MA Leading by Example Council Meeting

September 17, 2019

UMass Lowell

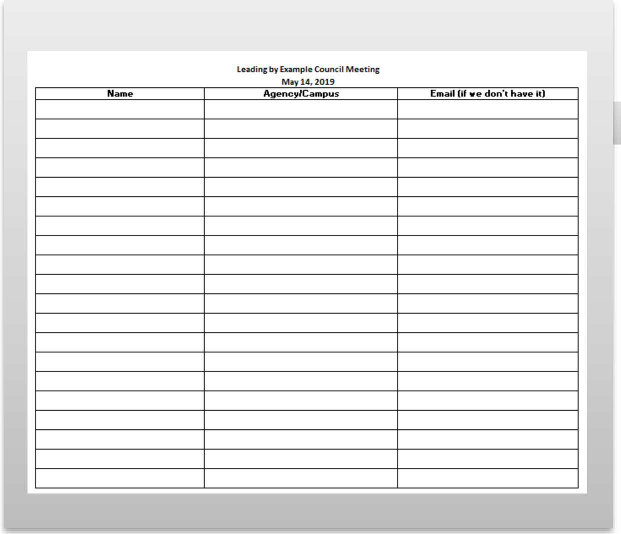
State Government Progress – as of September 2019

Greenhouse Gas (GHG) Emissions	Energy Use Intensity per Square Foot	Electricity via Renewable & Onsite Generation	Heating Oil Consumption at State Facilities
↓ 26%	↓ 13%	19%	↓ 84%
2004 -2018	2004-2018	In 2018	2006-2018

26.7 MW Installed Solar PV at State Sites	87 LEED Certified State Buildings	141 Electric Vehicle Charging Stations at State Sites	Leading by Example Grants Awarded
18.6 MW	50	78	$11.3 M
Since 2015	Since 2015	Since 2015	Since 2015

Welcome and Introductions

Share your name and organization


Leading by Example Council Meeting
May 14, 2019

Name	Agency/Campus	Email (if we don't have it)

Please make sure to add yourself to the sign-in sheet when it comes around

UMASS LOWELL SUSTAINABILITY INITIATIVES

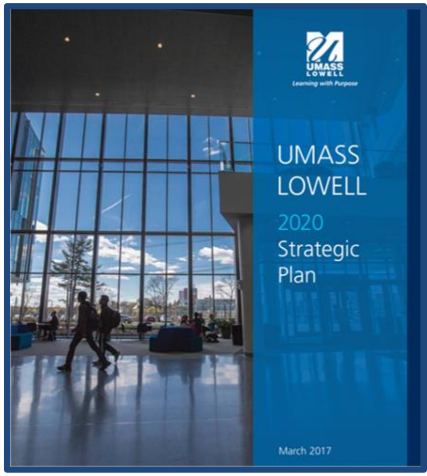
CAMPUS & COMMUNITY PARTNERSHIPS IN AN URBAN SETTING

LEADING BY EXAMPLE COUNCIL MEETING
09/17/19

UMASS LOWELL

BRIEF OVERVIEW

- 18,000 students and 2,000 employees
- 16 NCAA Division 1 Athletic Teams
- Over 40 buildings with 4.85 million square feet spread across 150 acres.
- UMass Lowell has undergone a significant transformation. FY2011 – FY2019:
  - 42% increase in gross building area
  - 23% increase in enrollment
  - 90% of freshmen living on campus
  - 50/50 split between commuters and residents
- Clear focus on sustainability in University Strategic Plan

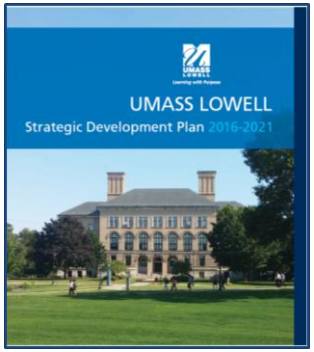


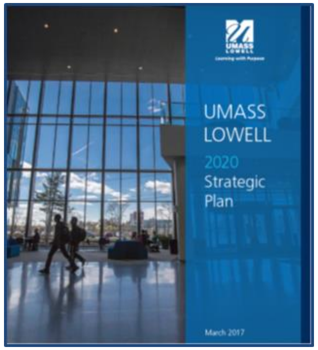
UMASS LOWELL

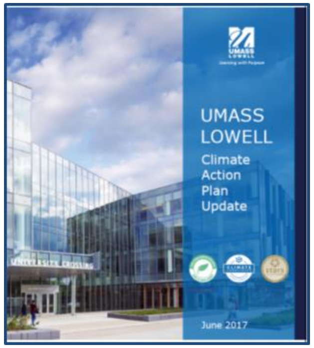
SUSTAINABILITY APPROACH

- Urban Campus – Focus on Urban Sustainability Issues.

- Continued support from our Chancellor and Executive Cabinet to prioritize sustainability in everything that we do.







- *"Establish UMass Lowell as an* ***urban-focused*** *center of excellence for sustainability and resiliency that merges expertise in academics, research and operations".*

SUSTAINABILITY AT UMASS LOWELL

HOW ARE WE DOING?

- A lot done, a lot more to do!
- Since the Climate Action Plan was adopted in 2012, emissions have fallen 28% per 1000 Square Foot and 19% per FTE despite a period of enormous growth.
- Collective focus on partnerships, both on campus and in the greater Lowell community.
- Merging operations with teaching and research to ensure our students get a holistic (and realistic) understanding of sustainability in real-world setting.

SUSTAINABILITY AT UMASS LOWELL

RECENT HIGHLIGHTS

- Largest Completed Accelerated Energy Program in State. $23.1m project implemented over 100 energy saving measures in 30 buildings across campus:

  - $1.2m in annual energy savings

  - 1.7m gallons of water saved annually

  - 9m lbs. of CO_2 avoided annually

  - $10m in deferred maintenance

SUSTAINABILITY AT UMASS LOWELL

RECENT HIGHLIGHTS

Transportation Enhancements
$13.7 million TIGER Grant
Close Relationship with City of Lowell
Free Regional Transit
Free Campus Transit
Bike Share (Freewheelers & Veoride)
EV Infrastructure build-out
Full Suite of TDM Options

SUSTAINABILITY AT UMASS LOWELL

ESSENTIAL SERVICES

Electronics Recycling	Centralized Shredding	Furniture Removal	I.T. Asset Recycling	Compost Enhancements
2016 - Cost for service 2019 Cost Neutral Receiving rebates/credits	Consolidated Services Centralized Billing Monthly Reports & Audit Trail	Partnership with Facilities O&S / Project Management	Joint Effort with I.T. & Procurement	Partnership with Dining / Facilities / Tsongas (Athletics)
Formal policies for all areas				

Grind2Energy installed in cleanup area with outdoor holding tank

SUSTAINABILITY AT UMASS LOWELL

SUSTAINABLE GROUNDS MANAGEMENT

SUSTAINABILITY AT UMASS LOWELL

URBAN AGRICULTURE PROGRAM

Sites Throughout Campus	Research Location	Farmshare Program
Urban Agriculture Farm Rooftop Gardens Community Gardens	Clean Energy Center Nutrition Department Center for Public Opinion	40 Participants 20 Week Program
Capital Funding supported over $400,000 in grant funds		
Partnership with local food access organization – Mill City Grows		

SUSTAINABILITY AT UMASS LOWELL

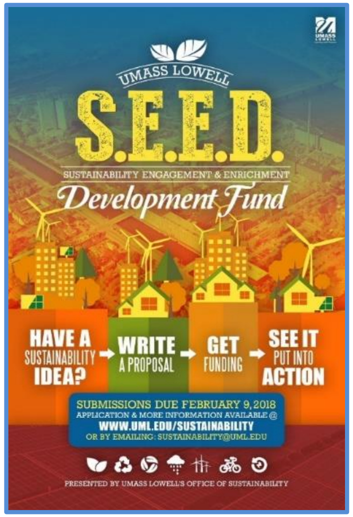
STUDENT ENGAGEMENT

- **Close relationship with SGA & environmental clubs on campus**

- **Student sustainability fee instituted in 2017**

- **$50K Annual S.E.E.D. Grant Program:**

- Bike Parking Upgrades
- Super Air Condensers in Org Chem Lab – eliminate 85,500 liters of water waste each year
- Lowell Energy Ambassadors



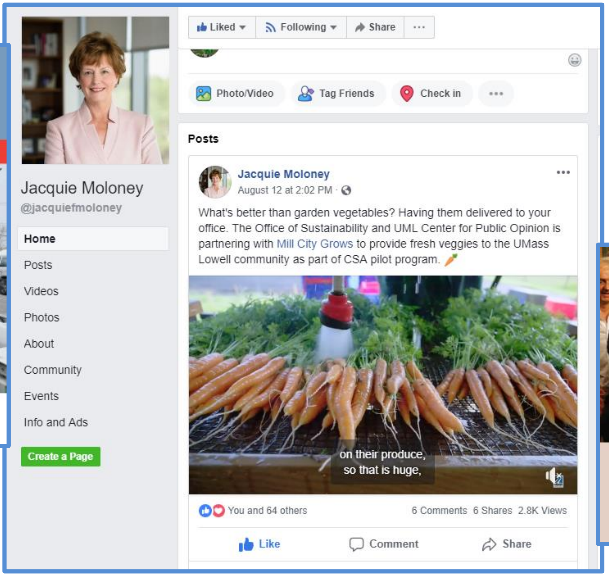
- ***Motion: "Support a change in the set-up of the existing Student Sustainability Fee from its current opt-out format to a mandatory annual fee with the caveat that student involvement in the administration of the fund is continued through initiatives such as the SEED Committee and Office of Sustainability engagement with student sustainability clubs and the Student Government Association".***

- **Outside of $50k S.E.E.D. Grant Program this funding also supports:**
  - LRTA, MVRTA, MBTA Program
  - Student Employees with Office of Sustainability
  - Support of continued academic programs e.g. Freshmen Seminar & CCI

SUSTAINABILITY AT UMASS LOWELL

CAMPUS / COMMUNITY ENGAGEMENT

- **Close working relationship with University Relations staff**
- **Critical to market the work that the university is doing around sustainability**
- **Dedicated writer from University Relations on all of our projects**



SUSTAINABILITY AT UMASS LOWELL

RANKINGS AND REPUTATION

- AASHE STARS Gold (highest ranked UMass Campus)

- 2019 AASHE Sustainable Campus Index – Top Performer

- Princeton Review Green Schools List (2016, 2017, 2018, 2019)

- Sierra Club Green Schools (137 place jump since first appearance in 2016)

- Important for perspective students and families

- Important for alumni engagement

SUSTAINABILITY AT UMASS LOWELL

NEXT STEPS

- Establish the RIST Institute for Sustainability and Energy
- UMass Lowell first college in North East to join Green Sports Alliance
- Continued GHG Reductions in all areas. Focus on increasing renewables.
- Enhanced Transportation & TDM Programs
- Ongoing Support of Teaching & Research Sustainability Efforts
- Continued pursuit of grant funding opportunities
- Partnerships & Consensus building are crucial to approach
  - Staff / Students / Community Partnerships

CONTACTS / QUESTIONS

UML.EDU/SUSTAINABILITY
@SUSTAINABLEUML

SUSTAINABILITY@UML.EDU

Test Your Knowledge!

PollEV.com/lbedoer647

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Image source

DOER
Massachusetts Department of Energy Resources

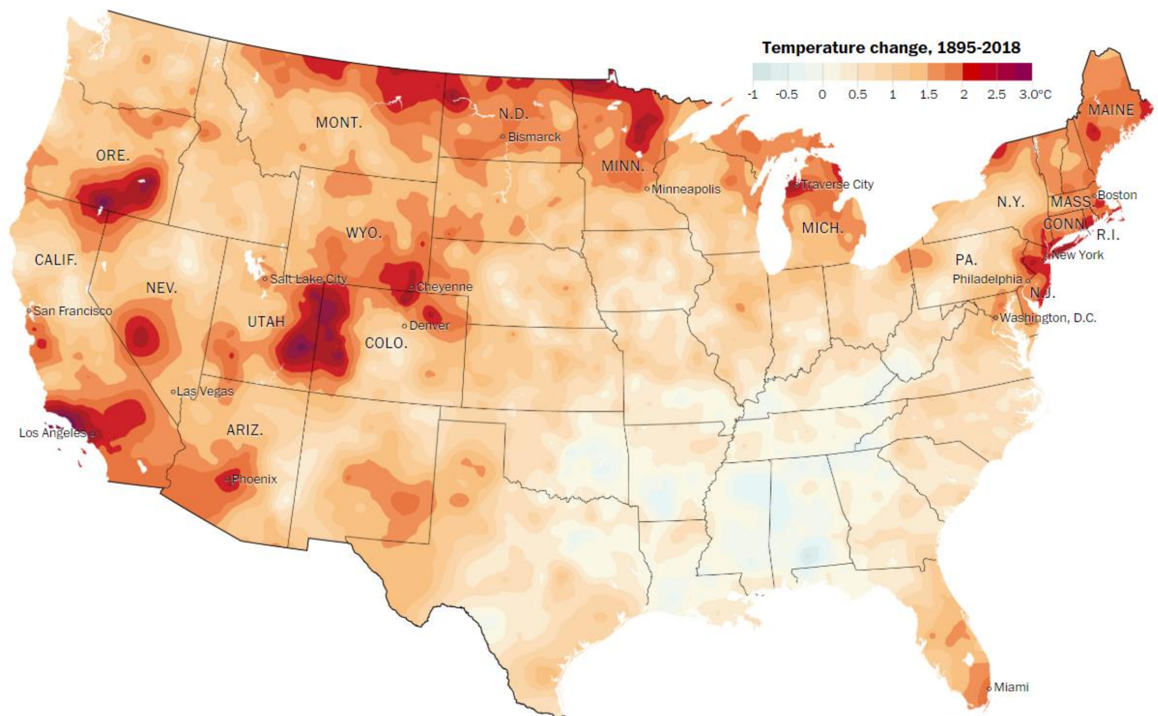
Agenda

- News From Around the World (I): Extreme Heat 2019
- Program Updates: SMART and CPS
- Climate and Energy Resilience
- LBE Updates
- News from Around the World (II)

News from Around the World (I): Extreme Heat 2019

2°C: Beyond The Limit

- July 2019 was the hottest month ever recorded on earth, 1.71°F higher than the 20th century global average of 56.7°F
- Winter temperatures across the northeast have risen by over 2°C since the late 19th century
  - ➢ Lake ice in New England breaks up 9 to 16 days earlier than in the 19th century



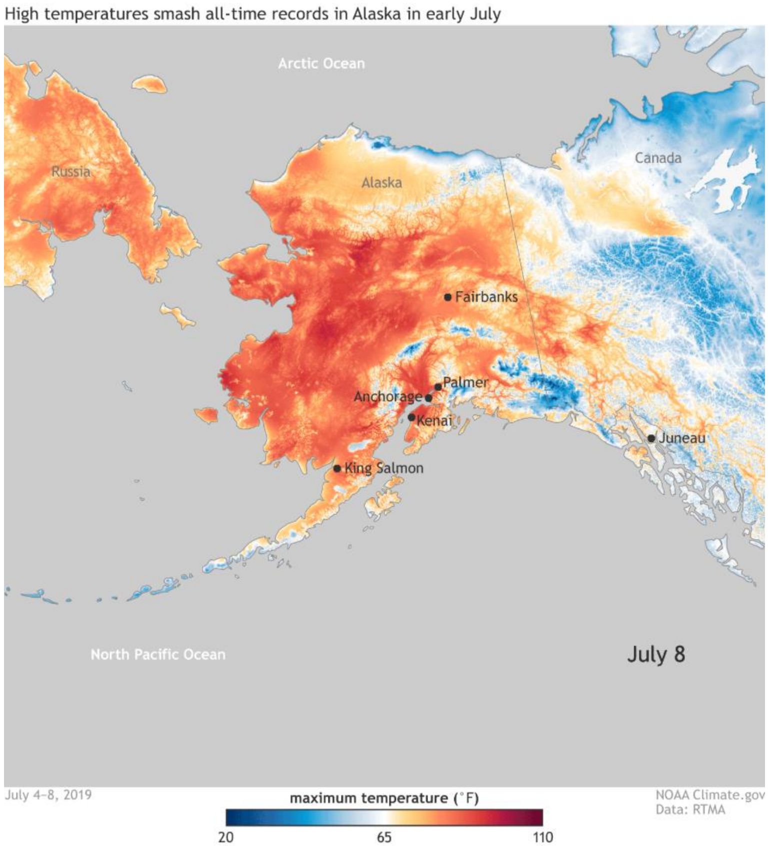
Source: [Washington Post](), [NBC News]()

Note: NOAA does not provide data for Alaska or Hawaii for this time period.

