



PARTNERING FOR THE CLEAN ENERGY ECONOMY

THE NORTHEAST ECONOMIC DEVELOPMENT MODEL FOR
THE CLEAN ENERGY FUTURE.

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ACKNOWLEDGEMENTS

Drawing upon NECEC's extensive work in the areas of clean energy policy, innovation and business leadership, this paper examines the policy and economic activities underway that prove how the Northeast US can lead the nation and the world in clean energy development, demonstrating how to address climate change while growing the economy.

This is an independent report produced by NECEC. It was written by NECEC President Peter Rothstein, Executive Vice President Janet Gail Besser, Corporate Development Executive Alistair Pim, Senior Director of Communications & Public Relations Kate Plourd Johnson and (former) Policy Analyst Sue AnderBois.

NECEC is a clean energy business, policy and innovation organization. Our mission is to create a world-class clean energy hub delivering global impact with economic, energy and environmental solutions. NECEC helps clean energy companies start, scale and succeed with our unique business, innovation and policy leadership.

We are the premier voice of businesses building a world-class clean energy hub in the Northeast. We bring together business leaders and key stakeholders to engage in influential policy discussions and business initiatives while building connections that propel the clean energy industry forward. Our results-oriented team is highly skilled at turning a clear vision into reality and effectively influencing policy to build a world-class clean energy hub in the Northeast.

NECEC was formed in late 2006 when leaders in the Massachusetts clean energy industry saw the need for a regional business association to convene clean energy stakeholders dedicated to growing the state and the region's clean energy economy. In October 2015, reflecting our growing activities in New York State and the rapidly growing community of member companies doing business in New York and across New England, NECEC became the Northeast Clean Energy Council.

NECEC includes the Northeast Clean Energy Council, a 501(c)(6) trade member organization, and NECEC Institute, a 501(c)(3). The Northeast Clean Energy Council is the lead voice for hundreds of clean energy companies across the Northeast, influencing the energy policy agenda and growing the clean energy economy. NECEC Institute leads programs that support Innovation & Entrepreneurship.

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INTRODUCTION

Transforming an energy system and the economy that relies on it is no short order. While the United States has seen more than 20 years of clean and renewable energy progress, it remains decades away from achieving an energy system based on 100 percent clean energy.

However, the direction of the US energy system is changing quickly, with several critical developments: the finalization of the groundbreaking EPA Clean Power Plan to reduce emissions from the power sector, the international climate agreement that emerged from COP21 in Paris, forecasts that the world's power generating capacity mix will change from a system powered two-thirds from fossil fuel to one that is 60 percent zero emitting resources by 2040 (1), with expectations that the innovations driving solar, wind and energy storage will make these clean resources, among others, cheaper than fossil fuels by 2030. These developments make the US poised to rapidly accelerate towards a clean energy based-economy in the next decades.

Transitioning to this new energy system is no longer a question of if, but one of how and how fast. Cities, states and private sector entities throughout the world view the dramatic transition as an opportunity to capture economic development, environmental and cost-saving benefits of a clean energy system.

In many ways, the Northeast US is leading the way to a new energy system through large-scale and distributed energy deployments, implementation of energy efficiency and rapid growth of the region's clean energy industry, all leading to greenhouse gas emissions reductions.

This progress has occurred during a time of strong economic growth, proving that a clean energy economy and the industry that has grown around it are contributing to economic growth and prosperity (jobs, investment, new company formation and expansion) throughout the region. While progress has been substantial, the next 15 years are critical. There must be radical energy market transformation and regulatory reform to unleash additional energy innovation. New financing mechanisms and new business models and roles for utilities must materialize. Customers must have increased access to technologies and providers that enable them to have more control over their energy use. And there must be rapid acceleration of scalable clean energy innovations that can make a significant contribution to the transition to a clean energy economy.

The Northeast US is already one of the world's leading and fastest growing clean energy clusters with strong support from public officials, a network of nonprofit innovation programs that are accelerating new cleantech breakthroughs and a population that overwhelmingly supports a transition to clean energy. With historically high energy prices, no native fuel sources and one of the nation's largest regional economies, the Northeast is a critical place to demonstrate that a clean energy economy can be sustainable and support economic growth. The Northeast's clean energy businesses are developing and scaling new clean energy innovations, market models, financial products, and business partnerships needed to transform the energy system and economy while also serving as a model for the rest of the world.

This paper, Partnering for the Clean Energy Economy, was developed to guide both public and private sector leaders through the policies, programs and support structures needed to secure the transition to a clean energy based economy in the Northeast. To achieve this objective, Northeast states must achieve specific clean energy targets by 2030 (See Targets for a Clean Energy Economy). (2)

NECEC analyzed the following three key economic development elements needed to ensure 2030 clean energy targets are achieved and that the region continues on its steady path towards a clean energy future:

- 1) The Clean Energy Policy Foundation
- 2) Clean Energy Market Development
- 3) Business Growth and Innovation

The following pages examine how the Northeast has been leading in these areas, through specific examples and approaches that are underway, as well as what more is needed to accelerate the region's energy transition to serve as a global example for how clean energy can be both a climate solution and a driver of economic prosperity.

