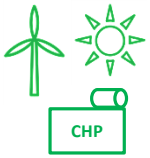
MA Leading by Example Council Meeting

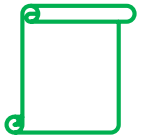
DOER Massachusetts Department of Energy Resources

January 14, 2020

MASSACHUSETTS LEADING BY EXAMPLE PROGRAM
PUBLIC LEADERSHIP. STEWARDSHIP. COMMITMENT

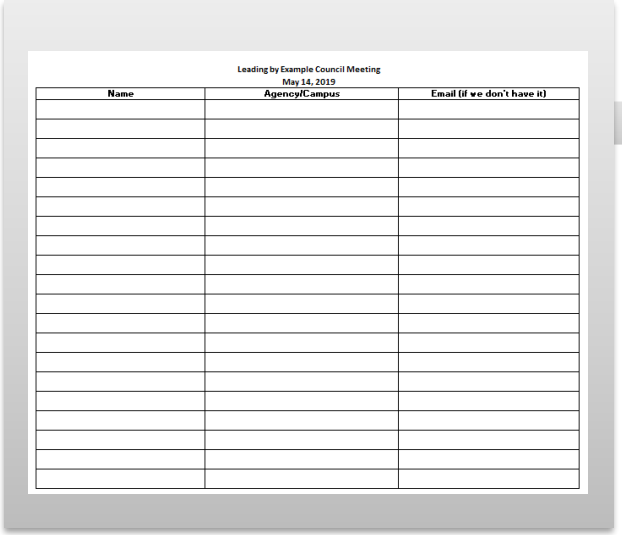
State Government Progress – as of January 2020

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

27.2 MW Installed Solar PV at State Sites	87 LEED Certified State Buildings	158 Electric Vehicle Charging Stations at State Sites	Leading by Example Grants Awarded
			
18.6 MW Since 2015	**50** Since 2015	**94** Since 2015	**$12.3 M** 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

Agenda


World News


Upcoming and Emerging Technology


Innovative Technology on the Horizon in MA


Innovation at MA State Facilities


Massachusetts and LBE News

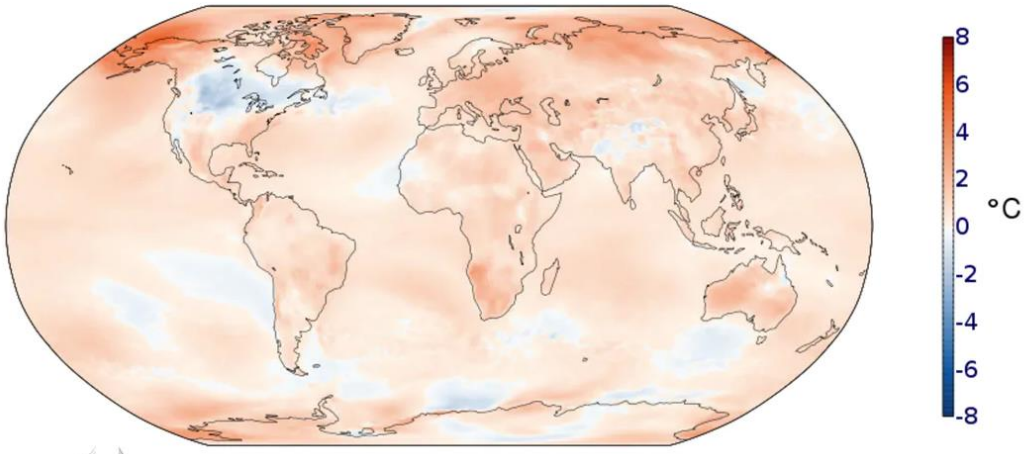

Optional: WTTC Tour

World News

2019: Second Hottest Year on Record

- Warmest decade in recorded history
- Past five years averaged 2-2.2°F (1.1-1.2°C) above pre-industrial levels
- The amount of CO2 in the atmosphere is at the highest level in human history; most likely higher than the last 3 million years
- Warmest summer in the northern hemisphere
- Hottest year on record in Europe

Surface air temperature anomaly for January 2019 to December 2019 relative to 1981-2010



Source: Washington Post

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UN's 10th Annual Emissions Gap Report

- Global emissions have risen 1.5% annually over 10 years

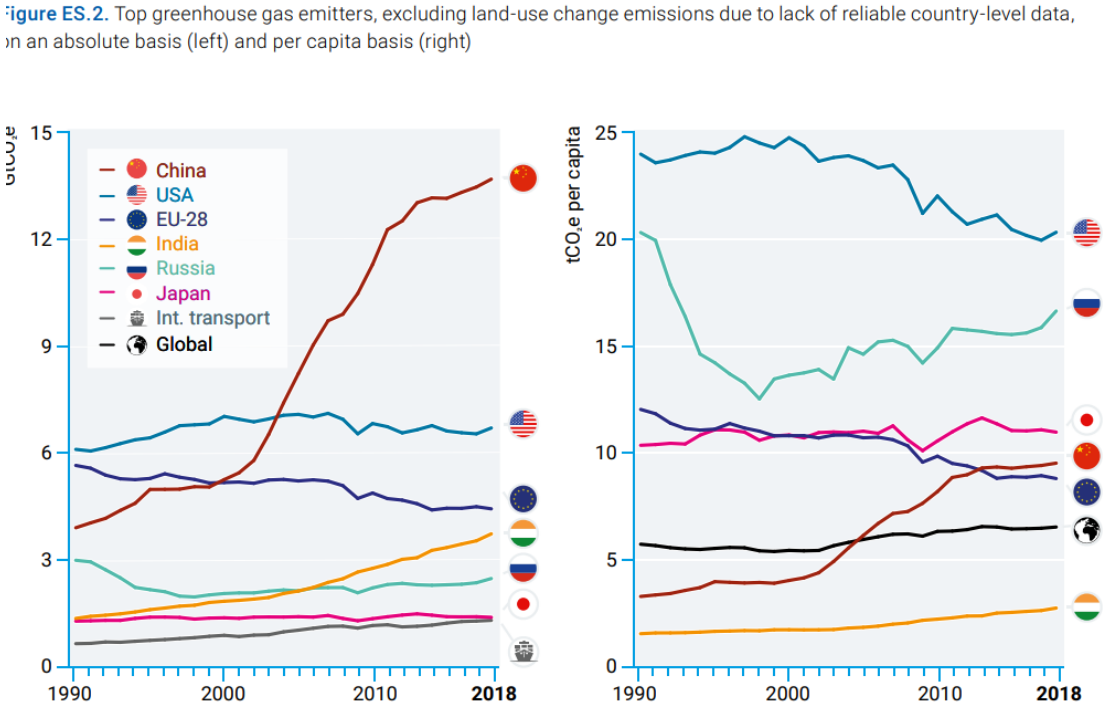
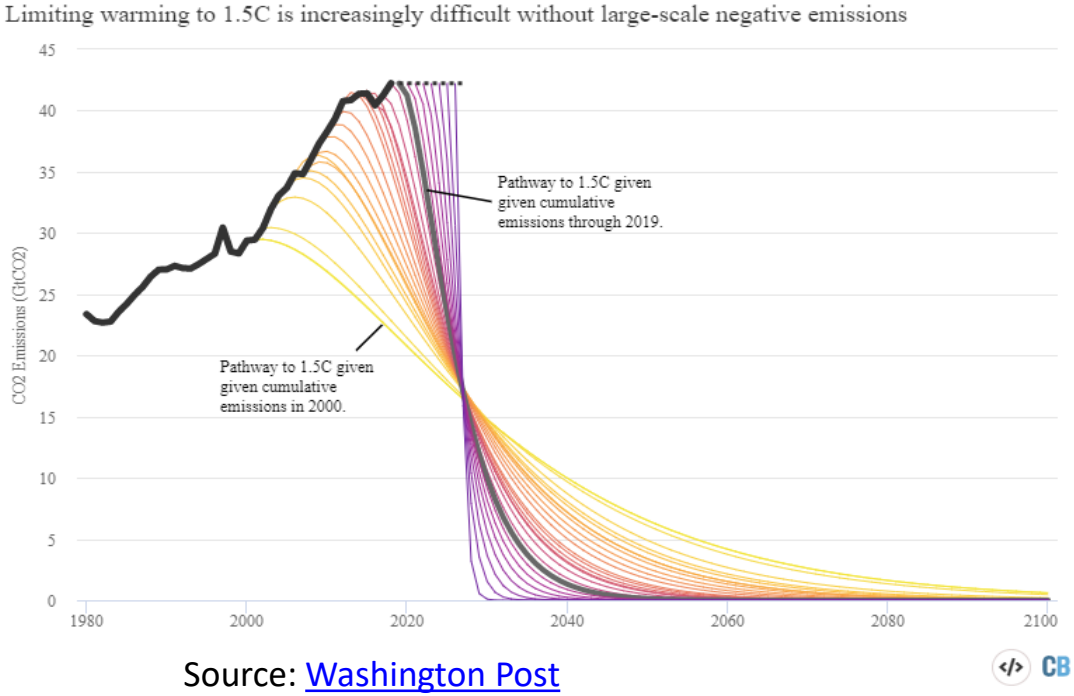


Figure ES.2. Top greenhouse gas emitters, excluding land-use change emissions due to lack of reliable country-level data, on an absolute basis (left) and per capita basis (right)



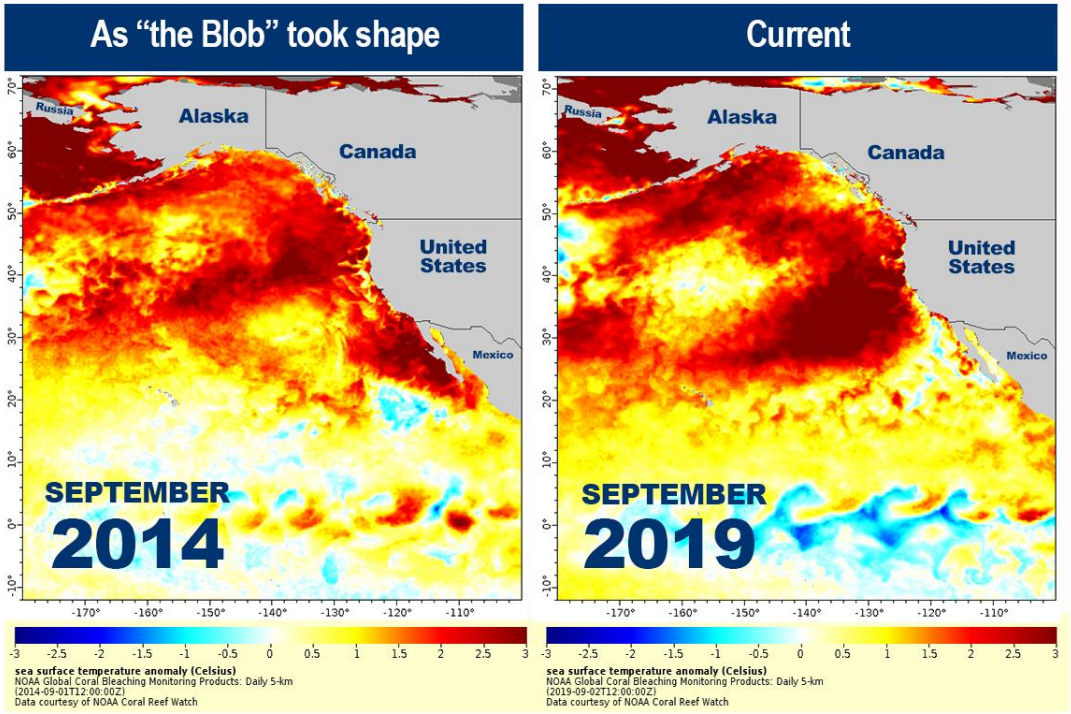
Source: Washington Post

- Emissions must fall 7.6% annually for 10 years to meet Paris Accord goal to "keep global temperature increase well below 2°C (3.6°F) above preindustrial levels"

Impacts to the North of us…

Alaska Cod Fishery Closes for First Time

- Regional ocean temperatures rose 4-5 degrees during a 2014 heatwave, causing mass die-off
- Cod numbers fell from 113,830 metric tons in 2014 to 46,080 in 2017

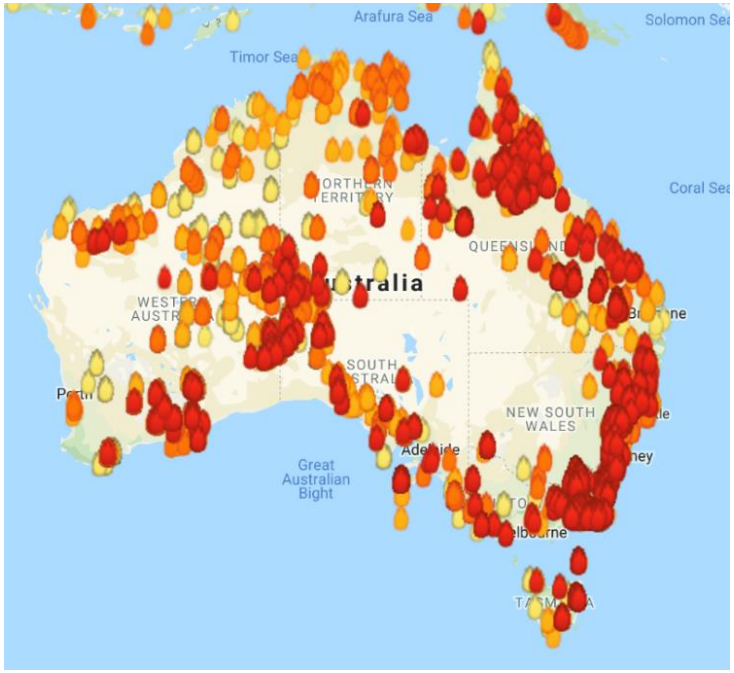


Source: NPR, NOAA

Impacts to the South…

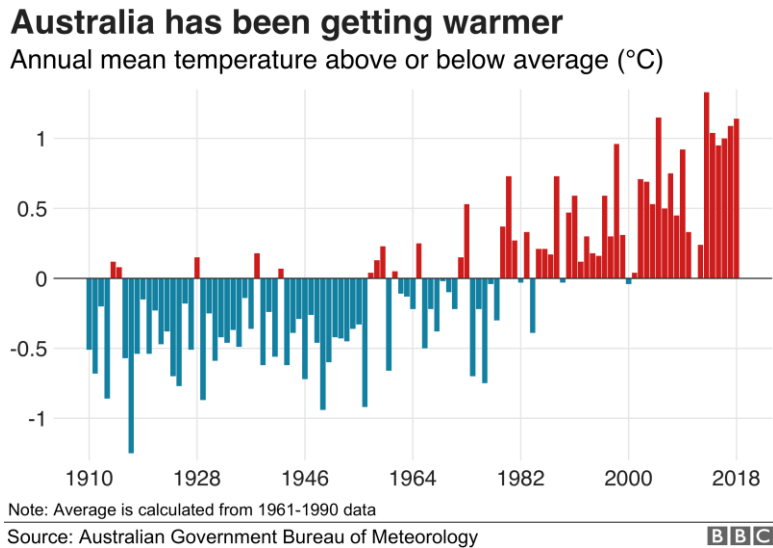
Over 17.9 million acres burned in Australia

