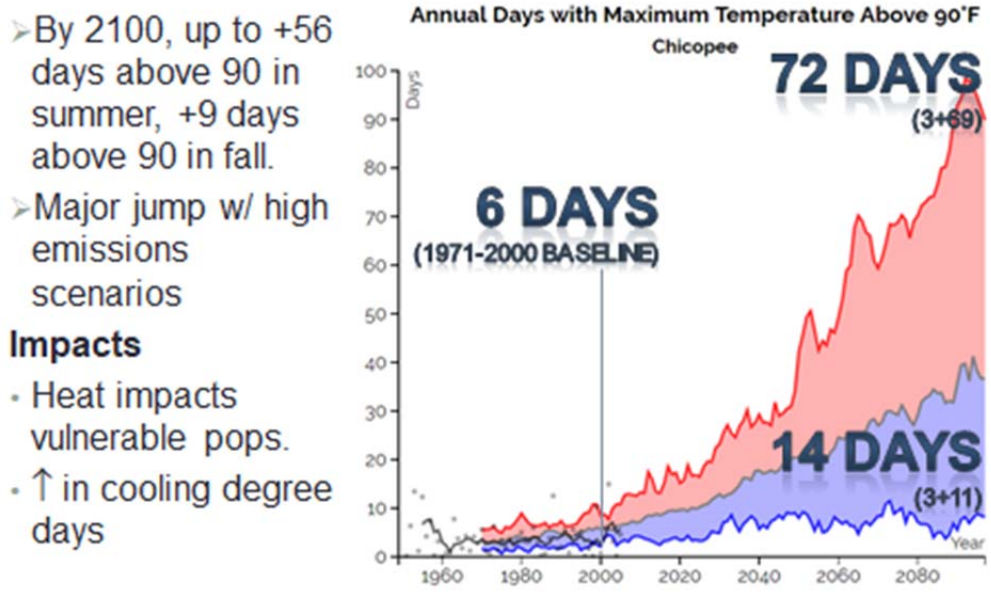


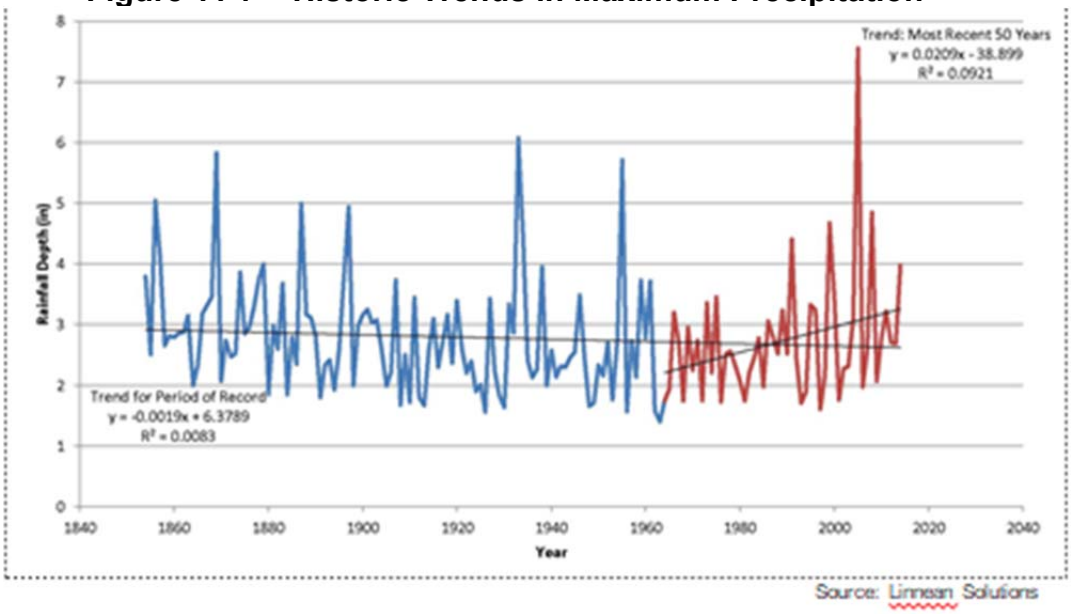
Figure 11-6 – Extreme Temperatures in Chicopee, MA