TARGETS FOR A CLEAN ENERGY ECONOMY

Today the Northeast runs on less than 10 percent renewable energy. While this is a significant increase from a decade ago, it is not enough to secure the transition to a clean energy-based economy that achieves the greater and faster emissions reductions needed to avoid impacts of climate change that could devastate economies throughout the region, the US and the world. In the next several years, public and private sector leaders must converge to commit to a rapid transition to clean energy that stands to prove that it is possible to grow the economy while addressing climate change. Commitments must include strong, interim clean energy and climate goals by 2030.



Renewable Energy

Clean energy generation must be 40 percent of the region's capacity by 2030



Energy Efficiency

The region must continue on its path of 2 percent demand (and peak) energy reductions per year



Grid Modernization

Modernized, intelligent electricity grid platforms in a majority of the Northeast states that prove a platform, model and pathway to support 80 to 100 percent renewables / zero emission generation by mid-century



Market Innovation

Markets that unleash innovative technologies and business models across our energy systems of electricity, buildings, cities, and transportation



Business Engagement

Strong business engagement to support the implementation of public policies for combating climate change and developing clean energy-based economies

SOLIDIFYING THE CLEAN ENERGY POLICY FOUNDATION

The Northeast has historically led the nation in the creation and implementation of innovative policy solutions to develop and expand clean energy resources. Northeast states were the first to pioneer utility energy efficiency programs in the 1980s, electricity industry restructuring in the 1990s, and renewable energy and adopting aggressive climate goals in the 2000s. Half of the American Council for an Energy Efficient Economy (ACEEE) list of the top ten most efficient states are in the Northeast and all of the states have Renewable Energy/Portfolio Standards and greenhouse gas (GHG) reduction targets.

The Northeast now stands at a unique moment in history. While it is poised to leap into a clean energy future, the region has become increasingly reliant on natural gas. Natural gas has grown from 18 percent of New England's electricity capacity mix in 2000 to 44 percent in 2014 – and ISO New England is currently predicting increased reliance up to 57 percent by 2024. This level of dependence will inhibit the region's ability to reach its climate and clean energy goals. While still a small part of the energy mix, renewable and clean distributed energy resources (DER) – from increasingly affordable solar panels and electric vehicles to internet-enabled energy management “smart” devices and other advanced power electronics – are growing at a staggering rate. Grid scale clean energy in the form of onshore wind has also grown significantly and the first offshore wind project in the US is about to become operational. The recently released 2015 Massachusetts Clean Energy Industry Report indicates that over 1 GW of renewable energy capacity is installed within the Commonwealth's borders. This past summer

Governor Cuomo announced that solar had grown more than 300 percent in New York between 2011 and 2014, with New York City seeing an increase of more than 500 percent alone. (3) Businesses, residential customers and other market participants are responding to clear market signals to increase investments in clean energy.

The innovative policies, programs, and regulations enacted in the Northeast (such as renewable portfolio standards and procurement of all cost-effective energy efficiency) that have brought clean energy this far remain necessary drivers of clean energy markets. However, these policies need to evolve as the industry is maturing and the scaling and integration of clean technologies is increasingly important. Policy and regulatory reform must now take a comprehensive approach to modernizing the energy system. The proliferation of DER, such as solar, energy storage and demand response, is challenging the operation of the 20th century electricity system originally built for one-way electricity flows from large, central power plants. Increased DER is fundamentally changing our energy system, increasing the amount of two-way power flows and the need for two-way communications and access to real-time information to increase efficiency, reliability and resiliency.

The Northeast again has the opportunity to lead nationally in this transition to a modernized energy system. It is time to modernize the region's policy and market support for clean energy and the electricity grid into which it needs to be integrated for the 21st century. The transition must be a smooth one so that it does not disrupt customer adoption and market

opportunities for the clean energy industry in the Northeast. It must also maintain and enhance the reliability and resiliency customers expect from the distribution and transmission network. The Northeast states already have years of experience with cost-effective renewable and clean energy and energy efficiency programs and policies that have delivered strong economic, energy system and environmental benefits. States must build on this foundation by:

- Evolving incentives and procurement mechanisms towards economic competitiveness
- Updating and expanding targets for renewable energy, greenhouse gas reductions and energy efficiency
- Laying the groundwork for the modern integrated grid of the future.

EVOLVING RENEWABLE ENERGY AND ENERGY EFFICIENCY PROGRAMS AND POLICIES

INCENTIVES, PROCUREMENT MECHANISMS, DRIVING TOWARDS ECONOMIC COMPETITIVENESS

As the costs of clean energy technologies become more competitive with traditional energy sources, the programs and policy support structures that jumpstarted the region's clean energy transition should evolve.

The Northeast is already experiencing this policy evolution, as many technologies – such as distributed solar and onshore wind – are seeing or will see incentive levels decline and shift as technology costs decline and markets mature and technologies become more competitive. While this is a positive sign of the transition to a clean energy based economy, policymakers must ensure that support for these maturing technologies does not decline precipitously and disrupt clean energy development. Rather it should gradually step down over time to ensure a smooth transition to a post-incentive policy framework based on competition, appropriate contracting mechanisms and fair compensation for clean energy technologies. Adjusting technology-specific incentives to take into account innovation, improving economics, the level of support needed and market signals and feedback is the best way to establish economically sustainable clean energy markets that can grow long term.

Most of the Northeast states are already engaged in studies to understand the changing economics, value propositions and compensation rate design options for solar and other distributed energy resources with growing distinctions across residential, commercial, industrial, municipal, community and grid-scale systems.