Massachusetts Department of Energy Resources

A Tropical Alaska

- Alaska averaged 58.1°F in July, 5.4 degrees above average
- Sea ice in southern Alaska melted earlier than any other year.
- By early August, over 2 million acres across the state



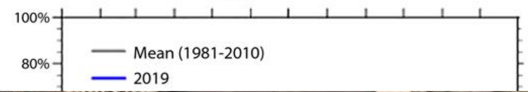
Anchorage reached 90°F for the first time EVER

The state had 30 days over 75°F, double its previous record

Source: Earth.com, KTVA

Heat Around the Arctic

- The current Greenland ice melt rate is equivalent to what models projected for 2070
- In Iceland, Okjökull was declared the first glacier lost due to climate change
  - ➢ Site was renamed to Ok after “Jökull,” Icelandic for “glacier,” was dropped

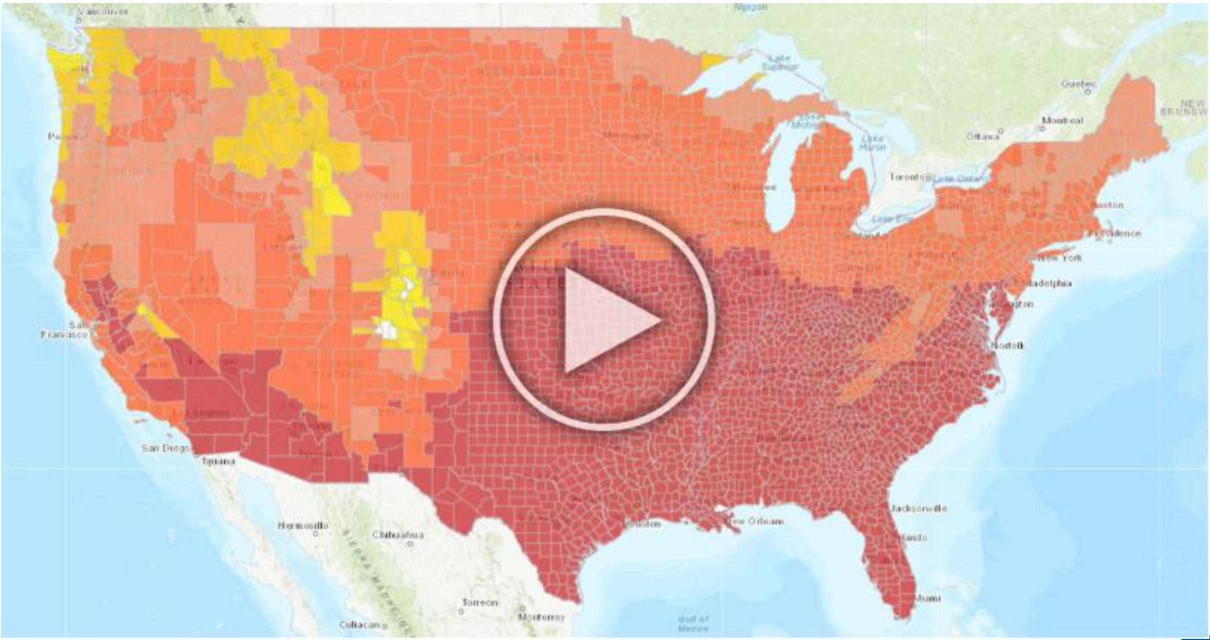


This combination of Sept. 14, 1986, left, and Aug. 1, 2019 photos provided by NASA shows the shrinking of the Okjokull glacier. NASA, via Associated Press

Source: Inside Climate News, EcoWatch, NY Times

The Future of Dangerously Hot Days

- UCS analyzed historic and projected data to track the increase in the number of extreme heat days across the US
- Created interactive map that enables viewers to see long-term heat impacts across the US of varying climate action scenarios



Source: [Union of Concerned Scientists]

DOER
Massachusetts Department of Energy Resources

DOER

Massachusetts Department of Energy Resources

Program Updates: SMART and CPS

SMART MASSACHUSETTS SOLAR PROGRAM Updates: 400 MW Review

- DOER has been conducting a review of the SMART program
  - Results and a straw proposal for program modifications were released this month
    - Since its launch in November 2018, SMART has received 11,300 applications for over 1,000 MW of capacity
    - SMART blocks for systems >25 kW are full or nearly full in most territories
- The straw proposal seeks to address program oversubscription, land use impacts, geographic and project type diversity, grid saturation, energy storage benefits, accessibility of low-income communities, and other administrative fixes

Source: SMART 400 MW Review Straw Proposal

Proposed Program Expansion

- **Expand capacity** by 800 MW, with future block values declining between 2% (BTM systems) and 4% (standalone)
- Require all solar generation units >500 kW be **paired with energy storage**
- Increase applicability and magnitude of **greenfield subtractor**
- Expand **alternative on-bill credit availability** and modify **value of energy for BTM** facilities to make more equitable with standalone systems
- Increase and support **low-income and community-shared** solar

Source: [SMART 400 MW Review Straw Proposal]()

Proposed Program Expansion

- Introduce a **pollinator adder** for projects awarded pollinator certification by UMass Amherst Clean Energy Extension
  - Both new and existing projects could apply for this adder
- Explore **locational benefits** by working with electric distribution companies to obtain data on where the grid could benefit from additional solar
  - A subtractor would apply for interconnected locations identified as too congested
- Exempt eligible storage systems from the 52-cycle requirement if they are participating in utility **demand response programs**

Source: SMART 400 MW Review Straw Proposal

Public Projects

The following changes would apply to public projects, which are defined as those sited on publicly owned or operated land with 100% of offtake to public entities:

- Increase public adder from $0.02/kWh → $0.04/kWh
- Enable applicants to earn a statement of qualification upon contract signing with an 18-month reservation period
- Qualify as Category 1 land use (exempt from greenfield subtractor)

Source: SMART 400 MW Review Straw Proposal

SMART MASSACHUSETTS SOLAR PROGRAM

Anticipated Next Steps

Proposed Block Expansion

Distribution Company	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8	Block 9	Block 10	Block 11	Block 12	Total
Unitil	3.947	3.947	3.947	3.947	3.947	3.947	N/A	N/A	N/A	N/A	N/A	N/A	**23.682**
National Grid (Massachusetts Electric)	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	90.022	**1,080.266**
National Grid (Nantucket Electric)	3.021	3.021	3.021	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**9.063**
Eversource (East)	91.514	91.514	91.514	91.514	91.514	91.514	91.514	91.514	107.249	107.249	107.249	107.249	**1,286.988**
Eversource (West)	15.735	15.735	15.735	15.735	15.735	15.735	15.735	15.735					
Total Capacity	204.239	204.239	204.239	201.218	201.218	201.218	197.271	197.271	197.271	197.271	197.271	197.271	**2,400.000**

- DOER collecting comments on the straw proposal through **September 27th**
- Review of draft regulation expected through mid-November 2019, with emergency regulations expected to be filed around late November
  - Most changes would go into effect upon regulation filing; tariff filings (e.g. AOBC for behind-the-meter) would need to go through DPU process first

Source: SMART 400 MW Review Straw Proposal

Quick Recap of Clean Peak Standard

- Part of 2018 Act to Advance Clean Energy
  - Without a policy to address peak periods, Massachusetts will remain dependent on gas and oil generation to meet our peak demand, resulting in high costs and emissions, despite our substantial investment in clean energy resources
- CPS is a market mechanism designed to **shift clean energy to peak and reduce demand at peak**, thereby decreasing emissions and costs
  - Any eligible resources that generate, dispatch or discharge energy during a seasonal peak period will generate Clean Peak Energy Certificates (CPECs)
  - CPECs can be sold to retail electricity suppliers, which are required to purchase a certain amount each year to meet the minimum standard obligation

Source: [DOER Clean Peak Energy Standard]()

Recent Clean Peak Standard Updates

- In August, DOER released draft CPS program details such as alternative compliance payment rates, annual obligation increases, eligibility criteria, and multiplier values
- Draft regulation is expected to be filed in Q4 2019

Eligibility

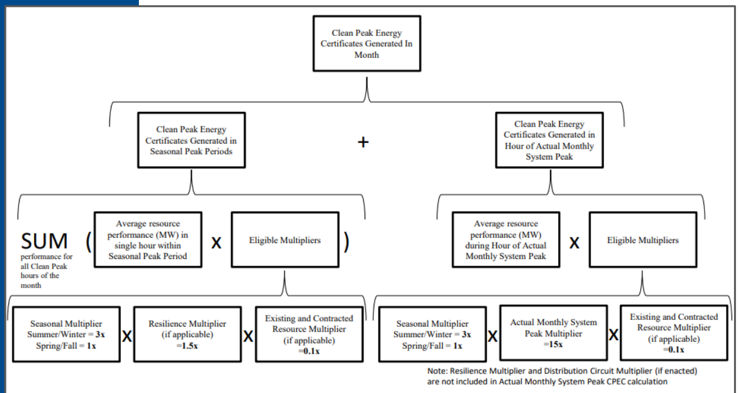
- New RPS Class 1 resources
- Existing RPS Class 1 or 2 resources paired with qualified energy storage systems
- Qualified energy storage systems
- Demand response resources

Multipliers

- Seasonal (higher for winter and summer vs. spring and fall)
- Actual monthly system peak
- Resource provides a resilience benefit by enabling provision of electric service to a load during external outage conditions
- Existing and contracted resources

Source: DOER Clean Peak Energy Standard

Clean Peak Energy Certificate Generation



- Clean Peak resource must provide hourly interval data for preceding month
- Reported data will go to NEPOOL GIS to mint CPECs

- Depending on configuration and performance, a new 1 MW storage project could theoretically generate tens of thousands of dollars annually

Actual CPECs generated in a month (and potential revenue) will depend on several variable factors

- Timing and frequency of energy generation/dispatch/discharge
- Monthly system peak
- Actual performance within seasonal peak periods
- Applicability of multipliers
- Time of year
- Etc.

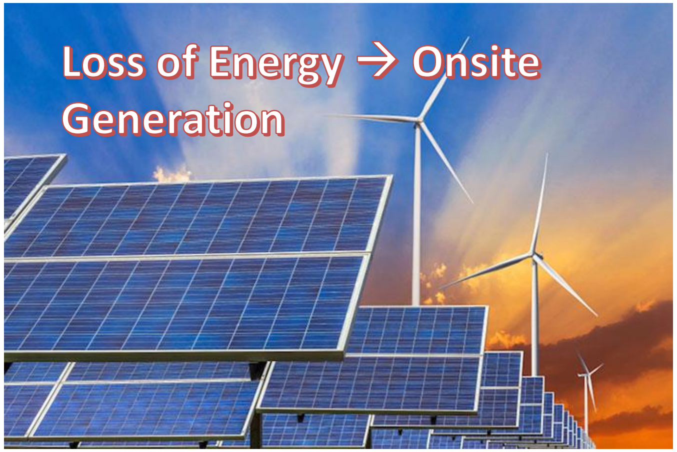
Preparing State Facilities for the Future: Climate and Energy Resilience

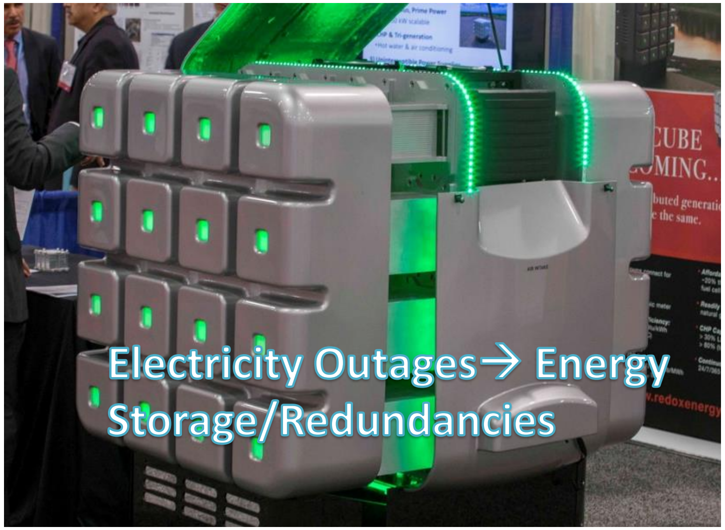
Resilience Comes in Many Forms

Resilience is: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner. (MA SHMCAP)

Energy Resilience

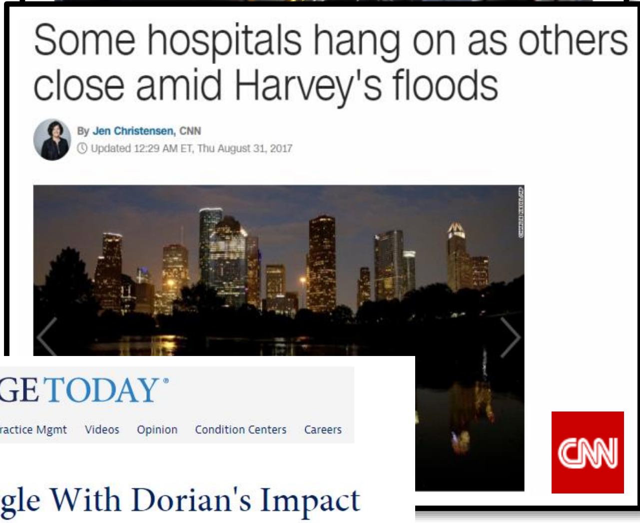
Energy Resilience is: The ability of an energy system to recover quickly from a shock or stress event and is a significant factor in a facility's ability to maintain critical operations during that time without disruption (Arup)





Why Do We Need to Be Resilient?