- Bigger than the Amazon rainforest fires (17.5 million acres) and 2019 CA fires (247,000 acres) combined
- Hottest day on record (107.4F) in Dec
- Driest spring in 120 years
- Fire season only just begun
- Fires outside every major city, with at least 28 people killed and thousands of homes destroyed




An estimated 1 billion+ mammals, birds, and reptiles have been killed since September

Source: BBC, NY Times, Grist, Daily Mail, CNN.com



Stuck in the middle with…

Trump Administration Blocks 2007 Light Bulb Efficiency Law

- New standards would have required all bulbs to use 65% less energy than incandescent bulbs
- Could cost consumers an extra $14 billion and lead to 30 additional large power plants

Source: ACEEE, energy.gov

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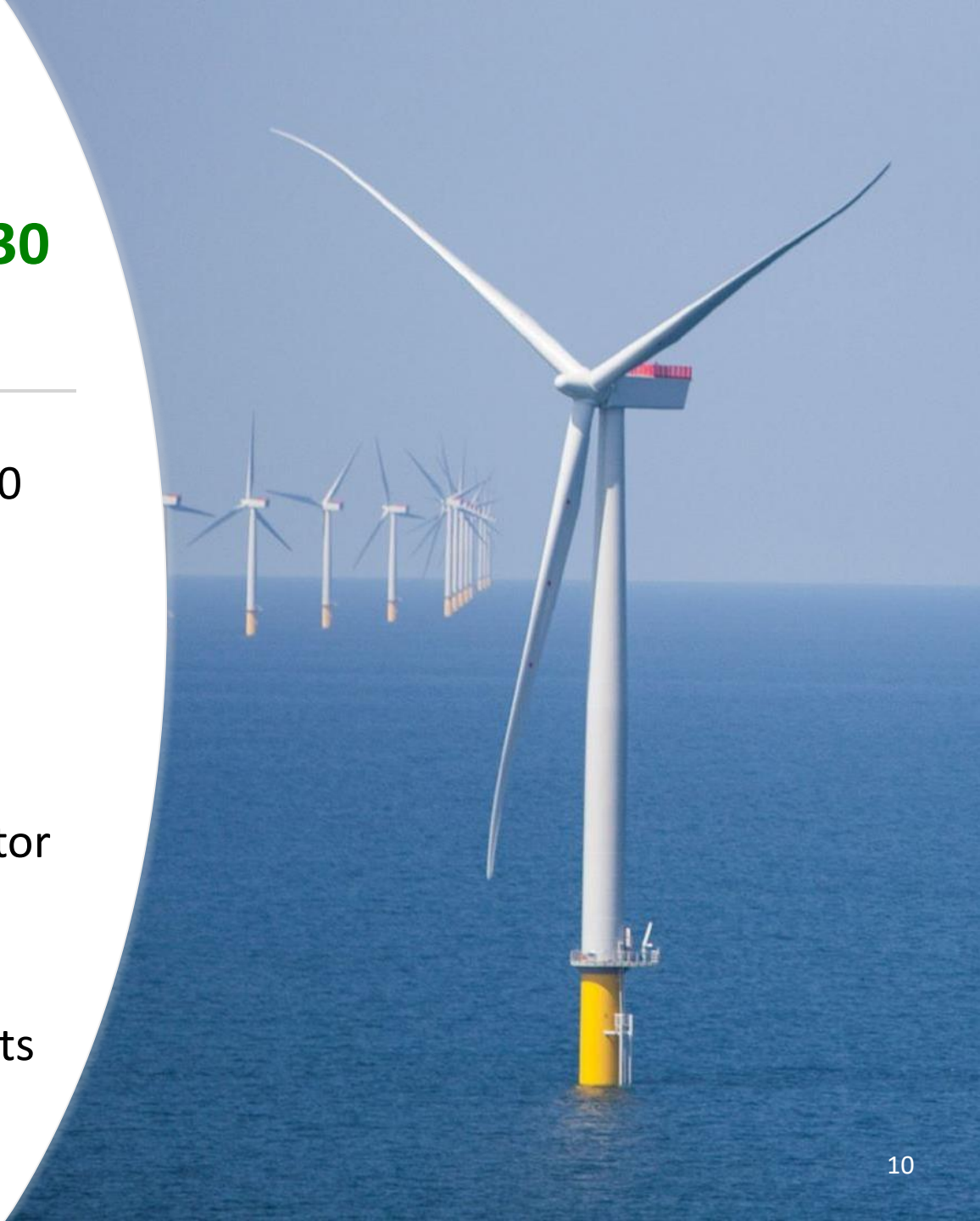
EU Close to Hitting 2030 GHG Emissions Goal

- EU on track to reduce emissions 30% below 1990 levels by 2030, 10% away from its goal
- Reductions thanks to reduced coal use and increased renewables (providing 18% of energy)
- Transportation is only sector where emissions are increasing
- Incoming EU President Ursula von der Leyen wants a 55% reduction by 2030



Source: Reuters, European Environment Agency

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LBE Council Spotlight: Innovation

Meeting Ambitious Goals Requires Innovation

Many entities are setting very aggressive GHG emissions reductions goals (e.g. net zero, carbon neutral, carbon negative) by 2050 or sooner

"Accelerating widespread clean energy innovation is an indispensable part of an effective, long-term global response to our shared climate challenge…" –Mission Innovation Launch Statement, on behalf of over 24 countries at COP21

Source: CarbonBrief, Mission Innovation

What is Innovation?

Merriam-Webster SINCE 1828

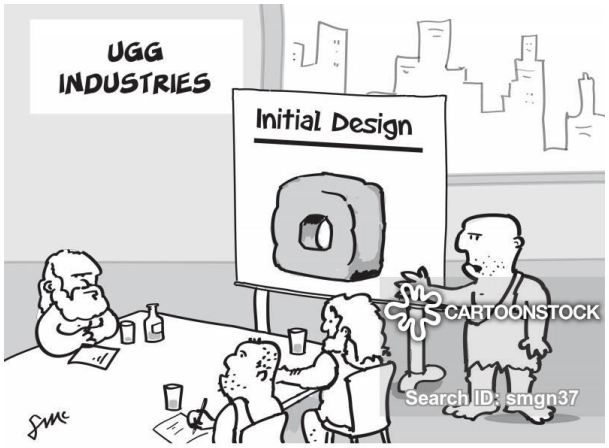
innovation noun

in·no·va·tion | \ ˌi-nə-ˈvā-shən \

Definition of *innovation*

1 : the introduction of something new

2 : a new idea, method, or device : NOVELTY



"OK everyone, we want fresh ideas. There's no point in reinventing the... the... errrmm..."

"Innovation is the unrelenting drive to break the status quo and develop anew where few have dared to go."

Steven Jeffes, Marketing & business expert

"Creativity is thinking up new things. Innovation is doing new things."

Theodore Levitt (1925 – 2006), Renown economist

"If at first the idea is not absurd, then there is no hope for it."

Albert Einstein (1879 – 1955), Mathematician

"If I had asked the public what they wanted, they would have said a faster horse."

Henry Ford (1863 – 1947), Founder of Ford Motor Company

Source: Viima, Lynda.com

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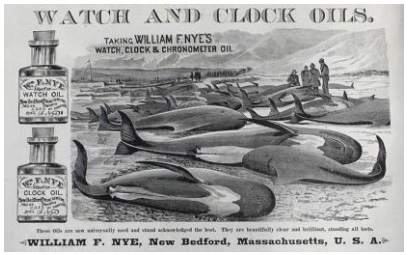
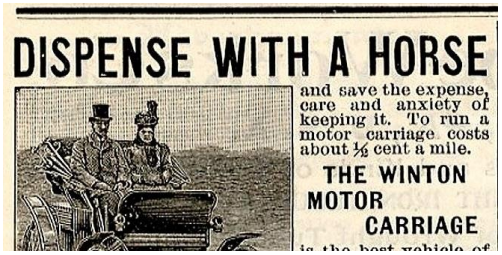
Innovative Tech Through History

1840s: Whale oils



1880s: Electricity

1890s: First Automobiles



1890s: Natural gas replaces coal-gas for lighting

1920s: Phones

1940s: Television

1970-80s: First Personal Computers

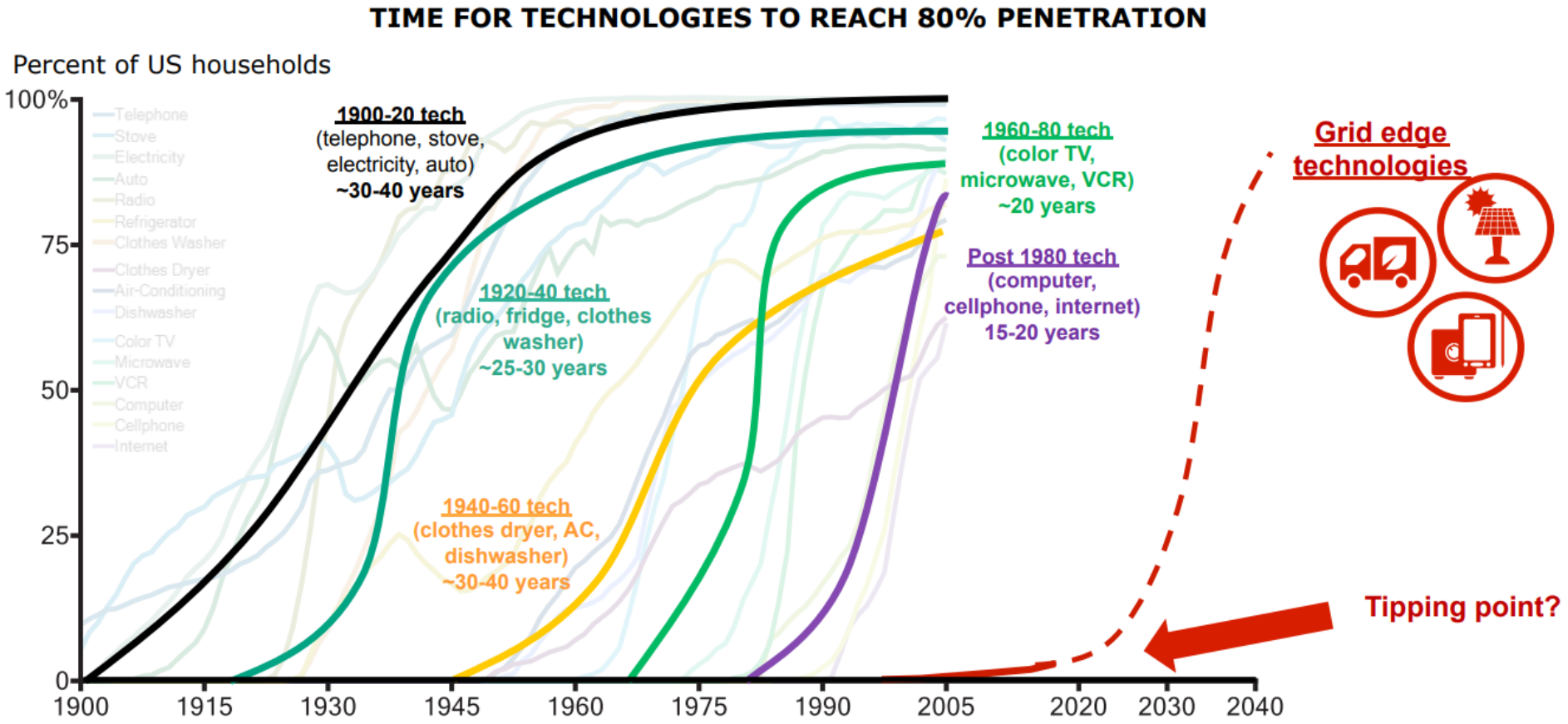
1970s: VCR

1980s: Mobile Phones

Today: Smart Phones

Future: TBD

The Technology Adoption S-Curve



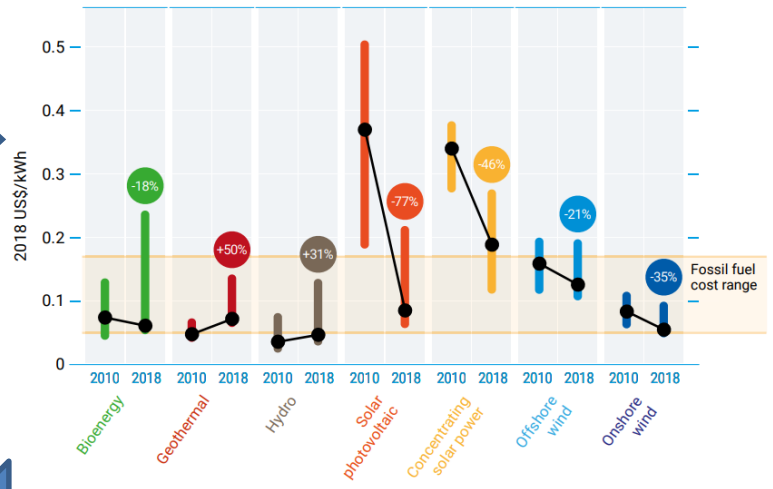
Grid edge technologies = renewables, electric vehicles, smart grid tech, etc

Source: World Economic Forum

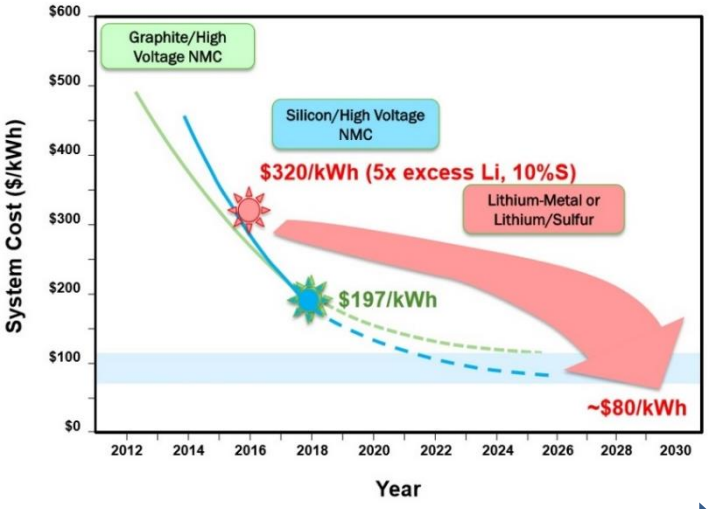
Declining Costs of Clean Energy Tech

Cost of new renewable power generation declining more rapidly than previously predicted

