

## 5-YEAR STRATEGIC PLAN: 2022 – 2026

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Public Version

January 2022

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# 1 Introductory Statement

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UMass Clean Energy Extension (CEE) was established in 2014 with support from the Massachusetts Department of Energy Resources and with the purpose of mobilizing University of Massachusetts resources to equitably accelerate the adoption of clean energy in the Commonwealth. **Since this time, CEE has developed its core staff, served thousands of stakeholders, convened a statewide clean energy conference and several workshops, developed outreach and educational materials, seeded UMass faculty research efforts and collaboration across disciplines and UMass campuses, engaged scores of students in research and internship projects, and leveraged staff, faculty, and students to support wider deployment of energy efficiency and renewable energy technologies across the Commonwealth.**

**UMass Clean Energy Extension mobilizes University of Massachusetts resources to equitably accelerate the adoption of clean energy in the Commonwealth through research, education, and outreach.**

CEE developed its first strategic plan in 2017, designed to articulate its purpose, focus its strategies, and develop an organizational roadmap that guided key decisions and directions during our start-up stage of development and growth.

As we embark on our next stage of development and growth, this newest five-year (2022 – 2026) strategic plan will help us to articulate our demonstrated value to the University and Commonwealth, equitably design and implement our programs for greatest impact, deploy our resources thoughtfully and efficiently, penetrate underserved markets, and measure and report our progress and contributions to a strong clean energy ecosystem for current and future generations of our University and Commonwealth.

## 2 The Role and Need for UMass Clean Energy Extension

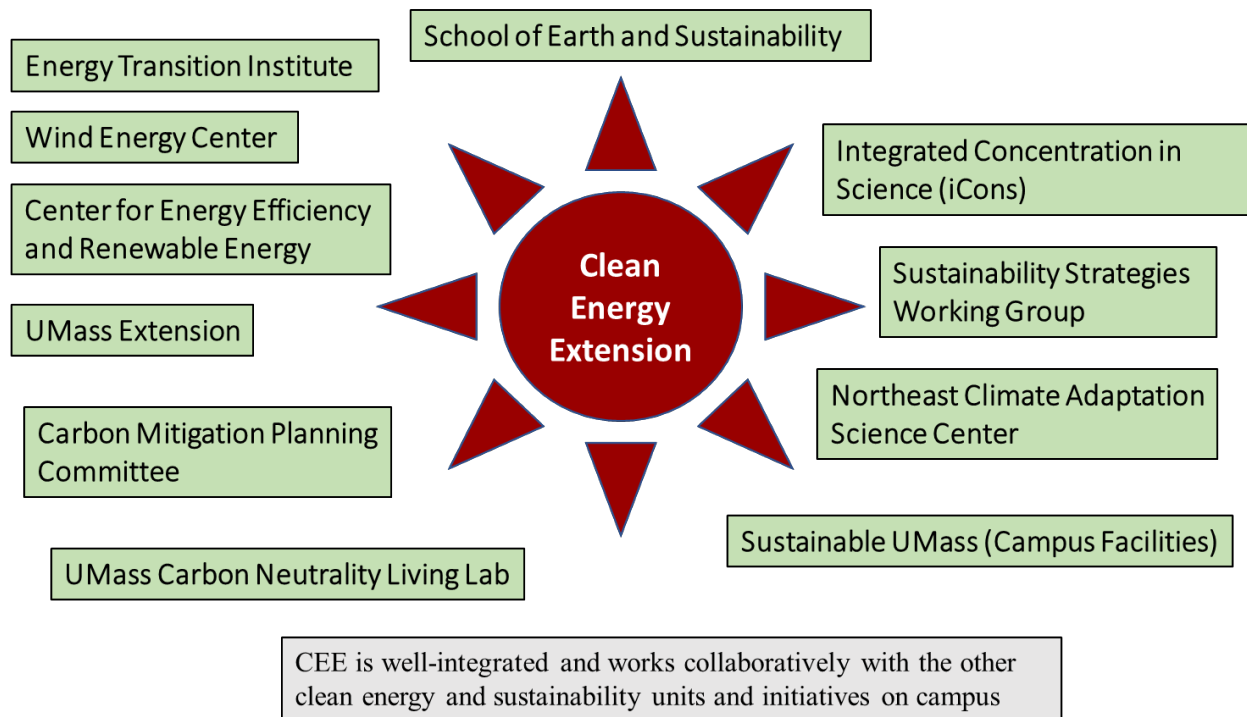
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The creation and usage of energy sourced from fossil fuels has led to global climate change, extreme weather events, and the degradation of sensitive environments around the globe. **There is now an opportunity to re-vision, manifest, and create an energy future based on efficient, renewable, and regenerative energy sources accessible to all.** As such, the Commonwealth has adopted a range of national leading policies, most notably the Global Warming Solutions Act (GWSA), a framework for reducing heat-trapping emissions from all sectors of the economy to reach legally binding commitments of a 25% reduction of Greenhouse Gas (GHG) emissions by 2020 and an 80% reduction by 2050. These goals were updated in 2021, when Governor Baker signed into law An Act Creating A Next-Generation Roadmap for Massachusetts Climate Policy, which mandates reducing statewide emissions to 50% below 1990 levels by 2030 and net-zero carbon emissions by 2050.

These goals include a focus on reducing Massachusetts' dependence on fossil-based energy sources derived from other regions, protecting Massachusetts consumers from energy price volatility, and taking advantage of an economic opportunity for growth of the Massachusetts clean energy industry while reducing the local economic drain of energy import spending.

As a public-serving, non-profit entity with research and extension partnerships across the disciplines of the University, **CEE is in a unique position to help the Commonwealth achieve these larger goals. We provide expertise, legitimacy, impartiality, academic rigor, innovation, and local responsiveness to the task of building the Massachusetts clean energy economy.** At the same time, we avoid competing with private-sector technology and service providers. Instead, we are able to support and collaborate with these entities by demonstrating clean energy market opportunities and researching new market and policy approaches, which can then be served most effectively by the private sector.

**Within the University, CEE provides a substantial role in serving the growing interest and passion of students to prepare for careers in the climate and clean energy sectors.** Our students gain practical and well-regarded experience that many have reported as instrumental for their entry into the clean energy workforce. **CEE also engages with aligned faculty, programs, centers, and institutes on campus to collaborate on applied clean energy research and outreach, and was requested by the administration to help lead efforts to develop a carbon mitigation plan for the campus.** As illustrated in **Figure 2.1**, CEE is centrally engaged in current efforts across campus to expand and enhance multidisciplinary and experiential curricular and research opportunities.



