EBC Energy Resources Program:

Update from the Massachusetts Clean Energy Center Leadership
Welcome

Daniel K. Moon

President & Executive Director
Environmental Business Council
Update from the MassCEC Leadership Team

Jennifer Daloisio, Chief Financial Officer
Amy Barad, Director, Commercial Programs
Kavita Ravi, Director, Emerging Markets
Kelsey Read, Project Manager, Solar Programs

Environmental Business Council of New England
Energy Environment Economy
Panel Discussion

Moderator: Briony Angus, *Tighe & Bond*

Panelists:
- Jennifer Daloisio, *CFO*
- Amy Barad, *Director, Commercial Programs*
- Kavita Ravi, *Director, Emerging Markets*
- Kelsey Read, *Project Manager, Solar Programs*
Environmental Business Council

Update from MassCEC Leadership

May 18, 2018
Agenda

• Overview of MassCEC’s 2017 Industry Report
  • Jennifer Daloisio, CFO

• Energy Storage and Microgrids Programs
  • Kavita Ravi, Director of Emerging Markets

• Organics, Hydro and Clean Heating & Cooling Programs
  • Amy Barad, Director of Commercial Programs

• Solar Programs
  • Kelsey Read, Project Manager
Our Mission

Grow the state’s clean energy industry while helping to meet the Commonwealth’s clean energy and climate goals.

**INVEST**
Invest in programs to increase renewable energy adoption by residents, businesses and communities.

**CONNECT**
Connect employers, job seekers, students, communities and investors to the clean energy industry.

**INNOVATE**
Help to spur innovation through infrastructure, funding and technology development support.
MassCEC Operations

FUNDING SOURCE

- Massachusetts Utility Customers
- 5 Municipal Lighting Plant Customers

$22M annually
Collected via a surcharge equal to $.29/month for an average residential customer

CORE ACTIVITIES

- Renewable Energy Generation
- Investments
- Innovation & Industry Support
- Wind Technology Testing Center
- Marine Commerce Terminal
The Massachusetts Recipe

- A growing **workforce**
- Leading universities and **research** centers
- Entrepreneurial **infrastructure**
- Presence of established and emerging industry **leaders**
- Access to **capital** and eager **customers**
Economic Impact

109,226 Jobs

$50,000
68% of workers earn more than $50,000

81%
Job growth since 2010

$11.4B
in economic activity

2.3%
of Massachusetts Gross State Product
Clean Energy Jobs 2010 – 2017

<table>
<thead>
<tr>
<th>Year</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>60,274</td>
</tr>
<tr>
<td>2011</td>
<td>64,310</td>
</tr>
<tr>
<td>2012</td>
<td>71,523</td>
</tr>
<tr>
<td>2013</td>
<td>79,994</td>
</tr>
<tr>
<td>2014</td>
<td>88,372</td>
</tr>
<tr>
<td>2015</td>
<td>98,985</td>
</tr>
<tr>
<td>2016</td>
<td>105,212</td>
</tr>
<tr>
<td>2017</td>
<td>109,226</td>
</tr>
</tbody>
</table>
# Jobs by Technology

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>2017 Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Energy</td>
<td>28,988</td>
</tr>
<tr>
<td>Energy Efficiency, Demand Management, and Clean Heating and Cooling&lt;sup&gt;8&lt;/sup&gt;</td>
<td>77,899</td>
</tr>
<tr>
<td>Alternative Transportation</td>
<td>1,761</td>
</tr>
<tr>
<td>Other</td>
<td>578</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>109,226</strong></td>
</tr>
</tbody>
</table>

**Renewable Energy Employees**
- Solar: 12.0%
- Hydropower, Bioenergy, and Similar Technologies: 23.0%
- Wind: 65.0%

**Energy Efficiency, Demand Management, and Clean Heating and Cooling Employees**
- Energy Efficiency: 29.0%
- Clean Heating & Cooling: 9.0%
- Storage, Microgrid, Smart Grid, and Demand Response: 62.0%
## Jobs by type – percentage of total

<table>
<thead>
<tr>
<th>Type</th>
<th>2017</th>
<th>Percentage of 2017 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>17,079</td>
<td>5.4%</td>
</tr>
<tr>
<td>Engineering &amp; Research</td>
<td>19,034</td>
<td>27.1%</td>
</tr>
<tr>
<td>Sales &amp; Distribution</td>
<td>28,749</td>
<td>15.6%</td>
</tr>
<tr>
<td>Installation &amp; Maintenance</td>
<td>29,639</td>
<td>26.3%</td>
</tr>
<tr>
<td>Professional Services (Consulting, Finance, Legal)</td>
<td>8,830</td>
<td>17.4%</td>
</tr>
<tr>
<td>Other</td>
<td>5,895</td>
<td>8.1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>91,256</strong></td>
<td></td>
</tr>
</tbody>
</table>
Talent data

Employers note that many candidates fall into the following categories, which lead to hiring challenges.