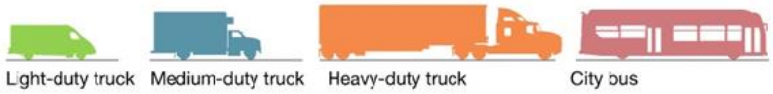
Figure ES.5. Changes in global levelized cost of energy for key renewable energy technologies, 2010-2018



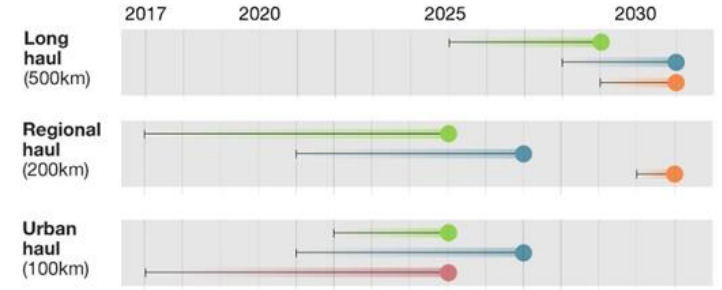
Investments in battery tech rapidly driving down battery costs, faster than predicted



EVs predicted to reach cost parity with conventional cars by 2024, most trucks by 2035



Timing of battery electric vehicle total cost of ownership parity with diesel vehicle, year achieved range



Sources: UN Environment Programme, Forbes, EPA.gov, Mckinsey

Innovation in Transportation: Electric Planes, Boats, and Automobiles

EV Pick-Up Trucks Coming Soon

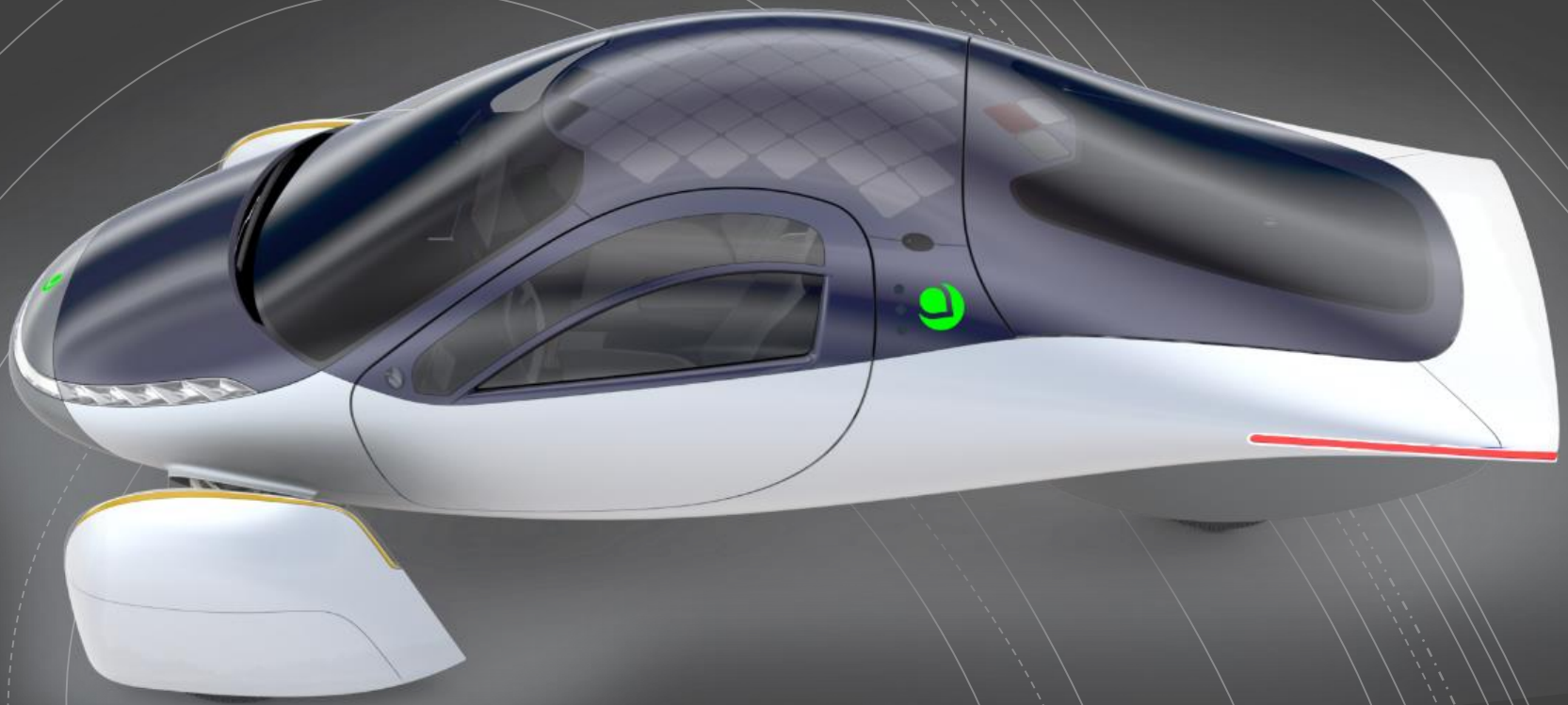
	Miles/charge	Hauling capability	Release date	Estimated price
Tesla 	*250-500 miles*	*3,500 lbs*	*Late 2021*	*$39,000-$69,000*
Atlis XT 	*300-500 miles*	*5,000 lbs*	*Late 2020*	*TBD*
Rivian R1T 	*230-400 miles*	*1,800 lbs*	*Late 2020*	*$69,000-$100,000*

Source: Inside EV News

Alternative Fuel for Public Transit

- World's 2nd largest ferry operator (WA) to switch 22 ferries to batteries or hybrids, will reduce annual diesel consumption by ~20 million gallons
- London will be the first to use hydrogen fuel cell double decker buses, rolling 20 buses out across three of its central routes

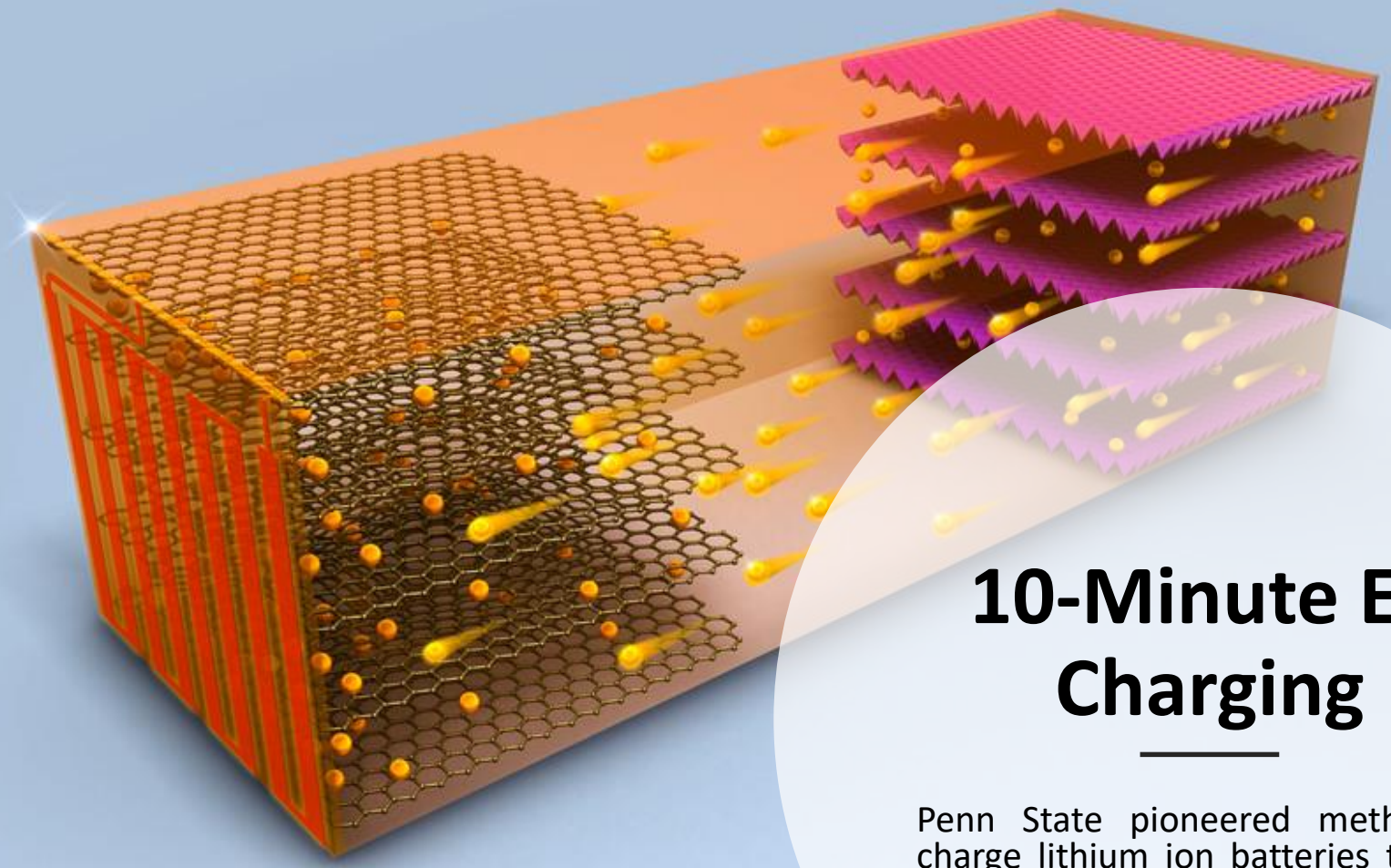
Source: The Guardian, Independent, Green Tech Media



Never-charge Electric Vehicle

- The Aptera promises 1,000+ miles on a charge, 40+ miles from integrated solar panels
- First prototype achieved over 300 MPGe

Source: Wefunder



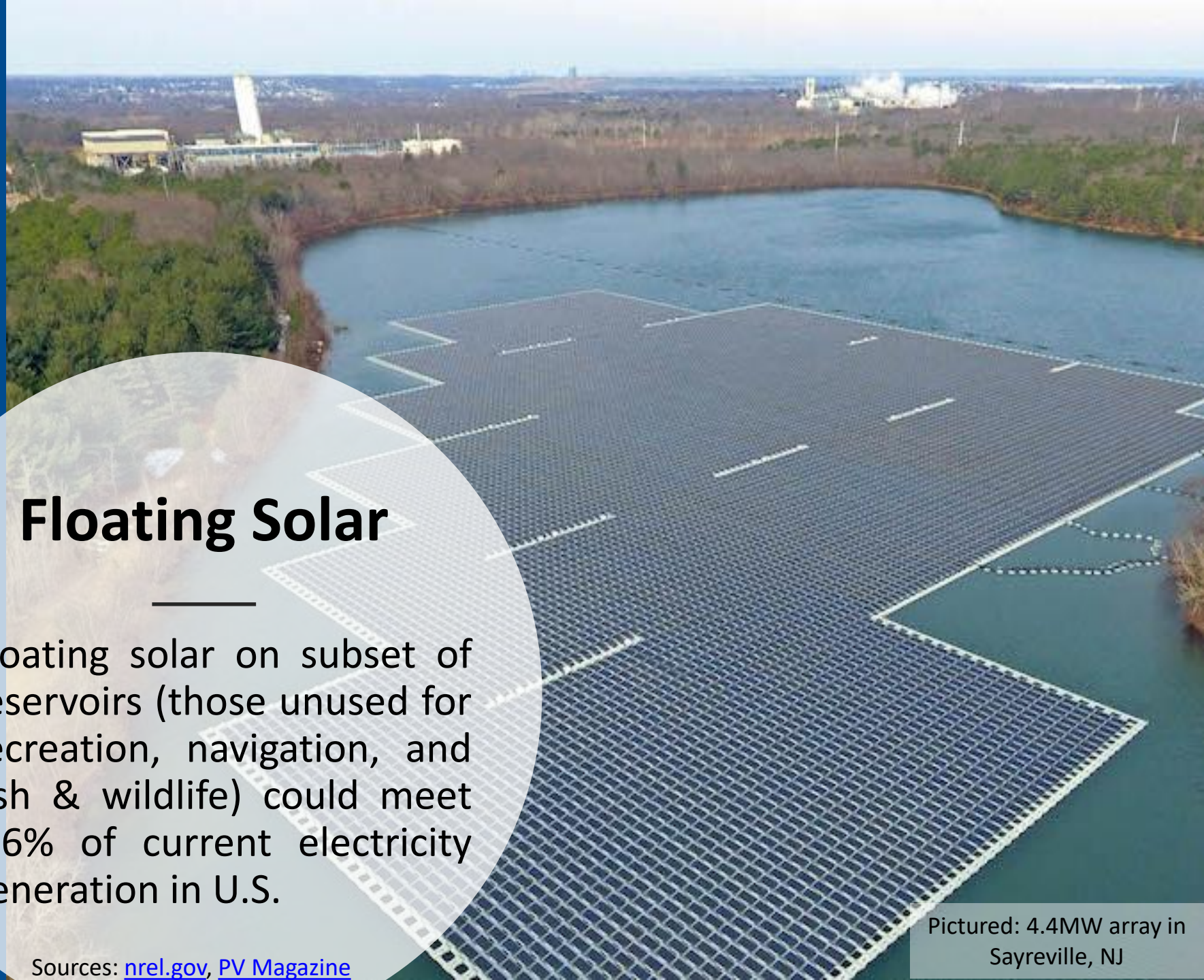
10-Minute EV Charging

Penn State pioneered method to charge lithium ion batteries to 80% capacity in 10 minutes by heating them to 140°F

Innovative Solar and Wind

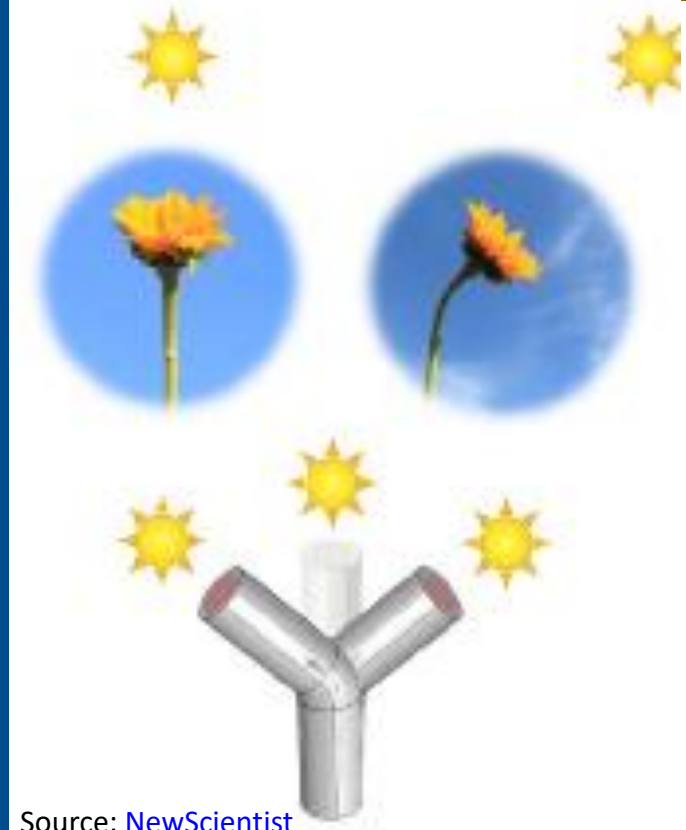
Floating Solar

Floating solar on subset of reservoirs (those unused for recreation, navigation, and fish & wildlife) could meet 9.6% of current electricity generation in U.S.