**Figure 2.1** CEE’s connections with aligned units and initiatives on campus.

Building on the Extension model that is at the founding of the University of Massachusetts and the organizational home of CEE, we are enabled to provide valued and responsive assistance to municipalities, state agencies, and under-resourced market participants – and to forge innovative ideas and solutions to address market barriers, unlike private sector consultants or standard academic research. **CEE serves as a unifying and value-adding force between public agencies, academia, and the for-profit and non-profit sectors.** As such, we are able to leverage the strengths of each sector in service of building a resilient, equitable, and flourishing clean energy economy for the Commonwealth.

## 3 CEE's Guiding Principles

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CEE joined the University's historic mission as a Land Grant College to provide research, outreach and extension to the Commonwealth, and applied research and engagement opportunities for students and faculty colleagues. No longer strictly limited to agriculture, the mission of UMass Extension extends to human health, social equity, and environmental well-being. In keeping with this mission, CEE serves as a resource to reduce market barriers, prepare the needed workforce, and accelerate the adoption of clean energy into the Massachusetts economy. The timely transition to a clean energy economy is critical for Massachusetts; it is an essential factor in meeting the state's legislated greenhouse gas reduction commitments, and it provides an opportunity to foster new areas of economic development in the Commonwealth. Following are the guiding principles by which CEE contributes to this transition.

### 3.1 Our Commitment

CEE is committed to the following operating principles in all of its activities:

1. **Collaboration:** Working collaboratively with the UMass community and Massachusetts state officials, agencies, institutions, and businesses to help meet our shared climate-related, energy, and education goals.
2. **Service:** Providing professional clean energy services, education, outreach, research, and workforce development for the public good of the Commonwealth.
3. **Integrity:** Conducting our work and relationships with honesty, academic rigor, objectivity, passion, continuous learning, fiscal responsibility, and inclusiveness.

### 3.2 Our Vision

With CEE serving as a primary clean energy market-building catalyst, we envision a healthy and thriving Commonwealth with a flourishing clean energy economy in which energy efficiency opportunities are maximized and the Commonwealth's energy needs are met with affordable, equitable, accessible, low-impact, secure, and locally generated clean energy. On campus, we envision CEE as a central element of a purposeful campus campaign to broaden, enhance, and establish nationally recognized excellence in sustainability education, research, and public service.

### 3.3 Our Mission

CEE's mission is to proactively, collaboratively, and equitably accelerate the Massachusetts clean energy economy. We accomplish this mission by providing objective and actionable assistance to municipal and under-resourced market participants, and through the development of applied research and innovation to remove market barriers and enhance equitable outcomes associated with the clean energy transition. Our mission leverages the resources of our staff, our state and community partners, and the UMass community of faculty, staff, and students. Our mission extends to serving the University through our commitment to student engagement and professional development, service to the campus's own progress on carbon mitigation, and initiation and contributions to research collaborations.

### 3.4 Our Unique Value in the Marketplace

We are uniquely equipped to achieve our mission due to the following assets:

1. **Our Positions:** Our position within the UMass community and alignment with the university Extension model affords us a distinctive perspective and specialized toolset with which to identify, understand, and develop

underserved clean energy markets as a public service to the citizens of the Commonwealth. Our position under a service agreement with the state Department of Energy Resources allows us to be available and responsive to the state’s needs and directly assist the Commonwealth in meeting its clean energy policy and programmatic goals.

2. **Our Structure:** Our small, public-sector structure and public-good mandate allow us to minimize transactional costs to our clients, streamline services to our clients and stakeholders, and to be locally responsive to opportunities while strategically and proactively addressing larger market needs.
3. **Our Staff and Stakeholders:** Our experienced staff, accomplished faculty investigators, professional advisors, and state partners, all serve to catalyze outreach and research opportunities and amplify our impact in the Massachusetts clean energy market.
4. **Our Relationships:** Our interdisciplinary relationships and experience working with University faculty and centers, state agencies, business organizations, municipalities, and non-profit and for-profit organizations enable us to collaborate across sector boundaries, respond to a diversity of needs, and innovate clean energy solutions for the benefit of the citizens of the Commonwealth.
5. **Our Brand:** Our alignment with the trusted and respected UMass brand allows us to provide legitimacy, objectivity, and authority in evaluating and implementing clean energy market opportunities.

# 4 Achievements, Testimonials, Financial Status, and Lessons Learned: 2015 – 2021

## 4.1 Achievements 2015 – 2021

Consistent with our first strategic plan, we have organized our 2015 – 2021 achievements into the following four activity areas:

- Technical Assistance & Advisory Services
- Collaborative Applied Research
- Education & Workforce Development
- Market Analysis & Outreach

These categories served us well in our start-up years and are still relevant to our work. However, a significant level of project crossover has evolved between these groupings and the category boundaries are now strained. The diversity and abundance of our work activities is reflective of the remarkable demand for our extension services and the range of projects of interest to our staff and students. Going forward, we re-vision project categorization according to our Focus Areas, further detailed in **Section 5** below.

**Table 4.1** below provides aggregated CEE metrics between 2015 and 2021. **These metrics demonstrate that CEE has in its initial years, emerged as an impactful entity in serving the University, the Commonwealth and its municipalities,** with the capacity to generate and compete for substantial external funds.

**Table 4.1:** Aggregated CEE Metrics, 2015 - 2021

Metric Area	Metric
Student Engagement	• 135 undergraduate and graduate students engaged
Community Engagement	• Engaged with 96 Massachusetts communities, partnering on over 182 different projects
Business Engagement	• 384 businesses engaged and 8 workshops convened
Public Events	• 182 public events with 10,600 attendees engaged
External Funding	• 19 proposals submitted • 14 proposals awarded • \$3,452,454 secured

### 4.1.1 Technical Assistance & Advisory Services

This activity area is focused on providing direct assistance to our client-base as provided by CEE faculty and staff specialists. **Assistance generally takes the form of information sharing, pre-feasibility and scoping studies, proposal development, funding guidance, project support services, and general consulting services.** The aim of technical assistance is to maximize the quality of project conception, implementation, and impact by supporting decision-making, vendor selection, policy and financial support navigation, etc. **Table 4.2** below provides a listing of major and secondary projects in which CEE played a lead or significant role, along with associated project partners, metrics, and outcomes.



