



Heating Up

How Schools can Combat
Extreme Heat with Equitable
Access to State-of-the-Art
Air-Conditioning

November 4, 2022
4 - 5:15pm
Centerville Room

Today's speakers

Moderator:



Sara Ross



Panelists:



Stacey Chacker



Kim Cullinane



Adam Klein



Extreme weather is closing schools & impacting student mental health across the country.



The74

When Climate Change Forces Schools to Close: Fires, Storms and Heatwaves Have Already Kept 1 Million Students Out of Classrooms This Semester

EducationWeek

STUDENT WELL-BEING OPINION

Climate Change Is an Education Emergency

Extreme weather events and rising temperatures take a heavy toll on students

By Adam Brumer — September 28, 2021 5 min read

Massachusetts residents, particularly in cities, are vulnerable to extreme heat.

Massachusetts is among the top 10 fastest warming states in the country, based on annual average temperatures since 1970.

SUMMER HEAT IN

Boston

UP TO

15.0° HOTTER IN THE CITY THAN IN NEARBY RURAL AREAS

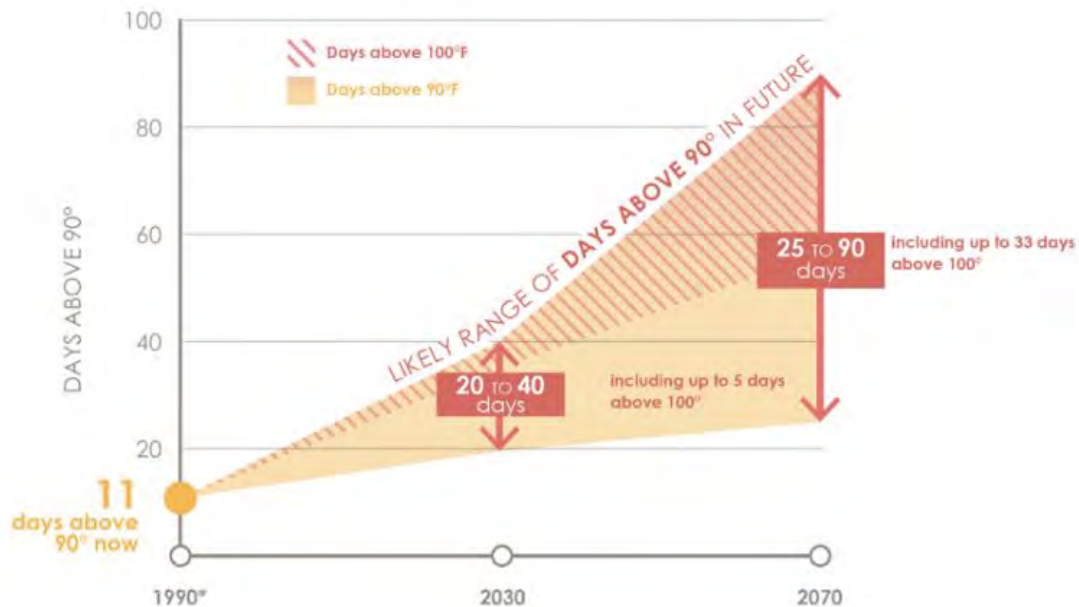
AVERAGE

1.3° CITY SUMMERS ARE HOTTER THAN IN RURAL AREAS

5 MORE DAYS ABOVE 90° F EACH YEAR, THAN RURAL AREAS



THE NUMBER OF VERY HOT DAYS WILL INCREASE



Data source: Rossi et al. 2015

* Baseline represents historical average from 1971-2000

Upper values from high emissions scenario. Lower values from low emissions scenario.

Our schools were not built for extreme heat.