Pictured: 4.4MW array in Sayreville, NJ

Sources: nrel.gov, PV Magazine



Mimicking Sunflowers for Solar Power

1mm-wide “SunBOTs” stems shrink in sunlight, causing panel to point towards sun and increasing solar intake up to 400%

Source: NewScientist

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Solar “Oven” Could Create Cement, Steel

Heliogen used AI & field of mirrors to generate heat in excess of 1,000°C

Source: CNN

Micro Wind Turbines

Halo Energy is piloting a 12-foot, 6-kW turbine effective in low winds with an estimated payback period of less than 1 year in ideal wind regimes

Source: WindPowerEngineering

Innovation in Energy Storage, Beyond Batteries

1414 Degrees: Energy Storage via Molten Silicon

- Clean energy used to create molten silicon to be stored and used as both heat and electricity
- In South Australia, 400 MW solar will be paired with grid-scale thermal storage system

Sources: 1414 Degrees, PV Magazine

Energy Storage via Liquid Air

50 MW storage facility in VT will liquify air by cooling to -320F. During high-demand periods, pressurized gas warms to turn turbine for up to 8 hours.

A demonstration project of the liquid-air storage at the Pilsworth Landfill in Manchester, England. Photo: Highview Power

Source: Concord Monitor

Power-to-Gas (P2G) Plants

- Excess renewable electricity can be used to create hydrogen or renewable natural gas to be stored and used when needed most
- P2G plants currently run in CO, CA, Germany, Denmark, and Switzerland

Source: Portland Press Herald, PowerMag.com

Part of a 2-MW power-to-gas plant in Falkenhagen, Germany

Innovation in Fuels: Renewable Gas and Hydrogen

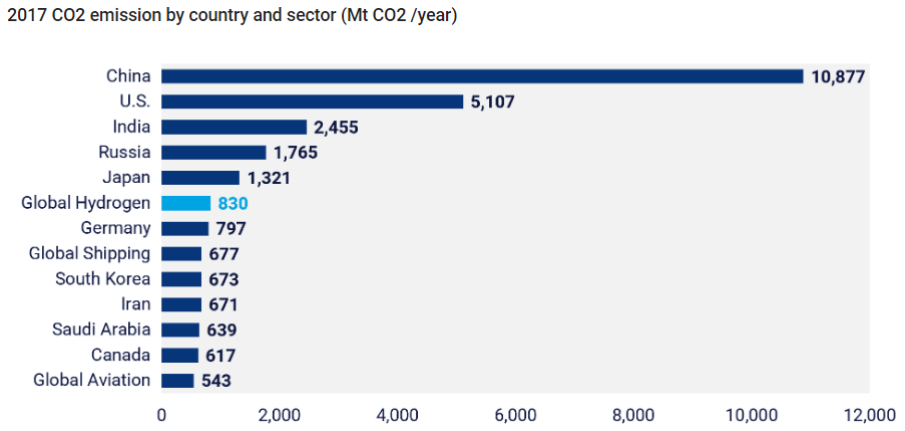
Gas-to-Power "Plants"

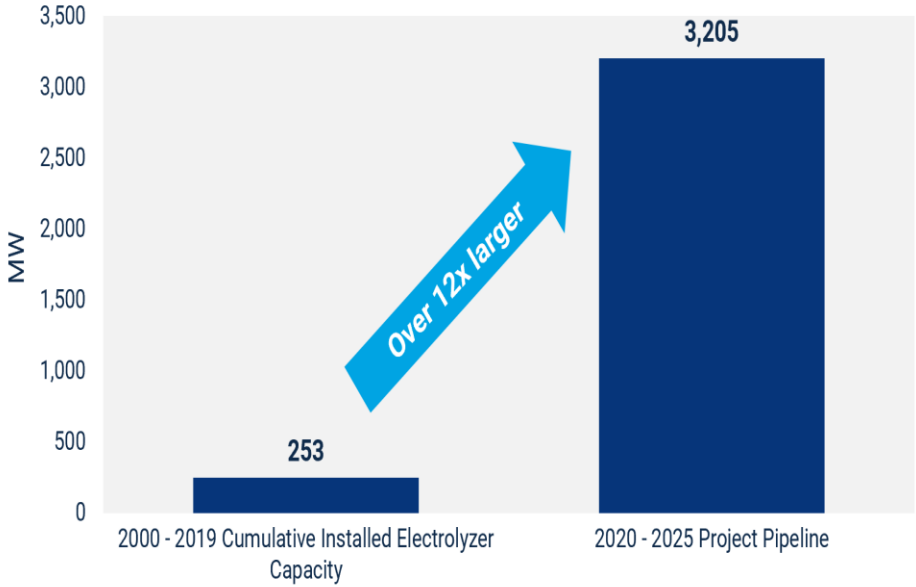
- Dominion Energy to develop and operate facilities in GA, NV, CO, NM, and UT to use methane from cow manure as natural gas
  - $200 mil project will reduce emissions equivalent to nearly 100,000 cars
- Summit Utilities in Maine will meet 45% of customers' gas demand with natural gas sourced from cows

Source: Summit Utilities Inc, Seattle Times

Hydrogen Production on the Rise

- 99% of hydrogen is currently produced using fossil fuels
- Green hydrogen expected to be cost-competitive with FF-based H in some countries by 2030, mostly using electrolysis powered by renewables

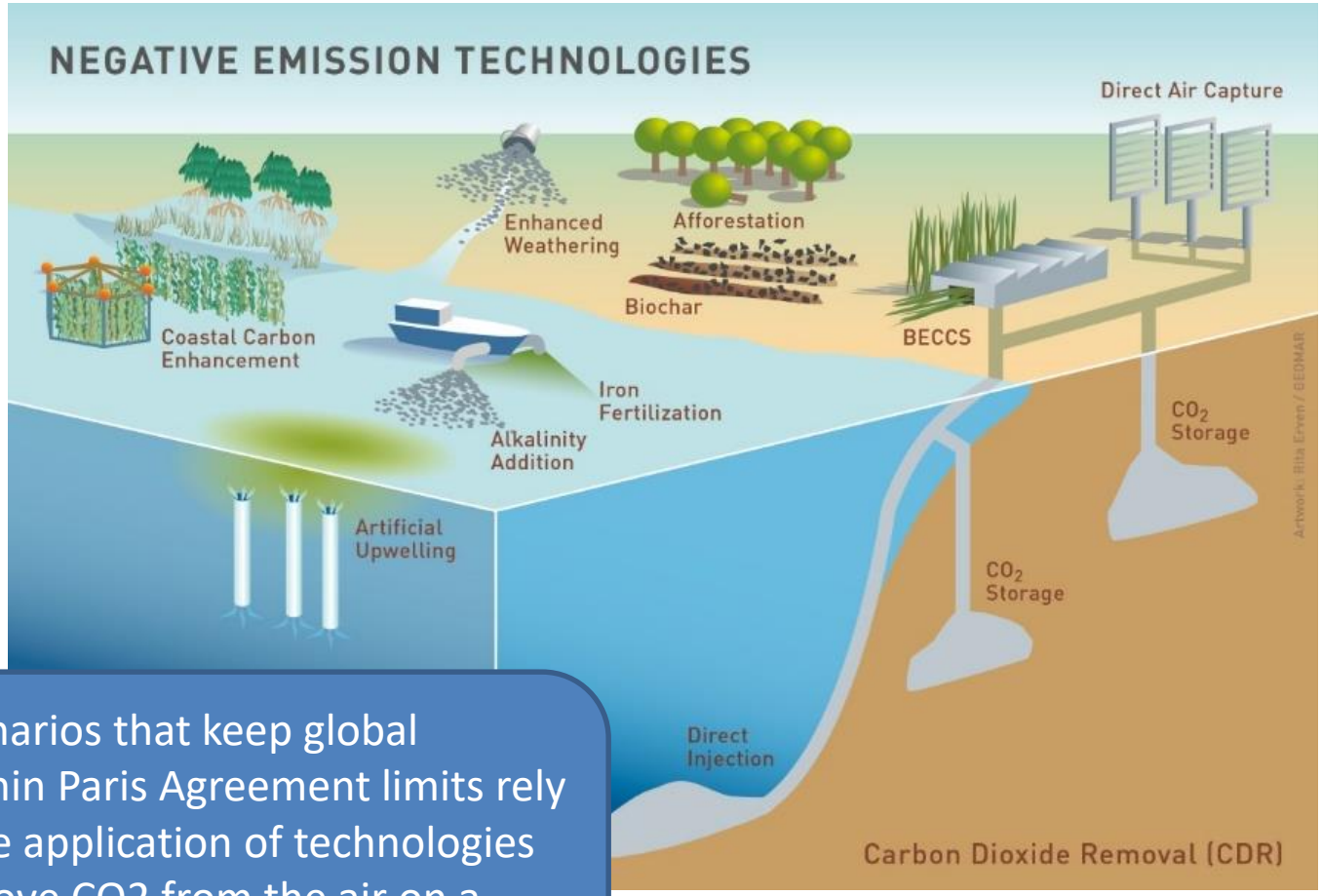




Source: Woodmac.com

Innovation in Carbon Sequestration: Buildings as Carbon Sinks

Atmospheric Carbon Removal Will Require Multiple Technologies



"Climate scenarios that keep global warming within Paris Agreement limits rely on large-scale application of technologies that can remove CO2 from the air on a huge scale." – European Academies Science Advisory Council, 2018

Source: PhysicsWorld, UNFCCC

Cement and Carbon Sequestration

CarbonCure captures CO_2 from industrials emitters and injects it into concrete, where it reacts with calcium to form and trap calcium carbonate minerals

360,000sq ft building, 725 Ponce in Atlanta, GA, was built with CarbonCure concrete to save 1.5 million lbs of CO_2

Source: Forbes

Algae Bioreactors

- Eos Bioreactors absorb CO2 from building systems and produce algae for food, fertilizer, cosmetics, or fuel
- A German building's façade composed of algae bioreactors sequesters 6 tonnes of GHG annually and provides a sustainable source of biomass for heating

Sources: FastCompany, Buildup.eu

Innovation Speakers: Programs and Case Studies in MA

State-Wide Innovation Programs

- Greentown Labs: Innovative Technology on the Horizon in MA (Jessi Duston)
- MassCEC Updates: Innovative Building and Transportation Programs (Amy Barad)

Agency/Campus Innovation Case Studies

- DEP's Growing Electric Vehicle Fleet (Chris Voss)
- UML's Urban Agriculture and Sustainable Landscaping (Ruairi O'Mahoney)
- UMD Master Energy Planning Process (Jamie Jacquart)
- UMA's Energy Storage and Management (Ezra Small and Steven Lemay)
- RCC's Center for Smart Building Technology (Frank Mruk)
- DYS Biomass Heat: Boiler Replacement DCAMM Energy Project (Kaitlyn Menyo)

THE LARGEST CLEANTECH INCUBATOR IN NORTH AMERICA

Overview 2020

January 14, 2020

Jessi Duston
Development Coordinator
Greentown Labs/UMass Lowell

GREENTOWN LABS

MEET GREENTOWN LABS

Our mission is to foster a passionate community of entrepreneurs committed to solving the world's biggest climate and environmental challenges by providing the resources and labs they need to succeed.

Community

We cultivate a supportive, creative community of cleantech companies

Climate

We fight for sustainable, innovative climate and cleantech solutions

Collaboration

We facilitate idea exchanges and partnership opportunities

Connection

We bring together people from throughout the cleantech ecosystem

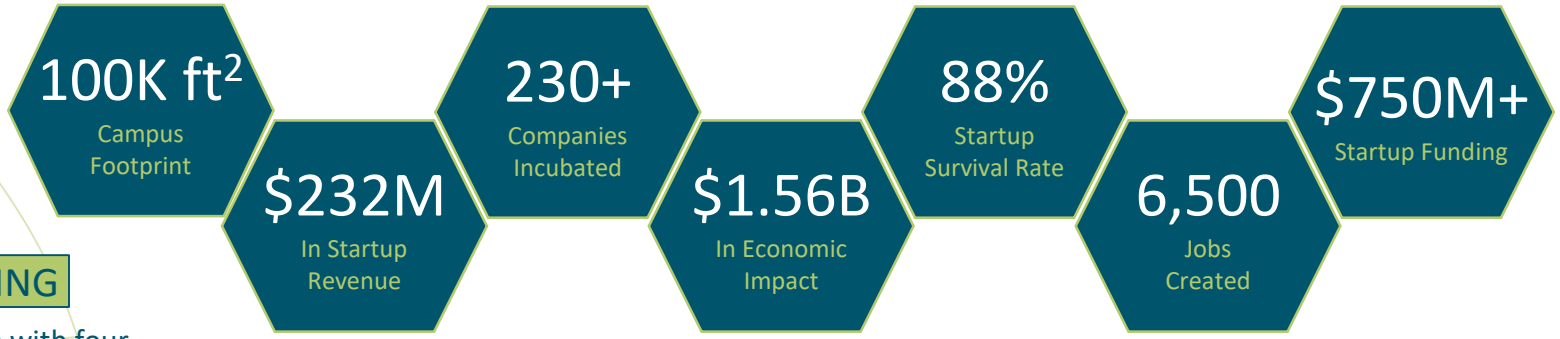
UMass Lowell Joins Greentown Labs as Gigawatt Sponsor

Partnership Aims to Support Clean Energy Commercialization through Cross-Collaboration among Students, Faculty, Entrepreneurs

Partnership Features:

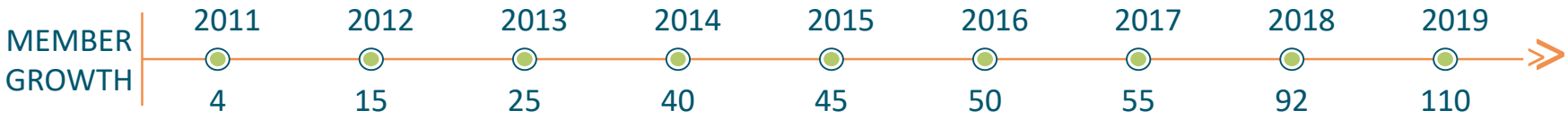
- Jointly facilitated events focused on clean energy research;
- Co-authored and co-run research projects and proposals;
- Programming and research dedicated to energy storage innovation and deployment across the Commonwealth;
- Shared access to each entity's breadth of resources for startups, students and faculty, including UMass Lowell's Core Research Facilities;
- A Faculty-in-Residence program at Greentown Labs for a member of UMass Lowell's faculty;
- Access to UMass Lowell's Global Entrepreneurial-in-Residence program for Greentown Labs' startups; and
- A staff coordinator from UMass Lowell who will support both organizations and work to facilitate connections between the two.