2. Precipitation

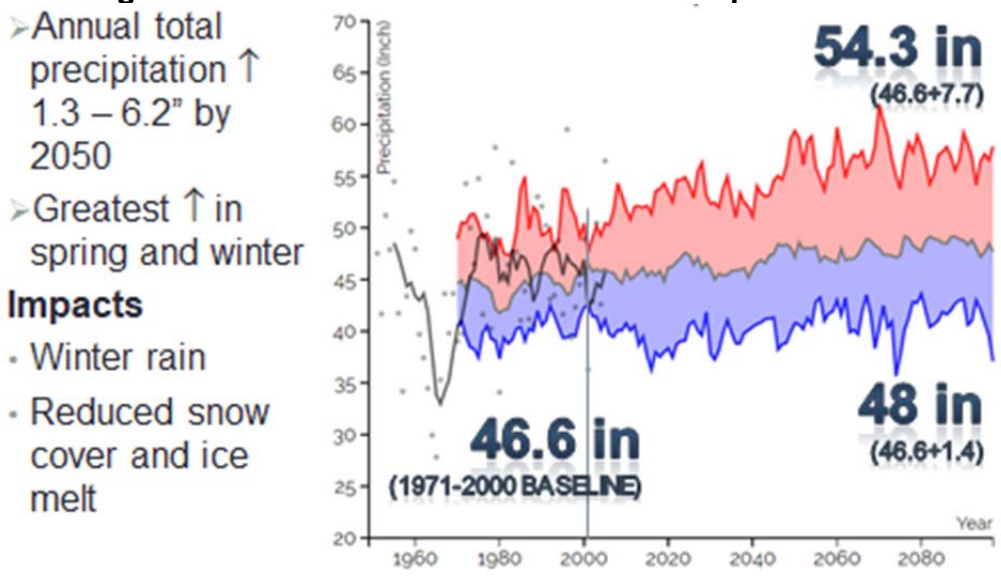
One of the most pronounced changes in climate in the northeast, more than any region of the U.S. during the past several decades, has been a 71% increase in the frequency of extreme precipitation events since the mid-1990s. Figure 11-7 shows the annual maximum 24 hour precipitation from the Amherst weather station, the closest station with solid historical data, showing a major change in the trend line since the 1960s.The highest 24-hour rainfall event recorded within the last few years was approximately 7.5 inches.https://www.climatehubs.oce.usda.gov/sites/default/files/ClimateRisksNortheast_02222017_final2.pdf.

Figure 11-7 – Historic Trends in Maximum Precipitation



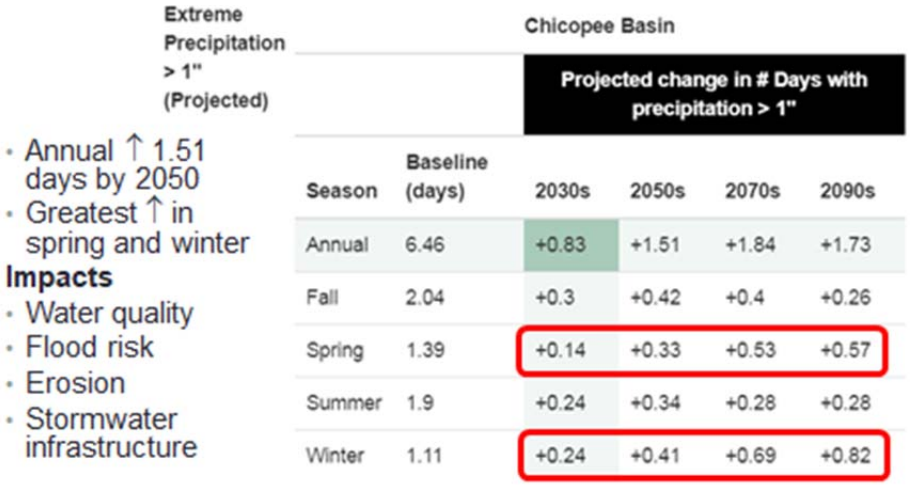
Annual precipitation in the basin is expected to increase by +1.1 to +6.0” by 2050 and by up to 7.7” by the end of the century. Rainfall is expected to increase in spring and winter months in particular. Understanding that both winter precipitation and winter temperatures could increase in future decades, we can expect more of this precipitation to fall as rain instead of snow. This could result in reduced snow cover for winter recreation and tourism, less spring snow melt to replenish aquifers, higher levels of winter runoff, and lower spring river flows for aquatic ecosystems. Less snowfall could also increase flood damage to roadways and other transportation infrastructure.