- Increases public and patient safety
- Avoids/delays evacuations
- Protects vulnerable populations
- Reduces burden on emergency management personnel
- Reduces costs associated with crisis management



State Government Programs Supporting Resilience Efforts

- Overall goal to make residents safer, keep vital services online, reduce long-term costs of climate-related risks, and protect the value of property

Examples of current resilience programs

Agency/Program	Goal
Executive Order 569	Establishes an Integrated Climate Change Strategy for the Commonwealth
Agricultural Climate Resiliency and Efficiency Grant Program (MDAR)	Improve resilience in agriculture by supporting practices that address potential impacts of climate on agriculture
Coastal Resiliency Grant Program (CZM)	Advance local efforts to address coastal flooding erosion and sea level rise
Statewide Resilience Master Plan (DCAMM)	Lays the groundwork to implement resilient building strategies for future projects at state facilities
Division of Ecological Restoration Priority Projects (DER)	Habitat restoration and culvert replacements to better prepare wetlands, rivers, and municipalities for climate impacts
Water Utility Resilience Program (DEP)	Supports local drinking water and wastewater utilities to build up resilience to severe weather events
Municipal Vulnerability Preparedness grant program (EEA)	Make communities safer, keep vital services online, reduce long-term costs of climate-related risks
Community Clean Energy Resilience Initiative (DOER)	Helps municipalities use clean energy to protect against service interruptions caused by severe weather

MA Integrated State Hazard Mitigation and Climate Adaptation Plan (SHMCAP)

- Required to receive FEMA Disaster Assistance
- First of its kind to integrate climate change impacts and adaptation strategies with hazard mitigation plan
- Identifies potential hazards for populations, government, built environment, natural resources, and the economy
- Resilient MA Action Team
  - Launched in August 2019
  - Inter-agency team led by EEA
  - SHMCAP implementation and guidance
  - Develop statewide climate resilience standards
  - Ensure capital investments are climate-smart

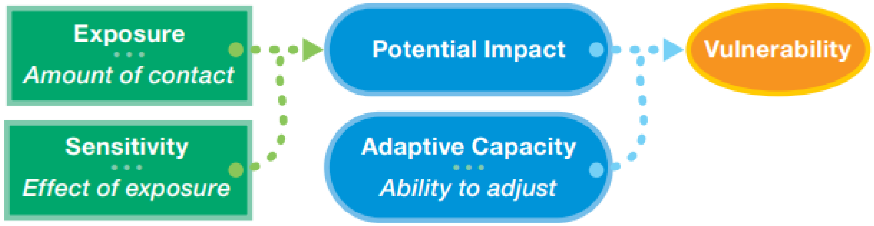
Source: SHMCAP

SHMCAP: State Agency Key Vulnerabilities

Key Vulnerability Assessment Findings for State Agencies

- **Vulnerability assessment completed by approximately 80 state agencies**
- **Nearly 1,000 critical items were assessed:**
  386 physical/non-physical assets | 340 functions | 231 population groups
- **Vast majority of agencies identified multiple concerns regarding impacts from climate change and natural hazards**
- **Top five hazards based on number of assets with a "High Risk" rating:**
  Extreme Precipitation | Hurricanes/Tropical Storms | Nor'easter | Ice Storms | Severe Winter Storm
- **Ability to withstand natural hazards and climate impacts:**
  Excellent: 6% | Good: 38% | Satisfactory: 42% | Fair: 14% | Poor: 0%
- **Length for agency to return to essential functionality following an extreme weather event that results in significant damage to critical assets and/or functions:**
  Months: 7% | Weeks: 32% | Days: 43% | Hours: 19%
- **Remote operation capability:**
  Yes: 82% | No: 18%
- **Status of incorporating natural hazard mitigation and climate change adaptation into programs:**
  Currently incorporating: 28% | Planning to incorporate: 32% | Not incorporating: 29% | Don't know: 10%
- **Plans, policies, or procedures in need of revision to better consider climate change:**
  Yes: 24% | No: 37% | Don't know: 39%
- **Application of factors derived from state agency adaptive capacity responses to risk scores significantly reduced the number of "High Risk" critical items – overall 80% reduction**
- **Top hazards with "High Vulnerability" scores based on number of critical items:**
  Physical/Non-Physical Assets: Severe Winter Storm/Ice Storm | Functions: Coastal Flooding | Population Groups: Coastal Flooding

Assessing Climate Change Vulnerability



DIVISION OF
CAPITAL ASSET
MANAGEMENT &
MAINTENANCE

Planning for Resilience at DCAMM

Agenda

1. Vulnerability – What is the problem?
2. Planning – How address the problem?
3. Implementation – Applying the solution.

Vulnerability

Sea Level Rise

Rising Temperatures

Changes in Precipitation

Extreme Weather

NEWS IN BRIEF

Atlantic Ocean Excited To Move Into Beautiful Beachfront Mansion Soon

9/14/15 11:39am • SEE MORE: NEWS

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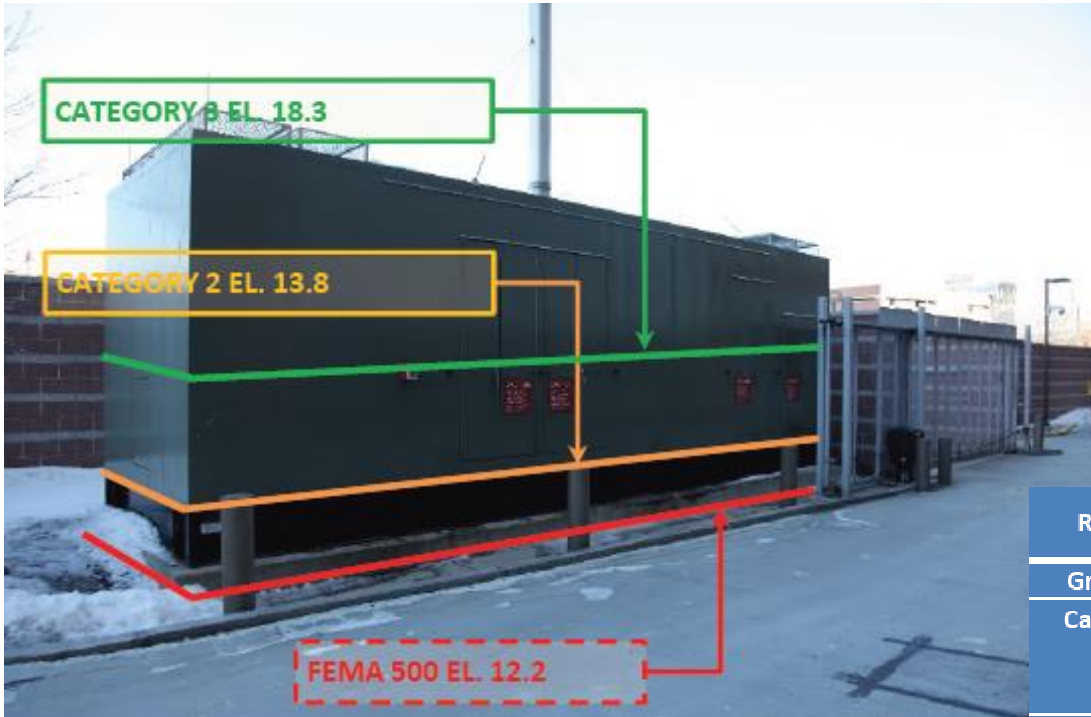
Flooding During March 2018 Noreaster

Resilience at DCAMM



Salem Ruane Judicial Center generator flood susceptibility.
MHHW represents Mean Higher High Water level.

Reference Level	Elevation in Feet (NGVD 29)[1]	Relation to First Floor (ft.)
Ground Elevation	12	-
Cat 1 Hurricane at MHHW[2]	10.1	Below ground
Cat 2 Hurricane at MHHW[2]	13.8	1.8
Cat 3 Hurricane at MHHW	18.3	6.3
FEMA 100	10.8	Below ground
FEMA 500	12.2	0.2

Extreme Heat & Health Risks

Extreme Heat and Health Risks

Health inspectors visit prisons after receiving complaints about heat

By Laura Crimaldi Globe Staff July 13, 2018, 6:56 p.m.

A cell block at MCI-Cedar Junction in Walpole. (GLOBE FILE PHOTO/1993)

By CRIMESIDER STAFF | AP | February 15, 2017, 12:13 PM

Civil trial ordered of Texas prisons after heat deaths

CBS

Massachusetts cites two prisons for ventilation problems

By Laura Crimaldi Globe Staff August 2, 2018, 6:40 p.m.

State public health officials have cited two state prisons for inadequate ventilation, after receiving complaints of excessive heat inside the facilities during a heat wave this summer.

During inspections conducted July 12, public health officials found parts of MCI Concord and MCI Cedar Junction in Walpole failed to meet state standards for ventilation in correctional facilities, according to Department of Public Health documents made public Wednesday.

Vulnerability at DCAMM

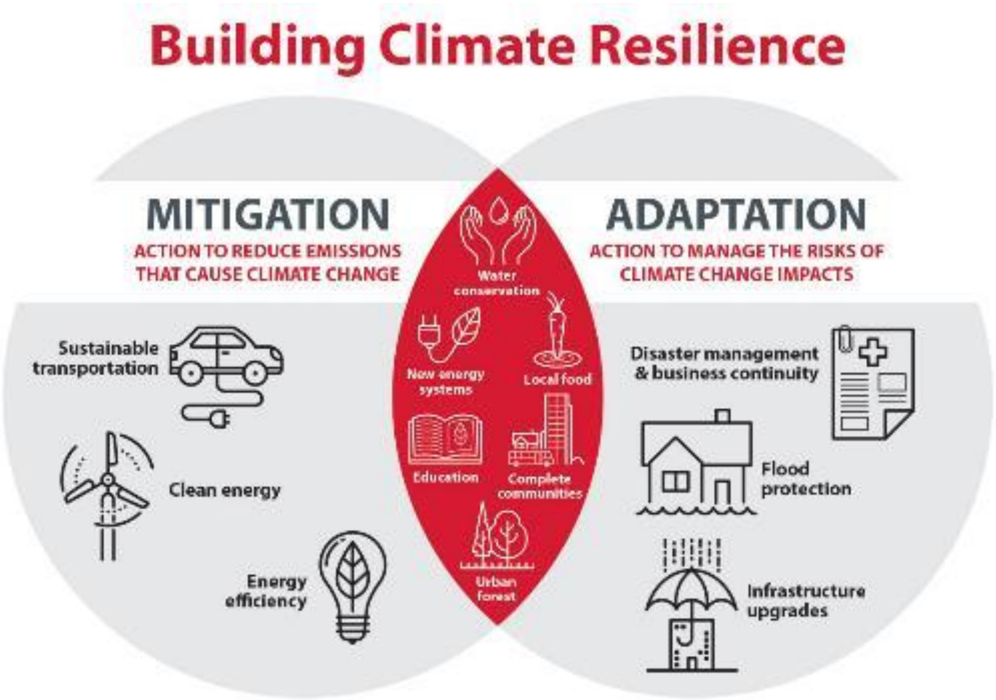
Basement Mechanical Room

Vulnerability at DCAMM

Max 1 Transformer

Stormwater Damage

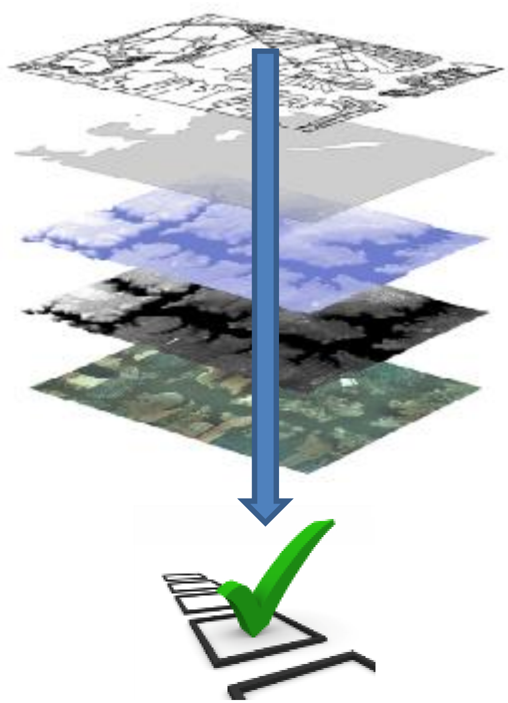
Planning



Calgary's Climate Program

Statewide Resilience Master Plan (SRMP)

Portfolio Evaluation



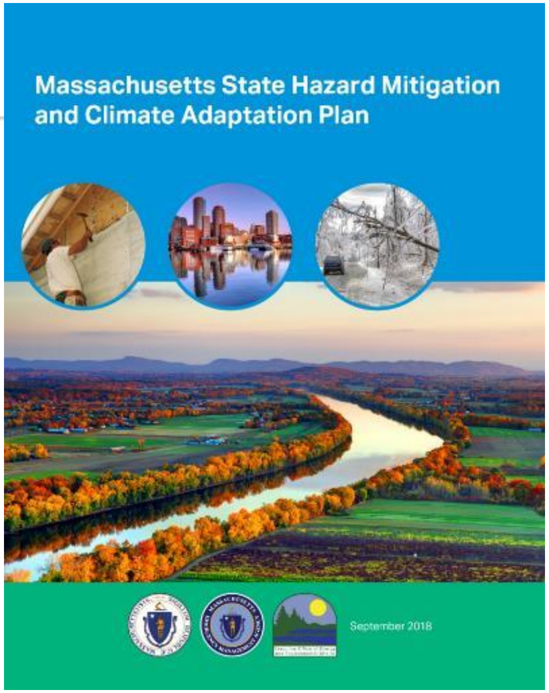
Guidelines

1. **Benchmarking & Criticality Analysis**
2. **Risk and Vulnerability Analysis & Pilot Site Workshops**
3. **Compilation and Distribution of Guidelines**

State Hazard Mitigation & Climate Adaptation Plan

Resilience goals for DCAMM

Incorporate hazard and climate change vulnerability into capital planning, master planning, and facilities management functions.	Incorporate climate change vulnerability, resilience, and adaptation standards into capital planning for new projects. Refer to agency climate change vulnerability assessments in master planning exercises. Integrate climate change vulnerability assessments into a facilities management system.	A&F / DCAMM	Greater than 5 years