**Table 4.2: Technical Assistance & Advisory Services Projects, 2015 - 2021**

Projects, 2015 - 2021	Timeframe	Partners	External Funding	Key Outcomes
<b>Major Projects</b>				
UMass Carbon Mitigation Task Force and Planning	2020 - Present	UMass Facilities		<ul style="list-style-type: none"> <li>Co-chaired campus-wide Task Force and consultant team leading to campus Carbon Mitigation Plan</li> <li>Support of campus Carbon Mitigation Planning and role of Living Lab</li> </ul>
Pollinator-Friendly Solar PV Certification Program	2020 - Present	DOER	\$200,000	<ul style="list-style-type: none"> <li>38 applications reviewed</li> <li>34 projects certified</li> <li>89 MW AC (143 MW DC) of solar capacity certified</li> <li>Over 600 acres of pollinator habitat approved for establishment</li> </ul>
SMART Program Dual-Use Application Review and Support	2018 - Present	DOER, MDAR		<ul style="list-style-type: none"> <li>Reviewed 43 dual-use applications</li> <li>Attended 15 proposed project site visits</li> <li>Compiled 8 fact sheets for farmers and developers</li> </ul>
MassEnergyInsight – User Support	2019 - Present	DOER	\$209,064	<ul style="list-style-type: none"> <li>Resolved 1,340 MEI support requests for 715 users</li> </ul>
Green Communities Outreach & Support	2015 - Present	UMass BCT, UMass MIE, DOER, MAPC		<ul style="list-style-type: none"> <li>Engaged with 96 Massachusetts communities, partnering on over 182 different projects since 2015</li> <li>Developed Green Communities program review process and tools with MAPC and provided pilot report to DOER</li> <li>Completed 6 Green Communities program reviews with 3 more in progress</li> <li>Trained staff of 6 regional planning agencies to conduct program reviews</li> </ul>
EPA Food and Beverage Industry Support	2016 - Present	UMass MIE, UMass Lowell, MassDEP, OTA, DOER, EPA	\$42,181	<ul style="list-style-type: none"> <li>7 in-person workshops and 7 webinars convened</li> <li>Approximately 350 participants engaged</li> </ul>
Business/Non-profit Outreach & Support	2015 - Present	UMass BCT		<ul style="list-style-type: none"> <li>Engaged 384 business since 2015</li> </ul>
<b>Secondary Projects</b>				
Pioneer Valley Planning Commission GHG Inventory Update	2020	PVPC		<ul style="list-style-type: none"> <li>Report delivered to PVPC staff</li> </ul>
Connecticut River Conservancy – GHG and Clean Energy Planning	2020 - 2021	CRC		<ul style="list-style-type: none"> <li>Report delivered to CRC staff</li> <li>Project presentation to CRC Board of Directors</li> </ul>
UMass Mount Ida Campus – GHG and Clean Energy Planning	2019	UMass Facilities, DOER		<ul style="list-style-type: none"> <li>Report delivered to campus administrators</li> </ul>
Community Choice Aggregation 3.0	2018 - Present	Amherst, Northampton, Pelham		<ul style="list-style-type: none"> <li>Provided review of cost and billing impacts of municipal aggregation across MA</li> </ul>

Projects, 2015 - 2021	Timeframe	Partners	External Funding	Key Outcomes
				<ul style="list-style-type: none"> <li>Drafted final report of the Inter-Municipal Task Force Members</li> </ul>
Wastewater Heat Recovery Development	2018 - 2019	UMass WINSSES, MassCEC		<ul style="list-style-type: none"> <li>Proposal with China-based technology provider for demonstration at Amherst water treatment plant</li> </ul>
Clean Heating & Cooling Opportunity Screening	2017 - 2018			<ul style="list-style-type: none"> <li>Drafted decision-making logistical pathways for municipal building options</li> </ul>

A notable highlight from this activity area is the **Pollinator-Friendly Solar PV Certification Program**, developed with funding from MA DOER and a broad range of collaborators. Across the country, there is increasing interest in planting large solar photovoltaic (PV) arrays with native vegetation to provide habitat for pollinators and other wildlife species. A number of states have established voluntary "pollinator-friendly" certification programs to help solar developers implement, maintain, and promote native meadow habitats under and around solar panels. However, Massachusetts is the first state to provide an incentive for such development and to include a rigorous monitoring plan, to ensure these projects continue to meet stated goals and provide pollinator habitat through the lifetime of the solar facility. CEE developed its pollinator-friendly certification program for solar PV facilities in Massachusetts in careful consultation with state and federal agencies, pollinator experts, and stakeholders in the agriculture, wildlife biology, and solar energy communities, in order to ensure certification standards are supportive of agricultural and ecological goals, while also being economically feasible and compatible with solar PV array operation and maintenance. The first pollinator-friendly solar facilities in the state were certified in 2020, and the program saw a large uptick in applications in 2021.

### 4.1.2 Collaborative Applied Research

This activity area is focused on supporting the UMass research mission and expanding the public knowledge base that supports the advancement and adoption of energy efficiency and renewable energy in Massachusetts and society at-large. To that end, **we actively foster applied clean energy research and development activities in three key areas: UMass faculty seed grants, university research partnerships, and industry research partnerships.** Table 4.3 below provides a listing of major and secondary projects in which CEE played a lead or significant role, along with associated project partners, metrics, and outcomes.

**Table 4.3:** Collaborative Applied Research Projects, 2015 - 2021

Projects, 2015 - 2021	Timeframe	Partners	External Funding	Key Outcomes
<b>Major Projects</b>				
Impacts of Dual-Use Solar on Crop Productivity and the Agricultural Economy in Massachusetts and Beyond	2021-2024	UMass Extension, Cranberry Station, Resource Economics, DOER, MDAR	\$1,819,996	<ul style="list-style-type: none"> <li>Establish 6-8 site trials around state in partnership with solar developers and farmers</li> <li>Provide data and analyses to assist policymakers, solar developers, and farmers in making informed decisions to regulate,</li> </ul>

