

ResilientMass Metrics

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ResilientMass

Acknowledgments

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Photo: Children in Worcester collaborate on strategies to make their school playground cooler during a project funded by the Municipal Vulnerability Preparedness action grant.

Cover Photos (l to r): Plum Island flood response, Norwood dam removal project, Wellesley Community Resilience Building Workshop, and Ayer pocket forest community planting day.

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1. Executive Summary

What are the ResilientMass Metrics?

In 2024, the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), in partnership with the Massachusetts Emergency Management Agency (MEMA), took a whole-of-government approach to develop a framework and corresponding set of metrics that measure and evaluate progress in implementing the ResilientMass Plan, and guide related strategies for the state's climate adaptation and resilience funding and action.

These agencies brought on a team of consultants with expertise in adaptation and resilience policy and metrics development. Together, this project team conducted extensive engagement within and outside of state government to develop and refine the resulting framework and metrics, and to ensure that it embeds environmental justice and equity throughout. This year-long process resulted in the ResilientMass Metrics (RMM) presented here.

The ResilientMass Metrics are intended to provide a strategic framework for driving the Commonwealth's climate adaptation and resilience work. The framework's goals, strategies, indicators, and metrics can be used as guideposts to focus cross-sector climate resilience action. Some metrics track the actions taken, others show the impact of state actions and can spur new conversations and opportunities to adjust course as needed. Other public, private, and community-based organizations in Massachusetts can similarly reference the metrics to inform their own climate resilience work or foster alignment with the Commonwealth to achieve greater shared impact.

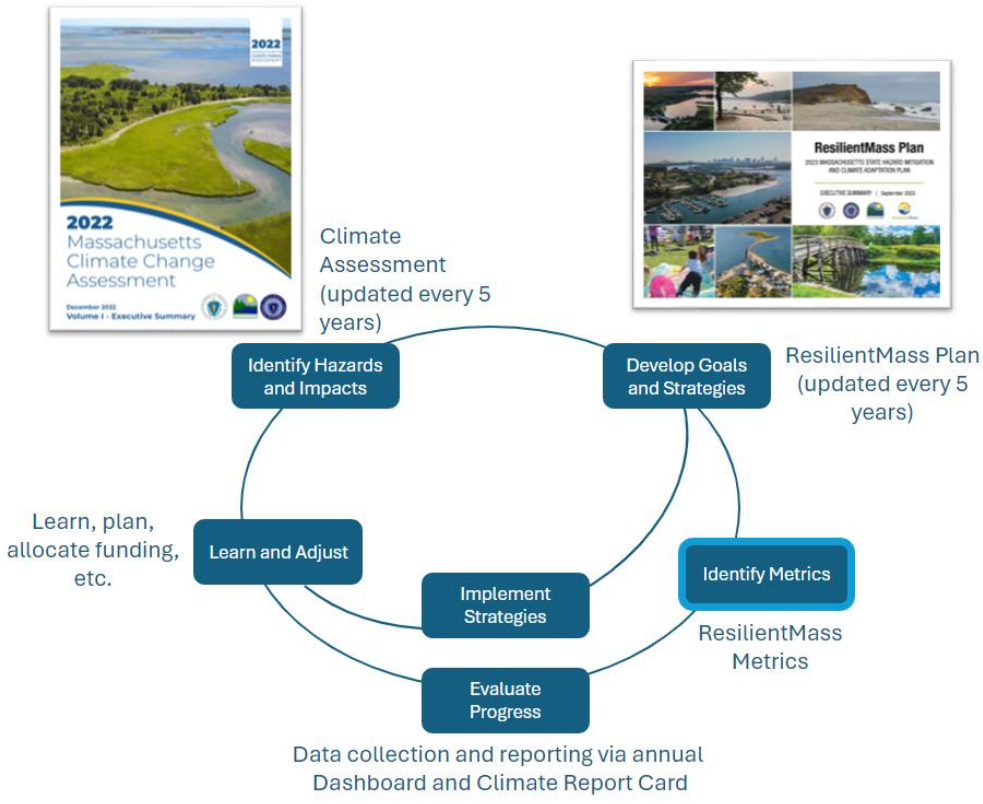
Throughout the US, policymakers are increasingly recognizing the importance of developing climate resilience indicators and tracking metrics. In reviewing other states' and cities' initiatives, the ResilientMass Metrics project team found examples in various stages of development and with different focus areas within climate resilience. In creating the ResilientMass Metrics, Massachusetts is among the early developers of these metrics at the state level and is contributing to the evolution of climate resilience metrics development efforts across the country by providing a model for other states and demonstrating how to align these metrics with state-led climate plans.

Where Does ResilientMass Metrics Fit In?

The Commonwealth of Massachusetts has taken significant steps to address climate change and enhance resilience through its ResilientMass program[1]. Massachusetts has demonstrated its commitment to climate action through the development of a comprehensive approach that includes:

- The 2022 Massachusetts Climate Change Assessment, which is a statewide analysis detailing how the Commonwealth's people, environments, and infrastructure are already and may be affected by climate change and related hazards through the end of the century.
- The 2023 ResilientMass Plan, which serves as the state's current integrated Hazard Mitigation and Climate Adaptation Strategy. The Plan was directly informed by the 2022 Assessment.
- The ResilientMass Climate Resilience Design Standards Tool, which helps agencies and municipalities incorporate climate projections into planning and design processes to assess and mitigate risk.
- The ResilientMass Action Tracker, which monitors over 142 state agency-led actions to increase resilience and reduce climate-related risks.

Figure 1. ResilientMass Metrics as a part of the ResilientMass program



1 ResilientMass is Massachusetts' cross-government initiative for reducing risks and building resilience to natural hazards and local impacts of climate change, and encompasses the State's climate adaptation and resilience planning, programs, and partnerships. https://resilient.mass.gov/home.html

- The Massachusetts Climate Report Card, which informs Massachusetts residents of some of the progress the Commonwealth's executive offices are collectively making to achieve both greenhouse gas reduction (mitigation) and resilience (adaptation). goals and mandates.

The ResilientMass Metrics (RMM) framework is the next tool in this suite of interrelated documents and guidance meant to support the Commonwealth in advancing climate resilience by providing a clear indication of progress in adapting to the Commonwealth's highest priority climate impacts. Together, the metrics will help tell the story of what is working, where more resources are needed, and where the state should go next.

How Were the ResilientMass Metrics Developed?

The Metrics development project team conducted a one-year metrics development process with broad engagement across state government and external partners to develop a framework and corresponding metrics that effectively measure progress toward climate resilience goals. ResilientMass Metrics builds on existing efforts within the Commonwealth and draws from relevant experiences in other states to design an effective framework for climate resilience metrics. A review of similar frameworks used in other states, municipalities, and organizations was conducted (see Appendix A) and identified six characteristics that make a climate resilience metrics framework effective and actionable, including: Development Process, Implementation, Indicator Types, Equity Focus, Baseline and Target Setting, and Visualization and Reporting (see Figure 2).

Figure 2. Six characteristics of effective and actionable climate resilience metrics