- Insufficient technical skills: 52.5%
- Insufficient experience: 43.9%
- Can make more money elsewhere: 22.3%
- Insufficient work ethic or job commitment: 22.3%
- Insufficient education or degree: 9.4%
- Prefer to work in other industries: 8.6%
- Insufficient communication skills: 6.5%
- Other: 13.7%
- Don’t Know/Not Applicable: 2.9%
Workforce Development

Since 2010, our workforce programs have had a significant impact

- **Internship program serving:** 2,521 interns and 371 companies resulting in 400+ part and full-time positions

- **Learn and Earn:** Over 250 Massachusetts High School students receive hands-on learning and academic training programs

- **Jobs Board**
Clean Energy Innovation

• In 2017, Massachusetts outpaced California for early stage clean energy funding per capita

• Between 2010 – 2016, Massachusetts companies attracted $4.7 billion in innovation funding

• Massachusetts is home to a diverse set of regional and statewide innovation assets
## Massachusetts Innovation Ecosystem

<table>
<thead>
<tr>
<th>Accelerators</th>
<th>Incubators</th>
<th>Research Centers</th>
<th>Universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>CleanTech Open</td>
<td>Greentown Labs</td>
<td>(Association of Cleantech Incubators of New England)</td>
<td>Tusfts University</td>
</tr>
<tr>
<td>Valley Venture Mentors</td>
<td>Cambridge Innovation Center</td>
<td>(Center for Innovation &amp; Entrepreneurship UMass Dartmouth)</td>
<td>UMass Amherst</td>
</tr>
<tr>
<td>VentureWell</td>
<td>Chestnut Innovation Center</td>
<td>(MassChallenge Prize)</td>
<td>UMass Lowell</td>
</tr>
<tr>
<td>TE ScaleUp</td>
<td>North Shore Innoventures (Boston &amp; Cleantech incubators)</td>
<td>Techstars</td>
<td>UMass Dartmouth</td>
</tr>
<tr>
<td>MIT Clean Energy Prize</td>
<td></td>
<td></td>
<td>Harvard</td>
</tr>
</tbody>
</table>

**Universities and Research Centers**
- Fraunhofer USA
- MIT Lincoln Laboratory
- Draper Laboratory
- Wood Hole Oceanographic Institution
- Tufts University
Funding opportunities from MassCEC

- **Equity Investments**
  - ~$500K Equity Investment
  - 1-3 Deals / Year

- **Venture Debt**
  - $100K - $1M Debt Investment

- **AmplifyMass**
  - Project Cost Share
  - Up to $500K Grant

- **AccelerateMass**
  - $150K Convertible Note
  - ≤5 Awards / Year

- **InnovateMass**
  - Up to $250K Grant
  - ≤10 Awards / Year

- **DeployMass**
  - Project-dependent

- **Catalyst Program**
  - Up to $65K Grant
  - ≤14 Grants / Year

- **Workforce Development Programs**

- **Research & Prototyping**

- **Demonstration & Acceleration**
  - Company Stage

- **Commercialization & Growth**
Our Emerging Initiatives

- OFFSHORE WIND
- ENERGY STORAGE
- MICROGRIDS
- WATER INNOVATION
MassCEC’s Programs: Energy Storage and Microgrids
**State of Charge Study: Energy Storage Benefits and Opportunities**

**History:** The Baker-Polito Administration’s Energy Storage Initiative (ESI) conducted a statewide energy storage study that was released in September 2016.