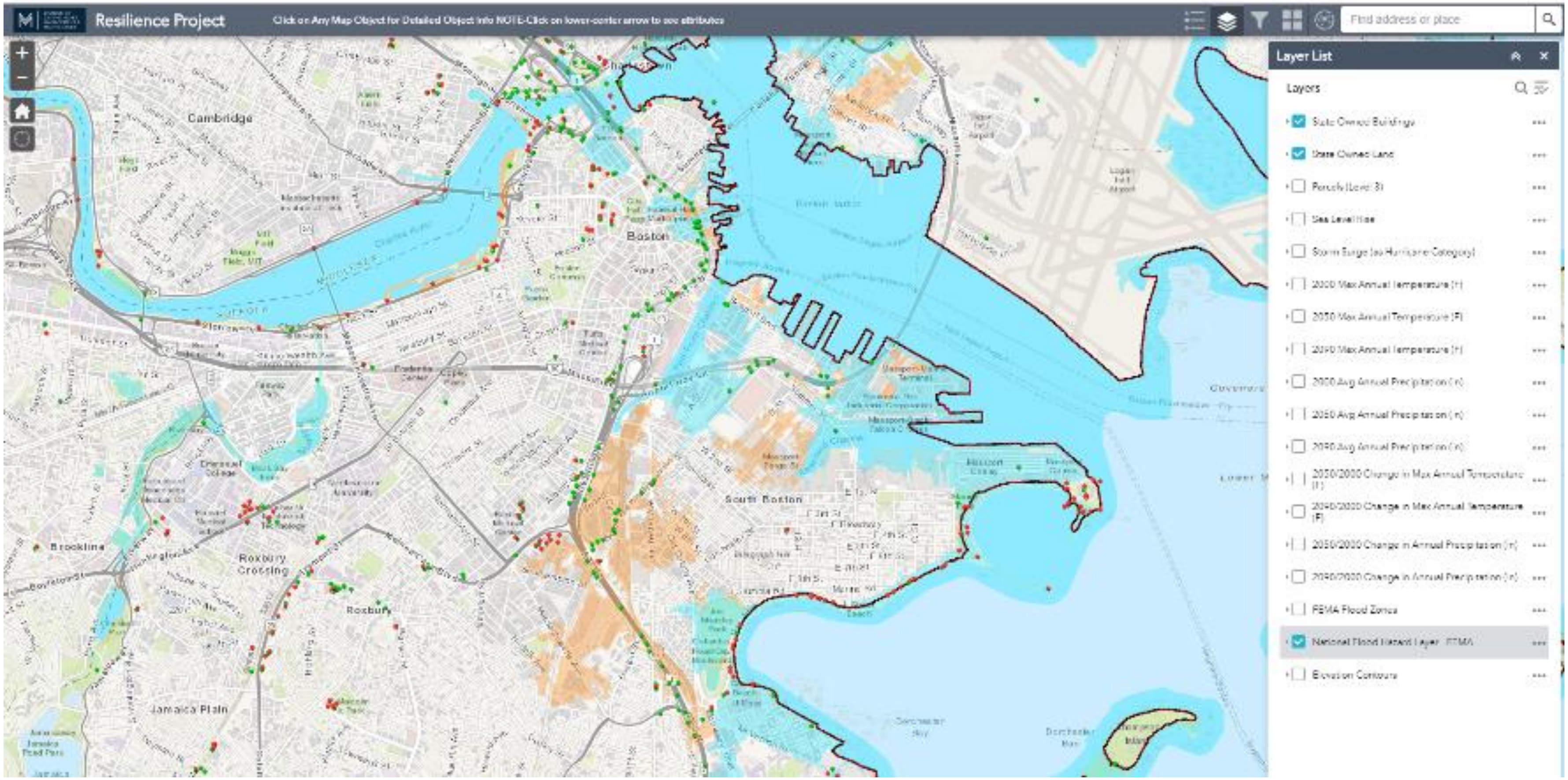
DCAMM Resilience Checklist

V. Flooding, Sea Level Rise, and Storms

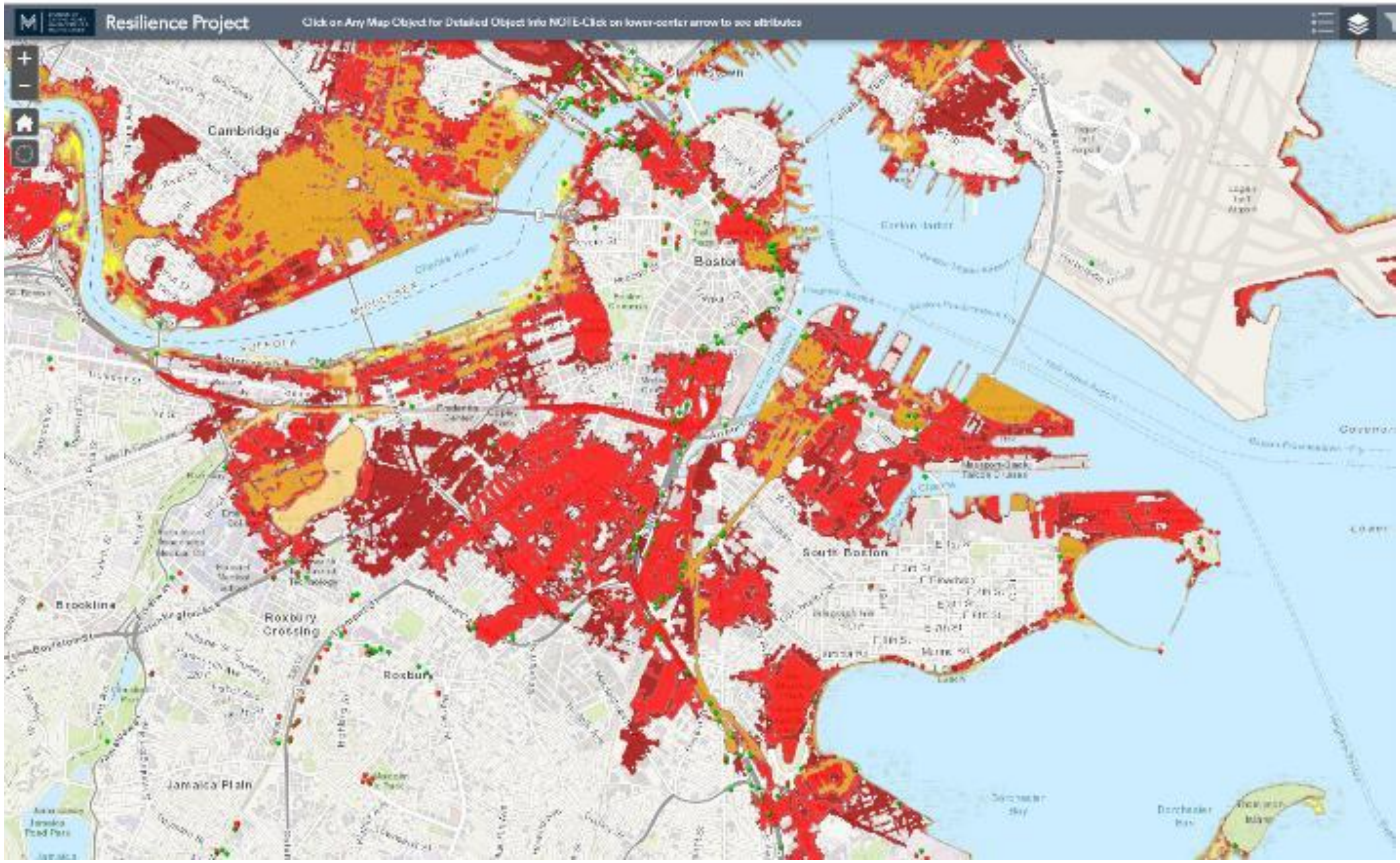
Inland Flooding			
For site-specific sea-level-rise and flood hazard information by address for Massachusetts, please visit: http://massgis.maps.arcgis.com/apps/webappviewer/index.html?id=930e4afb48c14cdca6b6e71b393fe023			
Is any part of the project site located in FEMA zones A, AE, AO, AH, or VE (1% annual chance of flooding)?:	*Yes / No*	Is any part of the project site located in a FEMA zone X (0.2% annual chance of flooding)?:	*Yes / No*
Sea Level Rise / Storm Surge [NAVD88]			
Will any part of the project fall within Hurricane Category 1?	*Yes / No*	What minimum level of sea level rise is the project vulnerable to (if any)?	*Feet*
If you answered YES to any of the above questions, please complete the following questions. Otherwise you have completed the questionnaire; thank you!			
Base Flood Elevation (BFE):	*Feet*	Site elevation at building:	*Feet*
Lowest occupiable floor elevation:	*Feet*	Proposed Site Elevation – High:	*Feet*
Lowest basement floor elevation:	*Feet*	Proposed Site Elevation – Low:	*Feet*
Accessible route elevation:	*Feet*		
List any building uses and critical equipment located below the *BFE (Base Flood Elevation) (e.g. switchgears, distribution panels, air handling units, generators, etc.):			
☐ Switchgear ☐ Transformer ☐ Distribution Panel ☐ Substation	☐ Emergency Generator ☐ Communications ☐ Water heater ☐ Air handling unit	☐ Boiler ☐ Server ☐ Elevator pit ☐ Other (list below)	

http://massgis.maps.arcgis.com/apps/webappviewer/index.html?id=930e4afb48c14cdca6b6e71b393fe023

Mapping – Flood Plains

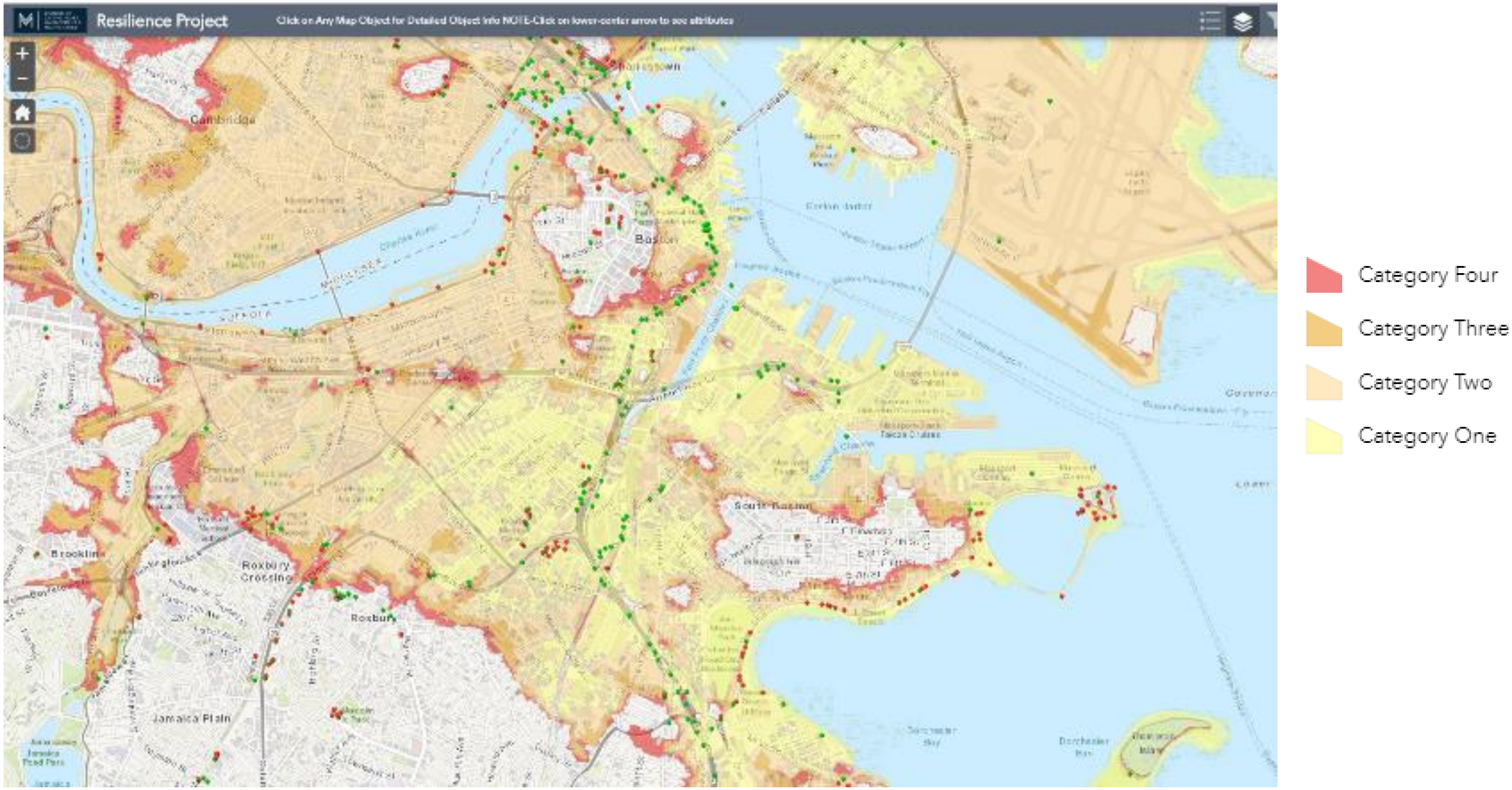


Mapping – Sea Level Rise



- 1 ft Sea Level Rise
- 2 ft Sea Level Rise
- 3 ft Sea Level Rise
- 4 ft Sea Level Rise
- 5 ft Sea Level Rise
- 6 ft Sea Level Rise

Mapping – Storm Surge



Implementation

SRMP Resilience Guidelines – Green Infrastructure

Exterior Site Features and Grounds Example

SITE DRAINAGE

Climate Stress:

- EXTREME PRECIPITATION
- FLOODING

Adaptation: Select green infrastructure, such as rain gardens, to facilitate infiltration and reduce stormwater runoff.

Planning Horizon: During/After

Strategy: Accommodate

Cost: $-$$

Effectiveness: Moderate

Feasibility: Yes

Adaptability: Flexible

Timing: Short- to Mid-term

Co-benefits: Heat reduction

Discussion: This adaptation will reduce stormwater runoff during extreme precipitation events and help reduce recovery times after flooding, as well as reduce heat island effects. Rain gardens should be constructed in accordance with the Massachusetts Stormwater Handbook. Feasibility and Adaptability are typically site dependent. In addition to lessening climate impacts, it is also beneficial to site aesthetics and community wellness.

SRMP Resilience Guidelines – Pervious Paving

Exterior Site Features and Grounds Example

SITE DRAINAGE

Climate Stress:

- EXTREME PRECIPITATION
- FLOODING

Adaptation: Install permeable pavement in the parking lot and walkways to aid with infiltration on site and reduce stormwater runoff

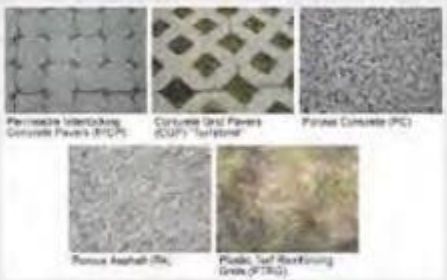


Photo courtesy of Oregon State University

Planning Horizon: During/After

Strategy: Accommodate

Cost: $$

Effectiveness: Moderate

Feasibility: Maybe

Adaptability: Not Flexible

Timing: Mid-term

Co-benefits: No

Discussion: This adaptation will reduce stormwater runoff during extreme precipitation events and help reduce recovery times after flooding. Porous pavement should be maintained in accordance with the designers' recommendations. Facility Managers should develop a schedule for maintaining the pavement in order to maximize effectiveness. Porous pavement may not be feasible at all sites.

Electrical Building System Example

BELOW GRADE TRANSFORMER

Climate Stress:
- FLOODING
- EXTREME PRECIPITATION

Adaptation: Elevate transformer to above-ground pad with critical threshold 2 ft. above predicted flood elevation.