GREENTOWN COMMUNITY BY THE NUMBE



OUR FOUNDING

A warehouse with four startups looking to share rent and resources.



MEMBER RESOURCES

Members gain access to more than $1M in resources!

From hardware equipment to software tools to legal services, we provide startups with the resources they need to thrive.

LAB RESOURCES

- PROTOTYPING LAB
- BSL-1 WET LAB
- MACHINE SHOP
- ELECTRONICS LAB

SOFTWARE

ANSYS, Altium, SOLIDWORKS, MathWorks, AUTODESK

PROFESSIONAL SERVICES

FOLEY HOAG LLP, Lux Research, CHUBB, Wolf Greenfield SPECIALISTS IN INTELLECTUAL PROPERTY LAW

UNIVERSITY RESOURCES

FACILITY ACCESS

UMASS LOWELL, Center for Nanoscale Systems, Harvard University

PUBLICATIONS

UMASS LOWELL

ONSITE DEPLOYMENT

9 MEMBER COMPANIES HAVE PILOTED THEIR TECHNOLOGIES AT GREENTOWN LABS

MEMBERS AT A GLANCE

The “Typical” Greentown Startup

No two Greentown members are the same, but once they’re settled into the community, a member profile often includes:

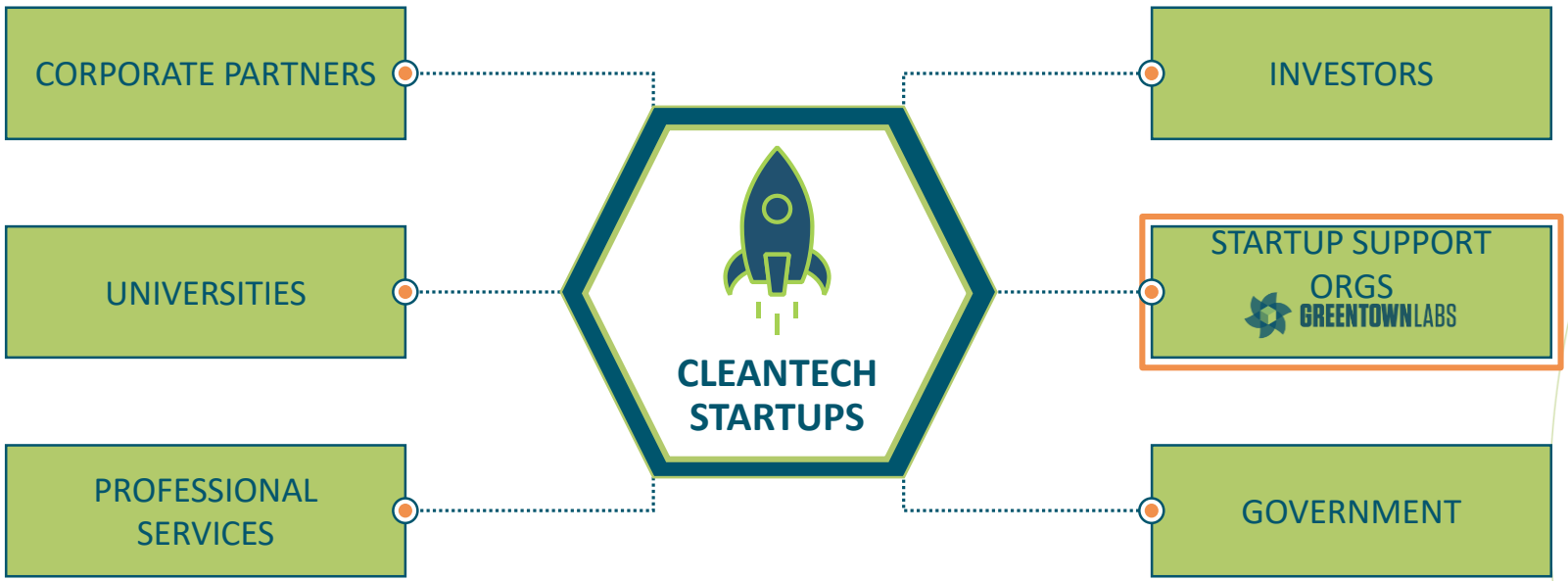
- 10 EMPLOYEES
- $5M IN FUNDING
- Level 7 TECH. READINESS
- 2 Years AT GREENTOWN

We purposefully define cleantech broadly as “doing more with less” and support entrepreneurs in key carbon emitting sectors:

- ELECTRICITY
- TRANSPORTATION
- BUILDINGS
- AGTECH + WATER
- MANUFACTURING
- PLATFORM TECHNOLOGY

ECOSYSTEM ACCESS

Greater Boston offers strong support for cleantech startups



GREENTOWN LAUNCH

From first meeting to first contract

Greentown Launch is a 6-month accelerator program that identifies, incubates, and prepares startups and corporates for partnership.

> *Through partnering with Greentown Labs, we will be able to leverage our in-market expertise, resources and network of contractors, distributors and builders to help startups grow and scale their businesses. By exchanging ideas, we can help startups develop a tailored solution that benefits both parties while improving the built environment value chain.*
>
> — **Minas Apelian, Vice President of Internal and External Venturing at Saint-Gobain**

INNOVATE 2019 CHALLENGE
DISRUPTING THE BUILT ENVIRONMENT

OUR STORY

Where we started + where we're going…

2011

4 clean energy startups sharing space **4,000 SQ FT**

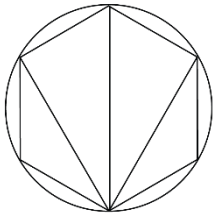
2013

Nation's largest Cleantech incubator **54+ startups, 40,000 SQ FT**

2017+

Global center for cleantech innovation 100+ startups **97,000 SQ FT**

Technology Highlights



MASSACHUSETTS CLEAN ENERGY CENTER®

MassCEC INNOVATION UPDATE

Amy Barad, Program Director

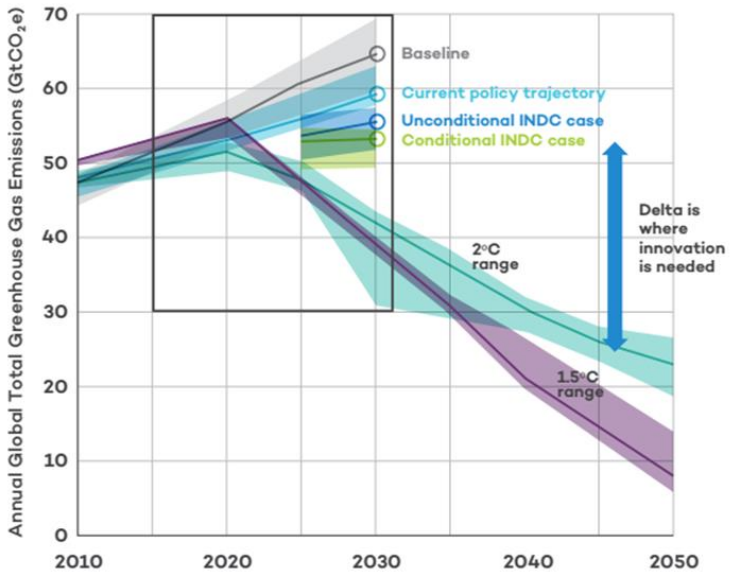
January 2020

MISSION: GROW THE STATE'S CLEAN ENERGY ECONOMY WHILE HELPING TO MEET THE COMMONWEALTH'S CLEAN ENERGY, CLIMATE AND ECONOMIC DEVELOPMENT GOALS.

HOW: MassCEC fosters innovation in:

- Technology development
- Company development
- Policy/regulatory and market development
- Financing models
- Business models
- Programmatic innovation

Meeting Deep Decarbonization Goals Will Require Significant Investments in Innovation



Model forecasts indicate that the world is not on a course to stay below the 2-degree Celsius limit with current INDC commitments. Significant innovation will be required to bridge the policy gap.

Source: Energy Futures Initiative (EFI), 2018. Modified from UNEP, The Emissions Gap Report 2017.

$229M awarded
to residents, businesses
and communities

Over **45,000**
Systems Supported

$60M awarded to
low-moderate
income residents

SINCE 2010, INNOVATIVE MASSCEC PROGRAMS HAVE INCREASED THE DEPLOYMENT OF RENEWABLE ENERGY TECHNOLOGIES

157 MW
Solar

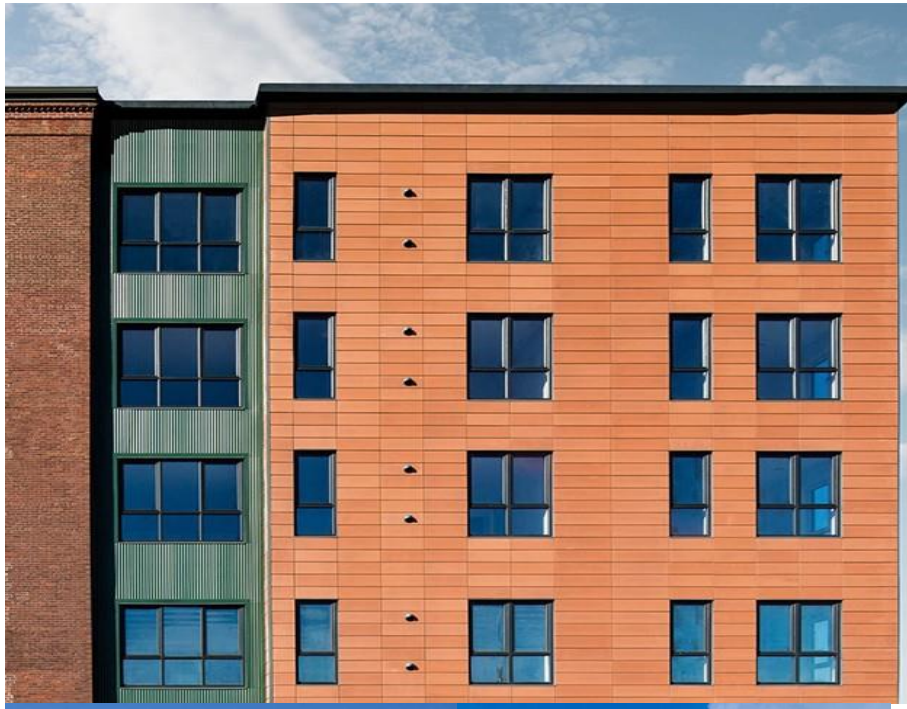
5,100 solar loans
supported
$164M in loan value

$1B in private
capital leveraged

240 MW
clean heating +
cooling

PASSIVE HOUSE DESIGN CHALLENGE

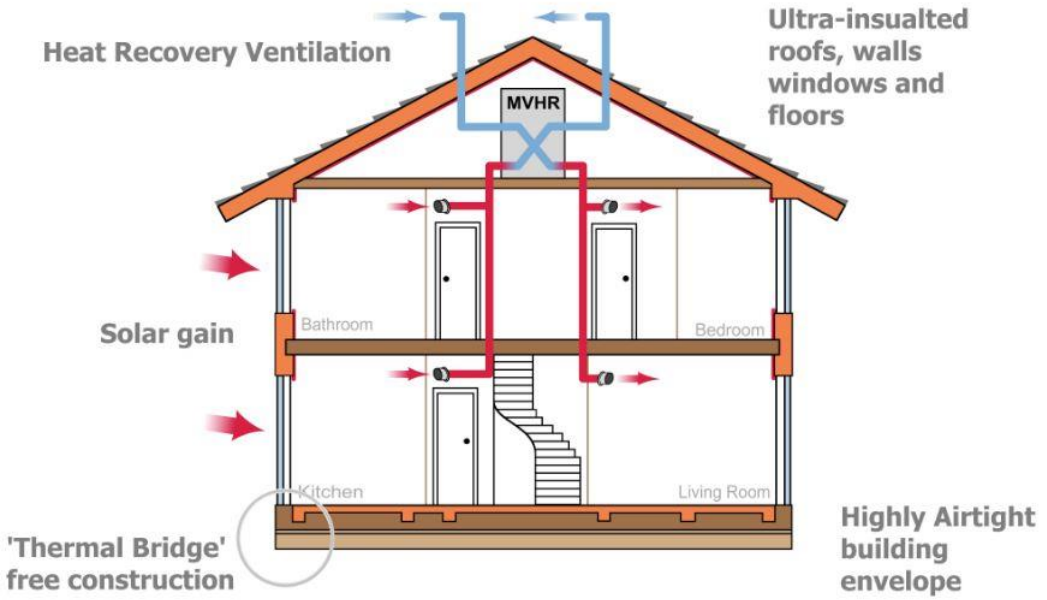
GOAL: Demonstrate multi-family housing can be built to Passive House standard at NO to LOW cost premium



MASSACHUSETTS CLEAN ENERGY CENTER®

PASSIVE HOUSE PRINCIPLES

- Very high levels of insulation
- Airtight construction
- High performance windows/doors
- Heat recovery ventilation system to provide fresh air
- Manage solar gain
- Smaller heating and cooling systems
- Much more **verification** than LEED on energy performance
- ***Not just for residential buildings***