<table>
<thead>
<tr>
<th>Benefit Categories</th>
<th>Benefit Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale Market Cost Reduction</td>
<td>Energy storage can be a flexible and rapid tool that help generators operate more efficiently through: 1) less wear and tear, 2) less start up and shut down costs, and 3) reduced GHG emissions.</td>
<td>$197M</td>
</tr>
<tr>
<td>Ancillary Services Cost Reduction</td>
<td>Energy storage would reduce the overall costs of ancillary services required by the grid system through: 1) frequency regulation, 2) spinning reserve, and 3) voltage stabilization</td>
<td>$200M</td>
</tr>
<tr>
<td>Energy Cost Reduction</td>
<td>Energy storage replaces the use of inefficient generators at peak times causing: 1) reduced peak prices which 2) reduces the overall average energy price. This also benefits the natural gas supply infrastructure.</td>
<td>$275M</td>
</tr>
<tr>
<td>T&amp;D Cost Reduction</td>
<td>Energy storage 1) reduces the losses and maintenance of system, 2) provides reactive power support, 3) increases resilience, and 4) defers investment</td>
<td>$305M</td>
</tr>
<tr>
<td>Increased Renewable Integration</td>
<td>Energy storage reduces cost in integrating renewable energy by 1) addressing reverse power flow and 2) avoiding feeder upgrades</td>
<td>$219M</td>
</tr>
<tr>
<td>Reduced Peak</td>
<td>Energy storage can provide peaking capacity to 1) defer the capital costs peaker plants and 2) reduced cost in the the capacity market</td>
<td>$1093M</td>
</tr>
<tr>
<td><strong>Total System Benefits</strong></td>
<td></td>
<td>$2,288M</td>
</tr>
</tbody>
</table>
Advancing Commonwealth Energy Storage (ACES)

*State of Charge* study recommended demonstration projects.

- ACES was designed to fund **energy storage demonstration projects** that pilot **innovative, broadly replicable energy storage use cases/business models** with **multiple value streams** in order to prime Massachusetts for increased commercialization/deployment of storage technologies.

- **Funding:** The Baker Administration originally allocated $10 million but doubled the amount in December 2017.

- **Timeline:**

  - June 9th
    - Application Deadline
    - Complete ✓
  - June - August
    - Initial Reviews
    - Complete ✓
  - September - October
    - Final Review and Recommendations
    - Complete ✓
  - Late November
    - Award Announcements
    - Complete ✓
  - November - February
    - Contracting
    - In Progress

**Awards:** 26 projects, 25 communities
$20M grants/$32M match
32 MW/85 MWh
## Lead Awardees and Award Amounts

<table>
<thead>
<tr>
<th>Awardee</th>
<th>Award Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ameresco</td>
<td>$348,848</td>
</tr>
<tr>
<td>Advanced Microgrid Solutions</td>
<td>$645,000</td>
</tr>
<tr>
<td>Boston Medical Center</td>
<td>$403,500</td>
</tr>
<tr>
<td>Borrego Solar (Acushnet Company)</td>
<td>$299,000</td>
</tr>
<tr>
<td>Borrego Solar (Braintree Electric Light Department)</td>
<td>$700,000</td>
</tr>
<tr>
<td>Constellation</td>
<td>$402,500</td>
</tr>
<tr>
<td>(Acton-Boxborough Regional)</td>
<td>$700,000</td>
</tr>
<tr>
<td>General Electric</td>
<td>$1,250,000</td>
</tr>
<tr>
<td>Systems (dba Greenlots)</td>
<td>$230,568</td>
</tr>
<tr>
<td>Bennett Award: $348,848</td>
<td></td>
</tr>
<tr>
<td>Massachusetts Municipal Wholesale Electric Company (Ashburnham MLP)</td>
<td>$645,000</td>
</tr>
<tr>
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<td>$402,500</td>
</tr>
<tr>
<td>National Grid</td>
<td>$700,000</td>
</tr>
<tr>
<td>NextEra Capital</td>
<td>$700,000</td>
</tr>
<tr>
<td>Reading MLP</td>
<td>$1,250,000</td>
</tr>
<tr>
<td>SolarCity (dba Tesla)</td>
<td>$1,250,000</td>
</tr>
<tr>
<td>Solecet Energy</td>
<td>$362,125</td>
</tr>
<tr>
<td>Sunrun</td>
<td>$1,250,000</td>
</tr>
<tr>
<td>Taunton MLP</td>
<td>$600,000</td>
</tr>
<tr>
<td>Tesla</td>
<td>$800,000</td>
</tr>
<tr>
<td>UMass Amherst</td>
<td>$875,000</td>
</tr>
<tr>
<td>UMass Boston</td>
<td>$500,000</td>
</tr>
<tr>
<td>UMass Marlborough - Memorial Hospital</td>
<td>$500,000</td>
</tr>
<tr>
<td>Vineyard Transit</td>
<td>$875,000</td>
</tr>
<tr>
<td>West Boylston MLP</td>
<td>$545,000</td>
</tr>
<tr>
<td>WH Bennett</td>
<td>$382,194</td>
</tr>
</tbody>
</table>