Heatwaves: How Extreme Heat Impacts Students and Educators

Posted on June 29, 2022 at 4:09 pm. Written by [Sasha Shyduroff](#)



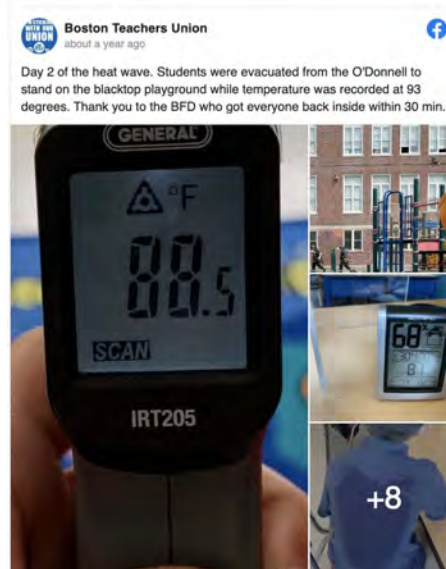
Opinion | No school should have to close because of extreme heat

By Joseph G. Allen

June 6, 2022 at 12:52 p.m. EDT



**The climate-driven cost to keep classrooms cool:
more than \$40 billion by 2025**



Boston Teachers Union
about a year ago

Day 2 of the heat wave. Students were evacuated from the O'Donnell to stand on the blacktop playground while temperature was recorded at 93 degrees. Thank you to the BFD who got everyone back inside within 30 min.

Adaptation to extreme heat takes multiple forms.

1. Cool Roofs

Chelsea Public Schools Install White Roofs To Reduce Heat

3. Public education



4. Action Planning

5. Air-conditioning

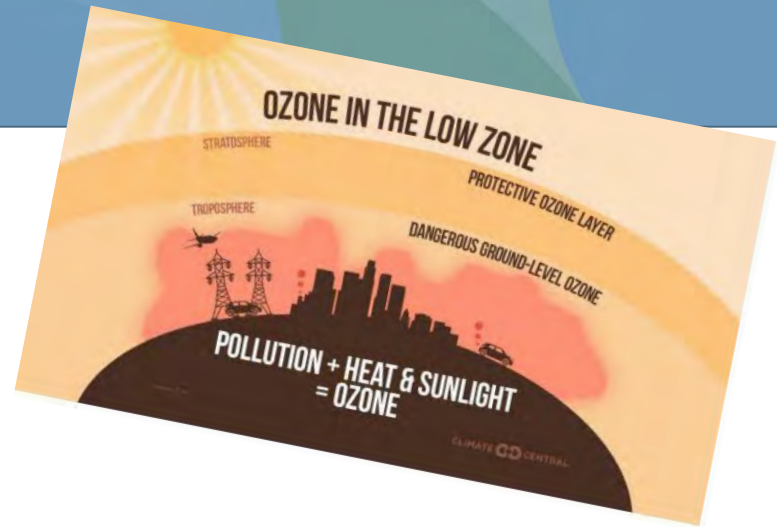
Questions for today

1. What do we know about the implications of extreme heat on student health and learning?
2. What new financial & technical supports are available for schools to implement cooling solutions in buildings?
3. What lessons can we learn from existing district experience?
4. How are equity, extreme heat, and air-conditioning connected?

Heat and Student Health



[Online Toolkit](#)



WEATHER

Heat Waves Affect Children More Severely

Children "are not little adults"—they have more trouble regulating temperature than adults do

skin redness

dilated pupils darkening in the eyes

dizziness

heat

nausea, vomiting

weakness drowsiness

headache

shaky gait

Rising temperatures leave Oregon schools grappling with excessive heat



By Elizabeth Miller (OPB)
Sept. 30, 2022 8:20 p.m.

“
In Massachusetts, 12.9% of children have asthma- among the highest rate in the country - and over a third (41%) of children with current asthma have missed school or daycare at least once a year because of their asthma.

America's Schools Are Overheating as Climate Change Cranks the Thermostat



Loss of Learning and Student Achievement



MAAP Spotlight

Massachusetts Coalition for Occupational Safety and Health (MassCOSH) & Teens Lead @ Work (TL@W)

This summer, MassCOSH's Teens Lead @ Work Program (TL@W) was featured in the National Council for Occupational Safety and Health (COSH) e-newsletter for organizing around the impacts of heat stress in schools. TL@W chose to tackle heat stress and climate change in Boston schools after fellow students developed rashes, headaches, and dehydration due to extreme heat in their classrooms.