Projects, 2015 - 2021	Timeframe	Partners	External Funding	Key Outcomes
				design, and operate farms that enhance the value of solar and agriculture
<i>Community Planning for Solar</i> Toolkit	2019 - Present	UMass ECo, DOER, MDAR, Co-op Power, PVSquared, Northeast Solar, Blandford Wendell, Easthampton, NREL, RMI	\$109,057	<ul style="list-style-type: none"> <li>Developing <i>Community Planning for Solar Planning</i> Toolkit</li> <li>Developing Toolkit dissemination and replication strategies to assist Massachusetts communities with planning and facilitate adaption of Toolkit components in states around the country</li> </ul>
Assessing Agricultural Productivity and Informing Adoption of Dual-Use Solar Arrays on Massachusetts Farmland	2018-2022	CAFE, USDA NIFA	\$70,000	<ul style="list-style-type: none"> <li>Fact sheets and outreach to MA farmers</li> </ul>
UMass Energy Storage Research - ACES	2018 - Present	UMass Facilities, MassCEC	\$120,000	<ul style="list-style-type: none"> <li>Convened 2020 Massachusetts Battery Energy Storage Innovation Ecosystem Symposium attended by 45 industry participants representing a cross-section of Massachusetts BES Ecosystem groups</li> <li>Researching battery control algorithms and thermal energy storage</li> </ul>
<b>Secondary Projects</b>				
Floating Offshore Wind Stabilization Research	2021 - Present	UMass College of Engineering, i-Corps, IALS, TTO	\$64,787	<ul style="list-style-type: none"> <li>Secured MassCEC grant funding to advance technology research and commercialization</li> <li>Developing technology modeling, testing, and intellectual property strategy</li> </ul>
AWWI Wind Power and Wildlife	2020 - 2021	AWWI	\$45,000	<ul style="list-style-type: none"> <li>Developed comprehensive framework to evaluate cumulative impacts of land-based wind energy development on wildlife species</li> <li>Conducted example evaluations for 6 at-risk species</li> <li>Manuscript for publication currently in development</li> </ul>
Solar and Equity Research	2019 – Present	UMass Resource Economics, ETI		<ul style="list-style-type: none"> <li>Model and analysis of SREC II program cash flow accruals to market participants</li> <li>Doctoral dissertation on-going furthering equity evaluation of residential solar market</li> </ul>
Renewable Thermal Market Penetration Impact Model	2018 - 2020	Yale University	\$19,984	<ul style="list-style-type: none"> <li>Spreadsheet analysis tool to evaluate market penetration and impacts</li> </ul>
Renewable Thermal-Carbon Tool	2018 - 2019	CESA, Yale University	\$5,000	<ul style="list-style-type: none"> <li>Technical review and module enhancements on CESA tool</li> </ul>
UMass Clean Energy Seed Grants	2015 - 2017	UMass Faculty		<ul style="list-style-type: none"> <li>Approximately \$100,000 in Seed Grants awarded across 9 projects to 6 UMass clean energy researchers</li> </ul>

A notable highlight from this activity area is the **Community Planning for Solar Toolkit**, developed with the support of a grant from the National Renewable Energy Laboratory’s Solar Energy Innovation Network. In this project, CEE is working with a large team of committed partners to lead development of community-focused solar siting and financing procedures in three rural western Massachusetts communities: Blandford, Wendell and Westhampton. When finalized, the project will demonstrate “bottom-up” solar siting processes driven by community residents and municipal officials, and offer models for evaluating financing mechanisms that can keep solar benefits within the community. The Toolkit is designed to be implemented across the Northeastern U.S. to ensure that solar projects are well-sited, in line with the preferences of local communities, and provide acceptable economic benefits to participating communities.

### 4.1.3 Education/Workforce Development

This activity area is focused on supporting the UMass educational mission, the mission of Center for Agriculture, Food and the Environment (CAFE), and the state's economic prosperity by providing workforce development and skills training opportunities to UMass students and other potential clean energy workers in the clean energy sector. **The aim of this activity area is to maximize clean energy educational opportunities and expand the volume and quality of the Commonwealth's clean energy workforce to meet current and anticipated demand.** **Table 4.4** below provides a listing of major and secondary projects in which CEE played a lead or significant role, along with associated project partners, metrics, and outcomes.

**Table 4.4:** Education/Workforce Development Projects, 2015 - 2021

Projects, 2015 - 2021	Timeframe	Partners	External Funding	Key Outcomes
<b>Major Projects</b>				
Offshore Wind Professional Certificate – Program Development & Implementation	2019 - Present	UMass UWW, CNS, ECo, Wind Energy Center, MassCEC, OSW industry partners	\$105,506	<ul style="list-style-type: none"> <li>45 graduate-level and professional students enrolled</li> <li>13 certificates awarded</li> </ul>
Offshore Wind Career Access Scholarship – Program Development & Implementation	2020-Present	MassCEC, CNS, OSW industry partners	\$228,392	<ul style="list-style-type: none"> <li>Development of scholarship program focused on student diversity, professional mentoring, and employment in the MA offshore wind industry</li> </ul>
UMass Clean Energy Corps	2015 - Present	UMass BCT (Prof. Ben Weil)		<ul style="list-style-type: none"> <li>85 students trained in building science analysis, technologies, and processes</li> <li>34 municipal buildings served by Clean Energy Corps students</li> </ul>
UMass Clean Energy Extension Internships	2015 - Present	Various		<ul style="list-style-type: none"> <li>50 students engaged in CEE research and/or service internships</li> </ul>

A notable highlight from this activity area is the **Offshore Wind Professional Certificate**, launched in 2020 with the support of a grant from the MassCEC Offshore Wind Workforce Development program. The program provides a professional certificate in offshore wind to professionals and graduate students seeking to up-skill and broaden their knowledge to address the needs of the offshore wind industry, and covers a broad range of disciplines

involved in the industry, including technology and engineering, development and finance, supply chain management, marketing, environmental impact, business logistics, law, and policy. 9 credits of coursework are completed through online courses, with special industry speakers and events. To help increase diversity within the certificate program and OSW workforce at-large, CEE has developed the **UMass Offshore Wind Career Access Scholarship** program. Scholarship recipients receive (1) full tuition support to the certificate program, (2) professional development support; (3) priority hiring consideration for an internship at an offshore wind energy industry partner organization; and (4) a non-curriculum stipend to help address specific personal and professional barriers on an as-needed basis.

#### 4.1.4 Market Analysis & Outreach

**This activity area is focused on conducting strategic research, analysis, and reporting related to determining the characteristics, extents, and dynamics of potential Massachusetts clean energy markets.** In addition, we conduct outreach and education in promising markets with the goal of developing and identifying clean energy projects and strategic opportunities within those markets. **Table 4.5** below provides a listing of major and secondary projects in which CEE played a lead or significant role, along with associated project partners, metrics, and outcomes.