Figure 11-8 – Predicted Annual Total Precipitation



The climate projections suggest that the frequency of high-intensity rainfall and storm events will continue to trend upward. Again, we see the greatest changes in the spring and winter. These are the types of storms that cause flooding, erosion, and pollutant runoff from agricultural activities. Flooding that results from a single intense downpour can cause widespread damage to property and critical infrastructure. High-intensity rainfall events mobilize pollutants such as sediments and nutrients and pose a threat to surface water quality.

Figure 11-9 – Predicted Rainfall Events > 1”



Chicopee Basin

Season	Baseline (days)	Projected change in # Days with precipitation > 1" 2030s	2050s	2070s	2090s
Annual	6.46	+0.83	+1.51	+1.84	+1.73
Fall	2.04	+0.3	+0.42	+0.4	+0.26
Spring	1.39	+0.14	+0.33	+0.53	+0.57
Summer	1.9	+0.24	+0.34	+0.28	+0.28
Winter	1.11	+0.24	+0.41	+0.69	+0.82

The Commonwealth is funding municipalities to undertake Community Resilience Building (CRB) workshops to prioritize risks to existing infrastructure, people, and the environment. In our region, transportation infrastructure, especially culverts and bridges, are emerging as the most pressing need for improvement, repair, and maintenance as all our municipalities understand the increased risk of flooding due to our changing climate.

The Federal Emergency Management Agency (FEMA) has been slowly updating their federal floodplains based on the new normal of our changing climate, but their updated maps are not yet available to the public. Information on FEMA’s flood mapping updates is available at this website: https://www.fema.gov/flood-mapping-products. The map below shows 100 and 500 year flood areas based on the latest flood map data available to the public.