In this process, the Northeast has an opportunity to accelerate solutions from competitive vendors who create new business models and customer offers that continue to lower the cost of DER to customers and the electricity system.

Increased use of competitive solicitations, and long-term Power Purchase Agreements (PPAs) for large-scale resources such as wind have also contributed positively to market scaling with declining and increasingly competitive prices. Regional efforts to align these procurements across Massachusetts, Connecticut and Rhode Island have also spurred grid scale clean energy market growth and significant benefits for ratepayers, customers and the economy.

At the same time, new policy support is needed on now emerging technologies, such as distributed and grid-scale energy storage, electric and hydrogen-powered vehicles, and offshore wind, that could have huge transformative potential if nurtured in similar ways to the policy mechanisms and innovation investments that have helped mature and drive down costs for solar and onshore wind. These emerging technologies will need focused programs to support the development of local markets and supply chains in the near term in order to establish regional expertise, infrastructure and economies of scale for the medium to long-term. Policies to reduce the “soft costs” of clean energy deployment, such as streamlined permitting and siting, and new financing approaches that leverage private investment should also be implemented to continue to improve their economics.

BUILD ON RENEWABLE ENERGY AND ENERGY EFFICIENCY PROGRAMS AND POLICIES

UPDATING TARGETS

While building on existing policies and programs is needed to continue to support development of clean energy, states also need to extend and expand targets for clean and renewable energy, greenhouse gas reductions and energy efficiency to provide strong and consistent market signals that attract clean energy investment, development and innovation. These targets should look out to the 2030 timeframe, recognizing that many clean energy projects and technologies take several years to develop, and increasingly, their customers and developers need to consider scenarios of changing needs, markets and business models that might favor the location and attributes of some over others. Updated market targets and initiatives to be extended to at least 2030 should include:

Expansion of Renewable Portfolio and Clean Energy Standards, with the addition of aggressive medium- and long-term clean and renewable energy goals to create demand for clean energy and enable it to scale and reach cost parity with traditional fuel sources. Rhode Island recently enacted an extension of its Renewable Energy Standard (RES, equivalent to RPS) to 2035 growing at 1.5 percent per year and New York set a Clean Energy Standard (CES) of 50 percent by 2030. (4)

Energy Efficiency Targets and the evolution and expansion of existing and new programs to achieve all cost-effective energy efficiency and demand response should be continued and accelerated. It is important to build on utility managed energy efficiency programs, exploring new financing and delivery

models. These include attracting private financing for deep energy retrofits through Green Banks and Property Assessed Clean Energy (PACE) programs in both the commercial and residential sectors (More on page 17 "Financial Innovation.") and creating more flexible program structures that enable opportunities for new technologies and new providers. There is significant opportunity to do more in energy efficiency and demand response by accelerating the pace of achievement of all cost-effective energy efficiency with more ambitious targets and investment levels such as reducing energy and demand by 2 percent per year.

Aggressive Economy-Wide Climate and Greenhouse Gas Reduction Targets of 80 percent or more for 2050 should be reaffirmed and interim goals for 2030 of 45 percent and 2040 of 65 percent should be established to ensure that the Northeast remains on track to achieve its long-term goals. (5) The extension and expansion of the Regional Greenhouse Gas Initiative (RGGI), which is a market-based program viewed as a national model for greenhouse gas reductions in the power sector, should be part of this discussion. RGGI's current targets go beyond the requirements of the EPA's Clean Power Plan and Massachusetts recently called for the RGGI states to require carbon emissions reductions at a rate twice as fast as current guidelines to ensure that state GHG reduction goals can be met in a way that has been proven to reduce compliance costs for customers and spur innovation in clean energy in the region.

LAY THE GROUNDWORK FOR THE 21ST CENTURY ELECTRICITY SYSTEM AND INTEGRATED GRID OF THE FUTURE

Building a 21st century electric system will require new technologies and investments in the grid, new utility planning and business models, revised regulatory frameworks, including rate design, to support and enable them, and new innovative technologies and competitive solutions. Utilities must increasingly adopt advanced technologies to enable two-way communications and power flows, which will provide greater visibility into the distribution and transmission grids, increased operational flexibility and efficiency, and the ability to integrate – not just interconnect – clean distributed energy resources.

Such advances will not only recognize and support the proliferation of clean energy, but they will enhance utilities' capability to communicate with and provide information to customers and third party providers of energy products and services, resulting in greater customer satisfaction and an overall more efficient and resilient grid. Moreover, utilities must explore new business models not dependent on increased delivery or sales of energy to meet traditional needs because customers – from the smallest residential to the largest industrial – are increasingly meeting their energy service needs by reducing their energy use or tapping into local energy sources. However, advanced technologies and new uses of electricity for transportation, heating and other thermal requirements offer opportunities for increased deliveries in the longer term. New distribution planning approaches and a new regulatory framework that supports and provides incentives for utilities to invest in the modernization of the grid is needed to align with the expectations and demands of customers for a 21st century electricity system.

The four key pillars of a strategy to move toward a modernized grid by 2030, outlined in NECEC's 2014 report "Leading the Next Era of Electricity Innovation: The Grid Modernization Challenge and Opportunity in the Northeast" (7) include:

1) Planning for Grid Modernization: This includes electric utility development and implementation of forward-looking business plans that prepare them for their evolving role within the modernized grid. This planning includes distribution system investment plans to enable the transition from a model where utilities deliver commodity electricity to a model where they serve as a distributed platform system operator, integrating distributed energy resources and third party technology and enabling two-way flows of electricity and information.