*"On the hotter days it is extremely hard to focus, especially when your sweating at your desk."
- Boston Public School Student*

*"In the summer it is so awful, it's so humid and there are no ACs and barely any fans so everyone is sweating and sticking to the chairs and so uncomfortable and people have had heat strokes before and nothing has changed."
- Boston Public School Student*



HOLYOKE PUBLIC SCHOOLS
JUNTOS PODEMOS | TOGETHER WE CAN

3-Hour Early Release on Monday, June 7 Due to Heat

June 6, 2023 | [View on Instagram](#)



Schools see a third of pupils absent as children stay at home in potentially-record breaking heatwave

Heat Disproportionately Harms American Black and Hispanic Students

“

...Some students do not come to class at all once it starts getting unbearable in the school building. Attendance drops dramatically once our building gets hot...

“

...The odds of a student failing a test on a day where temperatures are hotter than 90 degrees was 12% higher than if the test was taken on a 72-degree day.

“

Across 58 countries... standardized test scores fell for every additional day over 80° F ... **In the United States, however, that detrimental impact only affected Black and Hispanic students.**

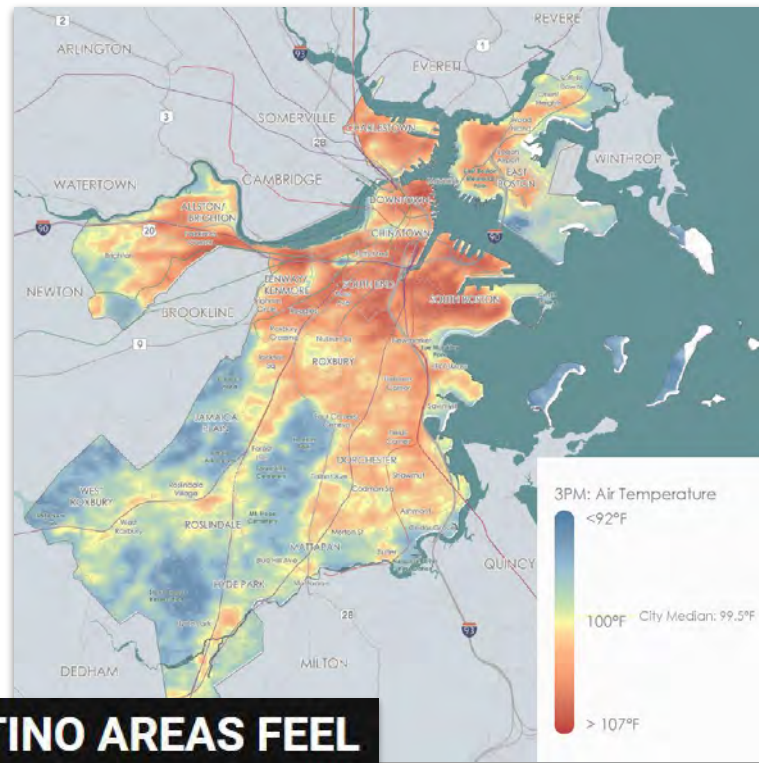
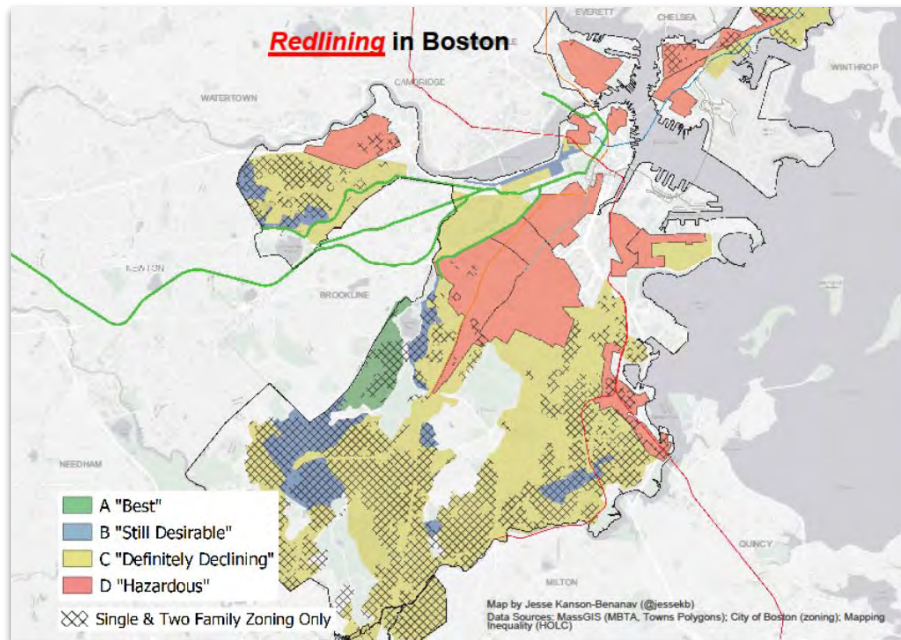
Learning is inhibited by heat exposure, both internationally and within the United States