Figure 11-10 – 100 and500 Year Flood Areas

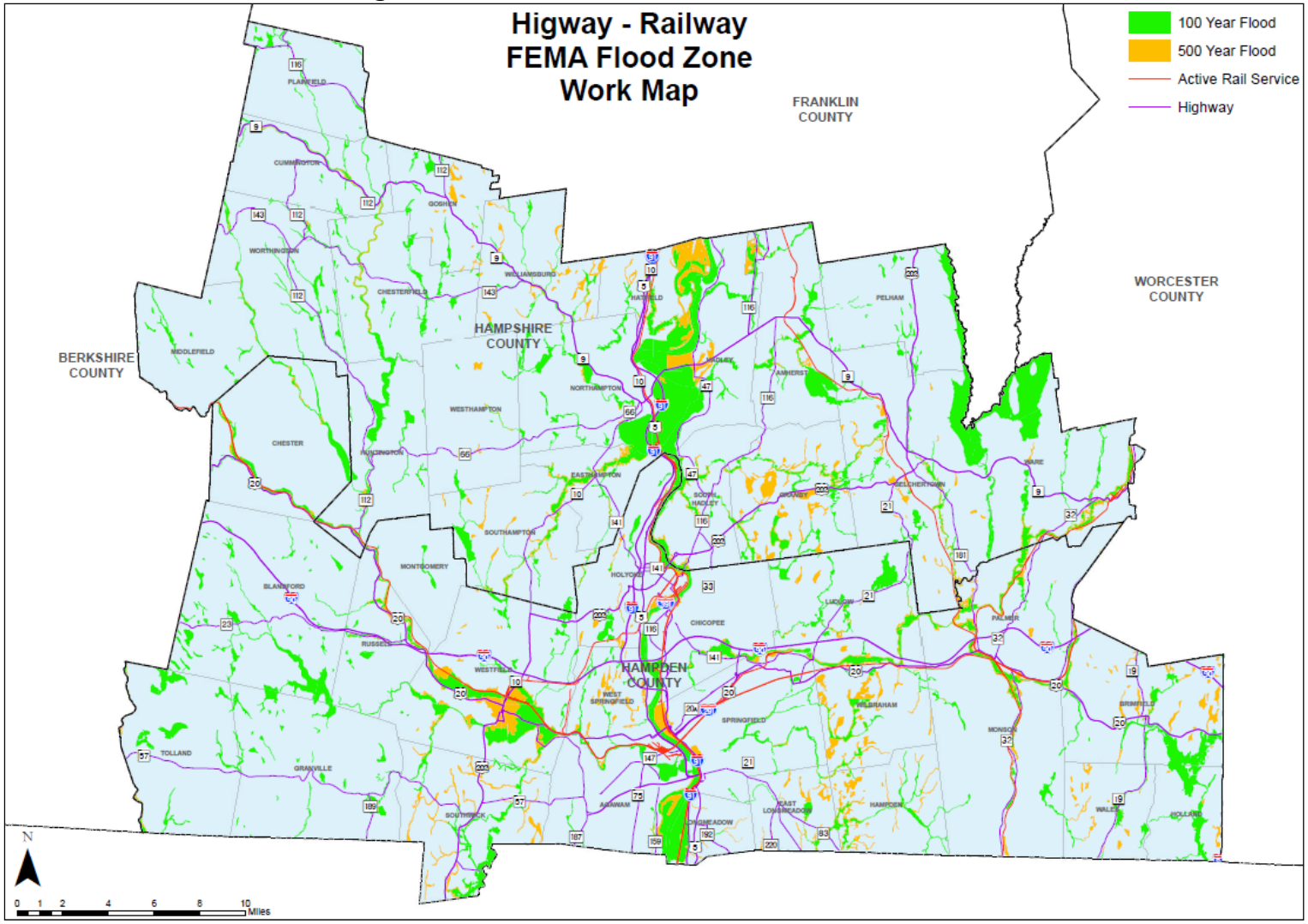
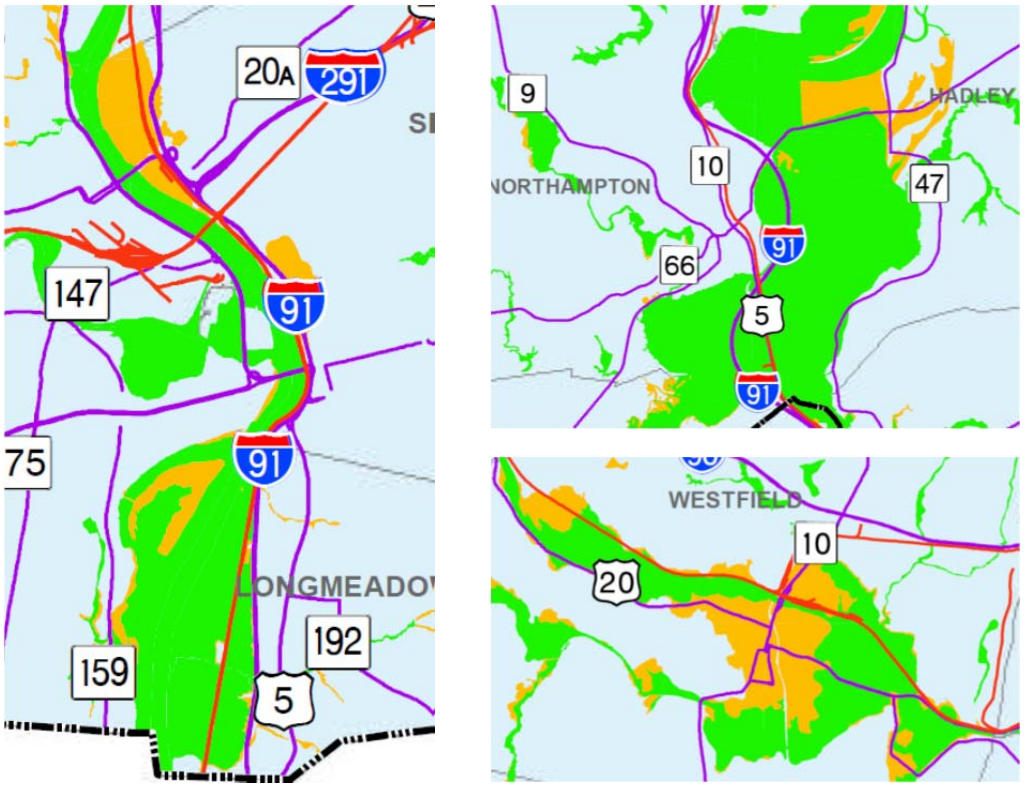


Figure 11-11 – Flood Zones for I-91, Route 9 and Route 20



The western border of Hadley and the eastern border of Northampton possess a 100 year flood zone. During flood events road closures could potentially occur on Routes 5, 9, and 47. The Connecticut River would be the source of the flooding event. In the City of Westfield the commercial and industrial areas along Route 20 and Union Street respectively are within the 100 year flood zone. During a 100 year flood Route 20 and Union Street could potentially be closed. The CSX rail line could also be potentially flooded at its lower elevation points in Westfield. Downtown Westfield is within the 500 year flood zone. If a flood of that magnitude occurs Routes 10, 20, and 202 as well local roads and the CSX line could potentially be flooded by the Westfield River.