2) Forward Looking, Outcomes-Based Regulatory Framework: In order to facilitate the development of a 21st century electricity grid, regulators should develop forward-looking, outcomes-based approaches to regulating distribution utilities. Regulators should partner with utilities and third-party stakeholders to define a set of outcomes that the utility will be expected to deliver in future years. Regulators should then properly align incentives to reward the utilities for meeting these goals while both delivering value and enabling value creation by customers and third parties who use the network.

3) Efficient and Fair Rates. Utilities and regulators will need to update the design of rates, recognizing that changing patterns of usage have implications for both

the utility and customers. Rates charged to customers need to provide them with timely and actionable price signals and information about the costs that their usage and patterns of usage cause for the system. These rates need to properly compensate distribution utilities for that use, and also incentivize and compensate the developers and owners of distributed energy resources for the value of the services they provide. The objective is to send price signals to customers to optimize system-wide efficiency and open the door to innovative and responsive demand-side solutions and support the investment in the system that will be required to do so.

4) Unlock Innovation: Distribution utilities will need to continually explore and adopt new technologies to adapt to changing demands from customers and the distribution system. Regulators will need to support these activities by allowing utilities to establish budgets for demonstration, testing, and integration of new technologies and processes to determine their value for broader deployment. Regulators also need to encourage utility and 3rd party explorations and joint projects that consider new business models, partnerships and innovation practices that accelerate creation and implementation of new solutions. At the same time, the industry and regulators need to balance utility innovation development and demonstration investments using ratepayer funds with encouraging competitive investments in new innovations and markets by third parties (including by unregulated utility affiliates, with appropriate competitive safeguards) to maximize value for customers.

IN THE SPOTLIGHT: GRID MODERNIZATION INITIATIVES IN THE NORTHEAST



Connecticut

Connecticut has called on NECEC and expertise from across the region to share grid modernization perspectives in legislative hearings and energy planning efforts led by the administration. This is expected to lead to grid modernization recommendations in the 2016 CT Comprehensive Energy Plan and legislative proposals in 2017 to advance the state's energy system.



Massachusetts

Grid Modernization proceedings at the Department of Public Utilities (DPU) began in 2012. In August 2015, the three Massachusetts electric distribution companies filed their required 10-year Grid Modernization Plans (GMPs) and five-year Short Term Implementation Plans (STIPs). In 2016, the DPU proceedings to review and approve these GMPs are under way, and NECEC is strongly engaged to represent clean energy and to accelerate progress towards utility investments in innovation and a modernized grid.



New Hampshire

New Hampshire started an effort to modernize its electric grid through a stakeholder process in 2016 that is drawing on models and approaches from across the region. NECEC and our state partner the New Hampshire Sustainable Energy Association are engaged parties in this important process to advance New Hampshire's electricity system.



New York

New York's Public Utilities Commission launched its comprehensive Reforming the Energy Vision (REV) in early 2014 to overhaul the regulation of the state's distribution utilities to enable the development of new energy products and services that help consumers make better and more informed energy choices through clean energy, prioritizing an expanded role and value from distributed energy resources. NECEC, in partnership with Advanced Energy Economy (AEE) and the Alliance for Clean Energy New York (ACE NY) are active participants in the REV proceeding, advocating and contributing detailed comments and white papers advancing clean energy opportunities and models. These activities are positively impacting REV's design of new clean energy markets and advancing New York REV as a leading model for the region and country.



Rhode Island

Rhode Island's Public Utilities Commission initiated a Docket 4600 on Rate Modernization in early 2016 to consider rate design in the context of grid modernization. In collaboration with the ongoing Systems Integration Rhode Island (SIRI) process, the Rate Modernization proceeding has the potential to launch Rhode Island as a strong location to pilot and demonstrate modernized electricity system initiatives. NECEC will continue to be involved in the implementation to ensure strong progress towards a modernized grid and appropriate rates to incentivize distributed clean energy innovations.

SOLIDIFYING THE CLEAN ENERGY POLICY FOUNDATION

Laying the foundation for a modernized grid is essential to catalyzing clean energy markets. Investments in two-way communications and the ability to handle two-way power flows will empower customers and communities to make their own clean energy choices if they are given access to data and the distribution utilities integrate customer DER into the distribution system and their planning. These capabilities can also open up the flow of information about customer energy use and electricity system status and conditions for customers and third party providers so that they can make choices and devise new solution to meet their energy need (More on page 15 "Increasing Access to Information.") Modernizing the grid will support moving toward a long-term sustainable energy policy framework that relies on evolving policies to reach expanding targets using more competitive market mechanisms.

Policy evolution, leadership and partnership from today to 2020, 2025 and 2030 are critical to advancing the clean energy economy. Continuing the Northeast's leadership in innovative policy solutions that expand clean energy markets requires collaboration among a variety of stakeholders. Clean energy businesses, environmental advocates, large employer groups, utilities, policy makers, consumer advocates and communities must work together to achieve policy success. Stakeholder engagement and policy development must be based on sound economic analysis and an understanding of the elements needed to unleash an innovative clean energy industry to develop and bring to market solutions for the region's and world's economic, energy and environmental challenges. By partnering and collaborating, the

necessary progress on legislation and regulation to build on and evolve current policies, update and expand targets and lay the groundwork for a 21st century electricity system that supports clean energy is attainable, and will be a key part of the solution to address climate change and advance economic growth and job creation in the region.