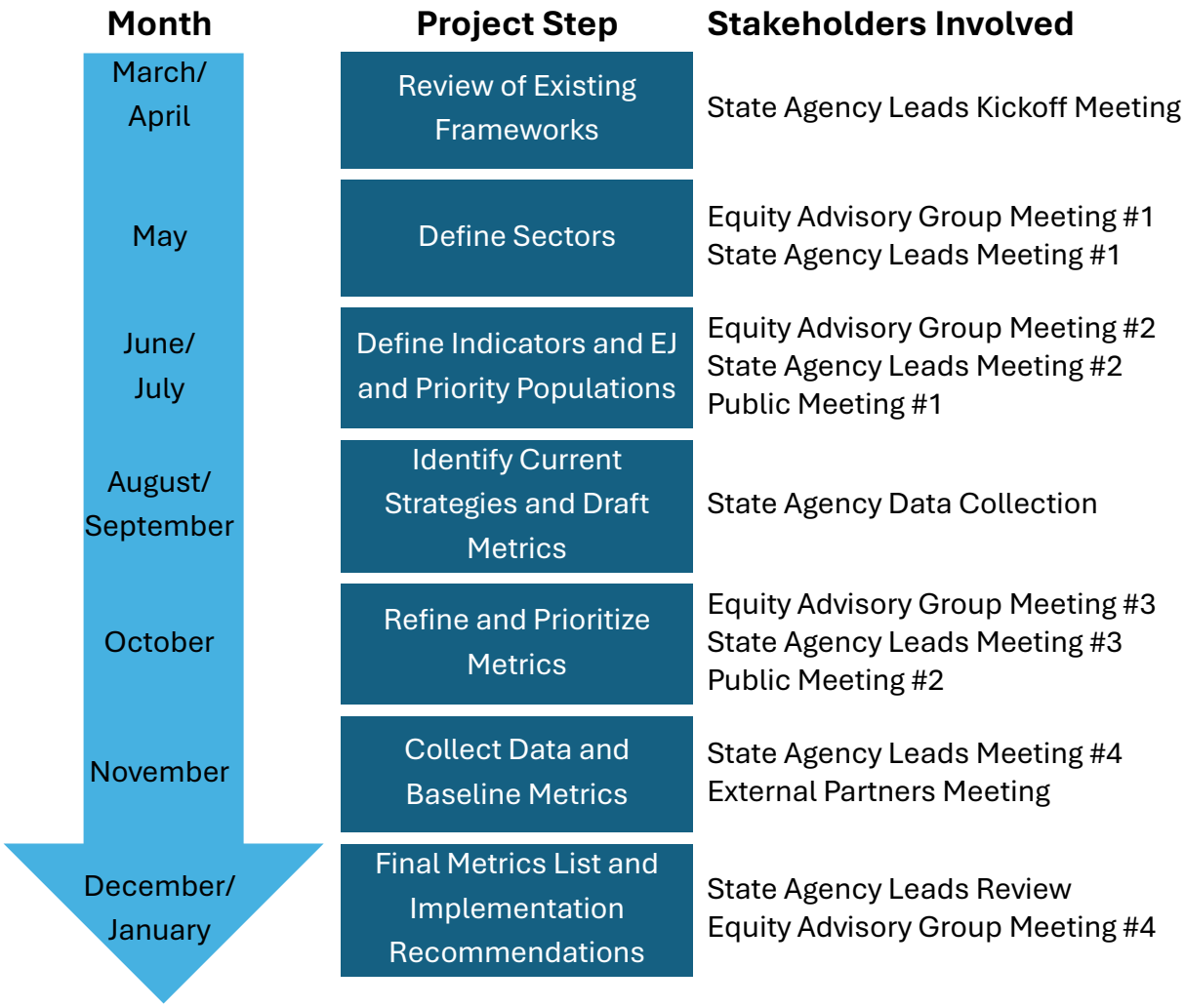
Following this review, the project progressed stepwise through development of the individual framework elements with engagement of the state agency representatives as detailed in Figure 3.

As part of EEA's focus on centering equity throughout the Metrics development project—from the framework and metrics to the engagement strategy—an Equity Advisory Group (EAG) was assembled to advise the project. EAG members represented a range of experiences, backgrounds, and geographies and were connected to, or have lived experience in, environmental justice communities and/or priority populations. EAG members reviewed and provided input at various stages of the metrics development project.

Two public meetings were held, and external partners (NGOs, academic partners, local governments, and others) were consulted to inform key stages in the framework and metrics development process.

Detail on stakeholder activities and feedback is provided in Appendix B.

Figure 3. ResilientMass Metrics development and stakeholder engagement process



A comprehensive metrics framework should include a mix of qualitative and quantitative indicators and metrics of the following types:

- **Inputs/Adaptive Capacity**: metrics reflecting the enabling conditions for adaptation
- **Process**: metrics of the quality and effectiveness of approaches to plan, implement, engage and communicate adaptation efforts
- **Outputs**: metrics of concrete products, services, or actions delivered in the process of adaptation
- **Outcomes/Impacts**: metrics of long-term primary or secondary effects of adaptation interventions

To develop an initial set of metrics, state agencies were asked to report on their activities, data they track, and the targets they have established. The ResilientMass Metrics consultant team conducted a thorough review of these actions and data to generate many of the draft metrics. The early phases of developing a set of resilience metrics yielded nearly 200 potential metrics across all sectors considered. Where Massachusetts-specific data or state-led actions that would have helped to generate a metric were not apparent, the consultant team drafted metrics based on expert judgement, the extant literature, and drawing from other relevant state and federal frameworks.

The project management team and consultant team worked iteratively to refine this list into a smaller set of priority metrics that focus on high-priority issues, are implementable and actionable over time, and help illustrate the scope and scale of state-led efforts across sectors (see Appendix C for additional detail on the prioritization criteria and process). Additional sorting occurred following state agency and EAG review and input into the metrics, especially with respect to data availability and readiness.

The resulting metrics were grouped into two main categories:

ResilientMass priority metrics:
Metrics that are already or will be developed and tracked annually, including:

- **Metrics "currently being tracked."** These consist mostly of metrics which already have data readily available and ranked high on the prioritization criteria. These metrics will be reported on the upcoming ResilientMass Metrics dashboard. A subset is also being reported in the annual Climate Report Card.
- **Metrics "prioritized for development."** These consist of metrics that were identified and prioritized by stakeholders as important metrics to develop and begin tracking as soon as possible, within the current five-year ResilientMass Plan cycle.

Metrics for further consideration:
By far the largest grouping of metrics, this set includes the remaining metrics that have been identified and reviewed through the initial Metrics development process. These metrics did not rank as highly on the prioritization criteria for a variety of reasons such as the need for gathering data from private sector entities, the need for more research into a topic, or that the metric may be most useful at the state agency level but not necessarily relevant for a statewide, public audience.

Section 2 provides a summary of each framework sector and corresponding metrics "currently being tracked." The list of all metrics developed through this project is available in Appendix E.

How Do ResilientMass Metrics Advance Climate Resilience?

Massachusetts has conducted essential, foundational work to understand local and state vulnerability to climate change impacts, and advance climate resilience projects, programs, and funding. The most recent Massachusetts Climate Change Assessment identifies and prioritizes impacts across five sectors (human, infrastructure, natural environment, governance, and economy). The ResilientMass Plan builds upon the Climate

Assessment and provides a set of goals and corresponding actions aimed at increasing capacity for addressing natural and other hazards and climate impacts through preparation, mitigation, adaptation, and risk reduction.

Both the Climate Assessment and ResilientMass Plan were developed by the ResilientMass Action Team—the inter-agency working group responsible for implementation, monitoring, and maintenance of the ResilientMass Plan—with involvement from local, regional, and community partners.

The ResilientMass Action Tracker currently tracks progress toward completing the ResilientMass Plan—actions intended to address the prioritized climate change impacts — ResilientMass Metrics, however, goes beyond tracking implementation of those initial set of strategies and actions. It helps state agencies and others outside of state government to grapple with the key question, "What does climate resilience look like in the Commonwealth?" as a way to develop a *compelling, shared vision of success* which will anchor and orient adaptation and resilience-building strategies going forward. As such, it helps identify a set of metrics that measure the Commonwealth's progress toward achieving that vision of resilience.

The ResilientMass Metrics framework focuses on the priority impacts to human, infrastructure,

natural environment, governance, and economic resilience identified in the MA Climate Assessment. Stakeholder input also elevated food and water security as critical. Given the cross-cutting importance of equity and environmental justice on each of these sectors, the metrics address equity and justice dimensions in each sector. Further, a distinct category of metrics for Environmental Justice, Equity, and Collaboration was developed to capture unique goals and efforts not captured by the cross-cutting ones. The ResilientMass Metrics can be used in several ways to support climate resilience work in the Commonwealth. These are detailed in Table 1. Additionally, information on the rationale for using metrics to support resilience capacity-building can be found in Appendix D.