PASSIVE HOUSE DESIGN CHALLENGE

- Eligible Participants: Affordable LIHTC multifamily new construction
- MassCEC incentive: $4,000 per unit
  - Staged through PH certification process
- Approx $1.7 million awarded
- 8 Pilot projects funded
- 30-135 units each
- Over 500 affordable apartments

PASSIVE HOUSE DESIGN CHALLENGE: STATUS

Awardee project status:

- 1 to be occupied in April
- 5 breaking ground this year
- 2 awaiting approval of tax credits

Info on cost premium:

- Applicants all expect cost premium of less than 3% over conventional construction
- Independent evaluator will examine costs when complete

Finch Cambridge:
$42.5 million new construction
98 Affordable Units
Resilient design, Solar PV, near Alewife T

PASSIVE HOUSE NEW CONSTRUCTION MULTI-FAMILY INCENTIVES (4+ STORIES)

- Up to $5,000 for Passive House Feasibility Study
- 75% up to $20,000 for Passive House energy model
- $3,000 per unit if certify

Contact: Kristen Simmons- 617.549.0332
kristen.simmons@icf.com as early as possible

**Single family and low-rise Incentives coming soon

COMMERCIAL NET ZERO ENERGY AND PASSIVE HOUSE NEW CONSTRUCTION INCENTIVES

- Eversource and National Grid are considering an incentive program
- Will likely be for envelope and efficient systems only (not renewables)
- Contact your utility

ACCELERATING CLEAN TRANSPORTATION NOW (ACT NOW)

MASSACHUSETTS CLEAN ENERGY CENTER®

Goal:

Catalyze the adoption of Clean Transportation solutions that pilot innovative, scalable business and financing models

ACT NOW PROGRAM
INNOVATIVE DEMONSTRATION/PILOT TOPIC AREAS

Light-duty vehicles

Financing models

Delivery and education models

Verifiable trip reduction and/or mode switching

Medium- and heavy-duty vehicles

Financing models

Verifiable trip reduction

Mass transit

Financing and maintenance support models

Models to service first mile/last mile transit needs

Models to enable intermodal transit

Other

Vehicle-to-grid technology

Price-responsive electric vehicle charging

Open applicant proposals

ACCELERATING CLEAN TRANSPORTATION NOW

Projects Supported

- Clean transportation demonstration projects that pilot innovative, scalable business and financing models
- Program details: https://www.masscec.com/actnow-0 (see Additional Resources for webinar or slides)

Funding

- $1.4 million program budget
- $50k-$200k per grant
- 50% standard cost share requirement; 25% cost share allowed for projects that benefit Environmental Justice Communities.
- Applications due March 3, 2020; awards by June, 2020

Collaboration Platform: http://bit.ly/ACTNowSlack

Online matchmaking platform to network and identify potential project partners

Electric Vehicles at MassDEP:

Reforming the Department's Fleet

Chris Voss, Director, Administrative Services

DEP Structure and Vehicle Fleet

DEP Vehicle Fleet by Regional Office

Location	Vehicles
HQ - Boston	11
Northeast - Wilmington	21
Southeast - Lakeville	12
Central - Worcester	17
Western - Springfield	11
WES - Lawrence	17
Total	89

BEVs arrive at DEP

MassDEP

BEVs Current Status

As of Spring 2020, BEVs will comprise 11% of MassDEP's fleet

Bolt Procurements		Turn-in Vehicles		
In Service	Number	Year	Make	Model
Jul 2018	5	2005	Ford	Taurus
		2005	Toyota	Prius
		2006	Ford	Escape 4x4 HEV
		2007	Toyota	Prius
		2008	Honda	Civic CNG
Mar 2019	4	2007	Honda	Civic CNG
		2007	Honda	Civic CNG
		2015	Ford	Transit Connect*
		2007	Chevrolet	Impala
Spr 2020	1	2005	Toyota	Prius

*Declared Total Loss due to collision

Total	10

BEVs Future Plans

- MassDEP Goal to add as many BEVs as feasible
- *MassDEP Electric Fleets Working Group* just established with the goals of:
  1. Increase availability of electric vehicles at MassDEP
  2. Increase availability of EV charging stations at MassDEP facilities to enable fleet expansion
  3. Implement policy changes to better capture EV charging infrastructure requirements into facility planning and procurement processes
  4. Increase EV and EV charging at other state agencies
  5. Share and continually update best management practices for EV/EV charging procurement and operation

Important Considerations for bringing EVs to your Organization

- Facilities equipped to handle EVs?
- Charging Infrastructure in place?
- Educating Staff
- Procurement Resources
  - Statewide Contracts:
    - VEH98 - Purchase of Vehicles Statewide
    - VEH102- Advanced Vehicle Technology Equipment, Supplies and Services Contract: *Category 1: Electric Vehicle Supply Equipment (EVSE), Hardware, Software, and Ancillary*

Final Note: Charger System Management

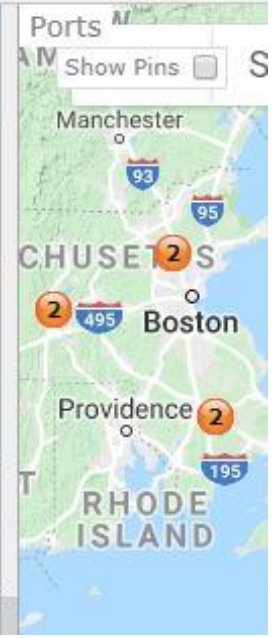
Stations Overview | Pricing and Reservations | Access Control | Video Ads | Station Messages | Waitlist | Remote Stop Charging

Table View | Org/Group View | Status View

Pinpoint New Station | Activate New Station | Create Group | Export Summary | --Export--

Show/Hide Columns | Showing 1 to 3 of 3 entries

Station Name	Org Name	MAC Address	System S/N	Address 1	Address 2	Floor Label
SERO / MASSDEP SERO	MassDEP Lakeville	0024:B100:0003:2C44	184841031004	18-26 Riverside Dr		
MASSDEP - CERO / MASSDEP CENTRAL	MassDEP-Worcester	0024:B100:0002:1499	143141005950	8 New Bond Street		
DEP WILMINGTON / DEP WILMINGTON	MassDEP Wilmington	0024:B100:0002:D6A6	182241009908	205 Lowell St		



UMass Lowell's Innovation in Urban Farming, Food Access in Lowell

Ruairi O'Mahoney
Director of Sustainability
UMass Lowell

LOWELL: UNIQUE URBAN SETTING

INNOVATION IN URBAN FARMING, FOOD ACCESS IN LOWELL

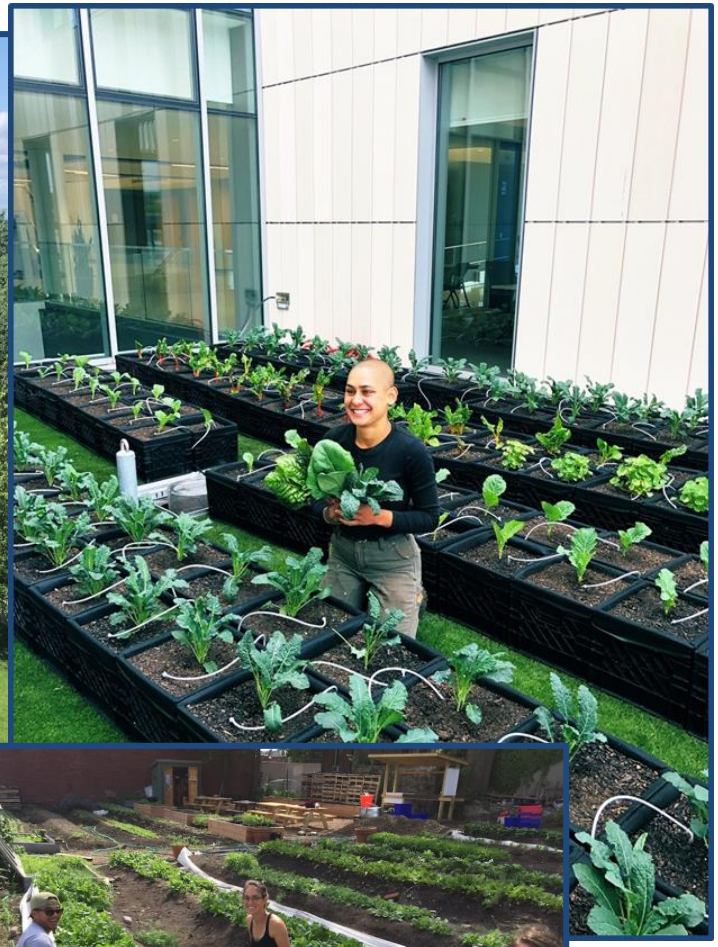
- The City of Lowell suffers from high levels of poverty, lack of access to fresh fruits & vegetables and high levels of adult and child obesity* Behavioral Risk factor Surveillance Data, Lowell Food Security Coalition's 2013 Community Food Assessment

- Local non-profit Mill City Grows needed secure access to land & year-round production space

- Desire to increase visibility of sustainability initiatives on the UMass Lowell Campus

- Faculty & Researchers interested in Food / Energy / Water Nexus – No viable site for hands-on research

BOTH ORGANIZATIONS CAME
TOGETHER TO FIND SHARED SOLUTIONS



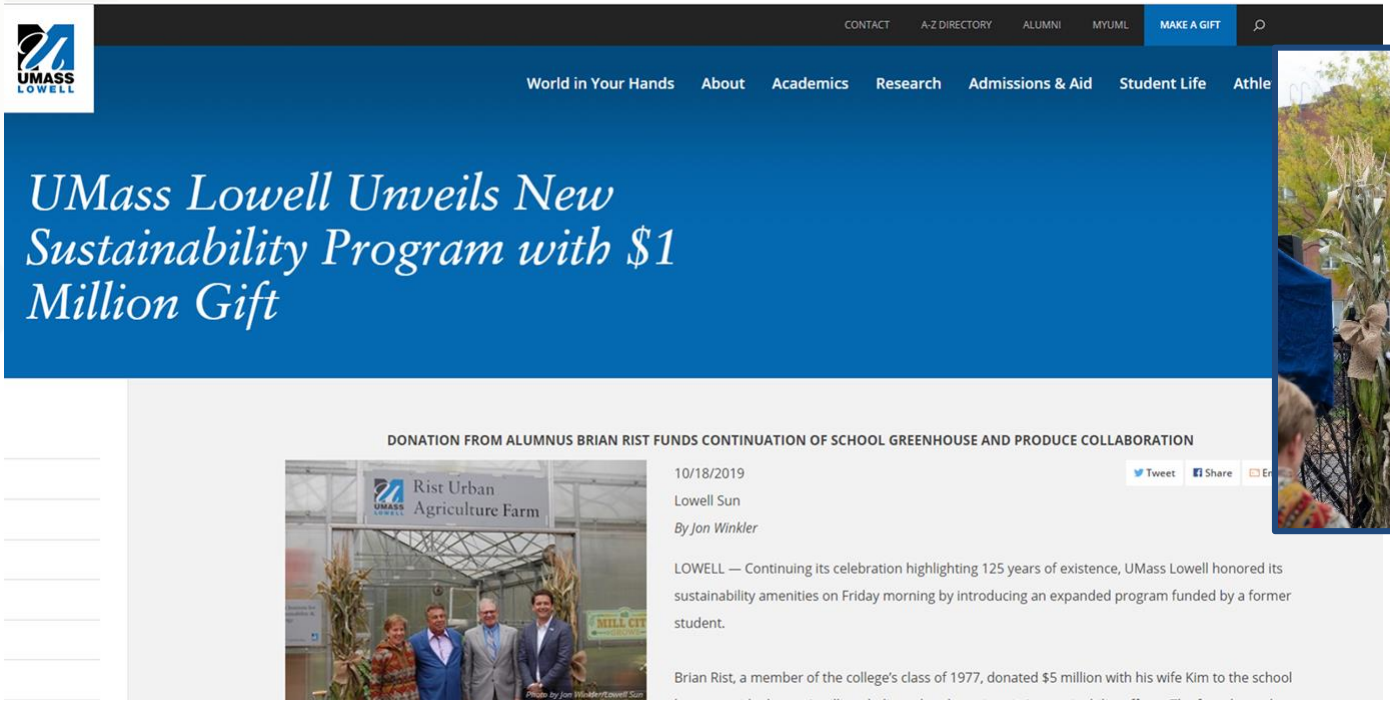
LESSONS LEARNED

- Community partnerships made the program possible and provided access to grant funding for commercial agriculture.
- Phenomenal interest across the campus, UMass Lowell alumni network and wider Lowell community. Once established, we were certain that there would be additional benefit and the university's involvement could really serve to elevate Urban Agriculture in Massachusetts
- Uncovered new markets and revenue stream for Urban Agriculture in Lowell
- ***Success of the program resulted in direction from Chancellor and Executive Cabinet to green the campus with a focus on partnerships unique to our urban setting***.
- Majorly elevated the sustainability program at UMass Lowell. As far as we know, no other campus is directly focusing on urban agriculture but we believe the UMass Lowell model is infinitely replicable & scalable.

SUSTAINABLE GROUNDS MANAGEMENT

PARTNERSHIP MOVING FORWARD

"Once established, we were certain that there would be additional benefit and the university's involvement could really serve to elevate Urban Agriculture in Massachusetts".



UMass Dartmouth's Energy Master Plan

Jamie Jacquart

Assistant Director of Campus Sustainability and Residential Initiatives

UMass Dartmouth

Why we needed one

- Goal to reduce our GHG's by 80% by 2050
- Conducted a campus-wide energy saving project in 2012
- Switched fuels, added a co-generation plant, solar, wind turbine
- Back-up oil tanks were compromised leaving us with a difficult backup source of fuel
- GHG reductions peaked at 16% then slid to 6% from baseline
- Aging infrastructure, $550M in deferred maintenance
- Annual utility expense roughly $10M

It’s time to Act!