Interstate I-91 is expected to be accessible during a flood event due to its higher elevation. However, many ramps in near downtown Springfield are at a lower elevation and at risk of flooding. The Connecticut River rail line runs adjacent to I-91 in close proximity to the Connecticut River. Portions of the rail line through Easthampton and Northampton are within the 100 year flood zone.

In addition to flood zones, in the Pioneer Valley, severe storms are causing an increasing number of washouts of culverts and bridge structures. In 2011, Tropical Storm Irene caused more than $25 million of roadway damage in the region, including many culvert wash outs. Culverts and bridges are structures usually built to

carry a road, rail line or path over a stream or river. Culverts and bridges are usually located at points where the banks narrow, either naturally or as a result of man-made earthworks. In either case, the effect is to create a potential “choke point” in the downstream water flow.

All culverts in the region are mapped on Figure 11-12 and summarized by municipality in Table 11-1. The top 5% deemed most ecologically vulnerable or sensitive to extreme weather and heavy rain are shown in red. Additional information on the potential increase in habitat connectivity that can result from improving a road-stream crossing is presented in Chapter 17 of the RTP.

Figure 11-12 – Culverts for Roadway Crossings in the Pioneer Valley

Table 11-1 – Regional Culverts

TOWN	Total	in top 5%	TOWN	Total	in top 5%	TOWN	Total	in top 5%
Agawam	100		Hadley	61	1	Plainfield	34	3
Amherst	87		Hampden	47	4	Russell	37	
Belchertown	146		Hatfield	32	1	South Hadley	46	
Blandford	74	10	Holland	35	2	Southampton	54	4
Brimfield	119	10	Holyoke	86		Southwick	72	
Chester	65	13	Huntington	41	3	Springfield	146	
Chesterfield	25		Longmeadow	35		Tolland	38	7
Chicopee	60		Ludlow	117	4	Wales	60	4
Cummington	44	8	Middlefield	29	5	Ware	95	
E. Longmeadow	45		Monson	124	4	W. Springfield	90	
Easthampton	45		Montgomery	32	2	Westfield	130	4
Goshen	27	3	Northampton	109		Westhampton	43	8
Granby	71	1	Palmer	92	3	Wilbraham	82	1
Granville	72	13	Pelham	36	16	Williamsburg	53	6
						Worthington	49	4
						TOTAL:	**2,885**	**145**

3. Extreme Weather Events

The climate crisis is manifest by overall warming temperatures across the globe and an increase in precipitation, and it is also bringing a dramatic and noticeable increase in extreme weather events. Across the country weather disasters cost $16 billion in 2017, tying the record set in 2011, our region's year of disasters.