Figure 4. Priority Impacts from the Massachusetts Climate Change Assessment

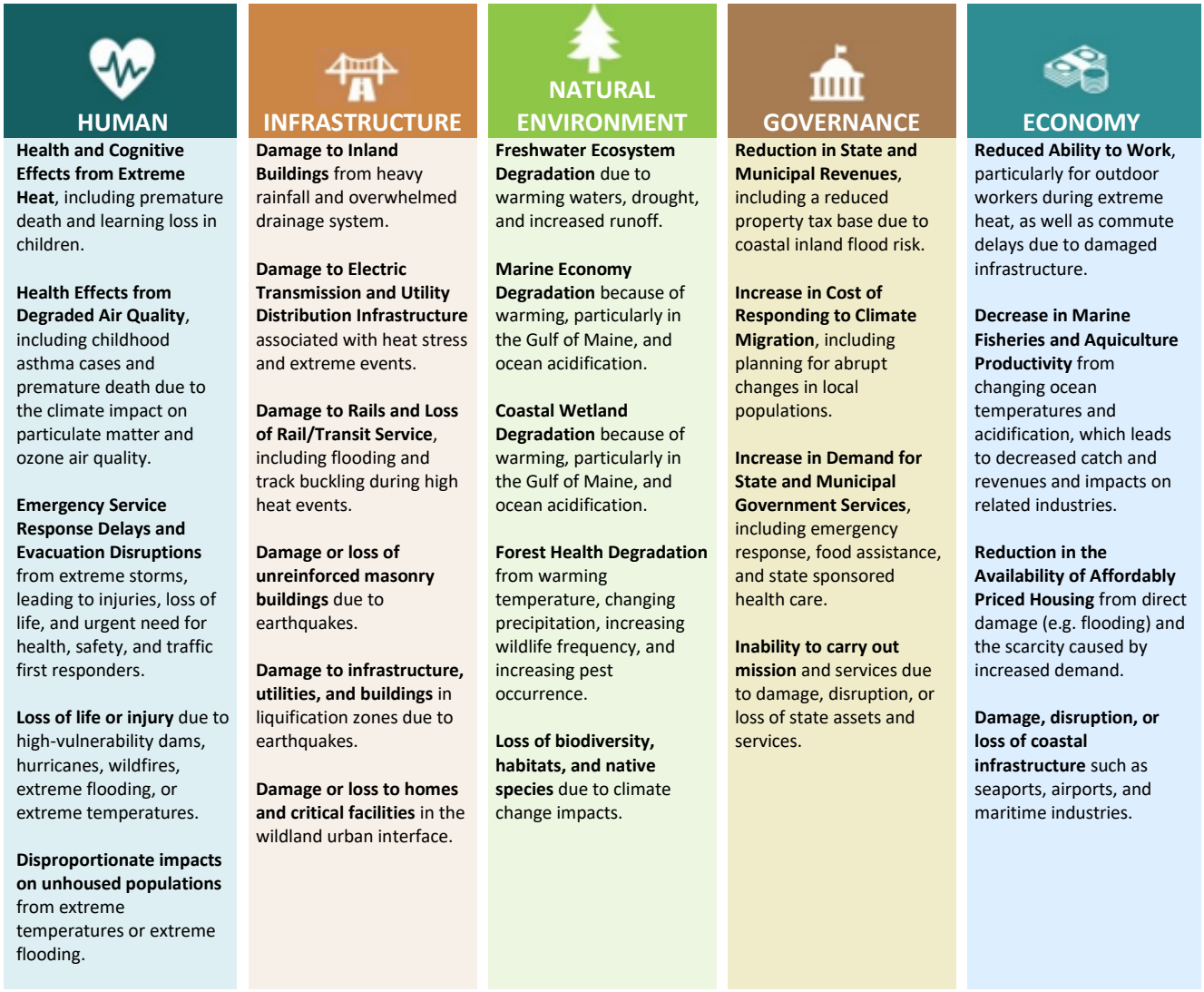


Table 1. How ResilientMass Metrics Will Be Used

	Applicability of metrics within uses	How ResilientMass Metrics will be used in MA
Deliberate planning and decision making	▪ Serve as guidepost for coordinated planning within and across agencies and sectors ▪ Provide a foundation for policymakers to set clear goals, align them with needed resources and strategies, and then track progress toward specific targets	▪ ResilientMass Metrics framework goals are directly linked to MA Climate Assessment priority impacts and ResilientMass Plan strategies and related state agency actions allowing EEA, MEMA, and RMAT determine the effectiveness and adequacy of current state-led actions in decreasing climate vulnerability, centering environmental justice, and increasing climate resilience along multiple dimensions. ▪ State grant programs can use the RMM to effect changes in grant program eligible activities, eligible entities, guiding principles, or selection criteria to incentivize action toward RMM goals and/or support data collection.

	Applicability of metrics within uses	How ResilientMass Metrics will be used in MA
Justification and expansion of funding for adaptation and resilience actions	▪ Support requests for adaptation and resilience funding with metrics that show progress and/or needs. ▪ Shift the perception of expenditures from costs to strategic investments in community prosperity by providing both • Quantifiable evidence of the potential benefits, based on existing, associated metrics, and • Clear, measurable indicators of what success will look like, based on new or updated metrics.	▪ An annual review of progress across all priority metrics supports EEA, the RMAT Co-Chairs, and Secretariat Climate Change Coordinators in identifying areas that may require more resources to fill gaps while also highlighting demonstrated successes and where there is a high return on investment. ▪ Metrics can also be used to set priorities for securing new funding and to develop partnerships with the private sector (e.g., insurance, investors).
Communications and public engagement	▪ Bridge scientific understanding with public motivation to act by providing accessible data on tangible benefits of adaptation and highlighting positive actions and success stories. ▪ Communicate hope by focusing on achievable goals rather than just threats.	▪ RMM goals and corresponding metrics focus on what the state is doing to address climate change and provide a way for non-state partners to act in alignment toward those goals. Public, private, and community-based organizations in Massachusetts can also use these metrics to inform their own resilience work or initiate local actions in alignment with the Commonwealth to achieve greater shared impact. ▪ Metrics related to specific sectors can be used by relevant agencies or within specific initiatives to support conversation and communicate progress within that sector. ▪ Metrics also support collaboration with municipalities, Tribal nations and Tribally (Native) serving organizations, non-governmental organizations, community-based, and private partners to work together to generate new data to improve the picture of resilience in Massachusetts, identifying additional financing avenues and other resource to implement adaptation actions.
Accountability and good governance	▪ Demonstrate transparency and commitment to climate resilience goals through clear, measurable targets and regularly reporting on progress. ▪ Details allow for a more accurate assessment of adaptation progress and effectiveness and helps identify where more work is needed. ▪ Helps to sustain trust between government and Massachusetts' residents as metrics tracking actions and progress show good-faith efforts to address climate risks.	▪ For public audiences, the resilience metrics framework and corresponding set of metrics will communicate progress in key areas across sectors through the RMM dashboard and as a component of the MA Climate Report Card, showing how state funding and efforts are resulting in positive outcomes for the state's residents.

	Applicability of metrics within uses	How ResilientMass Metrics will be used in MA
Support for learning and adaptive management	▪ Provide a feedback loop that enables ongoing strategy adjustments in response to changing conditions (e.g., climate risks, non-climate trends affecting vulnerability). ▪ Allow for systematic tracking and evaluation of adaptation efforts, helping organizations learn from both successful and unsuccessful interventions.	▪ Statewide metrics, as well as those disaggregated to track progress for specific EJ and other priority populations, enable the state to determine the effectiveness and adequacy of current state-led actions in decreasing climate vulnerability, centering environmental justice, and increasing climate resilience along multiple dimensions. ▪ Coordination among state agencies and programs responsible for climate, biodiversity, or related metrics (e.g., the Clean Energy & Decarbonization Metrics, biodiversity metrics) will provide opportunities for learning, alignment, efficiencies, and improvement on metric development initiatives ▪ Metrics prioritized for development or for further consideration that prove difficult to track, or that require more attention, can inform the next MA Climate Change Assessment so that relevant analyses on emerging risks are undertaken.

The framework and associated metrics will be broadly accessible via the ResilientMass website and links from other relevant areas of mass.gov and will be incorporated in the state's annual Climate Report Card.

A vision of success

A *resilient Massachusetts* is one that is well-prepared to face the challenges of climate change, with communities, businesses, and natural systems that are able to withstand, adapt to, and rapidly recover from extreme weather events and long-term environmental shifts. In this vision, Massachusetts displays preparedness, strength, and responsiveness in the face of climate hazards such as inland flooding, coastal erosion, and extreme heat. For example, transportation infrastructure remains reliable, businesses persevere despite supply chain disruptions, and public health systems are equipped to handle extreme events (with better health outcomes and fewer incidences of disease in the first place). A resilient Massachusetts is also proactive, innovative, and creative in developing solutions to an uncertain future.

In this vision of success, environmental justice and equity are at the forefront of all these resilience efforts: decision-making, resource allocation, and capacity building prioritize vulnerable populations and address disparities in climate impacts and related opportunities. In a resilient Massachusetts, all communities, regardless of socioeconomic status or geography, benefit from climate adaptation measures and are actively involved in the resilience-building process. ResilientMass Metrics will enable the state to measure and track the results and effectiveness of Massachusetts' resilience efforts.