Rethinking cities in the face of extreme heat



Redlining in Boston vs. Daytime air temperature maps in Boston at 3pm during a modeled heat wave

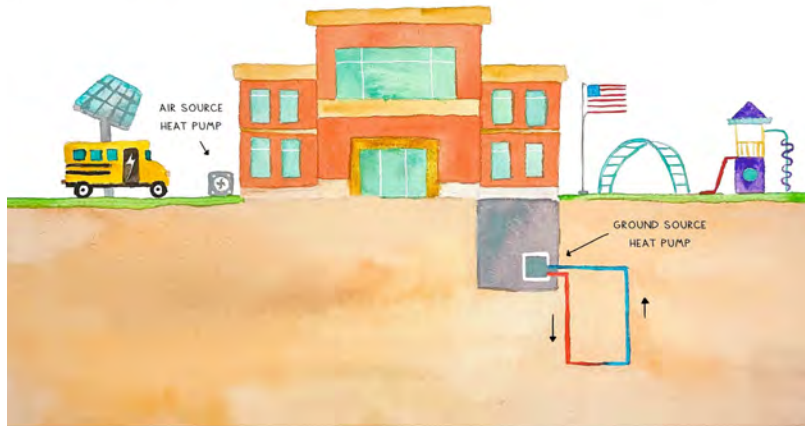


AS U.S. BAKES, MAPPING SHOWS BLACK, LATINO AREAS FEEL MORE HEAT



What is a heat pump?

COOL SCHOOLS HAVE HEAT PUMPS



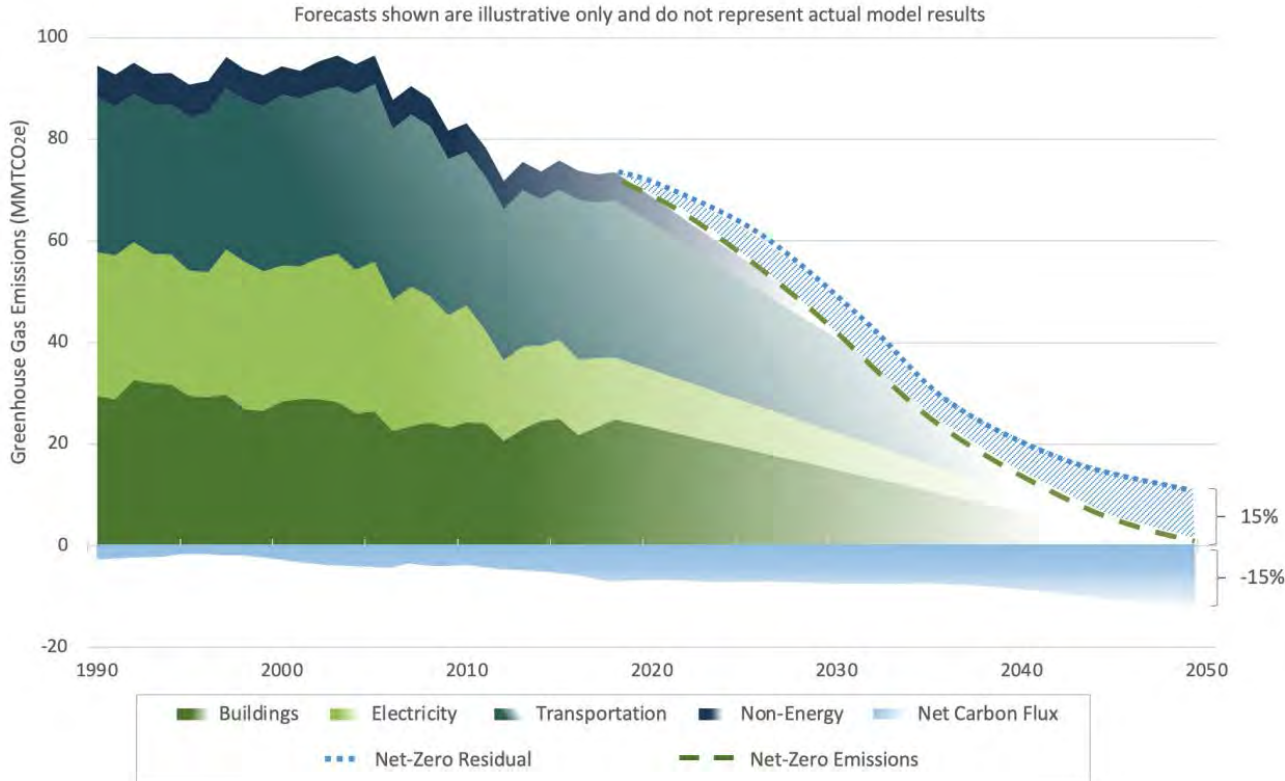
Heat pumps *move* heat rather than burning fossil fuels to *make* heat.