**Table 4.5:** Market Analysis & Outreach Projects, 2015 - 2021

Projects, 2015 - 2021	Timeframe	Partners	External Funding	Key Outcomes
<b>Major Projects</b>				
Mohawk Trail Woodlands Partnership	2019 - 2020	UMass LARP, School of Public Health, MA EEA	\$150,000	<ul style="list-style-type: none"> <li>Regional inventory of boilers / wood heating demand</li> <li>Air emissions monitoring and public health assessment</li> <li>Pellet/dry chip manufacturing alternative business models</li> <li>Regional economic analysis</li> <li>Renewable thermal GIS heat maps</li> </ul>
Massachusetts Battery Energy Storage Innovation Ecosystem	2018 - Present	Greentown Lab, NECEC, FORGE, MassCEC, BES Steering Committee	\$49,693	<ul style="list-style-type: none"> <li>CEE Report: <i>Benchmarking of U.S. Battery Testing Facilities</i>, January 2018</li> <li>CEE Report: <i>Building a Massachusetts Battery Energy Storage Innovation Ecosystem</i>, June 2019</li> <li>Online Symposium: <i>Creating Opportunity: Advancing the Massachusetts Battery Energy Storage Innovation Ecosystem</i>, December 2020</li> <li>CEE Report: <i>Leading the Charge: Accelerating the Massachusetts Battery Energy Storage Innovation Ecosystem</i>, July 2021</li> </ul>
Massachusetts Clean Energy Conference	2016			<ul style="list-style-type: none"> <li>Statewide conference attended by 92 people (40 municipal staff, 15 general public, 10 students, 10 speakers, 10 sponsors, and 7 CEE staff).</li> <li>Attendees rated the conference with an average overall score of 4.5 out of 5</li> </ul>

Projects, 2015 - 2021	Timeframe	Partners	External Funding	Key Outcomes
<b>Secondary Projects</b>				
Life-Cycle GHG Analysis of Cross-Laminated Timber (CLT) for Buildings	2018 - Present	NEFF, MA EEA	\$79,696	<ul style="list-style-type: none"> <li>Nine-member industry and academic advisory council engaged</li> <li>Analysis continuing</li> </ul>
Greening Municipal Fleets	2018 - Present	DOER, MA Clean Cities, Leverett		<ul style="list-style-type: none"> <li>Analyzed Green Communities data on municipal fuel use</li> <li>CEE student report: <i>Reducing Municipal Vehicle Fuel Consumption in Rural Massachusetts Communities</i></li> <li>Gathered full year of telematics data on municipal vehicle use in Leverett, with on-going analysis for a final report on best approaches for reducing municipal fuel use</li> </ul>
Renewable Thermal Energy Demand Mapping	2017 - 2019			<ul style="list-style-type: none"> <li>GIS-based analytical method to target opportunities for community district heating systems</li> </ul>
Offshore Wind and Storage Modeling	2017 - 2019	UMass Wind Energy Center		<ul style="list-style-type: none"> <li>Draft system dynamics model to evaluate value of energy storage with OSW</li> </ul>
UMass Electric Vehicle Infrastructure Analysis	2017	UMass Transportation Services		<ul style="list-style-type: none"> <li>CEE student report: <i>Electric Vehicle Infrastructure at UMass Amherst: Analysis and Recommendations</i>, May 2017</li> </ul>
UMass Distributed Wood Heat Opportunities Analysis	2017	UMass Facilities		<ul style="list-style-type: none"> <li>CEE student report: <i>Opportunities for Distributed Renewable Thermal Plants to Reduce Campus Steam Load at UMass Amherst</i>, November 2017</li> </ul>
Renewable Thermal in Agricultural Greenhouses	2017	MDAR		<ul style="list-style-type: none"> <li>Site visit and technical recommendations</li> </ul>

A notable highlight from this activity area is the **Massachusetts Battery Energy Storage Innovation Ecosystem** initiative, developed with sponsorship from the Massachusetts Clean Energy Center and the Department of Energy Resources. As part of this effort, CEE surveyed leading Massachusetts academic researchers and principals and entrepreneurs at a broad range of Massachusetts-based battery ventures to evaluate our battery energy storage (BES) innovation ecosystem. In our 2019 report, we present a set of Key Findings and Recommendations to empower new opportunities to grow this research, innovation, and business development in Massachusetts:

**Key Report Findings:**

- The Commonwealth’s colleges and universities have substantial technical, intellectual, and developmental BES resources that are of current and potential value to Massachusetts BES commercial ventures
- Massachusetts is both generating BES ventures and attracting them from outside of the state
- The Commonwealth has the critical BES innovation ecosystem elements necessary for the state to become a global center of BES innovation and commercialization

**Recommendations:**

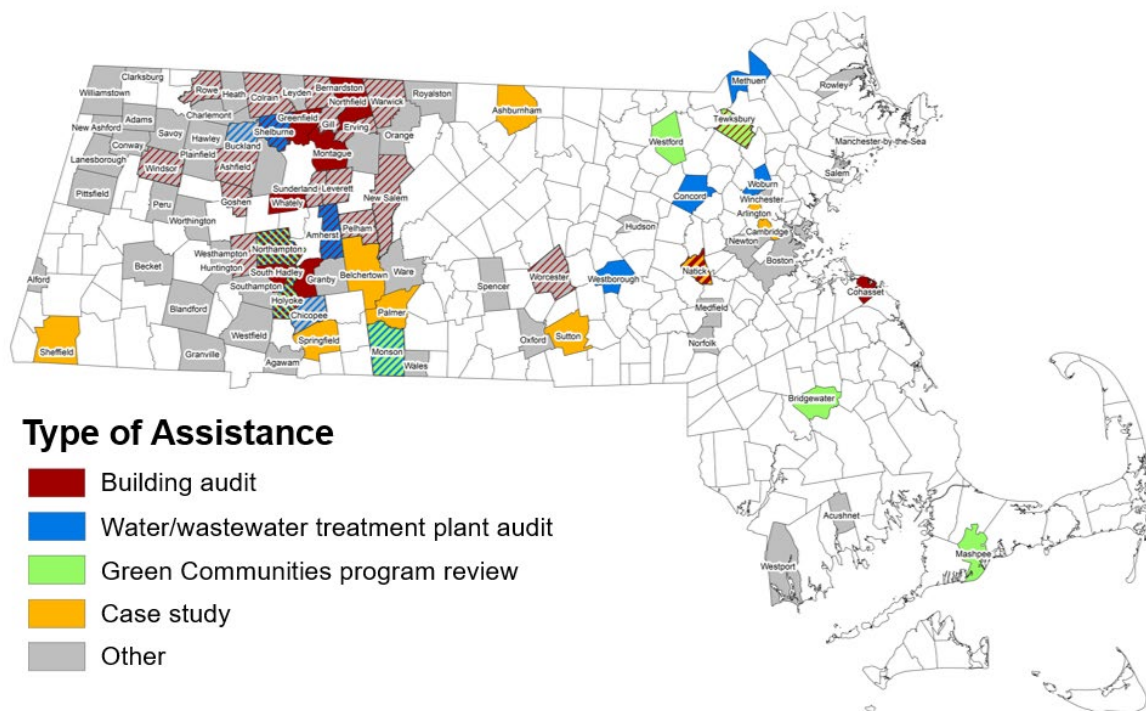
- Create a Massachusetts BES Leadership Consortium/Steering Group