Achieving this vision requires setting tangible goals, developing feasible strategies, and devising a way to check on, and sustain, progress. Vision is the destination, with concrete goals; strategies are the vehicles and routes; and metrics give us information on how far state agency-led efforts in implementing strategies and advancing goals have come. One of the most important aspects of developing the ResilientMass Metrics was co-creating this vision and associated goals so that the strategies, indicators, and metrics can be aligned toward them.

While some climate-related sets of metrics focus on tracking **vulnerability** (in other words, which people, structures, and systems are most susceptible to the effects of climate change and least able to deal with them), the ResilientMass Metrics tell a story of efforts to advance **adaptation**—the proactive and responsive measures that Massachusetts is taking to better protect its communities, economies, and environment from current and future climate challenges—and the outcomes of those efforts.

2. ResilientMass Metrics Framework

Framework Elements

The ResilientMass Metrics (RMM) framework includes six sectors and an additional category that collectively tell the story of the Commonwealth's climate adaptation progress and success (collectively called "sectors" here). These sectors build on the five sectors in the Massachusetts Climate Change Assessment (economy, government systems and services, health,[2] infrastructure, and natural environment), augmented with those highlighted in the MVP 2.0 Social Resilience Roadmap (food & water security) and one category that was identified early in the process as vital to include at a high level (environmental justice, equity, and collaboration).

Within each sector, specific elements are defined including goals, strategies, indicators, and metrics, and the particular environmental justice and other priority populations of particular interest in each sector.

Figure 6. ResilientMass Metrics framework elements

Sectors
Groupings of goals, indicators, and metrics that address similar themes.
EJ & Other Priority Populations
People and communities to consider in actions and tracking progress by sector.
Goals
Describe what a Massachusetts resilient to climate change would look like; highlight priority impacts that need to be addressed in order to succeed.
Indicators
Statements that could point to (indicate) success or progress; often includes a direction (e.g., more/less, increased/decreased).
Strategies
Specific actions that contribute to the climate resilience goals and indicators (e.g., funding, policy, technical assistance, etc.).
Metrics
Measurable (quantitatively) or trackable (qualitatively) outcomes that represent an indicator (or multiple indicators).

2 Referred to as "Human" in the 2022 Massachusetts Climate Change Assessment

As an integrated part of the Commonwealth's ResilientMass program, these framework elements draw upon the Massachusetts Climate Change Assessment and ResilientMass Plan. For example, the 2022 Climate Assessment identifies health and cognitive effects from extreme heat as a priority impact. Accordingly, the 2023 ResilientMass Plan includes strategies and principles for addressing these specific health risks. Therefore, the metrics framework contains a goal, indicators, strategies, and corresponding metrics related to health impacts from extreme heat. By implementing metrics that measure progress on addressing these priority impacts, Massachusetts state officials and interested residents will have a better understanding of what progress is being made to minimize these impacts.

Environmental justice and equity

Environmental justice (EJ) and equity are cross-cutting features of the framework. In all sectors, progress can be tracked statewide as well as for specific environmental justice and other priority populations to assess whether progress is occurring equitably. For example, a metric related to safe and affordable drinking water would be measured overall but also specifically for EJ populations, Indigenous peoples, or other priority populations in the Food and Water Security sector. The ability to disaggregate data by specific populations or geographies is one of the prioritization criteria and was a key aspect of the baselining efforts. Continuing to enhance data collection and reporting to be able to report for specific populations and geographies is a recommendation for ongoing framework implementation.

Additionally, there is an Environmental Justice, Equity, and Collaboration sector with its own specific goals, strategies, indicators, and metrics. While the six sectors largely describe **what** resilience looks like, many of the goals in this category speak to **how** and **for whom** the state should build resilience, and include topics like engagement, relationship building, avoiding unintended consequences, and reducing inequalities in the impacts of climate change. This sector also includes several specific goals important to EJ and priority populations.

The ResilientMass Metrics Sectors

High-level summaries for each sector follow, including the ResilientMass Metrics currently being tracked and prioritized for development, along with their corresponding goals, indicators, and strategies. A full list of all sectors and their EJ and priority populations, goals, indicators, and metrics is provided in Appendix E. For metrics currently being tracked, metric values can be found on the ResilientMass Metrics dashboard (to be developed and available at ResilientMass Metrics). A subset of these metrics are also published in the 2024 MA Climate Report Card.

It is important to note that while the framework and metrics contain robust information, it is not possible to track all state-led resilience- and adaptation-related efforts and outcomes, so the project team has focused on some of the areas identified as most important by state agencies; partner organizations; the Equity Advisory Group convened for this project, whose members provided input throughout the process; and the public. These metrics will continue to evolve over time.

Figure 7. ResilientMass Metrics sectors

EJ, Equity & Collaboration

Massachusetts has made a cross-government commitment to centering equity and increasing equitable outcomes for environmental justice (EJ) and other priority populations. While all sectors aim to measure whether progress towards goals is happening equitably, the EJ, Equity, and Collaboration category focuses on topics such as engagement, relationship building, avoiding unintended consequences, and reducing inequalities in the impacts of climate change.

In the near-term, data are available that provide insights regarding funding going to EJ and priority populations, as well as how many projects are underway to support resilience building in the state's tribal communities. State agencies are working to be able to track and report on metrics about the particular protocols and procedures being used to appropriately engage communities. Additionally, data are not yet collected on many of the more qualitative aspects of adaptation work, such as how meaningful engagement is to participants, or whether people feel they are connected to trusted networks they could reach out to in an emergency.

State agencies are working toward this category's goals by:

- Providing resources for public health assessments
- Collaborating with tribal nations, grassroots organizations, and municipal leaders
- Funding projects supporting EJ and priority populations; funding for community liaisons
- Translating project notifications and documents; offering interpretation (including ASL) services as meetings and forums
- Developing resources and online tools (e.g., analyzing cumulative impacts)
- Supporting equitable match programs for economically disadvantaged communities

These represent the strategies which informed the indicators and priority metrics below.

Table 2. EJ, Equity, and Collaboration Metrics Currently Being Tracked ([c]) and Prioritized for Development (*)

GOAL	INDICATORS	METRIC
Climate resilience funding, and the benefits of climate resilience investment, is equitably distributed.	**Equitable Funding:** Equitable funding for resilience going to priority populations	Percentage of state resilience funding to Environmental Justice Populations and Other Priority Populations[c]
Climate resilience solutions are based on science and Traditional	**Restorative Justice in Respect For IK/TEK:** Increase in the	Percentage of state-agency and state-funded resilience projects that incorporate or are based on

GOAL	INDICATORS	METRIC
Ecological Knowledge (TEK) or Indigenous Knowledge (IK)-informed decision-making.	proportion of climate resilience planning efforts that respectfully invite and integrate IK/TEK	traditional ecological knowledge (i.e., the evolving knowledge acquired by indigenous and local peoples over hundreds or thousands of years through direct contact with the environment)*
	Knowledge Partnerships: Increase in the collaboration between scientists and Indigenous wisdom holders to support climate resilience planning and decisions with integrated knowledge	Number of resilience projects conducted in collaboration with Tribal Nations and Tribally serving (Native serving) organizations[c]
People in Environmental Justice populations, Indigenous peoples, and other priority populations are meaningfully involved in resilience planning.	**Engagement Accessibility:** Increased accessibility (e.g., location, timing, and all other accommodations) of resilience planning meetings	Percentage of public meetings, listening sessions, and hearings regarding climate resilience held in EJ communities for projects impacting EJ communities*
State, Tribal, and local partnerships create a diverse network with robust capacity that shares resources and best practices for climate resilience initiatives and implement regional solutions.	**Joint MVP Applications:** More regional/joint applications for MVP grants	Percentage of MVP planning and action grants and Coastal Resilience Grants that regional/joint[c]
Strong community relationships and organizational networks provide resources and support day-to-day and in climate-related emergencies.	**Community Network Participation:** More people belong to a community network they trust and would turn to before, during, and after extreme weather-related events	Number of community members being compensated for their efforts through state resilience grant programs*
	Community Network Participation: More people belong to a community network they trust and would turn to before, during, and after extreme weather-related events	Number of Community-Based Organizations (CBOs) that received state/EEA grants for climate resilience and % of CBOs receiving climate resilience funding that operate in areas with EJ populations (as defined by the 2021 Climate Act)*
The inequitable distribution of climate impacts is reduced.	**Equitable Climate Burden:** Reduced inequitable burden of climate change across all tracked impacts (as measured for other indicators in this framework)	Dollar amount, number, and/or percentage of (a) all households statewide and (b) environmental justice and priority population groups who report they are experiencing (for example): Health and labor impacts: ▪ Unable to get to work or school due to weather ▪ Health impacts due to climate change and extreme events ▪ Business disruptions Problems with housing: ▪ Loss and damages to homes, affordability of safe homes ▪ Affordable energy costs Food insecurity: ▪ Trouble paying for food*

Economy

Many aspects of Massachusetts' economy are sensitive to climate changes and disruptions from extreme events. They can lead, for example, to supply chain disruptions, reduced ability to work, particularly for outdoor workers during extreme heat or resulting from commute delays due to damaged infrastructure. Similarly, the MA Climate Assessment projects a decrease in marine fisheries and aquaculture productivity from changing ocean temperatures and acidification, which leads to decreased catch and revenues and impacts on related industries unless adaptation actions are taken.