Planning Horizon: Before

Strategy: Retreat (elevate/relocate)

Cost: $$$

Effectiveness: Max

Feasibility: Yes

Adaptability: Not Flexible

Timing: Mid to Long-term

Co-benefits: Yes, easier to maintain

Discussion: This adaptation should be implemented before climate impacts. This adaptation is more expensive than replacement-in-kind for subgrade transformers, but the life cycle of the transformer will be longer than if left in the ground. By relocating/raising the transformer 2 ft. above the predicted flood elevation, flood risk is eliminated and easier access is provided to facility maintenance staff. Once the elevation is raised, the strategy is not flexible (i.e. cannot easily be adjusted to higher elevations). This strategy is likely feasible to implement once funds are available. It will require design and construction, so timing of implementation is mid- to long-term.

SRMP Resilience Guidelines – Heat Recovery

Mechanical Building System Example

HVAC SYSTEM

Climate Stress:

- HEAT

Adaptation: Air handling units with heat recovery.

Planning Horizon: Before

Strategy: Protect

Cost: $$$

Effectiveness: Maximum

Feasibility: Maybe

Adaptability: Not Flexible

Timing: Long-term

Co-benefits: Yes (wellness, energy)

Discussion: This adaptation should be implemented to prepare for heat waves and increased baseline temperatures. Its effectiveness depends on the overall efficiency of the of the mechanical system and the building envelope. This strategy may be feasible, but it would likely be an extensive retrofit for older buildings. The solution would help to ensure occupants' wellness and reduce building energy demands.

SRMP Resilience Guidelines – Foundation Floodproofing

Adaptation: Exterior drainage

Photo courtesy of dspinspections.com

Planning Horizon: During/After

Strategy: Accommodate

Cost: $$- $$$

Effectiveness: Moderate

Feasibility: Yes (depending on roof)

Adaptability: No

Timing: Mid to Long-term

Co-benefits: No

Discussion: In general, foundations, floor slabs and building walls are not designed to withstand hydrostatic pressures. Perimeter drains are custom in design, and effectiveness should be considered during prolonged flood events. Sump pumps may be required to bail the system if drainage systems are inundated and over capacity. Pressure relief valves discussed in other sections may be considered. Green infrastructure may be useful in reducing recovery time for the site.

SRMP Resilience Guidelines – Temporary Flood Barriers

Adaptation: Deploy temporary barriers to alter the flow of stormwater runoff away from the site.

Photo courtesy of NOAQ BOXWALL FLOOD BARRIER

Planning Horizon: During

Strategy: Protect

Cost: $

Effectiveness: Moderate

Feasibility: Yes

Adaptability: Flexible

Timing: Short-term

Co-benefits: No

Discussion: This adaptation should be during climate impacts when stormwater is flowing from another site onto this site. This solution provides temporary relief from water damage. This solution requires personnel on site immediately before, during, and after an event to implement. It will require purchase of the barriers, so timing of implementation is short-term. Barriers can range from sandbags, quick dams, to NOAQ flood defenses (pictured).

SRMP Resilience Guidelines – Temporary Flood Barrier

VULNERABLE FACILITY ELEMENT	LOCATION	CLIMATE STRESS	PRIORITY
Basement doorways to Outdoor Equipment Room, Mechanical Room, etc.	North side of site	Extreme Precipitation & Flooding	High

- **Planning Horizon:** Before & During
- **Strategy:** Protect
- **Cost** – $: ~$900/dam
- **Effectiveness** – Max: depends on structural strength of building walls
- **Feasibility** – Yes: easy to install, use, store and transport
- **Adaptability** – Flexible: 26" high, gate fits 30"-35" opening
- **Timing** - Short term: 2 minute installation
- **Co-benefits** - No.

SRMP Resilience Guidelines – Exterior Shading

VULNERABLE FACILITY ELEMENT	LOCATION	CLIMATE STRESS	PRIORITY
Window curtainwall	Facade-Floors 1 through 5	Heat	High

- **Cost** – $: $$-$$$ according to system selected and if additional structural requirement to support
- **Effectiveness**: medium to high
- **Feasibility**: to be assessed if shades will required their own structural system
- **Adaptability**: No
- **Timing** – short-term and long term
- **Co-benefits** – this measure will also reduce the energy demand for the building and contribute to achieve GHG reduction.

SRMP Resilience Guidelines – Operable Windows

Adaptation: Operable Windows

Planning Horizon: Before/During

Strategy: Accommodate

Cost: $ - $$

Effectiveness: Minimum to Moderate

Feasibility: Yes

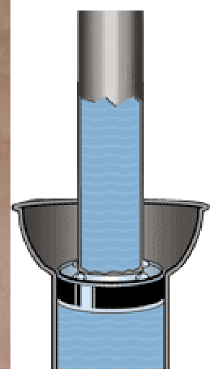
Adaptability: Flexible

Timing: Short- to Long-term

Co-benefits: Yes, occupancy comfort

Discussion: This adaptation allows introduction of outside air to improve quality and control temperature. This can be implemented for new windows or during retrofitting a structure. This adaptation is typically low to moderate costs. Typically installed by construction subcontractor. Typical results are improved occupant comfort and improved energy savings. Windows may be sized or designed with locks to provide security.

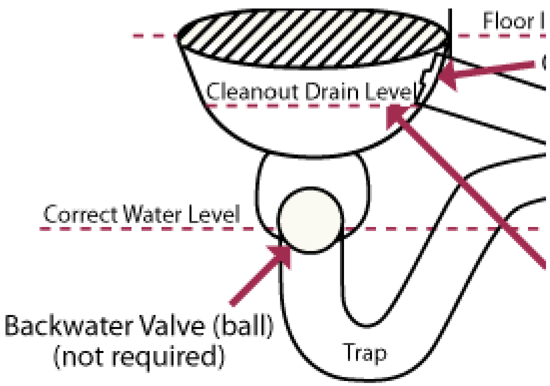
SRMP Resilience Guidelines – Under Slab Drains



VULNERABLE FACILITY ELEMENT	LOCATION	CLIMATE STRESS	PRIORITY
Mechanical & Electrical Room	Basement	Flooding	High

- **Planning Horizon:** Before & During
- **Strategy:** Accommodate
- **Cost** – $, Low, retrofit
- **Effectiveness** – Moderate, reduces hydrostatic pressure
- **Feasibility** – Yes: easy to install
- **Adaptability** – Flexible, taller pipes could be used
- **Timing** - Short term
- **Co-benefits** - No.

SRMP Resilience Guidelines – Backflow Prevention



VULNERABLE FACILITY ELEMENT	LOCATION	CLIMATE STRESS	PRIORITY
Mechanical & Electrical Room	Basement	Extreme Precip./Flooding	High

- **Planning Horizon:** Before
- **Strategy:** Protect
- **Cost** – $, Low initial cost, up to moderate cost for retrofit
- **Effectiveness** – Moderate, does not reduce hydrostatic pressure, requires maintenance, degrades over time.
- **Feasibility** – Maybe: ease of installation base
- **Adaptability** – Not flexible.
- **Timing** - Short term
- **Co-benefits** - No.

SRMP Resilience Guidelines – Elevating Servers

VULNERABLE FACILITY ELEMENT	LOCATION	CLIMATE STRESS	PRIORITY
MDF Servers, Communications	Basement	Extreme Precip./Flooding	High

- **Planning Horizon:** Before
- **Strategy:** Retreat (elevate within room or to first floor)
- **Cost** – $ - $$$
- **Effectiveness** – Moderate to Max; if moved within room, humidity is still a problem for the equipment
- **Feasibility** – Maybe: ease of installation base
- **Adaptability** – Flexible; not flexible.
- **Timing** - Short term; Long term.
- **Co-benefits** - No.

Thank you!

Questions?

Resilience Gaps and Clean Energy Solutions for State-owned Medical and Residential Care Facilities

MASSACHUSETTS LEADING BY EXAMPLE PROGRAM

PUBLIC LEADERSHIP, STEWARDSHIP, COMMITMENT

DOER

Massachusetts Department of Energy Resources

Resilience at HHS Facilities: A Study

Research Question

- Is there potential for clean energy solutions to support added resiliency at HHS critical care facilities that operate around-the-clock?

Goals

- Examine existing energy resiliency conditions and identify clean energy technologies that could improve site energy resilience
- Support the Commonwealth’s broader climate adaptation and mitigation objectives

[Study funded by DOER’s Leading by Example Program, conducted by Arup between February 2018 and March 2019]

Resilience at HHS Facilities: A Study

- The study included detailed evaluation of how each facility might expand or increase the duration of power maintenance during an electric grid outage
- Critical care facilities were chosen for the study due to the complications associated with relocation of residents, many of whom require significant medical attention

Study Phases

Task 1. Perform an existing conditions assessment and energy resiliency gap analysis

Task 2. Identify several clean energy technology options that could address energy resiliency gaps

Task 3. Conduct feasibility assessments on the most promising technologies for each site, including return-on-investment

Task 4. Develop resiliency guidance documents for other state agencies based on the experience of the study

Portfolio Systems Resilience Scorecard

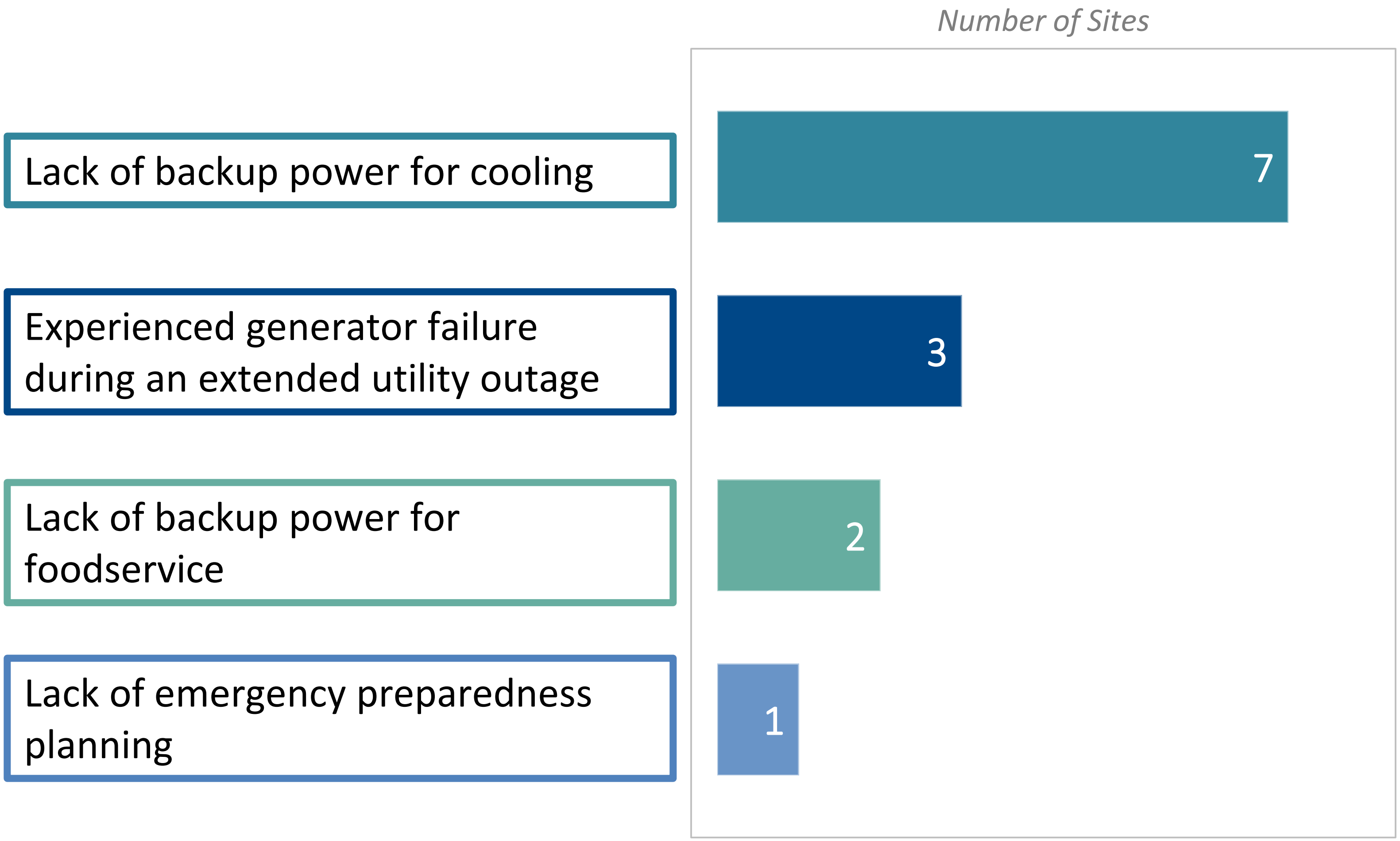
Score System

0	1	2	3
worst			best

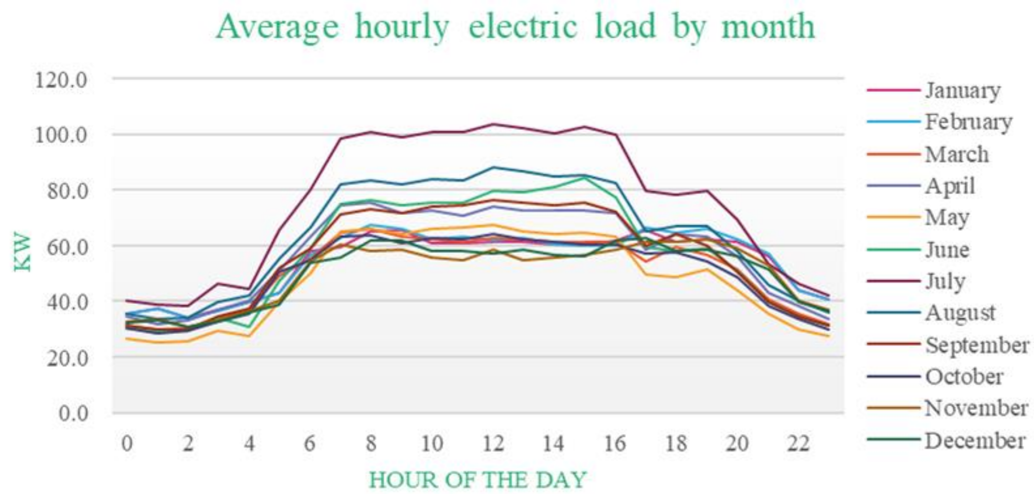
Systems Resilience Average	Systems Resilience Summary				
	Electrical		HVAC		Misc. Systems
	Normal Power	Backup Power	Heating	Cooling	
1.4	1.5	1.3	2.2	0	2.0
1.3	1.8	1	2	0	1.8
0.7	1.8	0	0	0	1.5
1.4	2	1.5	2	0	2.0
1.4	1.5	1.5	2.2	0	2.0
1.6	2	1.8	2	0	2.2
2.0	2	1.8	2.2	1.8	2.0
2.2	1.5	2.8	2.4	2.3	2.2
2.2	1.8	2.5	2.4	2	2.3
2.0	1.5	2.3	2	1.8	2.2
1.8	1.5	2	1.6	2	1.8
1.8	2.3	2.3	2.2	0	2.0
1.6	1.7	1.7	1.9	0.8	2.0

Each system and operational category was assigned a score between 0—3 based on existing conditions and expected impact on the facility's required emergency functions