Figure 11-13 – Disaster Events in the United States

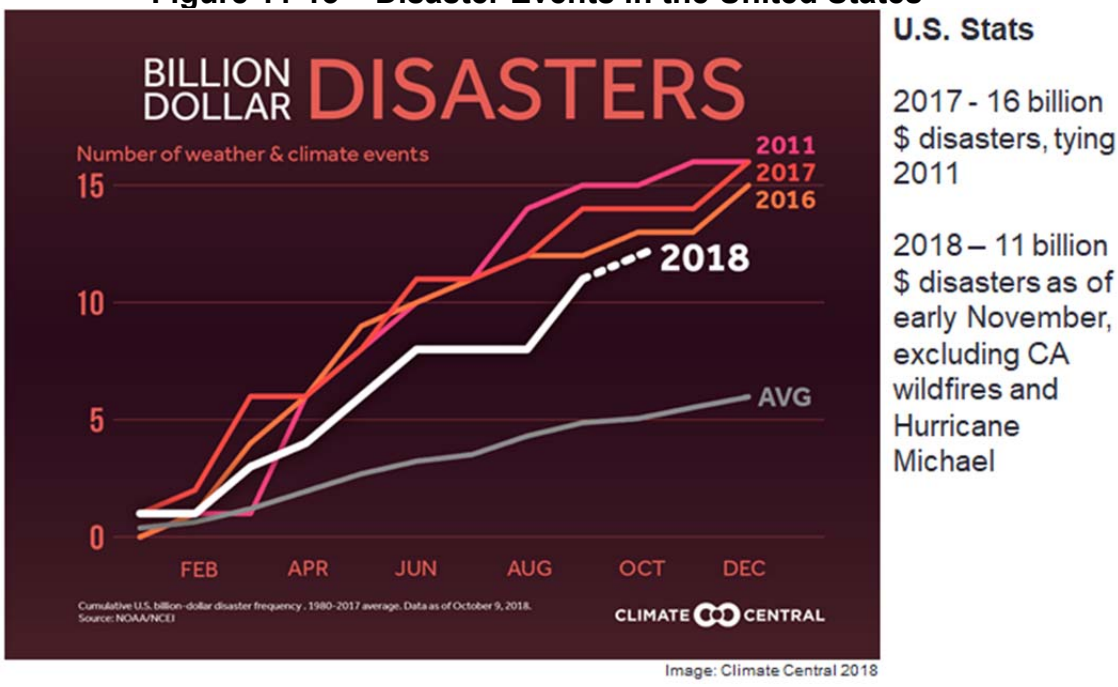


Image: Climate Central 2018

B. EXISTING POLICIES PROGRAMS

As noted, the Commonwealth is a leader in forward-thinking climate action policies, which are developed into programs by staff at MassDOT, EOEEA and other state agencies and departments. Since 2008, Massachusetts has been using a strong combination of regulation, legislation, incentives, requirements, technical assistance and support to achieve necessary GHG emissions reductions to maintain Massachusetts livability, as exemplified by both the Complete Streets and the Municipal Vulnerability Preparedness (MVP) programs.

The GWSA provides a strong foundation on which current efforts have been built while risk management and adaptation to the changing climate have been built into how the Commonwealth does business. At the regional level, PVPC works with member municipalities to advance their participation in the State programs. We also regularly collaborate with public/private governments, organizations and institutions to plan for and implement local policies and programs that advance livable communities.

1. Complete Streets

In 2016 MassDOT launched the Complete Street Funding Program to incentivize municipal best practice in Complete Streets policy and implementation. To date, 38 communities have participated in MassDOT sponsored Complete Streets training and 18 communities have actively participated in the Complete Streets Program. More information on the Complete Streets program is included as part of the Appendix to the Regional Profile Chapter of the RTP.

2. GHG emissions assessments as MEPA

In 2007 Massachusetts started the process of integrating GHG emissions impact assessments into the Massachusetts Environmental Policy Act (MEPA). This policy was extremely innovative and continues to play an important role in raising awareness of GHG emissions and educating people about how to mitigate impacts. As explained by the Commonwealth:

> “The Executive Office of Energy and Environmental Affairs (EEA) has determined that the phrase "damage to the environment" as used in the Massachusetts Environmental Policy Act (MEPA) includes the emission of greenhouse gases caused by Projects subject to MEPA review. EEA now issues the following Greenhouse Gas Emissions Policy to fulfill the statutory obligation to take all feasible measures to avoid, minimize, or mitigate damage to the environment.
>
> The Policy requires that certain Projects undergoing review by the MEPA Office quantify the Project's greenhouse gas (GHG) emissions and identify measures to avoid, minimize, or mitigate such emissions. In addition to quantifying Project-related GHG emissions, the Policy also requires proponents to quantify the impact of proposed mitigation in terms of emissions and energy savings. EEA recognizes that this Policy will not itself avert climate change. However, this