The ResilientMass Metrics economy sector goals, strategies, indicators, and metrics for this sector focus on topics such as support for businesses becoming more climate resilient, workforce development, and the state of outdoor recreation industries or the state's agricultural sector. Additional metrics in this sector that are slated for development aim to understand the level of preparedness of the business community for climate-related disruptions (i.e., through business continuity plans and technical assistance). Additional work is needed to get a better understanding of the state of preparedness for disruption among the state's farmers, and how many of the state's businesses are at relatively low risk because they are outside high-risk zones, such as floodplains.

State agencies are working toward this sector's goals by:

- Protecting agricultural lands, forests, and fisheries
- Providing resources for jobseekers (e.g., career planning, funds for occupational training, labor market research, employment-based English classes)
- Providing support for food manufacturers for supply chain planning
- Offering training for water treatment operations on climate hazards, including funds for first responder oil spill trainings
- Generating professional videos for raising awareness on climate jobs and related job opportunities
- Making investments in climate tech technologies and job growth

These represent the strategies which informed the indicators and priority metrics below.

Table 2. Economy Metrics Currently Being Tracked (c) and Prioritized for Development (*)

GOAL	INDICATORS	METRIC
Businesses experience limited disruption due to extreme events and climate-driven supply chain issues.	**General Business Continuity:** Massachusetts businesses experience minimal disruptions and damages from climate change and extreme events	Dollar amount of state funding for climate resilience improvements for businesses*
Local agriculture, forestry, marine fisheries, and aquaculture industries remain productive in the face of climate threats to support the local economy and food security.	**Continuity of Natural Resource Economies:** Minimized losses from climate stressors for all natural resource-based local businesses	Dollar amount of loss to farms per drought event (defined by the Palmer Drought Severity Index (PDSI)) and flood event (2 or more inches in 24 hours) [c]
Local workforces are skilled and trained to implement resilience projects and initiatives.	**Climate-Resilience Jobs:** Increase in the number of people employed in businesses supporting climate resilience	Number of jobs supporting climate resilience (e.g. jobs specific to climate adaptation research, development, and product manufacturing, and adaptation equity, etc.) (direct, indirect, and induced)*
	Professional Trainings: Increase in the quantity and diversity of professional trainings for climate resilience jobs	Number of workers trained in climate resilience-related skills via MassHire programs and other relevant state agency initiatives*

Food & Water Security

Food security in the face of climate change is a relatively new focus for resilience building in Massachusetts, while ensuring water security is a long-standing focus even as climate change makes maintaining sufficient and clean water more challenging.

The available metrics identify how much grant funding is going toward ensuring food and water security, particularly to ensure resilience for food distribution system. They also note how much of Massachusetts' land is protected for agricultural or drinking water supply purposes. The remaining metrics provide a sense of the health outcomes of the efforts to protect food and drinking water safety, that is, to minimize incidences of food-borne or water-borne illnesses.

With more effort, the state may be able to find data on local food sourcing and on state funding for programs that make the state more resilient to drought and coastal flooding, particularly to make food distribution safer against the risks from climate change. Data are not yet available for metrics that point to the affordability of food and safe drinking water; how much of a buffer the state has between the amount of water available, and water used; and what the state is doing to reach people who depend on groundwater and wells.

State agencies are working toward this sector's goals by:

- Supporting Emergency Action Plans for retail and wholesale food facilities
- Offering grants for projects relating to food and agriculture (e.g., community gardens and food forests)
- Running programs for produce and animal health safety
- Conducting research and investigation (e.g., tracking of foodborne illnesses from warming waters)
- Providing funding for drinking water quality protection
- Regulating food supplies and drinking water

These represent the strategies which informed the indicators and priority metrics below.

Table 3. Food & Water Metrics Currently Being Tracked ([c]) and Prioritized for Development (*)

GOAL	INDICATORS	METRIC
Food distribution networks provide uninterrupted access to healthy foods, even during extreme weather events and climate-driven supply chain disruptions.	**Reliable Food Access:** More reliable food access during extreme events	Amount of state funding for climate resilient food distribution systems [c]

GOAL	INDICATORS	METRIC
Local food production provides reliable access to healthy foods, day-to-day and in an emergency.	**Food Safety:** Decreased infections from food-born illnesses (e.g., vibriosis) that are sensitive to climate change.	Number of foodborne illnesses from shellfish due to warming*
	Local Food Sourcing: Increase proportion of diets coming from locally grown food sources	Acres of land protected for agricultural use [c]
People have access to safe and affordable drinking water via wells or public water supply in face of potential drought or water quality issues driven by climate change.	**Sufficient Public Water Supplies:** Increased or maintained buffer between water used and water available in public surface water supplies	Number (or percentage) of municipalities with up-to-date water supply protection plans (incl. drought plans, protection against contamination)*
	Water Quality Maintenance: Decreased impacts of harmful algal blooms and other water quality issues worsened by climate change at water supply sources	Acres of drinking water supply watersheds protected through state programs [c]
		Number of public health advisories in public water supplies attributed to harmful algal blooms*

Government Systems and Services

Well-functioning government systems and services—ranging from the provision of information and infrastructure, to planning, emergency preparedness and disaster response—are important for a resilient Commonwealth. The effective functioning of these services is mostly invisible in daily life but becomes essential in case of and after emergencies. Priority impacts from climate change identified in the Massachusetts Climate Change Assessment include a reduction in state and municipal revenues, increased costs of responding to climate migration, and increased demand for state and municipal government services such as emergency response, food assistance, and health care.

This sector's metrics speak to the state of preparedness of state and local agencies. Having a clear sense of which state facilities are vulnerable to climate risk is a critical first step. Having continuity of operation plans and hazard mitigation plans that are being implemented provides an even better sense of how well the state is ready to deal with the increasing risks from climate change. Additional metrics give a sense of the extent to which volunteers are available in local communities—often the first line of defense—to help out in the case of an emergency.

With additional effort, the state can track the amount of funding that is being put into developing emergency response and recovery plans and into upgrading vulnerable government facilities and operations to make them more climate-resilient, through facility upgrades, trainings, and staffing.

State agencies are working toward this sector's goals by:

- Preparing and testing Continuity of Operations and Asset Management Plans
- Moving services online; moving data into the cloud
- Increasing government service capacity through grants
- Conducting vulnerability assessments and prioritizations
- Updating standards, codes, etc. for resilience
- Providing/participating in technical assistance and trainings
- Installing backup systems for critical systems and services

These represent the strategies which informed the indicators and priority metrics below.