CATALYZING CLEAN ENERGY MARKETS

The clean energy policy portfolio that developed in the last two decades has powerfully influenced clean energy markets and effectively jump started the region's transition to a clean energy based economy. Today, the electric power sector stands at an inflection point with significant growth in grid-scale renewables, as well as increasing distributed energy models creating new opportunities to unlock clean energy, energy system efficiencies and ways for consumers to have direct choice and more control of their energy consumption.

In addition to the policy and regulatory changes described earlier, actions are needed to eliminate barriers to effective and efficient growth of clean energy markets. Examining the trends and activities of clean energy companies, large energy corporations, and energy researchers and innovators in NECEC's network, it is clear the following three strategies are critical to further catalyze clean energy markets in the Northeast:

- Empowering energy customers and communities to be more active participants in their energy choices
- Opening up the flow of information about energy use to utilities, consumers and solutions providers to enable behavioral changes and smart system investments and services, and
- Development of new financing models to increase capital sources and lower the cost of clean energy development.

EMPOWERING CUSTOMERS AND COMMUNITIES

CUSTOMER AGGREGATION

Enabling individuals and groups of customers to invest in clean energy is critical to further developing clean energy markets. Individual and groups of building owners and operators are playing increasingly active roles in energy management, budgeting, procurement and climate impact. However, there remain institutional barriers that prevent customers from taking active control of their energy choices in a cost-effective manner.

To reduce barriers, both public sector and private sector entities must establish mechanisms to help customers and communities take advantage of economies of scale when purchasing clean energy products. A key strategy for economy of scale and streamlining of customer clean energy investing is Customer Aggregation. This has proven to be effective in community models like Solarize, a solar photovoltaic (PV) group purchasing program that aggregates individual customers across a community for a group solar installation. Solarize—now active in hundreds of Northeastern communities—has proven to lower customer acquisition costs for the developer, while also lowering the price per kilowatt-hour of solar PV for customers in participating communities. Several Northeast states have successfully used this model to increase solar growth in targeted communities. Solarize has contributed to Massachusetts and Connecticut solar acquisition price declines of 20 percent. (8)

Another innovative example of customer aggregation can be seen with companies such as PowerOptions, a non-profit membership-based organization for nonprofits and public entities.

IN THE SPOTLIGHT: SUSTAINABLE WESTCHESTER

Sustainable Westchester launched as a pilot in 2015 to become the default provider of energy to the residences and businesses in the county's cities and towns who opt into Sustainable Westchester's group buying of clean energy. Utilities are delivery and billing partners, with Sustainable Westchester representing the aggregated communities in selecting a competitive supplier and their portfolio of clean energy sources. The model also provides aggregation for investment in local distributed energy options, such as solar, microgrids and efficiency projects.

PowerOptions provides energy purchasing of electricity and natural gas as well as two solar programs, bringing together customer communities of non-profits, including universities and housing authorities. Power Options members benefit from competitive procurements that achieve optimal prices and protections against market risks. Its pre-negotiated solar Power Purchase Agreements reduce costs and hedges against the volatile electricity market with 20-year, guaranteed prices. (9)

These strategies have spurred the development of a model called Community Choice Aggregation, which connects communities, municipalities and counties with competitive energy suppliers to become an aggregated, engaged customer for clean energy. This model is currently being demonstrated on the Cape and Islands in Massachusetts and in New York's Westchester County. (10) Customer aggregation models are unlocking opportunities for communities to be active customers of existing clean energy options, while also pushing communities to consider clean energy as they plan for infrastructure needs.

EMPOWERING CUSTOMERS AND COMMUNITIES

SUSTAINABLE CITIES

The re-urbanization of the US combined with aging infrastructure in many American cities has spurred the “smart cities” movement throughout the country. In the Northeast and elsewhere, municipal officials grapple with how to modernize public infrastructure and services in urban areas on tight budgets. Many of these initiatives are also being driven by extreme weather events, growing concerns about climate change and energy costs. To improve sustainability and resiliency while lowering energy budgets, many state and municipal officials are turning to new energy management strategies and clean energy solutions.

Local sustainability planning is being led primarily by municipalities who aim to transition to a modernized, integrated architecture – Smart, Sustainable Cities. These municipalities are partnering with their utilities and competitive energy products and services companies to pilot new technologies and models to truly be the cities of our energy future. For example, Green Mountain Power’s Stafford Hill Solar Farm in Rutland, Vermont includes solar, energy storage and microgrid technology in a new way to improve resiliency of the energy system. The project is the first in the nation to use a microgrid system powered entirely by solar and battery with no other fuel source. (11)

These factors have spurred municipal leaders throughout the Northeast to focus city planning on developing a more resilient clean energy infrastructure, and leverage rapidly evolving

technologies in lighting, sensors, controls and adaptive systems. This city-driven effort presents significant business and market opportunities for the clean energy industry.