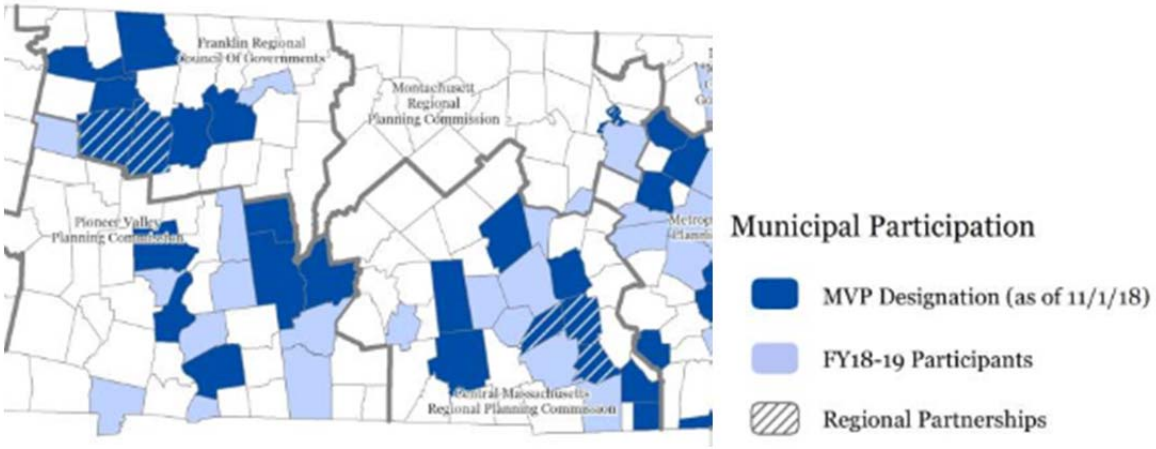
Policy is part of a larger effort to focus attention on the causes of climate change and harness creative thought and technology to implement long-term solutions.

EEA also recognizes that the GHG quantification required by this Policy will not result in absolutely accurate projections. The intent is not one hundred percent certainty as to the amount of GHG emissions; rather, it is a reasonably accurate quantitative analysis of emissions and potential mitigation that will allow the Project proponent and reviewers to assess the overall impact of the Project as proposed and the reduction in emissions if various techniques are used. https://eeaonline.eea.state.ma.us/EEA/emepa/pdffiles/misc/GHG%20Policy%20FINAL.pdf

3. Municipal Vulnerability Preparedness (MVP) Program

Every city and town is encouraged, but not required, to accept funding from the State to undertake a Community Resilience Building (CRB) process to identify municipal vulnerabilities and strengths, and to develop a prioritized action plan to build on strengths and minimize and mitigate vulnerabilities. The Commonwealth is funding MVP action grants up to $2,000,000/community in the second year of funding, 2019.

Figure 11-14 – Municipal Vulnerability Preparedness Program Participation



Fourteen member municipalities have participated in the MVP program in its first two years and an estimated 15 more are preparing to apply in the third year of planning work. Statements of findings from all 14 participating municipalities highlight the vulnerability of transportation infrastructure to extreme weather caused by our changing climate. In particular, concerns about under-sized and poorly maintained culverts and bridges are being raised across all participating municipalities.

4. Green Communities

The Green Communities Division provides funding opportunities to reduce municipal energy use and costs by way of clean energy projects in municipal buildings, facilities, and schools; guidance, technical assistance, and local support from Regional Coordinators working out of the Massachusetts Department of Energy

Resources (DOER). With respect to transportation, the program requires all participating municipalities to adopt a fuel efficient vehicle policy that requires the purchase of energy efficient vehicles by the municipality. This program is a “Lead by example’ initiative that shows residents and businesses in participating municipalities that it is possible to buy an energy efficient vehicle for most day to day uses and not suffer any negative consequences. There are 33 certified Green Communities in our region and three additional communities are working on certification. These communities have invested $10,617,410 to make their communities more energy efficient and reduce GHG emissions.

5. Local Bylaw/Ordinance & Other Regulatory Reform

PVPC’s Land Use & Environment Section leads the development and implementation of the region’s smart growth plan, Valley Vision. How land is used and developed determines how much people need to drive to fulfill their daily functions. The Pioneer Valley has been a leader for over 20 years with respect to promoting and encouraging smart growth, that is development that is targeted where there is existing infrastructure to support it, versus initiating development far away from roads, power lines, water and sewer lines etc. We work closely with our member municipalities to adopt and revise as needed, their existing bylaws and ordinances to make it possible for communities to minimize the need to drive and promote energy efficient modes of transportation such as walking, biking and using the bus.

For over 20 years the PVPC, along with many other organizations including the MAPC, MPHA, the MA Smart Growth Alliance and Transportation for MA have been advocating for and educating the Commonwealth about the need for zoning reform. A key area for improvement is the 2/3 majority needed to modify local land use regulations.