**Award Amounts:**
- Ameresco: $348,848
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- UMass Boston: $500,000
- UMass Marlborough - Memorial Hospital: $500,000
- Vineyard Transit: $875,000
- West Boylston MLP: $545,000
- WH Bennett: $382,194
Technology Providers/Integrators
<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility</td>
<td>8</td>
</tr>
<tr>
<td>Commercial</td>
<td>9</td>
</tr>
<tr>
<td>Education</td>
<td>3</td>
</tr>
<tr>
<td>Hospital</td>
<td>2</td>
</tr>
<tr>
<td>Residential</td>
<td>2</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1</td>
</tr>
<tr>
<td>Agriculture</td>
<td>1</td>
</tr>
<tr>
<td>Transit</td>
<td>1</td>
</tr>
<tr>
<td>Hotel</td>
<td>1</td>
</tr>
<tr>
<td>Defense</td>
<td>1</td>
</tr>
<tr>
<td>Biotech</td>
<td>1</td>
</tr>
</tbody>
</table>
## Energy Storage Use Cases (*State of Charge*)

<table>
<thead>
<tr>
<th>Investor Owned Utility (IOU) Grid Mod Asset: Distributed Storage at Utility Substations</th>
<th>1 Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal Light Plant (MLP) Asset</td>
<td>5 Projects</td>
</tr>
<tr>
<td>Load Serving Entity (LSE)/Competitive Electricity Supplier Portfolio Optimization</td>
<td>1 Project</td>
</tr>
<tr>
<td><strong>Behind the Meter</strong></td>
<td><strong>6 Projects</strong></td>
</tr>
<tr>
<td>C&amp;I Solar Plus Storage</td>
<td>No Projects</td>
</tr>
<tr>
<td>Residential Storage</td>
<td>2 Projects</td>
</tr>
<tr>
<td>Residential Storage Dispatched by Utility</td>
<td>No Projects</td>
</tr>
<tr>
<td><strong>Merchant</strong></td>
<td><strong>4 Projects</strong></td>
</tr>
<tr>
<td>Alternative Technology Regulation Resource</td>
<td>2 Projects</td>
</tr>
<tr>
<td>Storage + Solar</td>
<td>3 Projects</td>
</tr>
<tr>
<td>Stand-alone Storage or Co-Located with Traditional Generation Plant</td>
<td>2 Projects</td>
</tr>
<tr>
<td>Resiliency/Microgrid</td>
<td>2 Projects</td>
</tr>
<tr>
<td>NEW: Transit</td>
<td><strong>2 Projects</strong></td>
</tr>
</tbody>
</table>
Unique Business Models

Awards included different business models for the same use case and similar business models across different use cases.

They span **14 distinct business models** among the selected 26.

Examples
Community Microgrid Market Support Activities

Stakeholder Events

2014 MassCEC Microgrids Study
- Commissioned report prepared by DNV KEMA
- Evaluates benefits, models, barriers, and suggested policy initiatives in MA
- Information on variety of microgrid pilots and programs across US

2014 3-Part Boston Microgrid Workshops
- Co-hosted with Boston Planning & Development Association
- Energy Infrastructure Experts
- MA Department of Public Utilities
- Massachusetts utilities

2015 Microgrid Controller Symposium
- Co-hosted with MIT Lincoln Laboratories
- Microgrid controller technology companies
- Massachusetts utilities
- Energy infrastructure experts

2016 Community Microgrids: Opportunities for Municipalities
- Co-hosted with Metropolitan Area Planning Council (MAPC)
- Audience: Municipalities
- International District Energy Association
- MassDevelopment
- Pace Energy & Climate Center

2017 Microgrid Controller Symposium
- Co-hosted with MIT Lincoln Laboratories
- Microgrid controller technology companies
- Massachusetts utilities
- Energy infrastructure experts
MassCEC’s Community Microgrid Program

**Funding Opportunity:**

- Provide funding for clean community microgrid feasibility assessments to help catalyze the multi-user microgrid market in Massachusetts
- Awarded 14 feasibility assessments valued at up to $75,000 each

**Criteria:**

- Community/multi-user microgrid located in Massachusetts
- Active and engaged support of local utility
- Potential to reduce GHG emissions and energy costs
- Encompass a public or private facilities, including a critical facility
- Support the distribution system

<table>
<thead>
<tr>
<th>Program Launch</th>
<th>Viability Assessments Due</th>
<th>Awards</th>
<th>Projects Begin</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2017</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expressions of Interest Due</td>
<td></td>
<td></td>
<td>May 2018</td>
</tr>
<tr>
<td>Project Intervi ws</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MassCEC’s Programs: Organics, Hydro and Clean Heating & Cooling
Commonwealth Hydropower Program
Commonwealth Hydropower: Goals