- Convene and Facilitate BES Industry Events, Symposia, and Networking Opportunities
- Develop and Disseminate a Massachusetts BES Innovation Ecosystem Brand
- Develop a Multi-functional Web-based Platform to Connect Ecosystem Resources and Activities
- Develop and Support Publicly Accessible R&D and Testing Facilities
- Support the Massachusetts Academic Sector as the Engine of the BES Ecosystem

In December 2020, Massachusetts Battery Energy Storage (BES) leaders participated in an online working symposium entitled *Creating Opportunity: Advancing the Massachusetts Battery Energy Storage Innovation Ecosystem*, during which they envisioned opportunities, identified challenges, and created an action plan to advance and promote the Commonwealth's BES Innovation Ecosystem as a global center of BES activity and opportunity.

## 4.2 CEE’s Work Across Massachusetts

A map illustrating CEE’s municipal support engagements across the Commonwealth is provided in **Figure 4.1** below. Note that the map does not include the CEE-provided MassEnergyInsight user support, which is available to cities, towns, and regional government entities, and used by all 280 Green Communities throughout the state.



**Figure 4.1** CEE’s municipal support engagements across the Commonwealth.



## 4.3 Testimonials

A selection of CEE client, partner, and student testimonials is provided in **Table 4.6** below.

**Table 4.6:** Selected CEE client and partner testimonials

Year	Organization	Author	Testimonial
2021	Connecticut River Conservancy	Community Engagement & Partnerships Coordinator	This was by far the most thorough, professional, and customized service and end product we could have hoped to obtain. I believe with the skill sets and approaches reflected by the CEE team, anyone can find a way to become more responsive to the climate crisis in their operations.
2021	UMass Student	Offshore Wind Professional Certificate Student	UMass is doing a great job building the workforce for the Offshore Wind industry with this certificate program. They provide a well-rounded curriculum that is attainable to individuals of all backgrounds and experience levels. Additionally, the class drew a diverse mix of students, including professionals currently working in the industry, which led to some really valuable discussion, and great networking opportunities.
2021	Town of Natick	Town Official	Before engaging UMass, Natick was on track to spend hundreds of thousands of dollars to repair outdated, inefficient HVAC equipment. Now we are on a journey to make our main library a zero-carbon building - and save money in the process! Thank you, UMass!
2018	Franklin Regional Council of Governments	FRCOG Staff Member	The collaboration between FRCOG and UMass CEE has been extremely beneficial to many Franklin County towns that are already Green Communities and to those working towards their designation.
2018	Town of Warwick	Buildings & Energy Committee Chair	It has been a pleasure to have CEE on board – we could not have done it without you. We are all-volunteer Energy Committees and do not have the expertise to assess the measures needed to save energy, how the different measures interact with each other, and what the financial outcome might be.
2018	Town of Northfield	Energy Committee Co-chair	I know I speak for the multi-town committees when I say that we feel very lucky to have CEE resource to guide our work.
2017	Town of Northfield	Energy Committee Co-chair	I can't thank CEE enough for all of the incredible work you have been doing to help us get our schools into our baseline data! We are very excited about moving forward with applying for a Green Communities Competitive Grant to begin energy conservation measures in our buildings.
2017	Town of Montague	Town Administrator	On behalf of the Town of Montague, I can only say that our experience with Clean Energy Extension staff and interns was outstanding. We enjoyed a collaborative process when developing the project scope, found the CEE team to be professional and consistent in its communication during the project, and received a final product that provides useful and clearly organized findings that we will integrate into our broader capital planning agenda. Highly recommended.
2016	Town of Ware	Town Official	If any city or town in the Commonwealth of Massachusetts is thinking about becoming a Green Community, they need to use the UMass Clean Energy Extension team. Words can't express how good they were. You won't be disappointed.



## 4.4 Financial Trends and Current Status

[This section is redacted in the public version of the Plan.]

## 4.5 Lessons Learned 2015 – 2021

Over the six years of establishing, developing, and operating CEE, some important lessons have been learned and are articulated here as they have been considered in the design of our five-year strategic plan.

### **Funding, Effectiveness, and State Coordination**

- The addition of clean energy to the stable of university extension services has been effective in creating an objective and trusted source of information and outreach and in enabling flexible applied research to address market needs.
- The policy and programmatic focus on climate and clean energy in Massachusetts makes CEE particularly applicable and effective. Maintaining coordination with state agencies through changes in leadership and policies is essential for the extension services to be recognized as a state resource.
- CEE is one of a small number of diverse national energy extension programs each serving roles in their states. Regional coordination and potential expansion of energy extension programs in the Northeast could amplify the role of the land-grant universities in contributing to the regional clean energy and climate goals.
- As with all university extension programs, base government funding to support responsive and convenient public service, maintain staff continuity during funding fluctuations, and enable efforts to raise external funds will remain a critical need.

### **University Value**

- CEE brings value to research faculty across disciplines by unveiling new research opportunities, drawing in new government and industry partners as collaborators, and enabling outreach channels directly to market participants for research efforts.
- CEE has had great success in engaging with other energy and environmental units on campus, but further work remains to develop mutually effective collaborations on proposals, fund raising, and research.
- Student interest, at both the undergraduate and graduate levels, in the applied work of CEE is insatiable and invaluable in preparing students to competitively enter the clean energy workforce. CEE and the university have a tremendous opportunity to expand their support for student engagement and more substantially and purposefully support the Commonwealth's clean energy workforce needs.

### **Demands and Limitations on CEE Staff and Services**

- CEE has found many opportunities to advance applied research projects of its own making either with staff or students. Too often, these projects have not been sufficiently completed due to staff priorities, leaving a lack of valuable outreach through publications, white papers, or web sites. CEE needs to balance its priority research areas with staff resources and faculty collaborators, to assure the outcomes of the work find the means to be disseminated.

- The demand for CEE expertise and services, from municipalities, non-profits, farms, and others has been rewarding and growing over time. This demand has resulted in staff resource challenges and requires a greater need to manage expectations and potentially to restrain our service offerings.