Portfolio Energy Resilience Gaps

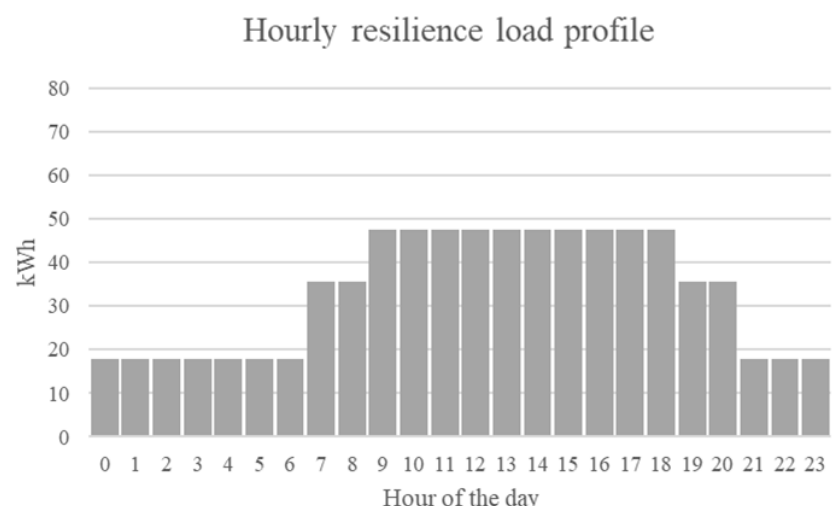


Energy Modeling and Resilience Needs



Typical annual and daily load profiles

Daily load profile of critical systems



Clean Energy Technologies Assessed

The study utilized a set of 12 performance criteria to assess the technologies including benefit to resiliency, cost-effectiveness, and ease of integration

Technology Comparison

	Energy Generation				Energy Storage		Microgrid
Technology	Solar PV	Solar Thermal	CHP	Fuel Cells	Electrical Storage	Thermal Storage	
Grid-making	0	0	3	3	3	0	3
Dispatchability	0	3	2	1	3	3	3
Thermal characteristics	0	2	3	2	0	3	0
Fuel/storage capacity	0	2	2	2	3	3	0
Black-start req.	0	0	2	2	3	0	3
Space req., power density	1	2	2	2	2	1	3
Ease of integration	3	2	1	1	2	1	1
Structural impact	3	2	2	2	1	1	3
Efficiency	3	3	2	2	1	1	3
GHG emissions impact	3	3	2	2	1	2	2
Order-of-magnitude cost	2	1	2	1	1	2	1

Score System

0	1	2	3

Least Beneficial ← → Most Beneficial

Clean Energy Technologies Assessed

These four technologies, either alone or in combination, were most commonly found to mitigate energy resilience gaps at facilities without extreme cost or modifications

Technology Comparison

	Energy Generation				Energy Storage		Microgrid
Technology	Solar PV	Solar Thermal	CHP	Fuel Cells	Electrical Storage	Thermal Storage	
Grid-making	0	0	3	3	3	0	3
Dispatchability	0	3	2	1	3	3	3
Thermal characteristics	0	2	3	2	0	3	0
Fuel/storage capacity	0	2	2	2	3	3	0
Black-start req.	0	0	2	2	3	0	3
Space req., power density	1	2	2	2	2	1	3
Ease of integration	3	2	1	1	2	1	1
Structural impact	3	2	2	2	1	1	3
Efficiency	3	3	2	2	1	1	3
GHG emissions impact	3	3	2	2	1	2	2
Order-of-magnitude cost	2	1	2	1	1	2	1

Score System

0	1	2	3

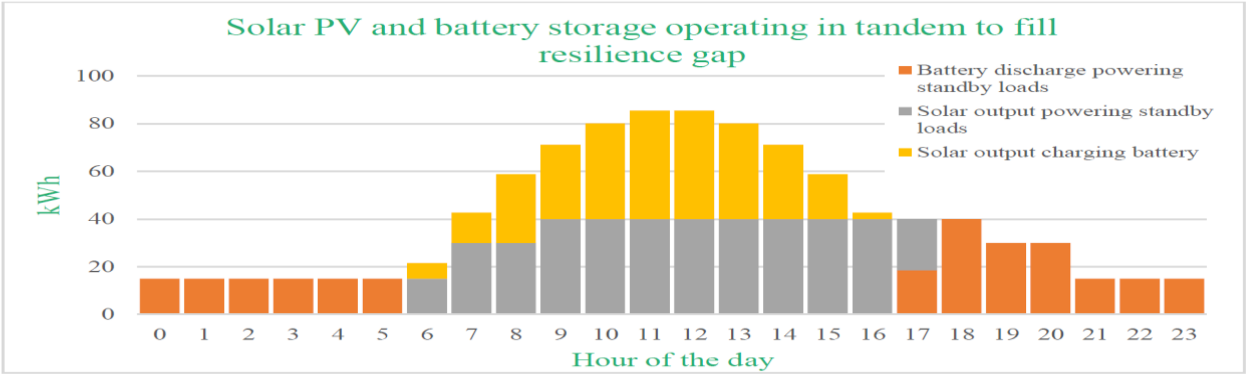
Least Beneficial ↔ Most Beneficial

Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth

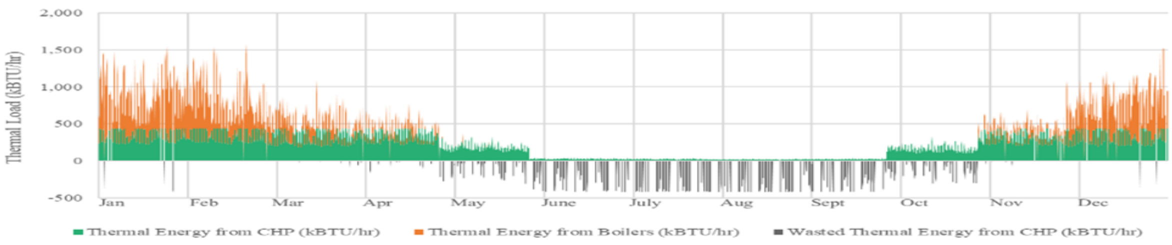
Massachusetts Department of Energy Resources

Clean Energy Load Profiles and Meeting Resilience Needs

Example: Solar + Battery Storage



Example: Combined Heat and Power (CHP)



Financial Analysis

	Baseline	65 kW CHP	65 kW CHP w/ 200 kW PV inside	65 kW CHP w/ 200 kW PV and 120 kWh battery	200 kW solar PV and 302 kWh battery
First costs ($)					
Installed cost	N/A	(215,000)	(1,315,000)	(1,448,000)	(1,435,000)
Mass Save CHP program incent.	N/A	27,100	16,900	15,800	-
LBE incentive	N/A	-	330,000	354,000	390,400
Net installed cost	*N/A*	***(187,300)***	***(968,100)***	***(1,078,200)***	***(1,044,600)***
Annual costs ($)					
Utility electric supply cost	(45,700)	(16,500)	(5,000)	(6,200)	(22,900)
Utility electric T&D cost	(25,900)	(9,400)	(2,900)	(3,500)	(13,000)
Utility electric demand cost	(11,000)	(4,400)	(1,800)	(100)	(4,800)
Utility thermal energy cost	(31,800)	(13,200)	(19,200)	(19,400)	(31,800)
Proposed clean energy system maintenance cost	N/A	(3,260)	(2,000)	(1,900)	-
Proposed clean energy system fuel cost	N/A	(40,940)	(25,000)	(23,300)	-
Annualized overhaul cost	N/A	(2,600)	(2,600)	(5,300)	(6,700)
SMART incentive	N/A	-	24,300	32,500	37,800
AEC incentive	-	8,000	5,700	5,700	-
Net annual cost	(114,400)	(82,300)	(28,500)	(21,500)	(41,400)
Net annual incentives	N/A	**8,000**	**30,000**	**38,200**	**37,800**
Annual savings compared to baseline	*N/A*	***32,100***	***85,900***	***92,900***	***73,000***
Summary					
Payback period (simple payback, years)	**N/A**	**5.8**	**11.3**	**11.6**	**14.3**
30-yr NPV ($)	**N/A**	***375,000***	***527,000***	***544,000***	***316,000***

Does not include financial benefits from resilience or draft Clean Peak Standard

First Costs

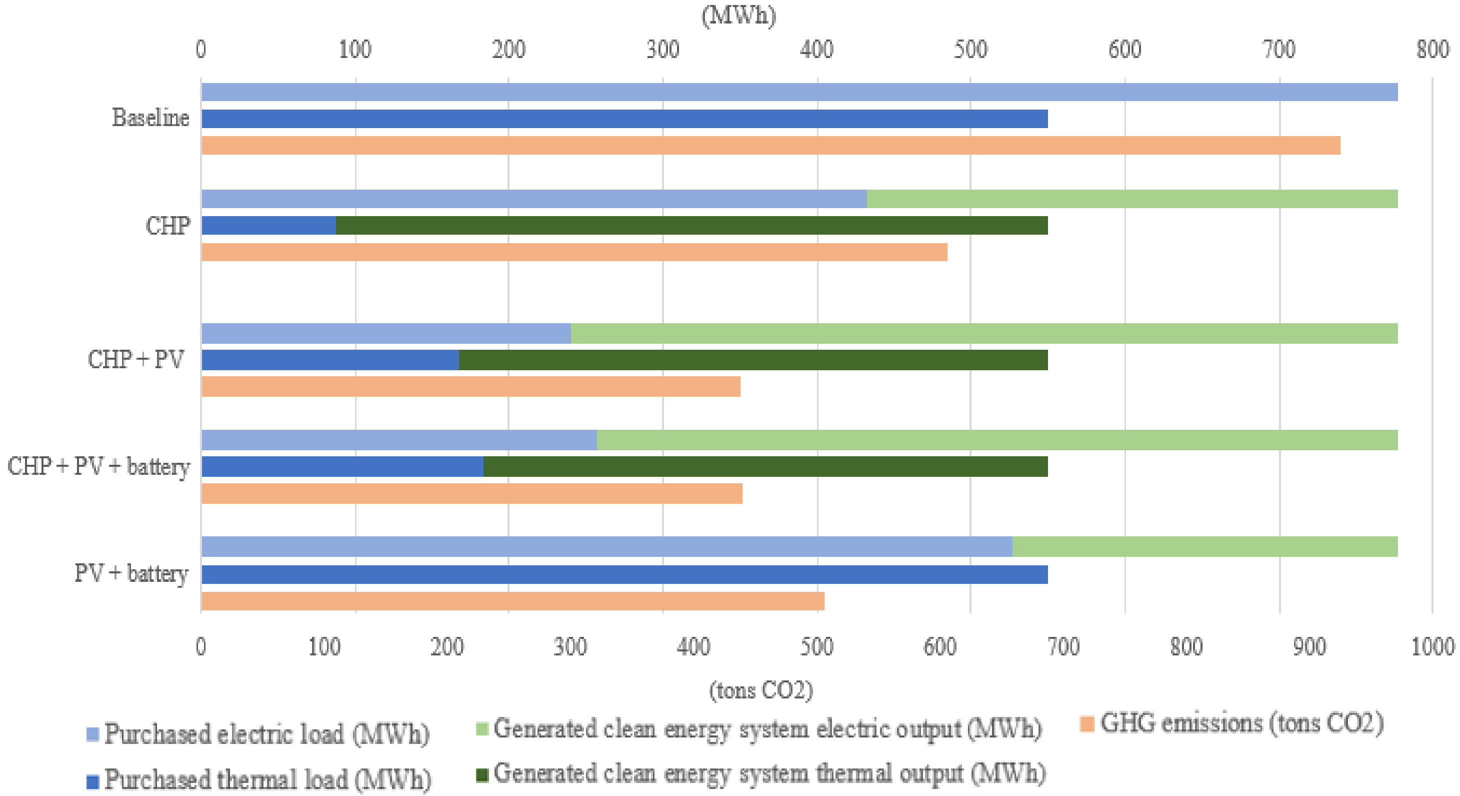
- Conservative cost estimates
- MassSave incentives
- LBE solar incentives

Annual Savings / Costs

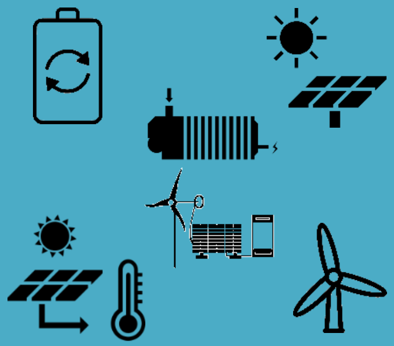
- Energy cost savings
- Demand charge savings
- SMART Program incentives
- AECs / RECs
- Clean energy system O+M costs
- Fuel costs

Greenhouse Gas and Energy Impact

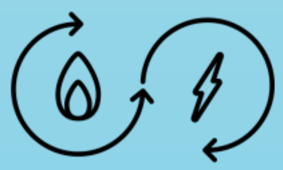
Confirmed overall GHG reductions for each option as well as reduction in purchased energy



Key Study Takeaways



Except for 2 gaps that were operational in nature, all identified critical resilience gaps could potentially be mitigated with the use of onsite clean energy technology



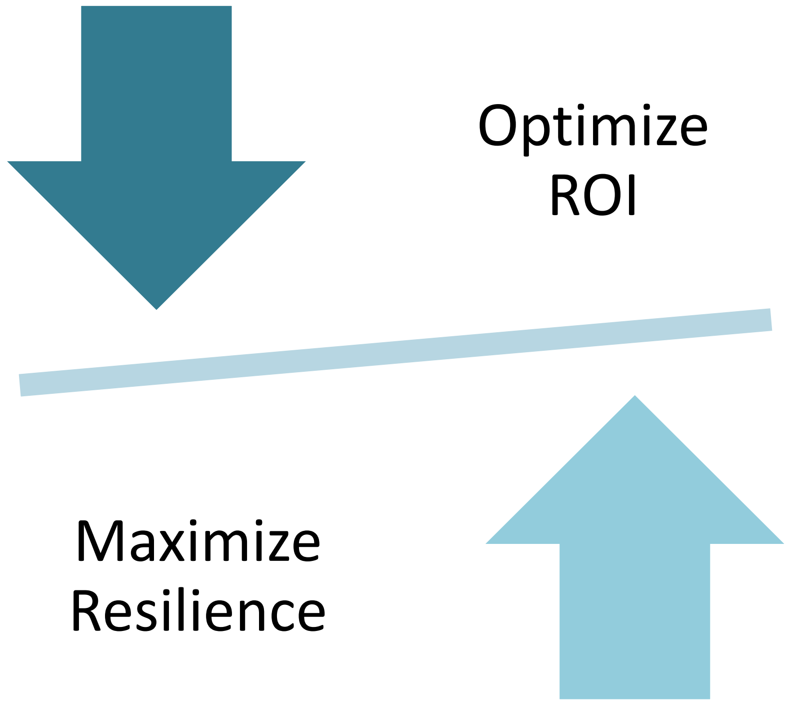
CHP is often the most cost-accessible clean energy option in the current market with or without a combination of battery storage and solar

Utility incentives have a pronounced impact on technology cost-effectiveness; future revenue programs, like the CPS, will likely change financial analyses further

Striking a Balance

Size system to maximize cost-effectiveness and then determine resilience benefit that can be provided