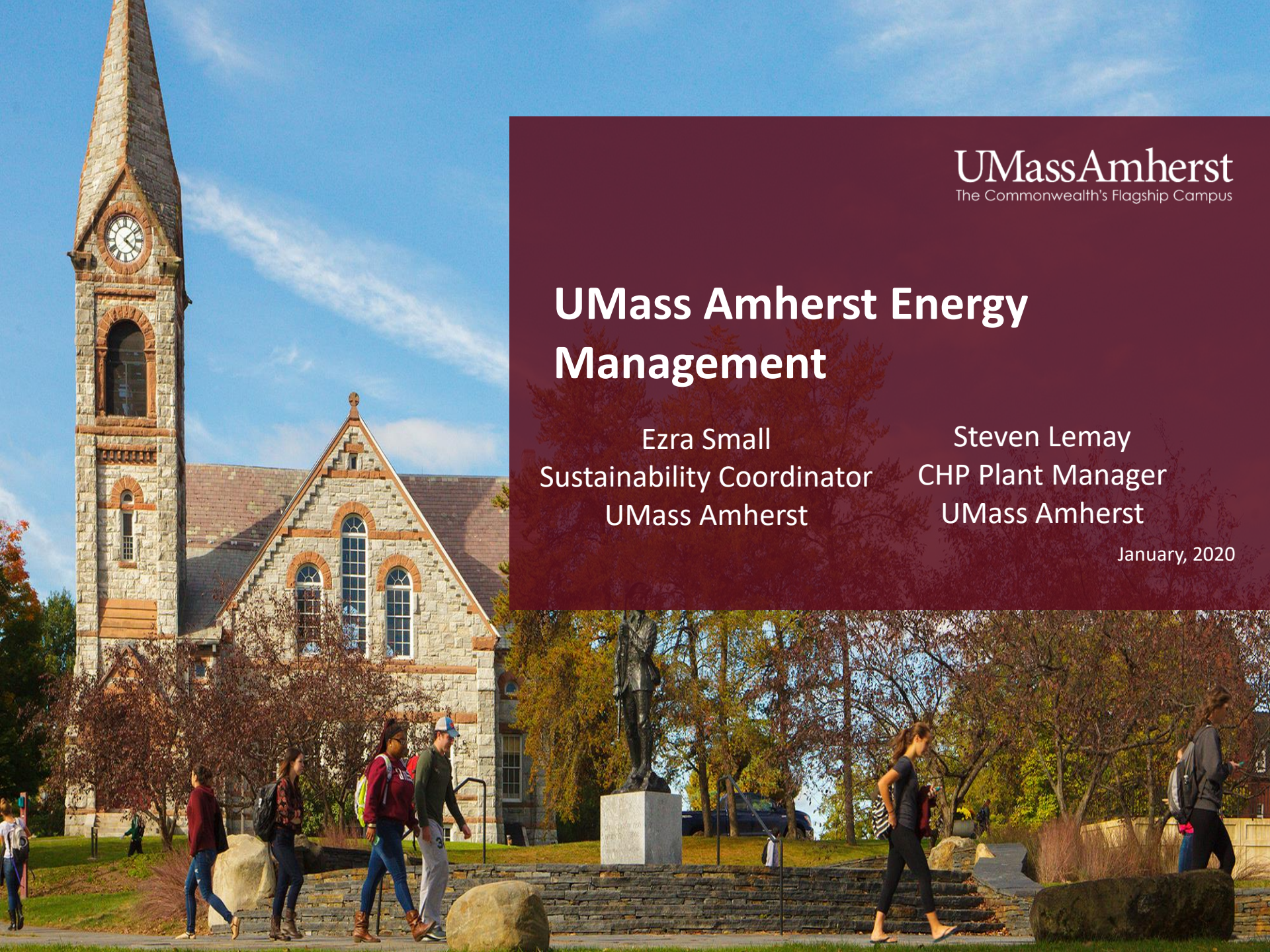
- Created an RFP starting in 2018, but could not fund it
- Funds became available in 2019 through the Alternative Energy Credits generated by the co-generation plant and payments finally came to the campus rather than DCAMM
- Pressure from our students and the Sunrise Movement to reduce our carbon emissions to ZERO by 2030 to be in line with additional scientific information available

Selection Process

- Utilized the services of Competitive Energy Systems to write the RFP as well as initially evaluate the bidders
- Shortened the list to 4 for interviews
- Selected 2 and conducted reference checks

Final Selection: Ramboll Engineering

- Long experience in the field
- Depth of experience with a variety of energy approaches
- Knowledge of the climactic challenges of the Northeast
- Experience with large, public institutions & capital funding challenges
- Experience with innovative approaches as things have changed in the past 5 years



UMassAmherst
The Commonwealth's Flagship Campus

UMass Amherst Energy Management

Ezra Small
Sustainability Coordinator
UMass Amherst

Steven Lemay
CHP Plant Manager
UMass Amherst

January, 2020

UMass Amherst At a Glance

UMassAmherst

Student population of over 28,000

Over the last decade, the campus has seen **17% increase in enrollment** and **22% increase in SF of facilities**

Approximately 1,300 full time faculty members and 5,000 other staff members

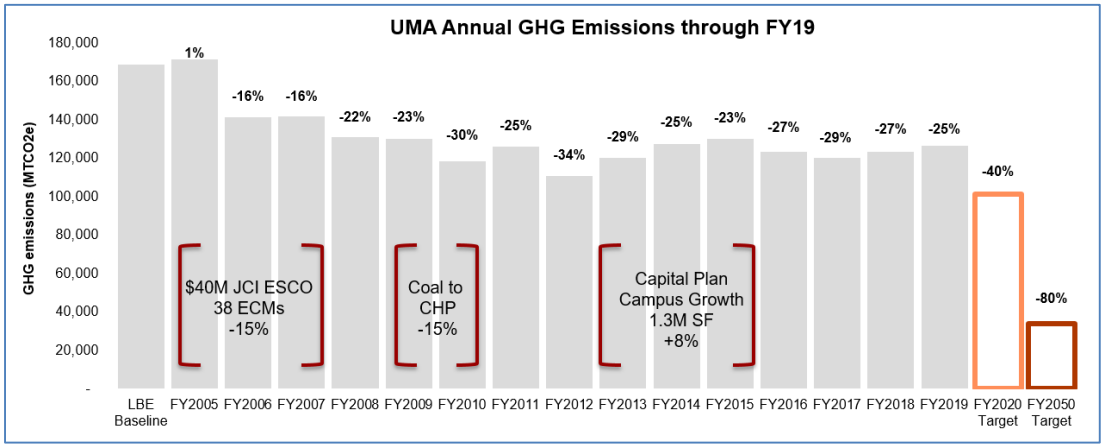
Recent expansion projects have added $1 billion in new facilities, buildings, and infrastructure to the campus since 2004.

Summary of energy use and losses:

Building Energy Use: 85%

Steam Distribution Heat Loss: 6%

In-Plant Steam Use for Process Loads: 9%

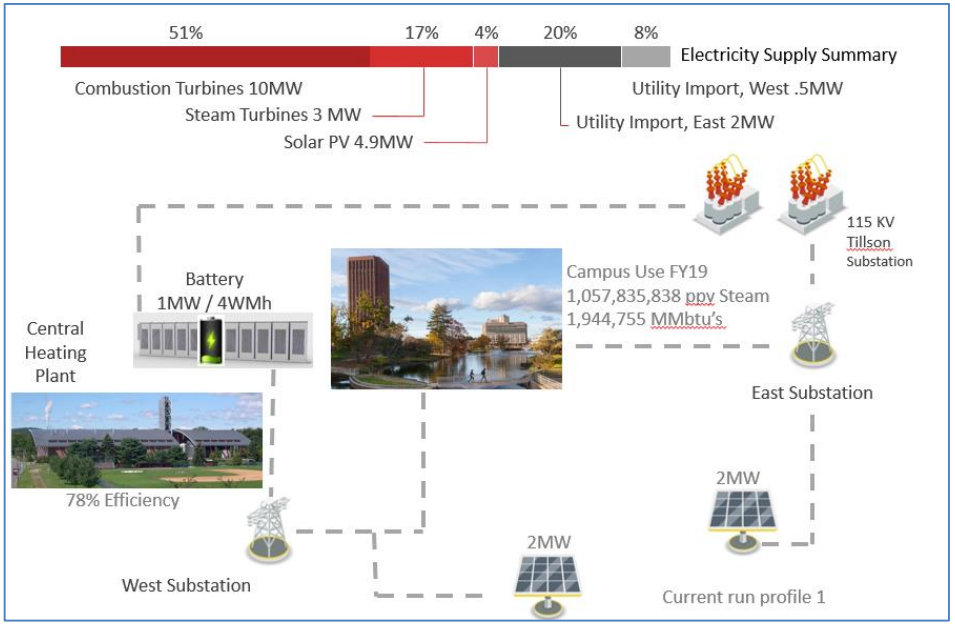


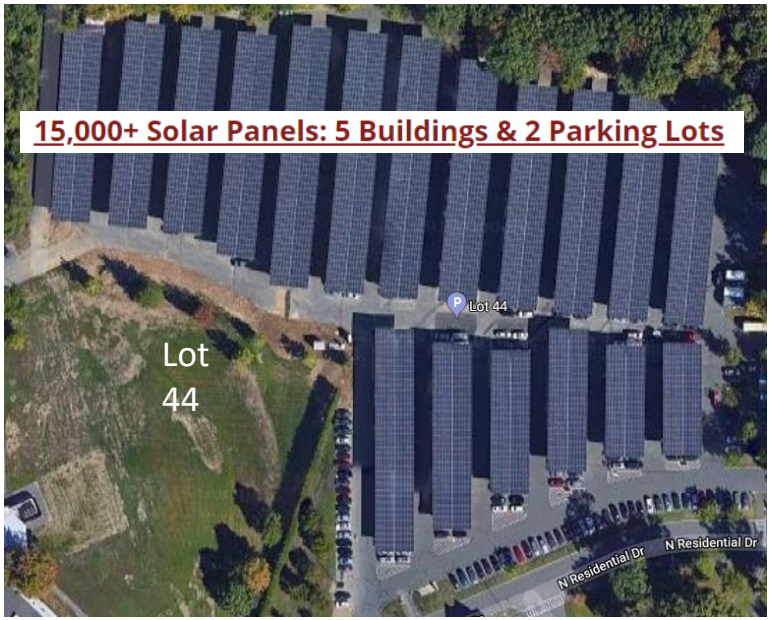
UMass Micro-Grid

UMassAmherst

Projects

Energy Command Center
Battery Storage
Solar Thermal
LNG Storage
Tillson 115kv Substation
Robsham Visitors Center – 300 kw
Parking Canopies/Rooftops- 5.5 MW





Energy Storage System (Battery)

UMassAmherst

1 MW/4MWh lithium ion battery installed by Borrego Solar Systems and operated by UMass Amherst

- Operations aim to reduce peak marginal capacity, help optimize onsite solar, and provide resiliency
- Comprehensive research initiative to be conducted by the UMass Clean Energy Extension
- Borrego to contribute $80,000 for educational initiatives not covered under ACES funding

PROJECT TEAM
University of Massachusetts Amherst, UMA Clean Energy Extension, Borrego Solar Systems

FUNDING AMOUNT
Requested ACES grant would cover 47% of $2.42 million total cost

SELECTION PROCESS
Extensive RFP and review process to select Borrego as project partner

Energy Command Center (ECC)

UMassAmherst

Market Data and Actions

TRACKED MARKET DATA

1. Electricity (LMP Day Ahead + Real Time)
2. Natural Gas Day Ahead
3. Static Contracted Prices and Volumes

CHARGE OR DISCHARGE BATTERY

Monitoring the cost of electricity and campus demand, operators can choose the best time to dispatch this resource.

MAKE OR BUY ELECTRICITY

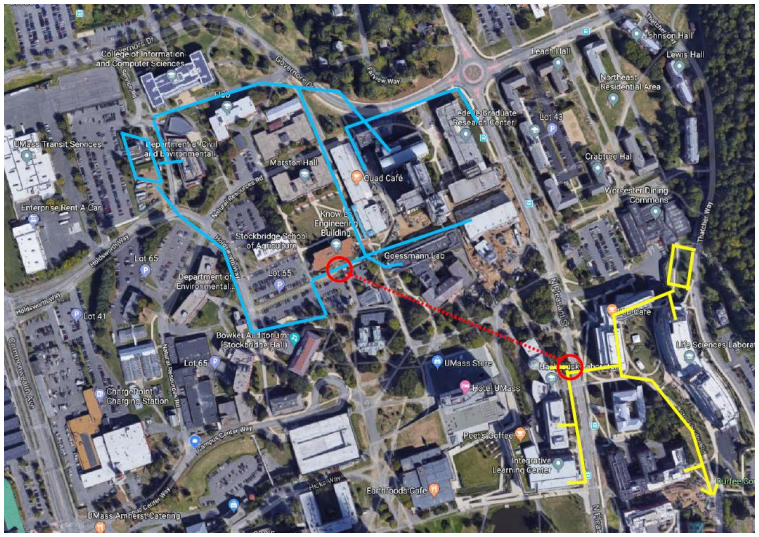
During market spikes, it may be more effective to back down generation and purchase from the grid

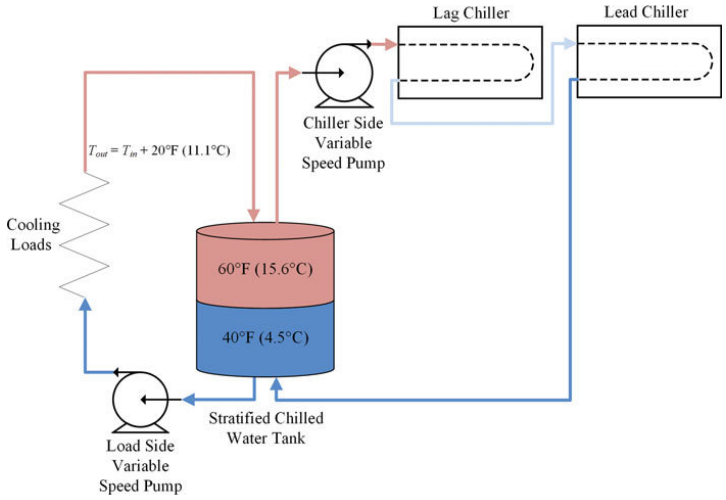
GOAL

Reduce operation cost by 3% or approximately $900,000 per year by making real time decisions on major equipment alignment based on current energy market prices.

Next Steps

- More Solar (Lots 22 & 49) + Battery Storage (3.5 MWh)
- Thermal Storage
- The Energy Command Center
  - Retro & Continuous Commissioning (Expansion of Analytics and Reporting)
  - Expanding user access to data
  - Additional visualization and reporting options
  - Energy Management and Fault Detection
  - Alert users to faults in real time
  - Design and production of advanced analytics and reporting
- Carbon Mitigation Plan
  - Explore electrification, low temp hot water, geo-exchange, renewable electricity procurement,
  - district heating/cooling, thermal storage, etc.
  - Using consultant and campus Taskforce





Lessons Learned

UMassAmherst

- Solar:
  - Code compliance (plumbing/stormwater)
  - Direct ownership model: O+M (inverter maintenance)
  - PPA model: Developers: over commit and under deliver
  - Have buyout and REC purchase terms in agreement

- Energy Storage:
  - Fire suppression!
  - Education of local officials before and during install
- Sub-station and Micro-Grid:
  - Relay coordination is difficult. Solar, batteries, gas turbine, and system can all trip system. Diversity = challenges
- Energy Command Center:
  - Integration is complex and difficult to standardize. You need to pick a system and get all assets talking to one system. Which products on market and then getting it to standardize (importing data and displaying data)

UMassAmherst

The Commonwealth's Flagship Campus

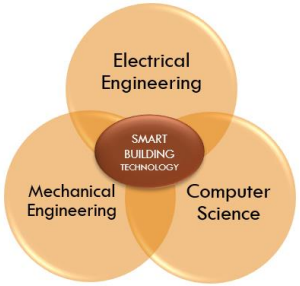
Center for Smart Building Technology

Frank Mruk, Executive Director

A New Profession

MISSION: The RCC Center for Smart Building Technology prepares the highly skilled workforce needed to implement the sustainable, high-performance, and energy-efficient smart building practices required to achieve Boston's 2050 carbon neutral goal.