# 5 Five-year Vision and Program Focus Areas: 2022 - 2026

Since its founding in 2015, CEE has built a strong reputation, brand, and service over our first six years serving both the Commonwealth’s clean energy and climate commitments and the University’s mission of research, teaching, workforce development, service, and outreach. With this solid foundation in place, CEE is now primed to expand our activities and provide even greater value both to the University and the Commonwealth, and the current five-year plan is designed to advance this objective. Our plan, built on the foundation of our past work, establishes six Focus Areas that will guide and organize our work going forward. **Each of the six Focus Areas (1) represent critical areas and opportunities to advance clean energy, (2) are appropriate for Extension’s role, and (3) are consistent with broader state and University commitments to support climate, energy, and environmental sustainability.**

**The six Focus Areas are distinct in their objectives, but not mutually exclusive. Intersecting scopes and synergies will help to reinforce each program’s cohesion and impact.** Additionally, CEE plans to continue to be open and opportunistic in pursuing other avenues of work that can be budgeted, managed, and add complementary value to the overall plan.

**Through this five-year plan, CEE will forge even stronger engagements with our state, regional, and University partners and colleagues.** Our objective is to further demonstrate the role and sustained value of a clean energy Extension program for the Commonwealth and serve as a model for other regions of the country.

CEE’s six Focus Areas are summarized in **Table 5.1**, and the following sections expand on each area’s critical need, scope, partners, and outcomes.

**Table 5.1:** Six Program Focus Areas, 2022-2026

Focus Area #1	<b>Building Energy Efficiency and Electrification</b> Technical services to Massachusetts municipalities and others Applied research and program designs to accelerate markets transitions
Focus Area #2	<b>Solar, Land Use, and Local Benefits</b> Planning, ownership, equity, and community benefits Dual-use agriculture and pollinator research
Focus Area #3	<b>Student Engagement and Workforce Development</b> Experiential learning and public-service courses and internships Graduate student research
Focus Area #4	<b>Offshore Wind Professional Certificate Program</b> Enrollment and diversity outreach and expansion UMass Offshore Wind Career Access Scholarship Industry partnerships
Focus Area #5	<b>Battery Energy Storage (BES) Innovation Ecosystem</b> Action Plan to enhance BES ecosystem impacts and value to the Commonwealth
Focus Area #6	<b>Regional Clean Energy Extension Network</b> Build collaboration of extension services across UMass system and New England/Northeast Land Grant campuses

## 5.1 Focus Area #1

### Building Energy Efficiency and Electrification

Technical services to Massachusetts municipalities, others

Applied research and program designs to accelerate markets transitions

#### Critical Needs to be Served

From its founding, CEE has provided support to the DOER Green Communities program and technical assistance directly to MA municipalities. Many of our municipalities are under-resourced and lack familiarity with clean energy options. Nonetheless, these communities are key strategic leaders that can influence broader adoption of clean energy aims while saving local tax dollars on energy costs.

To achieve our Commonwealth's commitment to decarbonization by 2050, a foremost challenge is to purposefully engage energy efficiency and clean energy adoption (primarily electrification) to our existing building stock. Applied research is critically needed to enhance our understanding of technical options, and to expand the business, social, and policy paradigms to increase adoption rates by the orders of magnitude required to meet this challenge.

#### Scope of Work

##### Extend Municipal and Green Communities Technical Services

- Technical assistance to MA municipalities on specific buildings and strategies to meet Green Communities energy reduction targets
- Continue to provide *MassEnergyInsight* user-support services, if invited by DOER
- Expand assistance to state facilities in coordination with Leading by Example program
- Expand assistance to include electrification strategies, micro district thermal systems
- Expand assistance to support municipal GHG inventories, and solar energy and carbon-neutral planning

##### Research Market and Policy Innovations to Accelerate Widespread Deployment

- Research pathways for water- and ground-source heat pumps to serve district heating/cooling
- Research replicable technical designs to upgrade MA housing stocks
- Conduct market, business, and policy research to innovate shifts in building energy service delivery
- Prepare pilot program designs for Commonwealth to test and evaluate new market approaches

#### Target Partners

**UMass:** Building Construction Technology, Energy Transition Institute, Isenberg School of Management, Public Policy

**External:** Department of Energy Resources, Green Communities, Massachusetts Clean Energy Center, Mass Save

#### Anticipated Outcomes

- Enhance Green Communities program and contribute to its continued evaluation and progress
- Expand University role and visibility in supporting municipal needs
- Bring applied research to innovate paradigm shifts in technology, policy, and markets essential to meet building efficiency and electrification goals.

## 5.2 Focus Area #2

### Solar, Land Use, and Local Benefits

Planning, ownership, equity, and community benefits

Dual-use agriculture and pollinator research

#### Critical Needs to be Served

To meet the Commonwealth’s clean energy and climate goals, sustained solar development is needed to contribute clean energy to the growing electric demand. Today, a bit over 3 GW of solar has been installed, and estimates suggest as much as 30 GW will be needed to contribute to the all-renewable electricity grid by 2050. As is now evident, siting solar energy in Massachusetts is creating tensions around land use, and the distributional impacts of costs, project benefits, and equity. **Communities need to be better equipped to understand and plan for solar development, and opportunities for meaningful economic and wealth creation for rural and low-income sectors are left underserved.**

Research on the agricultural productivity and farm viability impacts of dual-use solar (or *agrivoltaics*) is an important need for state agriculture and energy policy makers and for farmers in considering how best to embrace this technology. Meanwhile, the continued expansion of traditional ground-mounted solar installations creates substantial opportunity for the development of pollinator habitat. Certification of such habitat is needed to assure the effectiveness of these installations, and research opportunities abound to establish best practices and evaluate outcomes.

#### Scope of Work

##### Community Solar Planning and Enhancing Equity

- Expand local community proactive solar planning using CEE “toolkit”
- Evaluate impacts of solar ownership and financing options on wealth distribution and local economies
- Expand market and policy innovations to enable local, low-income, and BIPOC solar ownership
- Research valuations of tradeoffs in solar and land use, evaluate urban/rural equity balance, and design policy and market mechanisms to restore equity balance and meet environmental goals

##### Dual-Use Solar/Ag and Pollinator Friendly Solar Certification and Research

- Lead U.S. DOE grant with university, state, and solar partners to accumulate and analyze data on agricultural productivity and farm economics across varied farm conditions in the state
- Maintain outreach, high standards, and continual improvements in CEE’s Pollinator Friendly Solar Certification
- Establish collaborations with pollinator scientists and solar developers to conduct critical research

#### Target Partners

**UMass:** UMass Extension, Resource Economics, Public Policy, Isenberg School of Management, Energy Transition Institute, pollinator researchers

**External:** Regional Planning Agencies, Massachusetts Municipal Association, solar/equity community, Department of Energy Resources, Department of Agricultural Resources