Need to balance financial considerations with resilience needs



Additional Observations

- Understanding how overall and individual energy systems work can be critical to the development of strategies that can complement business-as-usual operations and enhance resiliency
- The better the data, the more accurate and potentially viable the solution
- Project economics are moving targets given changing technology costs, changing incentives, etc.
- Successful strategies will vary depending on how objectives are prioritized; some resilience is better than none
- Resiliency may address a range of challenges and include multiple strategies

DOER

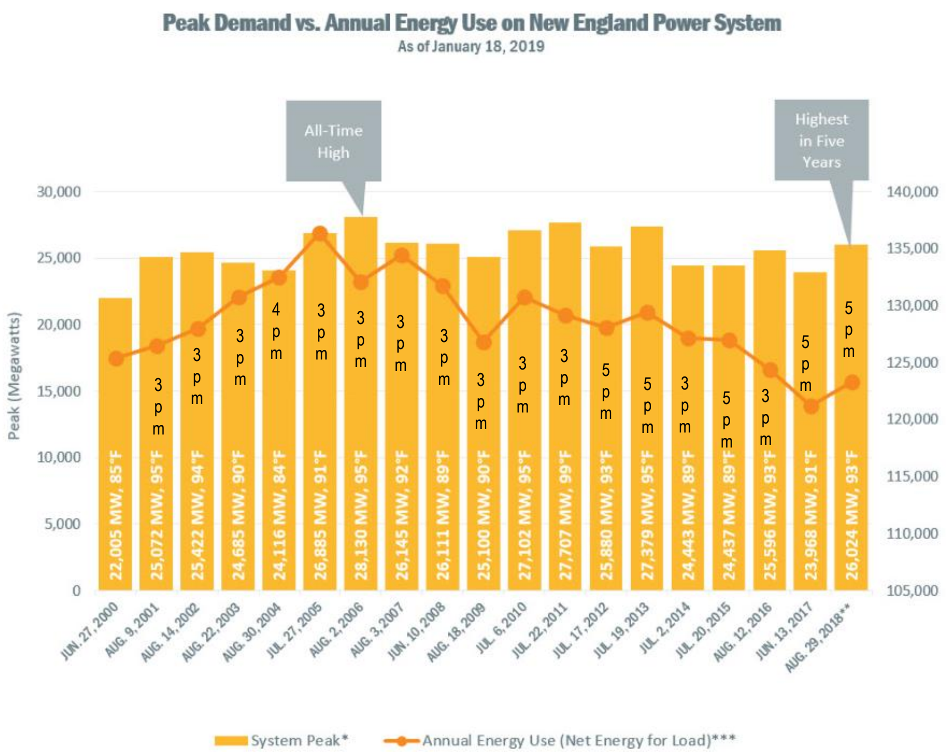
Massachusetts Department of Energy Resources

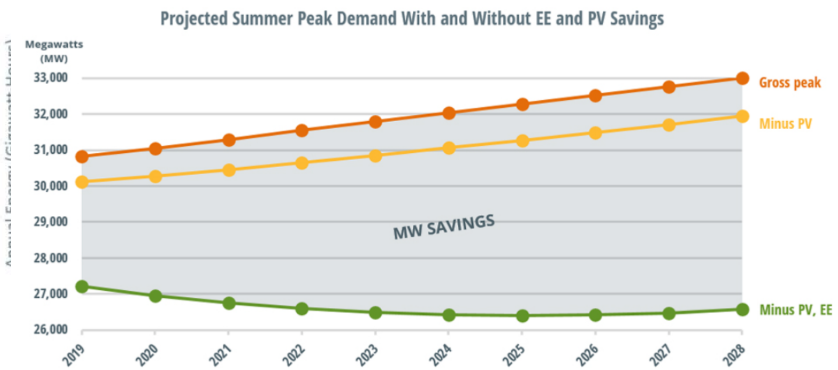
Resilience Discussion

LBE Updates

SSU Green Commuting Options

Regional Grid Historical Peak Demand





- 2019 Peak of 23.9 GW on July 30, 6 p.m.

Massachusetts Department of Energy Resources

2019 Peak Demand Response

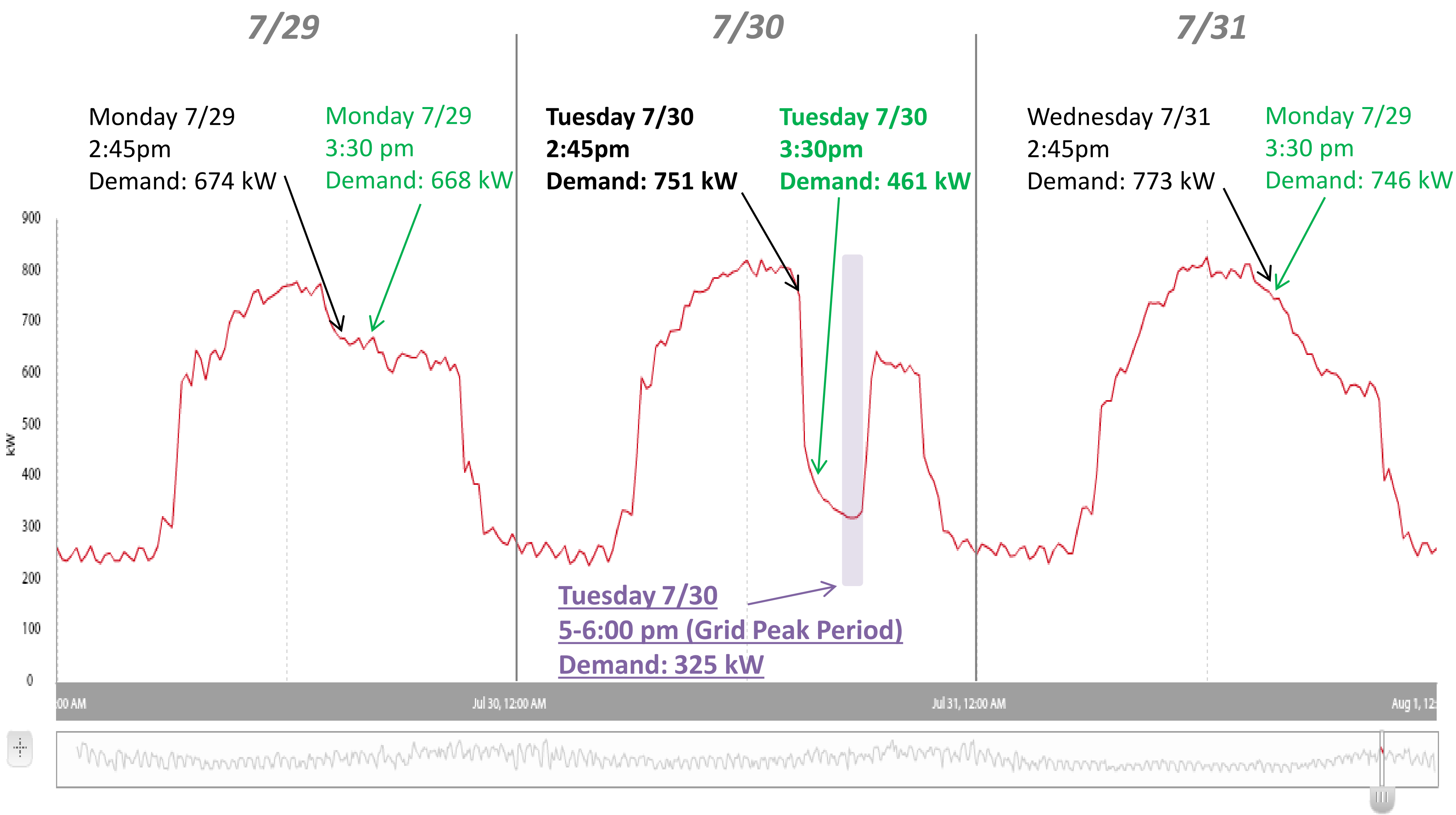
- July 2019 was Boston's hottest July on record, and the city's hottest month since meteorological data was first recorded in 1872

Did your facility participate in peak demand reduction on July 30th?

Would you be interested in a webinar about demand reduction tactics next spring?

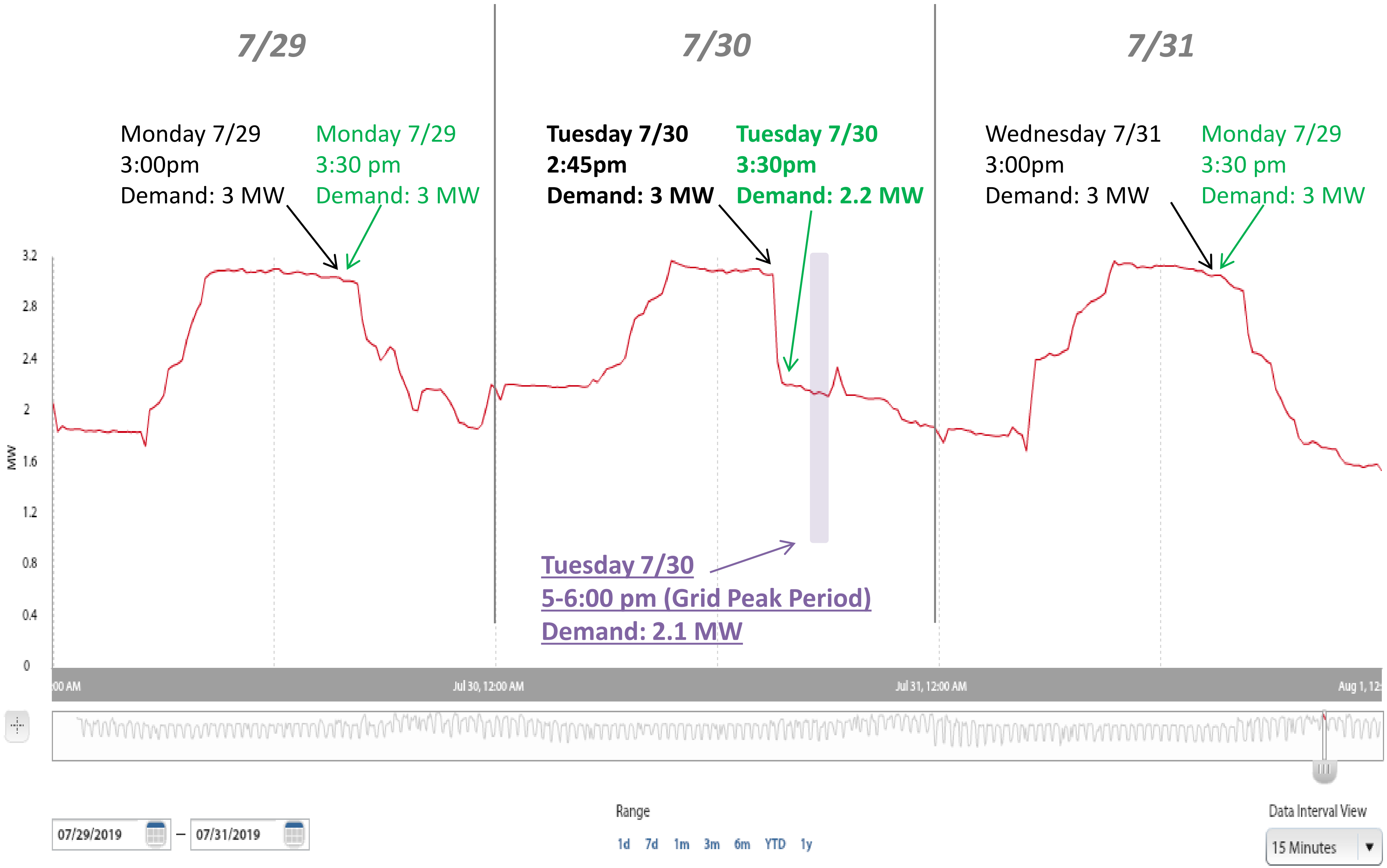
Source: WGBH

Peak Demand Reduction: Bristol Community College



Estimated $19,000 savings in next year capacity tag charges
(or $1,600/month savings per monthly utility bills)

Peak Demand Reduction: McCormark Building



FY19 LBE Tracking Form

- **Release date: September 20th**

- Tracking form categories:
  - Contact Info
  - Square footage
  - Utility account verification
  - Electricity consumption
  - Building fuel consumption
  - Vehicle & other fuel consumption
  - EE projects
  - Installed Clean Power
  - Vehicle Fleet
  - EV Charging Stations
  - Recycling
  - Water Use
  - Sustainability
  - Landscaping

- **New elements:**
  - **Utility account inventory**
  - **Energy storage section**
  - **Vehicle fleet inventory request**
  - **Landscaping tab reformatted**
  - **Additional autofill sections**

NEW ELEMENTS OF FY19 TRACKING FORM

The new tracking form for fiscal year 2019 has undergone some minor changes in an effort to make the tracking form more comprehensive and user-friendly. Below is a list of changes that have occurred to the form.

General	Where appropriate, we have automated additional tabs to pre-populate with previously submitted data. As with last year's form, ALL pre-populated fields rely on the selection of your agency/campus from the "Contact Information" tab dropdown. If not selected, no data will pre-populate. Additionally, you will no longer be able to select your agency/campus on individual tabs.
Utility Account Inventory	This new tab lists all electricity and natural gas utility accounts on file with LBE in one/both of our utility account databases. Accounts will autopopulate and we request that you either confirm or correct each account. If additional accounts are not listed, please provide these. If easier for your agency/campus, you may also submit a separate attachment with your submission that includes all active accounts.
Installed Clean Power	A third section requesting information about energy storage systems at your agency/campus as been added to this tab. Any energy storage information that LBE currently has for your site(s) will autopopulate and we ask that you make any necessary corrections. If an existing energy storage system is not provided or there is a planned system in the near future, please provide as much information in the appropriate space provided.
Vehicle Fleet	A question has been added to this tab inquiring into the availability of a detailed fleet inventory for your campus/agency. If available and your campus/agency is willing to share this inventory with LBE, we ask that you list vehicle details in the section provided or attach a separate document with your submission. If a detailed inventory is not available or you choose not to provide this information, please complete the rest of the tab as requested.
Landscaping	The format of this tab as been The pollinator-related section of this tab has been reformatted to pre-populate with any existing information LBE has regarding current efforts at your agency/campus . Please review any pre-populated data and make corrections in the appropriate section. If LBE is missing efforts entirely, please provide as much information available in the section provided.

- **Due date: December 20th**

VEH102 Update

- Statewide Contract VEH102 reopened for additional vendors in June; bids currently under review
  - Aims to cover a wide range of Advanced Transportation Technology (ATT) equipment, supplies and services including:

Electric vehicle supply equipment (EVSE) hardware, software, and installation

- Level 1, Level 2 and DCFC Hardware
- Inductive Charging Hardware
- Network Software and Reporting Services
- Billing Services
- Site Assessment
- Installation and/or Commissioning
- Servicing and maintenance
- EV chargers with clean energy (e.g. solar) and/or storage
- Portable EV chargers
- Software and services
  - Vehicle to X
  - Demand management
  - Fleet charging

Anti-idling technologies

After-market conversion technologies (retrofits, upfits)

VEH102 on COMMBUYS

LBE Awards: December 2019

Recognizing the outstanding energy and environmental sustainability efforts of Commonwealth agencies, public colleges and universities, and municipalities.