C. NEW/RECOMMENDED POLICIES

1. TCI

The Transportation Climate Initiative is an exciting future policy. If we can achieve the same success reducing GHG emissions from transportation that we have collectively achieved with RGGI reducing GHG emissions from buildings, we will be much better situated to have a safe and sustainable future for our children and our grandchildren. Excerpt from WBUR on 12/18/18:

> “Massachusetts and eight other states, along with Washington, D.C., announced Tuesday they will join together to try to reduce greenhouse gas emissions from the transportation sector.

In a statement, the Transportation and Climate Initiative (TCI) said it will design a proposal that "would cap and reduce carbon emissions from the combustion of transportation fuels, and invest proceeds from the program into low-carbon and more resilient transportation infrastructure."

Along with Massachusetts, the Northeast and Mid-Atlantic states participating in the TCI, as of its inception, are: Connecticut, Delaware, Maryland, New Jersey, Pennsylvania, Rhode Island, Vermont and Virginia. The initiative is based on the decade-old Regional Greenhouse Gas Initiative that has reduced carbon emissions produced by Northeast electric power plants through carbon-trading. A "RGGI for Transport" would be a similar market mechanism for fossil fuels used to power vehicles, charging wholesalers a fee at the border for fuels they import into the region.

In a 250-page report, the state's Transportation of the Future commission estimates that the new carbon price would cost the average driver $2 a month. The funds could be invested in building the transportation system of the future, offering rebates on electric cars, and constructing charging stations and bike paths.

Emissions from transportation account for the largest portion of the region's carbon pollution. In Massachusetts, the transportation sector accounts for nearly 40 percent of emissions.

"The trick in carbon pricing is to make sure you don't penalize people who can't adjust immediately," said Michael Barrett, chair of the Massachusetts Senate Telecommunications, Utilities and Energy Committee. Barrett suggested easing the pain of a carbon tax by paying people in advance to cut their future use of fossil fuels. For instance, the government could estimate the annual per capita cost of a carbon price, cut people a check for that amount, and let them decide what to do with the money. Perhaps they might use the advance to insulate their homes, or buy more fuel-efficient cars.

“Reducing emissions in the transportation sector requires a collaborative approach," state Energy and Environmental Affairs Secretary Matthew Beaton said in a statement, "and the Commonwealth is proud to partner with Northeast and Mid-Atlantic states to pursue a potential program to further mitigate the impacts of climate change, protect the health of our residents, and build a more resilient and sustainable transportation system for the next generation."

2. Housing Choice/Zoning Reform

As stated in a recent Boston Globe article, “in Massachusetts, even incremental legislation that aims to make it easier for towns to change their own zoning has proved to be a challenge. The (latest Zoning Reform) measure’s uncertain fate on Beacon Hill highlights the contentious politics around housing in a state that takes pride both in progressive social policy and in preserving local control of the look and

feel of its cities and towns." (Boston Globe, March 16, 2019.) Massachusetts is seeing a drastic decline in new housing development (half of the new housing development experienced in the 1970s and 80s) and the search for housing is causing more and more people to drive longer and longer distances to get to work and school and other important destinations. We very much need zoning reform in Massachusetts to address the connection between land use and zoning, housing and transportation, especially in the face of the severe consequences of our current global climate crisis.

3. Our Next Future

In 2014, PVPC wrapped up a three-year bi-state regional sustainability planning process: *Our Next Future: An Action Plan for Building A Smart, Sustainable, and Resilient Pioneer Valley***.** The plan is now being updated and implemented across all sections of the PVPC and in close partnership and collaboration with our member municipalities, the business and economic development sector, educational, health care, insurance, clean energy and other key anchor institutions, residents, the not for profit sector, community based organizations and the general public. These plans are available on our website: http://www.pvpc.org.

PVPC has a number of working committees/groups that meet regularly to advise staff and Commissioners on plan development and implementation. These include: the Joint Transportation Committee, Plan for Progress—focus on economic development, Valley Development Council—focus on land use and zoning, the Clean Energy/Climate Action committee, the CT River Clean Up committee, regional Housing Committee, and the Stormwater committee. All of these committees and working groups contribute to the region's livability.

4. Resources

Below is a list of websites and reports used in the development of this chapter.

https://necsc.umass.edu/projects/massachusetts-climate-change-projections

Massachusetts Climate Data Clearinghouse: http://www.resilientma.org

https://www.mass.gov/complete-streets-funding-program

https://www.mass.gov/municipal-vulnerability-preparedness-mvp-program

https://www.mass.gov/orgs/green-communities-division