## Anticipated Outcomes

- Reductions in solar siting tensions and improvements in solar siting acceptance
- New opportunities for state innovation and leadership in local solar ownership and greater returns of economic value of solar to Commonwealth communities
- Improved knowledge for farmers and policy makers to assess efficacy of dual-use solar under a range of farm conditions
- Large expansion of pollinator habitat, research, and understanding of best practices in Massachusetts

## 5.3 Focus Area #3

### Student Engagement and Workforce Development

Experiential learning and public-service courses and internships

Graduate student research

## Critical Needs to be Served

University students are increasingly drawn to address the challenges of climate change and to engage professionally in the energy transition. UMass has a breadth of departments and research units that contribute to student learning and opportunities in these fields. **UMass has prepared a clean energy plan to mitigate greenhouse gas emissions from its operations by 2032, and a Living Lab is being prepared to enhance this energy transition as an educational and research opportunity for the entire community.** Substantial effort at the University is needed to deliver on this Living Lab and provide the student experience needed to prepare the clean energy workforce that will serve Massachusetts and beyond. To meet this need, **CEE is uniquely prepared at UMass to engage students as interns in its work, further extend its teaching capacities in coordination with its public service, and to enhance its support graduate student research and mentoring.**

## Scope of Work

- Expand student internship program and “alumni” networking for career development
- Create opportunities and proactively pursue graduate students to support research projects
- Provide leadership in developing and implementing Living Lab in coordination with campus Carbon Mitigation Planning
- Expand CEE teaching capacity and deliver experiential and public-service learning course offerings to support communities in areas including buildings energy assessments, solar planning, greenhouse gas accounting

## Target Partners

**UMass:** Department of Environmental Conservation, School of Earth and Sustainability, iCons, Commonwealth Honors College, Energy Transition Institute, Libraries

## Anticipated Outcomes

- Increase student success in accessing jobs and career paths in clean energy and sustainability
- Expand UMass recognition by prospective students as choice university for clean energy and sustainability learning, innovation, and professional development

- Increase student engagement with local communities, broaden students’ experience with real-world, hands-on public service

## 5.4 Focus Area #4

### Offshore Wind Professional Certificate Program

Enrollment and diversity outreach and expansion  
UMass Offshore Wind Career Access Scholarship  
Industry partnerships

#### Critical Needs to be Served

The offshore wind workforce in Massachusetts and the world over will need to grow rapidly over the coming years to keep pace with accelerating project deployment. **CEE serves the professional workforce with a one-year Certificate, and the program has gained recognition over the year-and-a-half since its establishment.** The program is well-prepared to expand in enrollment; industry partnerships; diversity, equity, inclusion, justice (DEIJ) initiatives; and revenue.

#### Scope of Work

- Continuously improve curricular content, freshness, guest speakers, and virtual logistics. Achieve efficiency gains in serving larger enrollment
- Manage and expand program outreach and engagements with the industry
- Develop industry partnership to support program costs, our *Offshore Wind Career Access Scholarship*, and to engage with our students and connect with UMass research at the Wind Energy Center
- Grow and manage the *Offshore Wind Career Access Scholarship* funds. Expand scholarship outreach to additional DEIJ targets including veterans and Historically Black Colleges and Universities, as well as our Massachusetts Gateway Cities, low income, and BIPOC
- Maintain excellence in course instructors and on-line pedagogy

#### Target Partners

**UMass:** Department of Environmental Conservation, College of Natural Sciences, University Without Walls

**External:** Massachusetts Clean Energy Center, MassCEC Offshore Wind Community of Practice

#### Anticipated Outcomes

- Increased enrollment in Certificate courses (target 40 per course)
- Robust industry partnerships adding value to the program
- UMass recognized as national leading OSW professional curriculum and certificate

## 5.5 Focus Area #5

### Battery Energy Storage (BES) Innovation Ecosystem

Action Plan to enhance BES ecosystem impacts and value to the Commonwealth

## Critical Needs to be Served

Massachusetts is an emerging leader in the battery energy storage (BES) innovation technology space, drawing its strength in part through the strong coupling between the academic, private, and policy sectors that broadly underlie the robust Massachusetts technology economy. **CEE has completed a multi-year examination and coordination with the BES ecosystem and found that Massachusetts has the critical BES innovation ecosystem elements necessary for the state to become a global center of BES innovation and commercialization.** CEE is prepared to implement its BES Innovation Ecosystem Action Plan with key Massachusetts partners, with the goals of promoting, coordinating and accelerating the state’s BES innovation industry.

## Scope of Work

- Sustain and curate *BES Innovation Ecosystem Steering Committee* and outreach to ecosystem sectors
- Develop, launch, and maintain a Massachusetts BES innovation virtual platform, and expand ecosystem communications and branding
- Establish BES accelerator and incubator programs, and voucher program for Massachusetts advanced manufacturers
- Establish DEIJ support for graduate student research and entry to BES workforce

## Target Partners

**UMass:** Isenberg School of Management

**External:** MassCEC, NECEC, Greentown Labs, FORGE

## Anticipated Outcomes

- Enhanced functioning, collaboration, and impact of Massachusetts BES ecosystem, leading to increased business venture and innovation in battery research and commercialization
- Massachusetts BES nationally recognized and branded ecosystem
- Increased DEIJ in BES research, entrepreneurship, and commercial ventures

## 5.6 Focus Area #6

### Regional Clean Energy Extension Network

Build collaboration of extension services across UMass system and New England/Northeast Land Grant campuses

## Critical Needs to be Served

**As the pace of clean energy deployment needs to ramp up several orders of magnitude to meet climate mitigation commitments, University Extension offers a potent model for advancing market change.** Across the country, a small but growing group of energy Extension programs are emerging over a range of missions, scopes, and structures. Within the Northeast, a significant set of land grant and other universities are active in applied research, outreach, technical support, and public service curriculum, but little has been done to coordinate, share, and consider state or regional Extension initiatives to scale our impacts to better bring change to the market delivery of clean energy.



## Scope of Work

- Lead campaign to outreach and organize collaborations among regional institutions
- Create a regional affiliation with mission statement and governance
- Establish working agreements, coordinate programs, and pursue shared funding opportunities

## Target Partners

**UMass:** CAFE/CNS, UMass system, UMass President's Office

**External:** Northeast Land Grant universities

## Anticipated Outcomes

- Enhanced innovation and effectiveness of university extension
- Coordinated regional research with findings applicable across regional conditions
- Region-wide outreach pilots and programs that accelerated market change
- Enhance UMass and regional competitiveness in pursuing large federal grants

# 6 Staffing/Budget Needs and Funding Strategy

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[This section is redacted in the public version of the Plan.]