…with a sense of urgency and environmental equity!



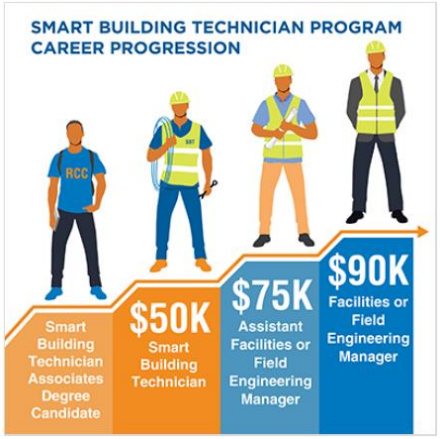
A NEW PROFESSION

It is estimated that up to 50% of the current skilled workforce is nearing retirement age. This creates a more urgent need to fill the impending gap of technicians qualified to manage over 6 million commercial buildings in the U.S. Building account for 40% of CO2 Emissions.

Home for Best Practice Certification Programs

BEST IN CLASS CERTIFICATION PROGRAMS

New Occupational Ecosystem



Career Pathway – Energy Systems

Center for Smart Building Technology

Vocational High School Degree, Facilities	Certificate Program, Installers	Associates Degree, Smart Building Technician	Bachelor Degree, Energy Engineering	Master Degree, Energy System Management
Skill Level: Maintain Existing Equipment	Skill Level: Install Specific Energy Solutions	Skill Level: Maintain and Repair Systems	Skill Level: Solve customers energy consumption challenge	Skill Level: Design complex energy systems and energy modeling
Career Opportunities: ➢ Entry Level Position in Facilities ➢ Apprenticeship (Union or Non-Union) ➢ Starting Salary - $32k	Career Opportunities: ➢ Solar Installation Tech ➢ LED Lighting Specialist ➢ Starting Salary - $40k	Career Opportunities: ➢ Facilities Engineer ➢ Technician for ESCO or ECM solution provider ➢ Starting Salary - $55k	Career Opportunities: ➢ Energy Manager C&I ➢ Project Developer for ESCO ➢ Facilities Manager ➢ Utility Program Manager ➢ Starting Salary - $90k	Career Opportunities: ➢ Engineering Specialist (Solar, Energy Storage, Bio Mass, etc.) ➢ Project Developer for ESCO ➢ VP of Facilities Management ➢ Consultant or Policy Leader ➢ Director of Programs, Utility ➢ Starting Salary - $150k

Commonwealth Dual Enrollment Partnership (CDEP)

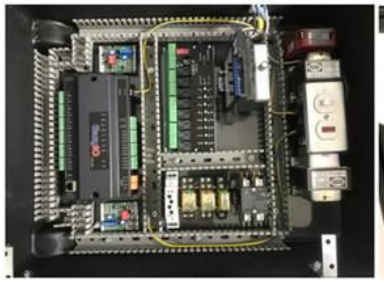
INTENT: EXTRACT BEST PRACTICES FOR NEW STACKABLE & MODULAR ASSOCIATE DEGREE PROGRAM embedded with certifications

ROXBURY COMMUNITY COLLEGE

State of the Art Classrooms/LABS + Partners

COME JOIN US!

- $600,000 in GRANTS
- BUILDING EFFICIENCY FOR A SUSTAINABLE TOMORROW (BEST)
  - 1of 5 COMMUNITY COLLEGES IN US
  - 1st to LAUNCH
  - Partnership w/NSF and Siemens Foundation on suitcases & curriculum
- New TINY HOUSE
- Numerous Industry Partners
- Lecture Series
- Train the Trainer Classes




SIEMENS NEW ECOLOGY DCAMM DOER Massachusetts Department of Energy Resources BPL BUILDING performance LAB national grid ARUP AIA GREENOVATE CITY of BOSTON SKANSKA EMCOR EVERSOURCE Sustainable Minds CBRE AUTOMATEDLOGIC NECA SASAKI HIROKO FOUNDATION abcd BOSTON MEDICAL BOMA

Department of Youth Services- Boiler Replacement- DCAMM Energy project

Kaitlyn Menyo
Energy Project Manager
Division of Capital Asset Management & Maintenance

DEPARTMENT OF YOUTH SERVICES- BOILER REPLACEMENT- DCAMM ENERGY PROJECT

Technology and Scope

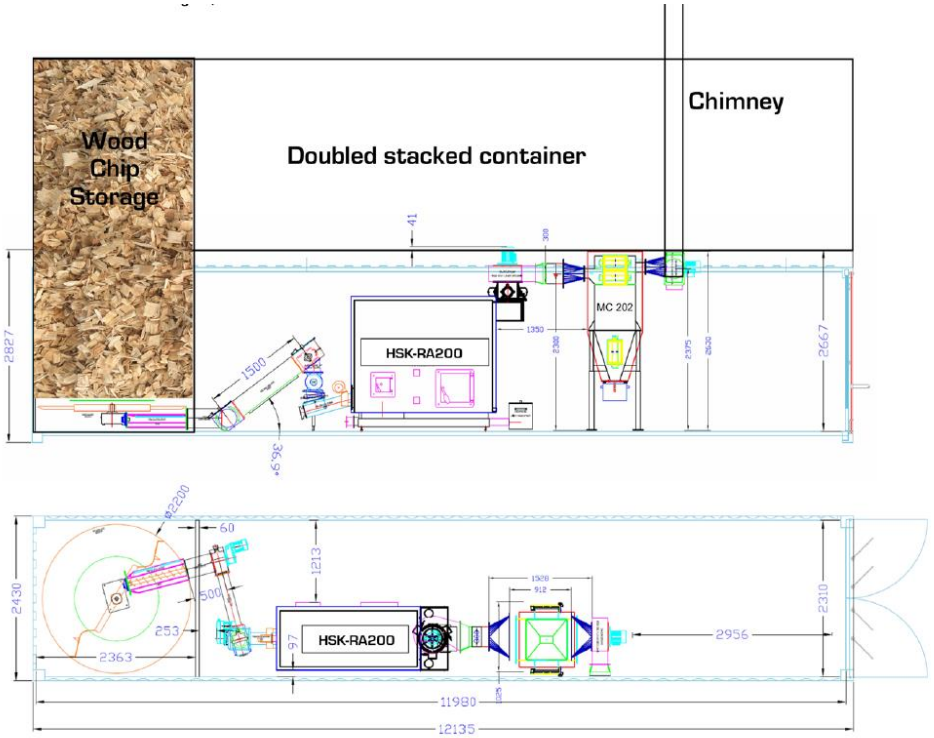
- Replace two existing oil-fired steam boilers (1955) with one 200 kW containerized biomass fired boiler and two gas fired boilers
- A single biomass boiler → heating load for 70% of the time or more
- Gas fired boiler → peak heating
- Alternative Portfolio Standard credits (renewable thermal program) AEC credit @ 19.5/MWh= $11,661 annually
- Project Cost (with replacement distribution)- 5.6 mil
- Biomass Boiler Cost- 2.2 mil

Why DCAMM and DYS selected biomass

- Deferred Maintenance Project- Replace with just gas
- Good fit for the facility- upfront planning
- Greenhouse gas emission reduction

System	CO2 emissions for fuel	Annual site GHG emission	20 years GHG emissions	Total avoided GHG Emissions over 20 years period	% Carbon Reduction based on Life Cycle Calculation
	[lbs/MMBTU]	[Tons CO2]	[Tons CO2]		
Oil- Exisiting	213.4	463	9260	0	
Biomass option with gas back up	218.3	284	5680	3580	96.2%

DEPARTMENT OF YOUTH SERVICES- BOILER REPLACEMENT- DCAMM ENERGY PROJECT



Layout Containerized Boiler Room - Double Stacked Container

Drawing Sheet 1/2
Rev 0 - March 18-2019

DEPARTMENT OF YOUTH SERVICES- BOILER REPLACEMENT- DCAMM ENERGY PROJECT

Goals

- Install with minimal disruption to the facility → focus on security
  - Maintenance will be performed outside of the secure facility making it easier and more efficient to coordinate
- Renewable and alternative energy credits

Lessons

- Project Timeline and Grants (MA CEC rebate $500,000)
- Agency priorities- Sensitivity to conservation efforts
- Different requirements for emission control for sensitive populations under APS- design

Massachusetts News

&

LBE Updates

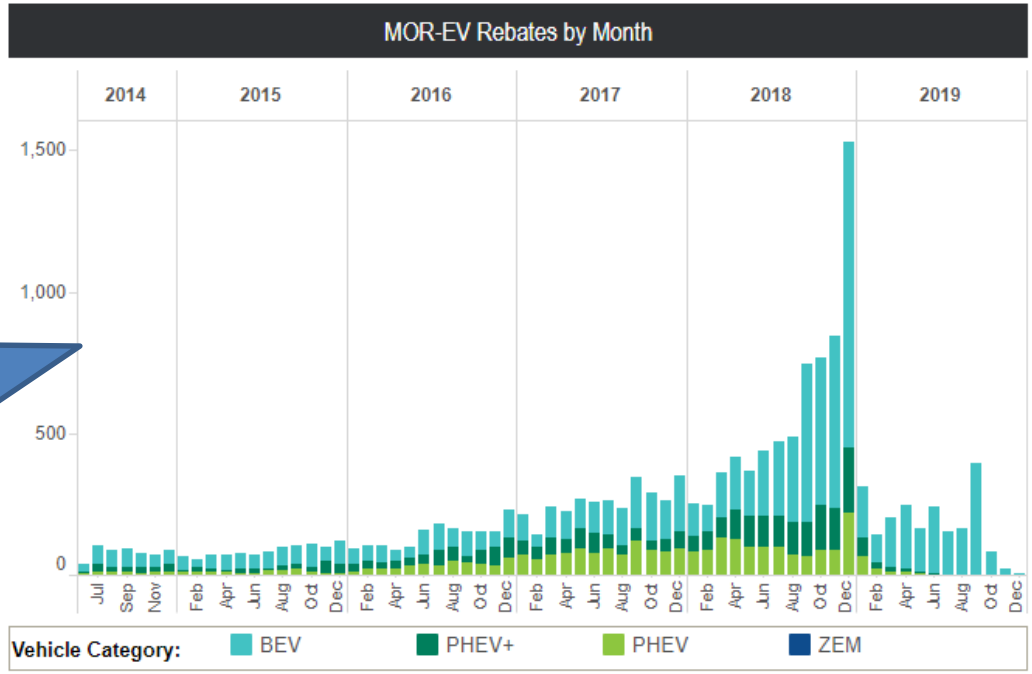
Creating A Clean, Affordable and Resilient Energy Future For the Commonwealth

DOER
Massachusetts Department of Energy Resources

MOR-EV Renewed As Of Jan 1, 2020

- Rebates of up to $2,500 for battery electric, fuel cell electric, and plug-in hybrid vehicles, up to a $50,000 final purchase price
- Program will last through at least Dec. 31, 2021
- Available to individuals only

Over 15,000 rebates issued since 2014!



Source: MOR-EV

MOR-EV
Massachusetts Offers Rebates for Electric Vehicles

DOER
Massachusetts Department of Energy Resources

VEH102 Update

Advanced Vehicle Technology Equipment, Supplies and Services

- VEH102 renewal & reopening complete – extended through 2021
- 20 vendors now on contract (individual links to vendors in CommBuys below)
- New contract manager – David Sargeant, OSD

Category 1:
EVSE hardware, software, & installation

- ENVISION SOLAR
- EV LAUNCHPAD
- EVSE LLC
- FREEWIRE TECHNOLOGIES
- GRAYBAR
- GREENLOTS
- GREENSPOT
- GUARDIAN ENERGY MGMT
- LIQUIDSKY TECHNOLOGIES
- NUVVE
- OASIS CHARGER
- OPCONNECT
- REVISION ENERGY
- REXEL
- VERDEK
- VOLTREK

Category 2:
Anti-idling technologies

- POWER PRODUCT SYSTEMS
- STEALTH POWER

Category 3:
After-market conversion technologies

- NATIONAL VAN BUILDERS
- XL HYBRIDS

Contact Chelsea for vendor cheat sheets
chelsea.kehne@mass.gov

EV Station Technologies

Envision Solar

Portable solar + battery EVSE

Freewire Technologies

Battery-integrated mobile EVSE

Nuvve

Vehicle-to-grid EVSE

LiquidSky

Dual high-power Level 2 EVSE

Multiple Vendors

DC Ultra-Fast EVSE

2019 LBE Recognition Awards

Municipal Category

City of Worcester

Cape Cod Regional Transit Authority

Agency Category

Department of Correction

Massachusetts Port Authority

Higher Ed Category

Berkshire Community College

UMass Lowell

Individual Category

Jillian Wilson-Martin, Town of Natick

Claudine Ellyin, MassArt

Read about the winners on our website!

Changes to LBE Solar Grant

Revisions

- Added language to reflect expected SMART Block expansion
  - Same incentive calculation and maximum grant amount as Block 8 for later blocks
- Extend PON end date from December 31, 2019 to end of December 2020
  - $3.3M of $5M budget not yet committed
  - Applications still to be accepted and reviewed on rolling basis
- Revert to original grant amount formula based on DC capacity (vs. AC)
- Require that grant be applied for prior to execution of final contract with a solar developer
- Enable DOER to request information and periodic check-ins, as well as application resubmission if there are material changes to the project

Upcoming Dates of Note

- RecycleMania (2/2/20 – 3/28/20)
- Earth Hour (3/28/20)
- Earth Day (4/22/20)
- MA Park Serve Day (4/25/20)

Next LBE Council Meeting

Save the Date!

March 10, 2020

10:00 am–12:00 pm

Location TBD

2020 Tentative Meeting Dates:

May 12

July 14

Sept 8

Nov 10