Eliminating on-site combustion improves indoor & outdoor air quality.

Heat pumps are highly efficient. A new gas boiler may be 98% efficient. A ground source heat pump can be 300-600% efficient.

Heat pumps offer clean heating & cooling. The same equipment provides both benefits to buildings.

How do heat pumps support climate, health, & jobs?



Annual impact of
“clean heat” by 2050

12,400

days of work absences
avoided.

**\$2.2
BILLION**

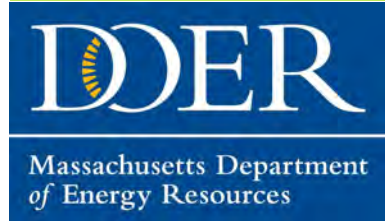
in total health benefits.

**OVER
5,400
JOBS**

by 2050 will be created to
support building electrification
and efficiency.

The policies that impact HVAC investments today

New building codes



Building performance standards

BERDO

*Building Emissions Reduction and
Disclosure Ordinance*

Governor Baker's 2021 Climate Act

AN ACT CREATING A NEXT-GENERATION ROADMAP FOR
MASSACHUSETTS CLIMATE POLICY.

New federal and utility incentives improve affordability of ground-source heat pumps



Inflation Reduction Act of 2022

Incentive based on cost - 30-50% off total cost of ground-source heat pump

- Available for 10 years
- Non-competitive, no application
- Tax credit paid as a cash payment to non-taxable entities
- No funding cap!

**Typical value to school project:
\$2 - \$6 million**



Incentive for ground source heat pumps based on size - \$4,500 per ton

- Available today
- Non-competitive
- Incentives paid by the Mass Save sponsors

**Typical value to school project:
\$500k - \$2 million**



Financial and Technical Support

WE ARE MASS SAVE:



EVERSOURCE



nationalgrid



Boardwalk Campus at Acton-Boxborough School District



Ground-source heat pumps in action



Comfortable, healthy indoor air



Thank you!

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Appendix

Schools buildings critical to meeting our goals

Figure 8. Percentage of Massachusetts built square footage by typology and vintage for commercial buildings. Note differing scale from Residential.



Asthma, EJ, and drop-out rates for the nine MA communities

Community	Asthma ER visits per 10,000	Pediatric Asthma Prevalence	% Census Block Groups with 1+ EJ criteria	High School Drop Out rates
<i>MA Statewide</i>	58.2 ³	12.1 ⁴	12.1% ⁵	1.8% ⁶
Brockton	114.5	15.1	96.8%	3.9%
Chelsea	103.5	10.5	100%	5.0%
Holyoke	220.1	19.9	72.8%	3.6%
Lawrence	126.2	16.6	100%	5.0%
Lowell	85.3	15.3	87.6%	3.7%
Lynn	80.9	12.3	80.7%	4.7%
New Bedford	109.4	18.2	69.6%	3.2%
Springfield	192.6	16.6	89.6%	4.4%
Worcester	94.5	14.8	70.7%	2.6%

¹ Massachusetts Department of Elementary and Secondary Education. School District Profiles. Retrieved from <https://profiles.doe.mass.edu/>. Accessed September 7, 2021.