Table 4. Government Systems & Services Metrics Currently Being Tracked (ᶜ) and Prioritized for Development (*)

GOAL	INDICATORS	METRIC
Emergency planning at the state and municipal level accounts for climate change-driven extremes, including changes in frequency, intensity of events, and the possible occurrence of serial and compound events.	**Local Emergency Readiness:** More communities have trained Certified Emergency Response Teams (CERTs) available to assist in extreme events	Percentage of municipalities covered by Community Emergency Response Teams (CERTs) registered with FEMA that have participated in a training with MEMA in the last two years [c]
State-owned buildings, facilities*, and assets as well as key facilities used in partnership with the state or local governments) are resilient to coastal flooding, inland flooding, wind, extreme heat, and extreme storms.	**Climate-Safe State Facilities Investment:** Increasing portion of State infrastructure project designs that account for future climate change	Amount of state funding for state facility resilience improvements*
	Government Facilities Safety: State government facilities experience minimal damages from climate change and extreme events due to climate-safe design standards, operational practices and siting decisions	Percentage of new state facility construction projects that consider projected flooding, heat, wildfire, and wind risks throughout the project's lifespan.*
The government has enough capacity to meet the increase in demand for infrastructure maintenance, public health resources, and emergency services caused by climate stressors.	**Government Planning Capacity:** Increased availability of personnel to plan and implement climate-resilience projects across all regions and communities, at the state and local levels	Number of communities with updated MVP 2.0 or Hazard Mitigation Plans (HMPs) [c]
	Government Service Capacity: Increased availability of state government resources to meet increased demand for all government services due to climate change	Number of state agencies with climate vulnerability assessments of assets and operations [c]
		Amount of federal and state resilience funding [c]
		Percentage of 2023 ResilientMass Plan actions in progress or complete [c]
The government is able to minimize interruptions to the services it provides amid threats from coastal and inland flooding, storms, wind, and extreme heat.	**Service Continuity:** State government services experience minimal disruptions and losses from climate change and extreme events	Percentage of state agencies with up-to-date "Continuity of Operations Plans" [c]

Health

Both physical and mental health, despite growing climate extremes and long-term climate changes, are critical to the wellbeing of Massachusetts residents. Extreme heat, air quality worsened by climate warming, and delays in receiving emergency services due to extreme storms are of highest concern.

Available metrics track some aspects of the preparatory measures the state is taking to address these vital concerns, including heat (e.g., providing publicly available cool spaces, staff trainings on climate and health) and air pollution (e.g., upgrading ventilation systems in schools or other public facilities).

More work is needed (both to analyze potentially available data or to gather relevant data) to better understand efforts made toward improving the outcomes achieved for other health risks, such as mental health, but also more detail on staying safe and healthy in extreme heat—both for the population as a whole, and for specifically vulnerable groups such as children and outdoor workers.

State agencies are working toward this sector's goals by:

- Implementing systems which alert community members and health practitioners about heat waves
- Providing shade in the form of planting, structures, swimming areas, etc.
- Coordinating across agencies for consistent power systems (e.g., electric HVAC, heat pumps)
- Providing grants to support outdoor recreation and fitness, with focus on support for priority populations
- Establishing guidelines for safety during extreme heat events
- Conducting air quality assessments
- Training first responders
- Assisting municipalities with disaster planning

These represent the strategies which informed the indicators and priority metrics below.

Table 5. Health Metrics Currently Being Tracked (ᶜ) and Prioritized for Development (*)

GOAL	INDICATORS	METRIC
People are safe and healthy during and following coastal and inland flooding and windstorm events and related power interruptions.	**Flood & Storm Event Morbidity:** Fewer emergency department visits during flooding, storms, and related power outages.	Number of morbidity incidences (injuries, diseases) attributable to a specific flood and storm event (normalized to the number of events/year and population)*

GOAL	INDICATORS	METRIC
People are safe and healthy during extreme heat events.	**Access To Cool Spaces:** Increased and sustained access to public and/or private cool spaces	Dollar amount for projects that focus on reducing negative extreme heat health outcomes*
		Number and percentage of relevant projects requiring MEPA review that implement best practices for climate resilience solutions for heat*
		Percent of population with public outdoor recreation opportunities for cooling within half mile of home [c]
		Number of shade structures (including tree plantings) implemented in areas scoring high in the DCR's Shade Suitability Assessment (e.g. in EJ communities, in areas with low existing canopy cover)*
		Percentage of MA residents who report having a cool space they are comfortable using (public or private) during the day and during the night*
	Classroom Heat Safety: Increase in the number of schools (K-12), colleges and university that are designed and equipped to provide safe temperatures for students and teachers	Percentage of public K-12 schools with low-emission cooling systems (including back-up power, passive functionality etc.)*
	Heat Morbidity: Fewer cases of illness linked to extreme heat events	Number of emergency department visits and hospitalizations attributable to extreme heat (normalized to the number of events/year and population)*
	Public Heat Awareness: Increased awareness of heat events and education to caregivers (e.g. parents and guardians, camp counselors, coaches, teachers) about signs and treatment of heat-related illness.	Number of state employees and local health officials who complete climate and health trainings from DPH [c]
	Worker Heat Safety: Decrease in the incidence of job-related illness and injuries during extreme heat events.	Number of worker injuries and illnesses occurring during extreme heat events (normalized to the number of events/year and population)*
People are safe from and healthy during climate-driven air quality events, like wildfire smoke, allergens, and general pollution that is made worse by climate change (for example, faster ozone formation with warmer temperatures and less frequent flushing of particulate matter with changing precipitation patterns).	**Air Quality Maintenance:** Decreased exposure to poor air quality (made worse by climate change)	Amount of state funding toward improving school ventilation and air quality [c]

Infrastructure

There are many types of critical infrastructure in the state—for energy production, storage and transmission, for water and wastewater, for transportation by car and rail, for communication, for port operations, and housing. Some of these the state has direct control over in terms of planning, designing, maintaining and upgrading, while for others (for example, communication), private entities are in charge of many of these tasks, even though there is regulatory oversight from both federal and state government. Damage to transportation infrastructure, increased strain on energy systems, and impacts on water infrastructure are among the most urgent concerns related to climate change.

The metrics developed for the state concern both the status of the infrastructure—in particular how much of it is built to withstand current and future climate risks—and whether money is being invested in upgrading existing infrastructure to meet future climate challenges. Several metrics measure how much funding is put toward increasing infrastructure system resilience, while other metrics examine outcomes, such as how often or how long state residents experience disruption in service. Some metrics point in particular to critical facilities—such as hospitals, police or fire stations—and what efforts are going into making them safer from climate risks. There are also some metrics that point to the degree to which ongoing adaptation efforts that make use of, or include, nature to shore up the safety of different types of infrastructure.

Finally, climate-safe, affordable housing is of critical importance in Massachusetts. As the state addresses its housing crisis, it is crucial to get a sense of how safe and affordable the existing housing stock is, how existing homes are being upgraded to better withstand climate extremes, and whether people are (re)locating to areas with elevated climate risk. With the available data, it is possible to get a first sense of climate resilience investments in state-aided housing.

State agencies are working toward this sector's goals by:

- Evaluating flood risk and generating recommendations for climate-safe development
- Providing grants to alleviate risks associated with storms, flooding, erosion, and sea level rise
- Allocating funding for building/renovating affordable housing
- Requiring housing projects to assess climate risks with the Climate Resilience Design Standards Tool
- Evaluating relocation strategies/conducting buyout studies
- Considering flood risks in coastal road and bridge projects
- More "Complete Streets" supporting all travel modes

- High-quality GIS resources/mapping for effective planning
- Updated standards, codes, etc., for safety and resilience
- Conducting vulnerability assessments and prioritizations
- Offering advice on electrification and grid modernization
- Developing a State Energy Security Plan with associated metrics
- Funding for infrastructure projects that account for future climate change

These represent the strategies which informed the indicators and priority metrics below.

Table 6. Infrastructure Metrics Currently Being Tracked (c) and Prioritized for Development (*)

GOAL	INDICATORS	METRIC
People have access to housing that is safe from flooding and other climate hazards and is affordable, even as demand for safe housing increases and resilience projects make some areas more desirable.	**Climate-Safe Housing:** Reduced damage from flooding and other climate-driven extreme events to private and public housing (incl. more building permits in climate-safe locations and buildings designed/built to state-set resilience standards)	Percentage of state-aided housing developments, identified as highly vulnerable to multiple climate hazards, that have received climate resilience funding [c]
	Decarbonized Housing: More housing is retrofitted or built to maintain safe conditions with minimized energy use.	Number of residential heat pump installations (annual and cumulative) [c] , +
		Number of residential heat pump installations (annual and cumulative) [c] , +
Communities are prepared to support new residents relocating to areas with fewer climate risks or driven from their homes by climate disasters, and both existing and new residents feel supported.	**Climate Migration Planning:** Increased comprehensive planning for potential population fluctuations driven by climate change (inmigration and outmigration)	Percentage of local hazard mitigation plans, comprehensive plans, and/or climate action plans that consider the potential for population changes driven by climate change (in/outmigration)*
Dams and culverts can manage the increasing pressures from a changing climate.	**Resilient Dams & Culverts:** Increased capacity for dams and culverts	Dollar amount awarded/budgeted for dam maintenance, repair, or removal that support climate resilience [c]
Ports experience minimal infrastructure damage and minimal closures due to sea level rise, coastal erosion, and storm surge, as well as high wind events from tropical and extra-tropical storms.	**Climate-Safe Port Infrastructure Investment:** Increasing funding for port-related infrastructure projects that account for future climate change	Amount of state funding for resilience improvements for port operators, port business suppliers, and other port-related businesses*
Public transit and rail networks face minimal disruptions from sea- level rise driven flooding and inland flooding, storms and other extreme climate events.	**Transit & Rail Reliability:** Reduced frequency and duration of weather-related outage events for public transit and railroad networks due to climate-safe design standards, operational practices and siting decisions	Number of hours of weather-related transit service disruption (average per event and cumulatively per year)*
		Amount of capital funds for MBTA projects with resilience benefits [c]
		Percentage of public transit and rail organizations (Regional Transit Authorities, Amtrak etc.) that have