One industry sub-sector with significant activity and support from state-level initiatives and policies is the development of microgrids: small scale electricity generation, storage and distribution systems that utilize distributed energy resources (such as solar, co-generation, or combined heat and power) and are managed locally, rather than through a centralized power grid. Microgrids allow for island-ability if the grid goes down, providing reliability and resiliency for customers.

Connecticut, Massachusetts and New York have initiated programs in recent years to support microgrid projects. Connecticut’s 2013 \$30 million Microgrid Pilot Program was first, and now has 11 projects built or under development and expected to be operational in 2016. Meanwhile the \$40 million community microgrid program NY Prize was launched in 2014 as a way to ensure that New York can maintain a reliable grid in the case of another Super Storm Sandy. The first round awarded 83 grants to conduct project feasibility studies to municipalities, campuses, communities, vendors, grid integrators and utilities to build microgrids. These projects will prove new models that can seed a market for smart distributed energy systems throughout the region. (12) (More on page 14 “The City-Led Microgrid Revolution.”)

EMPOWERING CUSTOMERS AND COMMUNITIES

SUSTAINABLE CITIES

States are supporting broader levels of sustainable city development through innovative programs to empower clean energy and energy efficiency progress in municipalities. In Massachusetts, the Green Communities Designation and Grant Program provides technical assistance to cities and towns to meet specific criteria to become a designated Green Community. Once designated, the municipality qualifies for additional grants and technical support to finance energy efficiency and renewable energy projects and support municipal and community planning (More on page 17 "Financial Innovations.")

Green Communities are assisted by state program coordinators who simplify clean energy opportunities for municipalities and their communities, including clean energy adoption. These municipalities share best practices and common tools to analyze and track energy use and climate impacts. Program coordinators educate town officials on energy investment decisions, and provide local expertise to municipalities pursuing clean energy goals. New York's Cleaner, Greener Communities Program similarly encourages communities to create public-private partnerships and develop regional sustainable growth strategies for energy efficiency, renewable energy, low-carbon transportation, and other carbon reduction opportunities.

With the shift underway to a clean, smart, more distributed energy system, customer aggregation will serve as a key strategy to increase market efficiencies and economies of scale, while empowering

communities to become more active customers of their energy future. Customer aggregation needs policy support and the private sector's innovative services and models. Northeast cities and states must grow their support of communities deploying new energy technologies and community-scale solutions from community solar, shared neighborhood storage, to microgrids and electric vehicle charging infrastructure. The private sector also needs to lead by listening closely to customers and integrating new solutions with appropriate business models to improve sustainability, and support the growing economies in the region's cities.

GLOBAL LEADERS IN SUSTAINABILITY

The Northeast's largest cities have been recognized among the most sustainable cities in the world by C40, a network of the world's megacities committed to addressing climate change.

→ NEW YORK CITY

New York was awarded a prestigious C40 Award three years in a row for its Stronger, More Resilient New York plan developed after Superstorm Sandy, the NYC Carbon Challenge program which aims to reduce emissions by more than 600,000 metric tons through programs for building owners, and for its One City: Built to Last, and the Buildings Technical Working Group, a 10-year plan to improve the energy efficiency of NYC's one million buildings through a combination of public investments in City-owned buildings and new programs to spur private-sector action.

→ BOSTON

Boston was recognized with a C40 Award in 2015 for the innovative Greenovate Boston program that creates an umbrella brand to unify programs in different city departments and establish a broad platform for communication, community engagement, and recognition of achievement towards the city's overall climate and sustainability goals.

IN THE SPOTLIGHT

A CITY-LED MICROGRID REVOLUTION IN THE NORTHEAST

Resiliency for Fairfield

In the aftermath of Superstorm Sandy, public officials in the Town of Fairfield, Connecticut identified a critical need to make the town's power grid more secure and reliable in case of another natural disaster. Town officials utilized Connecticut's Microgrid Pilot program which helped finance a microgrid that combines solar photovoltaic panels and a separate generator that is capable of providing power 24/7 in the event of a power outage. The project, built in partnership with Schneider-Electric and local utility United Illuminating, serves the town police and fire departments, emergency communications, a cell tower and a homeless shelter. It will serve as a key way to protect public safety and to better prepare the state in the event of natural disasters, while allowing the town to reduce energy costs.

Economic Security in Schenectady

Economic development is a huge driver for Schenectady, New York's plans to establish a microgrid. Mayor Gary McCarthy saw the development as a way to improve electricity system resiliency and yield efficiencies, while also improving the city's competitive edge to attract businesses, particularly technology companies, to the area. Schenectady's microgrid is being developed with support from NYPrize through a consortium of companies including GE, National Grid and more than a dozen local businesses such as ASI Energy. The microgrid would expand power distribution to the City Mission, Salvation Army, County Jail, Sheriff's Department, County Public Library and the city's fire and police stations, and provide back-up power to buildings like City Hall and the city's police headquarters.

Keeping Emergency Services Running in Northampton.

The City of Northampton, Massachusetts is in the early stages of developing a microgrid to link its three highest priority emergency services facilities (a hospital, the Department of Public Works Headquarters and a Red Cross shelter in a High school) to existing and planned solar arrays, batteries and other power generation sources to provide power in the event of outages, and to reduce the city's carbon emissions. Currently the hospital has two biomass plants that generate a mix of steam and electricity. However, if a power outage occurs today on the electricity grid, one of these plants is unable to fully operate and provide power to the hospital. The microgrid project will include new switchgear that would keep both biomass plants up and running during an outage, which would improve the services that the hospital could deliver. As in Connecticut, the state program is in response to several recent extreme weather events. The intent is to identify facilities where the loss of electrical service would result in the disruption of a critical public safety or life-sustaining function, including emergency services, shelters, food and fuel supply and communications infrastructure.