• Increase energy output of the Commonwealth’s hydropower assets
• Invest ratepayer funds in cost-effective opportunities
• Require good environmental performance (MA RPS eligible)
• Develop “conduit” hydropower projects
Commonwealth Hydropower: Incentives

• Construction Grants
  • Up to $750,000

• Feasibility Study Grants
  • Up to $45,000
Commonwealth Hydropower: Awards

2010-2018 Awards

• 15 Construction Grants, $4.2 mil
• 10 Feasibility Study Grants, $328,000

Expected incremental generation:

8 mil kWh/year
Commonwealth Hydro: Conduit Projects

• “Screening tool” to identify opportunities within drinking water and wastewater infrastructure:
  • Google: DEP hydropower tool

• Promising projects eligible for follow-on feasibility study and construction grants
Commonwealth Organics-to-Energy
Organics-to-Energy: Overview

• Provides grants to developers of new or upgraded anaerobic digestion systems and other technologies that create energy from organic feedstocks
Organics-to-Energy: Statewide AD

<table>
<thead>
<tr>
<th>Anaerobic Digesters</th>
<th># Facilities</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deer Island</td>
<td>1</td>
<td>19.1</td>
</tr>
<tr>
<td>Other Installed, with electricity generating capacity</td>
<td>11</td>
<td>5.9</td>
</tr>
<tr>
<td>Other Installed, heat-only</td>
<td>3</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Total Operating</strong></td>
<td><strong>15</strong></td>
<td><strong>25.0</strong></td>
</tr>
<tr>
<td>Advanced Pipeline</td>
<td>3 new; 2 upgrade</td>
<td>6.4</td>
</tr>
</tbody>
</table>

Facilities by Type

- **Existing**
- **Advanced Pipeline**
Organics-to-Energy: Incentives

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Maximum Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility</td>
<td>$50,000</td>
</tr>
<tr>
<td>Implementation</td>
<td>$500,000</td>
</tr>
<tr>
<td>Technical Services/ Technical Study</td>
<td>$150,000</td>
</tr>
<tr>
<td>(public entities only)</td>
<td></td>
</tr>
</tbody>
</table>
Organics-to-Energy: Key Issues

• Regional sludge facilities?
  • Could address growing need for sludge management capacity as incinerators close
  • Aggregate multiple plants for economies of scale

• Availability of high-strength feedstocks?
  • High demand for food wastes, FOG
  • Enough to go around?

• Challenges
  • Net metering
  • Interconnection
Clean Heating & Cooling Programs

- Air-source heat pumps, including VRF
- Ground-source heat pumps
- Modern wood heating (pellet/chip boilers)
- Solar hot water
MassCEC’s Solar Programs
Solar Programs

• Remarkable growth over the past 10 years
• Designed to grow and support industry, reduce costs, encourage financing, and tackle barriers
  • Mass Solar Loan
  • Solarize Mass
  • Solar Adoption Initiatives

2016
Solar Programs – Mass Solar Loan

- Launched December 2015
- $40 Million Dollar Program
- 17 local lenders and 100 + installers
- Current program – Incentives focused on Income Eligible customers
  - Reduced interest rates / Reductions in loan Principal / Support for low credit
  - Non Income Qualified customers – Competitive Market Rate Loans
  - 3,900 loans closed, $29.5 million in awards, and over $127 million in total loan values supported
  - 69% of funding to date provided to low-moderate income participants
Solar Programs - Solarize Mass

- Community based education, outreach and group purchasing program
- Partnered with over 65 communities
- Simplifying the process
- Increasing adoption
- Reducing Installation Costs
- Currently open and accepting communities
Solar Programs – Other Initiatives

- Educational Resources, trainings and more
  - For new construction, rental units, or commercial/industrial.

- Upcoming trainings for electrical inspectors

- Developing Trainings for:
  - Real estate agents, appraisers and HERS raters
  - Encourage solar in all aspects of the home purchasing or construction process.

- Educational resources & market data
  - Facilitate informed customers
  - [www.masscec.com/solar](http://www.masscec.com/solar)
Solar Programs – Commercial Solar (+Storage)

- Educational resources, tools and other tailored commercial content
  - Market Data on system costs
  - FAQ and Resource Library
  - Procurement resources & template RFPs
  - Ask an Advisor – Free technical assistance, procurement guidance, etc

- Further guidebooks, case studies and webinars currently in development
- Upcoming work looking at challenges in accessing financing
  - Potential for standardized financing documentation
- Sign up for E-mail updates: [www.masscec.com/email-updates](http://www.masscec.com/email-updates)
Thank You