GOAL	INDICATORS	METRIC
		completed systemwide resilience assessments and plans*
Reliable and affordable electricity access, and minimal repair costs to the Commonwealth, related to damages caused by extreme events that directly affect the transmission and distribution system and demand surges during high temperatures.	**Reliable Electricity:** Reduced frequency and duration of weather-related electricity outage events due to climate-safe design standards, operational practices and siting decisions	Average annual weather-related electricity outages, measured with the System Average Interruption Duration Index (SAIDI)*
Roads and bridges remain accessible and safe for travel despite potential damage from extreme precipitation, flooding, windstorms and temperature increases, with minimal government spending on reactive repairs.	**Climate-Safe Road Infrastructure Investment:** Increasing funding for transportation-related infrastructure projects that account for future climate change	Amount of state funding for climate-resilient road infrastructure*
	Road Safety And Reliability: Minimal disruption to transportation routes (roads), bridges, and supporting infrastructure from climate-driven extreme events	Number of stream crossings built to resilient standards based on the State Hydraulic Model.*
Water and wastewater treatment infrastructure are resilient to flood damage and drinking water supply sources remain affordable and protected from bacteria (surface water), saltwater intrusion (groundwater), and drought (both).	**Climate-Safe Water Infrastructure Investment:** Increasing funding for water treatment-related infrastructure projects that account for future climate change	Amount of state funding for making drinking and waste water treatment infrastructure climate-resilient [c]
	Reliable Water Treatment: Fewer treatment plants are located in high-risk areas, and/or protected against climate-driven extremes	Percentage of new and existing water and wastewater treatment plants that consider projected flooding, heat, wildfire, and wind risks throughout the project's lifespan.*
% of local hazard mitigation plans, comprehensive plans, and/or climate action plans that consider the potential for population changes driven by climate change (in/outmigration)	**Nature-Based Solutions:** Increasing proportion of development and resilience solutions include nature-based solutions	Amount of state funding for projects that include implementing nature-based solutions (NbS) for resilience*
		Number of nature-based solutions (NbS) projects implemented through MA grant programs*
Critical facilities such as hospitals, fire and police stations, resilience hubs, and shelters, are protected from flooding and other climate hazards, are accessible, and remain functional during extreme events.	**Reliable Critical Facilities And Services:** Decreased damage to critical infrastructure from extreme events due to climate-safe design standards, operational practices and siting decisions, and decreased related service interruptions	Percentage of new and existing critical infrastructure facilities that consider projected flooding, heat, wildfire, drought, and wind risks throughout the project's lifespan.*
		Percentage of new and existing critical facilities with backup electricity supplies.*

+ Metric is part of both ResilientMass Metrics and Massachusetts Clean Energy and Climate Metrics

Natural Environment

Massachusetts has a rich natural environment. The 2022 Massachusetts Climate Change Assessment identified several priority climate impacts on the natural environment sector. Among the most urgent are freshwater ecosystem degradation, marine ecosystem degradation, and coastal wetland degradation. Freshwater ecosystem degradation is expected to occur due to warming waters, drought, and increased runoff. These can lead to changes in water quality, habitat loss, and shifts in species composition. Marine ecosystem degradation is primarily driven by ocean warming, particularly in the Gulf of Maine, and by ocean acidification. These changes can affect marine biodiversity, alter food webs, and impact commercially important fish species. Coastal wetland degradation is also projected to result from sea level rise and storm surge. These threaten habitats such as wetlands and dunes, which are vital for numerous bird and fish species and serve as important natural defenses against coastal flooding. In general, the metrics developed through ResilientMass Metrics are focused on urban, coastal and marine, freshwater, and forest habitats. For each of these different types of habitats, the set of metrics were developed in a comparable way, looking at the amount and the quality of these habitats, the ability of these ecosystems to provide certain benefits to society, and for everyone to have equal access to them.

Based on the immediately available data, it is possible to get a first sense of the extent of coastal and freshwater habitats that are protected or restored, and any efforts underway to protect them against too many nutrients entering them. Similarly, it is possible to assess the amount of tree cover, an important defense against extreme heat, especially in urban areas, and how much of the state is paved—a condition that prevents water from sinking into the ground, leading to flooding urban areas, as well as run off and potential pollution of drinking water sources or natural ecosystems.

State agencies are working toward this sector's goals by:

- Funding land acquisition for public open space
- Tree planting and greening projects
- Increasing transit access to outdoor recreation sites
- Developing models and maps that provide biodiversity and hydraulic information
- Managing invasive species
- Funding projects (e.g., dam removal, cranberry bog restoration, wetland restoration, stream continuity, habitat connectivity, forestry research)
- Supporting and improving regulations

These represent the strategies which informed the indicators and priority metrics below.

Table 7. Natural Environment Metrics Currently Being Tracked ([c]) and Prioritized for Development (*)

GOAL	INDICATORS	METRIC
Everyone has safe and easy access to public green space, tree cover, aquatic recreational areas, and natural open space.	**Urban Green Space:** Increase in urban green space and tree cover	Percent tree canopy cover within developed areas [c]
Forests and other native inland ecosystems, including urban green spaces, are resilient and maintain biodiversity and biomass despite increasing pests, storms, and wildfires.	**Forest And Other Inland Habitat Management And Restoration For Resilience:** Restored habitats, improvements to surrounding conditions, and adaptive management such that habitats are more resilient to climate change stressors	Number of acres of land acquired by Tribal Nations using state funding and/or returned to Tribal Nations from state ownership, for purposes of land management using traditional methods [c]
	Forest Habitat Quality: Maintained or improved forest and urban forest habitat quality including through (but not limited to) reforestation, species management etc.	Number of total acres (and acres increase/year) of connected forested areas (per UMass Amherst Critical Linkages Conservation Assessment and Prioritization System or BioMap)*
Freshwater ecosystems are resilient to rising temperatures and changing precipitation patterns.	**Freshwater Ecosystem Services:** Maintained or improved provision of ecosystem services (e.g., biodiversity and carbon storage)	Progress toward state biodiversity goals for freshwater species (Phase, state of completion)*
	Freshwater Habitat Management And Restoration For Resilience: Restored habitats, improvements to surrounding conditions, and adaptive management such that the habitats are more resilient to climate change stressors	Percentage change in impervious cover and acres of reduction [c]
		Percentage of freshwater wetlands, streams, other freshwater habitats protected or restored added/year*
Marine and coastal ecosystems, including beaches, dunes, and coastal wetlands, are resilient to sea level rise and the effects of increased temperatures, precipitation, and storms.	**Coastal And Marine Habitat Availability:** Maintained and increased area of healthy coastal habitats (e.g., salt marsh, beaches, dunes, swamps)	Number of acres of coastal habitat and resources protected and restored (acres or percentage protected and increased/year) [c]
	Coastal And Marine Habitat Management And Restoration For Resilience: Restored habitats, improvements to surrounding conditions, and adaptive management such that habitats are more resilient to climate change stressors	Number of combined sewer overflow events in inland and coastal areas (normalized by precipitation events)*
		Number of acres of land acquired and/or protected for salt marsh migration with state funding*

3. Next Steps

As part of the ResilientMass program, the ResilientMass Metrics (RMM) will continue to evolve and be refined over time, in the same way the Massachusetts Climate Change Assessment and ResilientMass Plan are updated every 5 years. The ResilientMass Action Team (RMAT), co-chaired by EEA and MEMA, will be the coordination point for ongoing metric tracking, new metric development, and refinement of the Metrics framework. This work will occur under the authority and direction of the EEA Secretary and the MA Climate Chief. RMAT Climate Change Coordinators (CCCs) and state agency staff will be responsible for working with the RMAT co-chairs to track and report metrics, develop, add new or delete metrics, and apply the metrics to improve their adaptation work. Those serving as RMAT CCCs come from each secretariat and the majority of state agencies for maximum state representation.