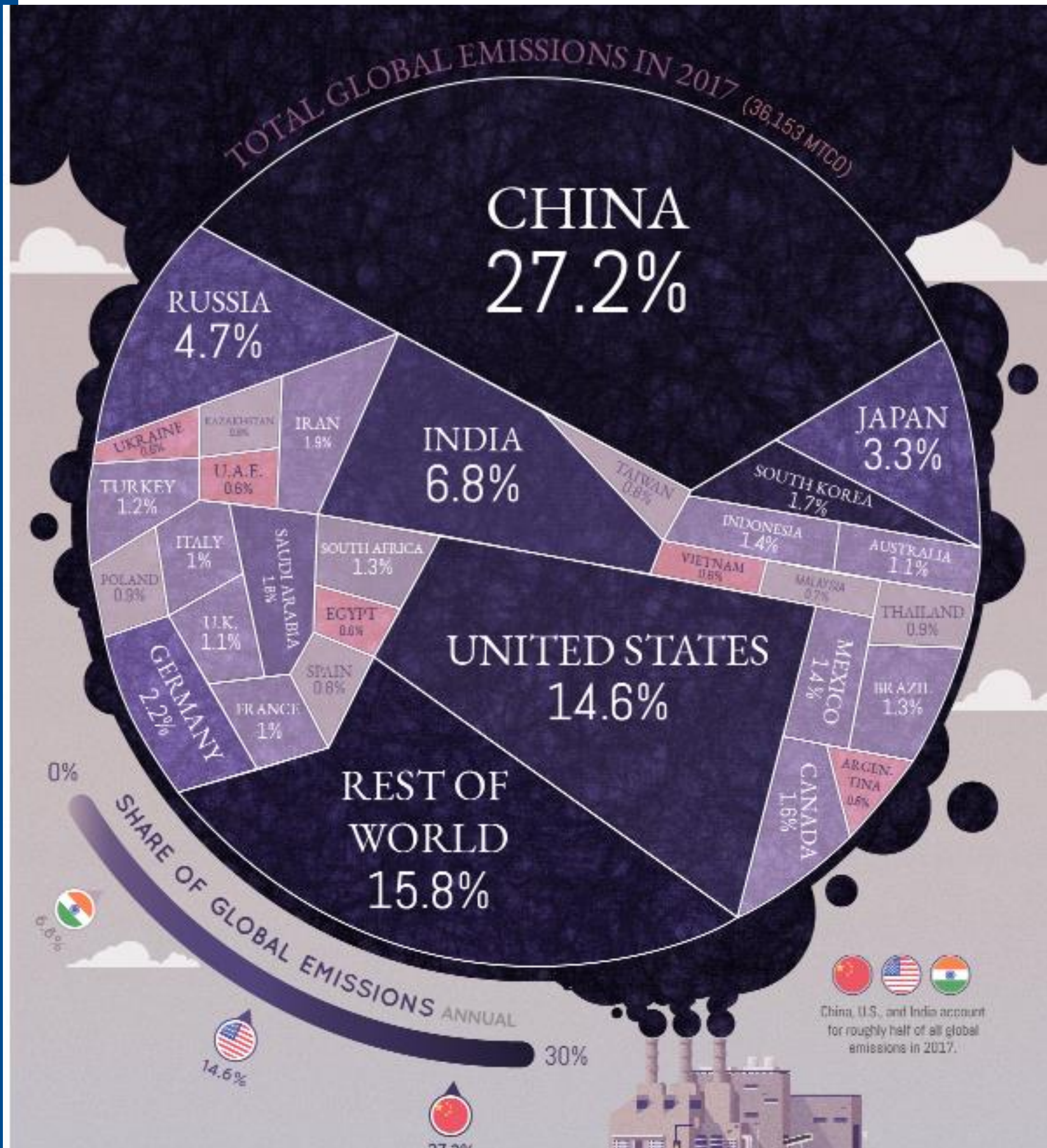
Nomination Deadline: Tuesday, October 1st, 5pm

For more information and to submit a nomination, email: Ryan.Kingston@mass.gov

Or visit: https://www.mass.gov/service-details/leading-by-example-awards

News from Around the World (II): Global Emissions and Energy Shifts

Global Emissions Share by Country



China, the US and India account for 48.6% of global emissions

DOER

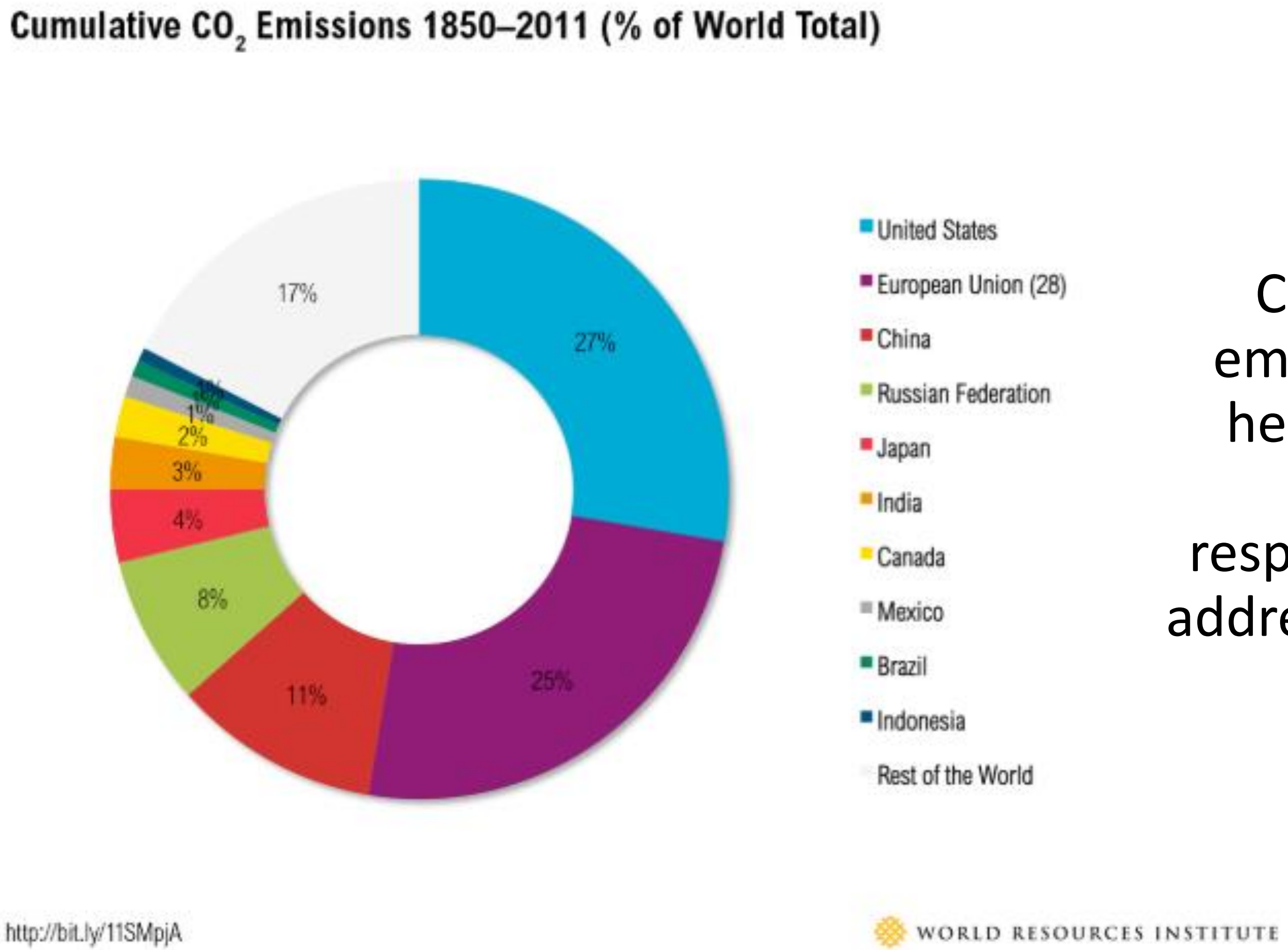
Massachusetts Department of Energy Resources

Emissions per person

- The US is the 8th highest emitter of GHGs on a per capita basis at 16.2 tons pp
- China emits fewer than 7 tons pp
- India emits fewer than 2 tons pp

Data only for locations with a population over 1 million

Cumulative Emissions



Cumulative emissions data help to assign overall responsibility for addressing climate change

Lightbulb Efficiency Standard Rollback

- Trump administration proposed roll-backs to energy efficiency standards that were to take effect in 2020
    1. Eliminate new energy efficiency requirements for standard pear-shaped bulbs
    2. Eliminate rules on ‘non-traditional’ types of bulbs, such as three-way bulbs and candle-shaped bulbs used in chandeliers
- Industry claims that by the end of 2019, 84% of “general purpose” light sockets will be filled by LED and compact fluorescent bulbs, regardless of regulation

Eliminating inefficient bulbs nationwide would save enough energy to shut down at least 25 large power plants

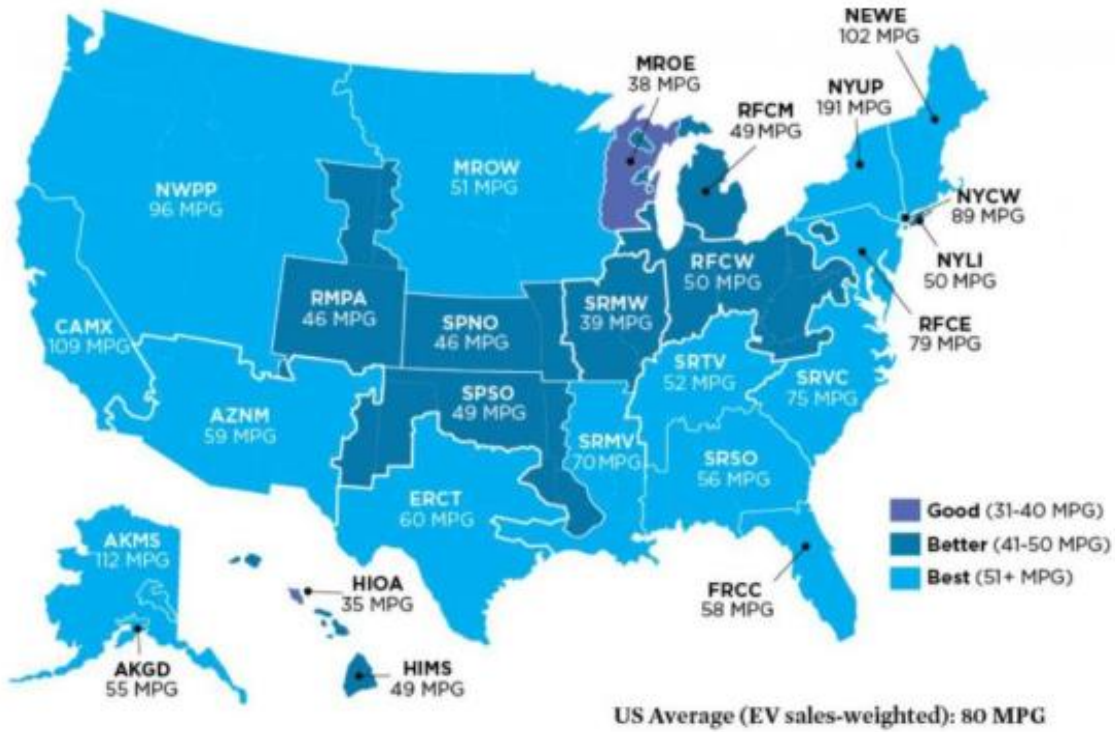
Renewables on the Rise

- Jan-June, 2019, Scotland's wind turbines generated 10 million mWh of electricity, enough to power a second Scotland!
- Germany to close all 84 coal plants over the next 19 years. Renewables to provide 65-80% of power by 2040.
- In July, Berkley became first city in US to ban natural gas in new buildings
- In 2018, MA became 5th state to go a year without burning coal

Carbon Emissions from EVs

The average EV in the US has the same GHG emissions as a car getting 80 mpg

- MA: An EV produces 1.2 metric tons of emissions per year. Traditional vehicles produce 4.9 metric tons.



Average miles per gallon equivalent of electric vehicles, 2018 UNION OF CONCERNED SCIENTISTS

EVs on the Rise

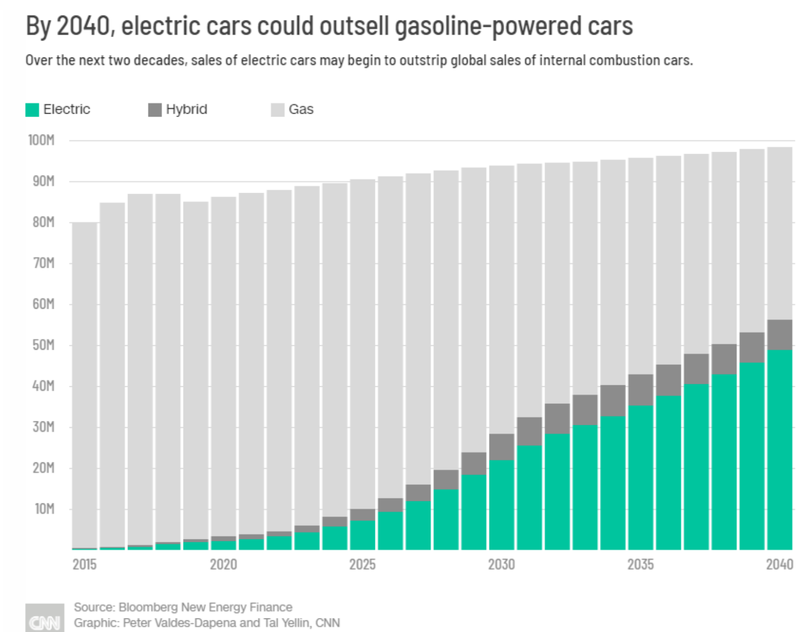
- Cadillac Escalade EV SUV touting 400-mile range
- Electric Ford F150 pulls 1M+ lbs of train
- WiTricity: Developing systems that deliver power wirelessly to car batteries using magnetic resonance
- EV sales in MA rose 94% from 2017 to 2018, reaching 22,573 sold by Jan 2019

Source: WiTricity

EV Sales Projections

"Today, electric car batteries cost about $176 per kilowatt-hour, but that figure will drop to just $87 per kWh by 2025."
(Source: CNN)

"Oil will have to fall to $9-$10 a barrel in the long-term in order for gasoline cars to remain competitive with clean-powered electric vehicles." (Source: Bloomberg)



Cape Air: Flying Without Fossil Fuels

First airline in the world to order commercial airplanes that run on electric batteries; could be as early as 2023

- Lithium ion batteries will provide instant power to the rear-facing propellers to take off on shorter runways
- Will be able to fly 50% faster and farther then current fleet, and will be quieter
- Expect to spend 40% less on direct operating costs

Next LBE Council Meeting

Save the Date!

Scheduled for November 12th

10:00 am–12:00 pm

Location: TBD

Should we change the date due to Veterans Day?

Potential Theme:

Strategic Electrification

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