INCREASING ACCESS TO ENERGY INFORMATION

The evolution to a clean energy based economy relies significantly on the ability to integrate increased amounts of distributed energy resources into the electric power grid. This evolution is nearly impossible without greater transparency and access to real time (or near real time) data and information about customer energy usage and the status of the grid. Three key transitions must take place to increase access to energy information:

- Distribution utilities need greater visibility into the real time information about the grid and its rapidly increasing distributed energy resources to assess and address system-wide functionality (including real time information about how the combinations of changing demand and distributed generation are impacting local portions of the grid).
- Distribution and regional grid operators and utilities need to provide real-time information and time-of-use pricing to customers and distributed demand operators (C&I buildings, microgrids, smart devices, storage, etc.) to effectively draw value from distributed energy resources (DER) to the grid.
- Customers and competitive energy service companies need access to real-time and historical customer and system data to enable the creation of innovative new products and services to meet customer demands and expectations and to devise solutions to distribution system needs.

As distributed energy resources proliferate on the electricity system, distribution utilities are forced with having to change their role. Historically utilities have

forecasted customer energy onsite generation, needs and behavior, but with DER growth utilities need to take on the role of a network operator of an intelligent, modernized distribution system. To safely, reliably, and efficiently operate a distribution system with two way power flows, utilities will require visibility that currently does not exist about the location and performance of specific resources, both behind the meter and in front of the meter.

This includes distributed generation, demand response and energy storage. Currently, utilities (and by extension regional transmission operators) cannot “see” much of the distributed generation on the grid, and therefore have limited capabilities to plan for, value or make better use of these resources for customers. This increased need for data regarding system status and the operation of DER requires utilities to significantly expand both their system monitoring capabilities and their information technology and communications infrastructure to manage increased volumes and types of data on the distribution system and customer usage.

Customers and energy technology and services businesses similarly need greater access to information about current and historical energy use to make better energy management choices and to enable businesses to develop products for customers and utilities to better manage energy use. Access to real-time information and energy pricing allows customers to make energy choices to save money and reduce energy use. Innovators could have access to data to create the next Nest thermostat, the Uber of the energy world, and more. Advanced metering

functionality and sensors and controls at individual energy devices will be needed to collect and share this information. While many large commercial and industrial (C&I) customers already have access to granular data from interval metering, most residential and small commercial customers do not. As utilities invest in distributed devices and a modern, digital information network to collect and manage this level of data, they will also need to make it available to customers and third parties. Data and information will need to be provided in usable formats in real (or near real) time so that third parties (and utilities) can develop products and services that enable customers to optimize their energy usage. While information must be subject to legal customer privacy policies and standards, third parties should be given free access to their customers' data (with customer permission) and local grid performance information in order to design and offer new, valuable products and services.

Access to data and information has proven to be an effective way to engage customers and inspire behavioral changes that reduce energy consumption. Today utility energy efficiency programs that provide energy usage information to customers comparing their usage to their neighbors are driving the adoption of energy efficiency measures.

There is a variety of existing and emerging technologies, opportunities and tools that use real time information and time-of-use pricing to incentivize efficient customer energy use, investment, and new third-party solutions. Access to energy information is critical to unleash even more benefits for customers and energy managers. What matters most is that the information is available in real time, it is clear, easily actionable, and that it provides compelling economic and sustainable value to the customer.

FINANCIAL INNOVATION

Catalyzing markets also requires scaling current technologies and addressing barriers that stand in the way of new innovations. To truly scale clean energy markets, there is a need to broaden access to capital and to lower the cost of capital for clean energy deployment and innovation. This requires larger sources of low cost capital aligned with the risk, return and timeframes realistic to clean energy investments.

Most clean energy projects have little or no fuel and operating costs but can have significant upfront capital costs, such as with onshore and offshore wind farms, solar plants and installations, and deep energy efficiency retrofits. Lowering the up-front cost of clean energy can be achieved through financing approaches that combine lower costs of capital with long-term financing mechanisms.

The Northeast is a home to a number of leading examples, in particular state Green Banks. The Connecticut Green Bank was the first such organization in the country, and has now been followed by the New York Green Bank and the Rhode Island Infrastructure Bank, and most recently Massachusetts legislation authorizing a Commercial Property Assessed Clean Energy (CPACE) program. In addition, the Massachusetts Clean Energy Center also runs several financing programs that combine low interest public funds with private capital to lower financing costs and expand private sector financing support for clean energy projects.

While there are variations on the model, at their core, green banks and innovative public-private financing

organizations are being established as state-chartered public or quasi-public entities that are able to bond and/or aggregate public low-interest funds, and structure partnerships with private sector financing institutions. These green banks enable a combination of public and private funds that provide low-cost, long-term financing support to clean, low-carbon projects. Each public dollar can support multiple dollars of private investment, and engages banks and other financial institutions as more active lenders for clean energy projects.