² Massachusetts Department of Public Health, Bureau of Environmental Health. Environmental Public Health Tracking Community Profile. Accessed September 7, 2021.

³ Massachusetts Department of Public Health, Bureau of Environmental Health. Environmental Public Health Tracking Community Profile. Accessed September 7, 2021.

⁴ Ibid

⁵ Massachusetts Department of Public Health, Bureau of Environmental Health. Environmental Public Health Tracking Community Profile. Accessed September 7, 2021.

⁶ Massachusetts Department of Elementary and Secondary Education. Dropout Rates in Massachusetts Public Schools: 2018-19



C&I Retrofit Standard Offer

Program Overview

WE ARE MASS SAVE:



EVERSOURCE



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Common commercial EE systems & opportunities

- HVAC
 - Boilers, furnaces, water heaters
 - Heat pumps
 - Chillers & air conditioners
 - Controls & EMS installations
- Lighting systems & controls
- Variable frequency drives (VFD/VSD)
- Kitchen equipment
- Retro-commissioning



New Incentives/Offers for C&I Installations – Major HVAC Overhauls

Air Source Heat Pumps

Includes single- and multi-head split systems, as well as central and RTU systems

\$2,500/ton

Air Source Variable Refrigerant Flow (VRF)

Includes systems larger than 5.4 tons that meet AHRI Standard 1230

\$3,500/ton

Ground Source Heat Pumps

Includes both closed and open loop systems

\$4,500/ton

Incentives apply to projects 150 tons or less



C&I Deep Energy Retrofit Offering

Program Overview

WE ARE MASS SAVE:



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Defining Deep Energy Retrofit (DER)



Definition

- Reduce annual GHG (CO₂) emissions by **at least 40%** at an individual building
- Reduction is relative to existing conditions
- Renewables are not included



Project Requirements

- Required measures:
 - Partial or full **space heating electrification**
 - Weatherization and/or ventilation improvements
- Installations must:
 - Be completed within 3-year DER Term
 - Be verified according to DER Standards
- Energy Star Portfolio Manager



Building Eligibility

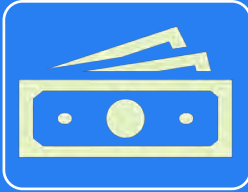
- Buildings must:
 - Have commercial meter(s)
 - Be occupied for at least 1-year prior to DER engagement
 - Have no plans to change space use
- Cannot be Income Eligible
- Cannot participate in Major Renovation Pathway

Participant Benefits



Drastic Decarbonization

- Significant reductions in site energy consumption
- Progress towards customer climate goals



Financial Benefits

- **Technical Assistance**
 - Free Site Assessment and Scoping study (~\$5,000 - \$10,000 value)
 - Detailed TA Study, minimum 50% co-pay (~\$15,000 - \$20,000 value)
- **DER Payment: \$1.00/ft²**
 - Milestone Payment: \$0.40/ft² upon 25% GHG emission reduction achievement
- **Commissioning Reimbursement** (up to a total of \$20,000)



Non-financial Benefits

- **DER Roadmap:** Path to DER achievement
- **Quality Assurance:** More rigorous verification/commissioning ensures savings realization
- **Guidance:** Regular (bi-annual) DER Check Points
- **Publicity:** Celebration of DER achievement

C&I New Construction Offering

Program Overview

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New Building/Major Renovation Participation Pathways



Path 1	Path 2	Path 3
Net Zero & Low EUI Buildings	Whole Building EUI Reduction	High Performance Buildings
		

Low EUI Pathways

WE ARE MASS SAVE:



Mass Save Commercial New Construction Incentives



Prime Focus on Building Electrification/Decarbonization (Heat pumps!)



Focus on Low Energy Use Intensity (EUI) and Net Zero – up to \$3.50/sf in incentives plus heat pump incentives →



Three paths to accommodate different project types and customer needs

Heat Pump Support Levels are Significant

Heat Pump Incentives for Commercial New Construction/Major Renovation Projects

Air source heat pumps:	\$800/ton
Variable refrigerant flow (VRF):	\$1,200/ton
Ground source heat pumps:	\$4,500/ton

Visit www.MassSave.com/cincmr to learn more