Non-state partners such as municipalities, Tribal Nations and Tribally (Native) serving organizations, non-governmental and community-based organizations, private industry and others also have a role to play working with the Commonwealth to advance shared goals and track and report data such as through joint research projects, reporting data through participating in state grant programs, initiating actions that align with the ResilientMass Metrics goals, communicating adaptation progress to Massachusetts' residents, or developing partnerships to track state data.

Ongoing metric tracking and reporting via the ResilientMass Metrics Dashboard and MA Climate Report Card

As an immediate next step, EEA will develop a publicly accessible online dashboard to report on developed Metrics on the ResilientMass website. Some of the Metrics were also included in the 2024 MA Climate Report Card, and will continue to be reported there annually.

The RMAT, MA Climate Chief, EEA Secretary, other state staff, and non-state partners will also be engaged in potentially developing or tracking the Metrics for Further Consideration over time. This may include, but is not limited to, working to fill gaps in data, developing partnerships to gather non-governmental data or develop methods to collect qualitative data in new ways, or using the metrics framework as a way to drive conversations and set collaborative resilience agendas with non-state partners.

Periodic review of the ResilientMass Metrics framework and metrics development, refinement, and use processes

To ensure the metrics meet the needs of users, they will be evaluated every 5 years in alignment with updates to the ResilientMass Plan, and more frequently to review the metrics to identify needs for refinement or to improve their use.

New metrics, principally those in the metrics prioritized for development category, are expected to be added as it becomes possible to measure them. Additionally, the way metrics are measured may change. For example, if a metric speaks to work that three agencies contribute to but only two agencies currently have data, the metric currently being tracked may only report on those two agencies. In the future, when the third agency begins tracking data the metric will include data from all three agencies and this revision should be included as a footnote to the metric wording so that users of the data understand and appropriately interpret the change.

Appendix A: Review of Resilience Metrics Precedents

ResilientMass Metrics – Review of Resilience Metrics Precedents

Appendix B: Stakeholder Engagement Summary

ResilientMass Metrics – Stakeholder Engagement Memo

Appendix C: Metric Prioritization Criteria and Process

ResilientMass Metrics - Metric Prioritization Criteria and Process

Appendix D: Why Metrics are Important for Resilience Planning

Across the United States, there is a growing recognition of the importance of standardized, comprehensive climate resilience metrics in coordinating adaptation efforts across different levels of government and sectors of society.

At the federal level, in 2024, the White House Council on Environmental Quality spearheaded efforts to develop a set of climate resilience indicators and metrics that could be used across all federal agencies.

State-level initiatives are also making significant strides in developing robust resilience metrics frameworks. For example, California's Integrated Climate Adaptation and Resiliency Program (ICARP) and New York's Climate Smart Communities Program are developing their own sets of resilience indicators (example frameworks such as these were analyzed in the early stages of developing the ResilientMass Metrics).

These initiatives—via the process of developing a shared vision, goals and corresponding metrics—allow those engaged in building resilience to continue to create and refine their shared language and understanding, and align their thinking. Ultimately, this makes climate adaptation more effective. Key reasons for developing and tracking metrics include the following:[3]

1. Deliberate planning and decision making

In the complex landscape of climate resilience planning, metrics serve as essential guideposts for careful, coordinated planning and informed decision-making. They provide a quantitative foundation that enables policymakers and planners to set clear goals and ensure both internal and external consistency in their strategies.

Setting clear goals is the first crucial step in effective climate resilience planning, which is why this effort began with building a compelling vision of a resilient Massachusetts. Metrics play a vital role by providing a specific, measurable way to track progress toward goals or quantified targets. In this way, metrics provide a clear direction for all stakeholders involved in the planning and implementation processes.

2. Justification and expansion of funding for adaptation and resilience action

In an era of competing priorities and limited budgets, climate resilience metrics help in justifying and prioritizing investments in adaptation and resilience measures. Data collected during and after implementing a project can demonstrate that the money spent was worthwhile. This, in turn, can support funding for replicating successful interventions. However, climate resilience planning also requires trying novel strategies, which often need funding before they can begin. In this way, ex-ante justification of adaptation expenditures (supporting securing funds for projects or programs before they are conducted) stands as a critical challenge that metrics can help address.

Metrics play a pivotal role in this justification process by providing both (1) quantifiable evidence of the potential benefits, based on existing, associated metrics and (2) clear, measurable indicators of what

3 www.resiliencemetrics.org

success will look like, based on new or updated metrics.

Moreover, metrics can be used to articulate specific objectives and criteria against which the success of an adaptation project can be evaluated. This approach transforms abstract concepts of resilience into concrete, achievable goals. For example, instead of aiming to "improve heat resilience," metrics allow planners to set specific goals such as "decrease the number of worker injuries and illnesses occurring during extreme heat events." By framing adaptation goals in more precise terms, metrics provide a clear benchmark for assessing the benefits that will be generated. Simultaneously, by demonstrating the positive outcomes of adaptation measures, metrics can shift the perception of these expenditures from mere costs to strategic investments in communities and their long-term prosperity.

3. Communications and public engagement

The threat of climate change can feel overwhelmingly large, unwieldy, and complex. Metrics, particularly those co-created with a range of stakeholders (from policymakers to utility companies and small business owners to community-based organizations) highlight positive actions and illustrate outcomes with accessible data. Climate resilience metrics help link scientific understanding with public understanding and motivation to act. Metrics communicate hope for the future, via accessible, actionable steps (e.g., decreasing the number of emergency department visits during heat waves) rather than focusing on the threat alone (e.g., increasing intensity and frequency of heat waves). They can also build buy-in and a shared understanding of how best to address climate challenges together. Collaborative processes lead to better, more comprehensive outcomes. In this case, metrics that are meaningful to multiple parties help orient actors to a shared vision of success: the goals they work towards.

Measuring and quantifying information helps make comparisons and understand complex issues.

4. Accountability and good governance

Climate resilience metrics are instrumental in fostering accountability and promoting good governance in adaptation efforts. By establishing clear, measurable targets and regularly reporting on progress toward meeting them, they demonstrate transparency and commitment to climate resilience goals. Different types of metrics demonstrate the different ways governments and organizations can make progress. For instance, metrics can track the number of green infrastructure projects implemented, but also how much funding was allocated to the different projects, which communities benefited from the investment (e.g., environmental justice or priority populations), and their effectiveness in reducing urban flooding. This level of detail allows for a more accurate assessment of adaptation progress and effectiveness and helps identify areas for improvement.

5. Support for learning and adaptive management

Climate change adaptation, as an unprecedented challenge, requires learning, flexibility, responsiveness, and iteration. Climate resilience metrics support this kind of approach by providing a feedback loop that informs ongoing strategy adjustments. Monitoring metrics provides objective data for ongoing learning and evaluation. This enables adaptive management, where strategies can be adjusted at regular intervals (e.g., every five years) based on measured outcomes, and in response to the changing context.

In light of the many uncertainties and complexities involved in climate change and in adaptation, not all adaptive interventions may be successful. Society must learn how to live with a rapidly changing climate that is full of surprises. Tracking adaptation efforts closely, and reflecting on what worked and didn't work, allows for deliberate learning and thus more rapid adjustment of adaptation approaches over time.

While a metrics framework should be stable enough to allow measuring progress over time (i.e., tracking similar adaptation efforts in a given sector over time), it should also allow for the identification of emerging risks and trends, unexpected outcomes, and new vulnerabilities as they arise. For example, metrics related to community resilience, such as access to climate information, can highlight areas where capacity-building efforts may be needed. By systematically collecting and analyzing data points in order to report an updated metric, organizations can continuously refine their understanding of complex systems and adjust their strategies accordingly.

As Massachusetts' understanding of its climate impacts and effective adaptation strategies evolves, so too can the metrics. Reviewing and sharing best practices ensures that resilience planning remains at the cutting edge of climate change science and adaptation practice.

Appendix E: List of all ResilientMass Metrics

ResilientMass Metrics – List of all ResilientMass Metrics


ResilientMass