Green banks are building programs such as PACE lending, solar loans, energy services contracts, and other financing mechanisms. They play valuable roles in municipal sector projects, as well as private sector opportunities, lowering the cost and accelerating the buying decision for clean energy deployments, including distributed generation such as solar, energy efficiency (including building deep energy retrofits), demand response and energy storage resources, electric and low-emission vehicles and infrastructure, and other solutions.

The growth of state green banks and other public agencies, combined with the region's world-class financial institutions, creates an important opportunity for the Northeast to lead further in financial innovations for clean energy deployment. Recent efforts to use Master Limited Partnerships and Yieldco's as structured public market investment vehicles to bring capital into the clean energy deployment market have not led to predictable and stable tools for investors or for project developers. More effort is needed from financial sector leaders to

refine the structures and develop market confidence necessary for financial instruments and reliable capital for the world's transition to clean energy economies. The Northeast is well positioned as a sizeable market with active public and private institutions to help solve and prove out new financial models.

Pension funds, foundations, family offices and private individuals have recently started to engage in impact investing directly and in capital markets that underwrite clean energy innovations and deployments. These approaches should include models that remove barriers to deployment in low to moderate income housing, in communities that combine a diversity of residents, private owners and municipal assets, and in combination with funds that support new technology R&D, pilots and demonstrations. Additionally, the clean energy sector needs models that can assume the risk premiums associated with new technologies. This includes more patient equity capital and so-called "Impact Investment" that seeks to co-invest in early-stage equity in clean technology startups and innovations. Combinations of private and public capital that can combine patient investments with grants and support for first-customer projects have potential to bridge innovation stages and entice significant sources of traditional capital into clean energy technology development. Institutions like green banks have the potential to partner by underwriting the less risky portion of projects and enabling new clean energy technologies to be proven in the field (More on page 19 "Fostering Business Growth & Innovation.")

As financial institutions analyze the milestone climate agreement reached in Paris at COP 21, they are paying particular attention to the financial models, institutions and market structures that will be needed

for clean energy deployment to scale to keep greenhouse gas emissions below the 2 degree Celsius goal. In January 2016, CERES and Bloomberg New Energy Finance reported that the level of investment in new renewable power generation needed to solve climate change, would be \$12.1 trillion over the next 25 years, or "\$5.2 trillion above business-as-usual projections." (13)

Work needs to be done to eliminate barriers to effective and efficient clean energy markets and to enable a robust clean energy industry that provides affordable products and services. The Northeast public sector, its growing clean energy industry and financial services industry are collaborating in leading initiatives to enable customers & communities, information access, and financial innovation. These are key ingredients of market development and drivers that are advancing new clean energy solutions faster in the Northeast. They will continue to be critical to enabling new solutions and business models to be tested, demonstrated, deployed and scaled as the region aims for further renewable energy generation and reduced greenhouse gas emissions by 2030.

FOSTERING BUSINESS GROWTH AND INNOVATION

The Northeast's regional economy has been a leader in numerous innovation and technological industries over many generations. Today, it remains a hub for a variety of industries that give the US a global competitive edge. Over the past decade, various metro areas in the Northeast have produced a regional clean energy cluster with researchers, entrepreneurs, investors, and corporate executives creating viable businesses from clean energy innovations that are addressing climate change mitigation. Many of these businesses rely upon the region's robust clean energy innovation ecosystem that provides innovation and entrepreneurial support, an active investor community, entrepreneurial and energy industry experts, corporate partnerships and access to emerging clean energy and technology markets.

This ecosystem must remain strong and connected to ensure that clean energy businesses and innovators in the Northeast continue to develop the technologies and business models to fundamentally change our energy system and fuel the transition to a clean energy based economy. The people and programs across the innovation ecosystem play critical roles helping startups address early-stage technical and business challenges to reach commercialization milestones. Industry associations, including NECEC, focus on supporting cleantech innovators at the most fundamental business level, by finding and fostering people leading these breakthrough businesses and ensuring they have the talent, mentorship and resources needed to start, grow and scale cleantech ventures.

Maintaining and accelerating the pace of business growth and innovation in the cleantech ecosystem requires the following:

- Public support for early-stage innovation
- Programs that foster early commercialization, pilot & demonstration opportunities
- Corporate partnerships and encouraging open innovation



PUBLIC SUPPORT FOR EARLY-STAGE INNOVATION

While private capital needs to play a major role in innovation development and scale-up, public sector support is critical for the Northeast to remain a leader in cleantech early-stage innovation.

Public sector support from institutions such as NYSERDA and MassCEC have targeted important gaps in private investment and contributed to dozens of companies making technology and business progress, attracting follow-on private investment and first customers. Early-stage innovation support has included funding incubators and accelerators that supply cleantech entrepreneurs with entrepreneurial training and mentorship, providing financial support through innovation grants and awards and providing financial assistance to programs and events that convene and connect the regional innovation ecosystem. Various models exist throughout the ecosystem and must be supported by the private and public sector.

Entrepreneurial support and training programs that are general or specific to cleantech and clean energy are essential to ensuring that innovators are commercially ready before bringing technologies to market. The Northeast states lead the nation in supporting the development of new programs and tools to support entrepreneurs. For example, NECEC is collaborating with NYSERDA on an innovative new web-based platform called StartupGPS to be launched in late 2016 to serve as a “commercialization toolkit,” including a library of best practice curricular frameworks and guides to shepherd entrepreneurs through common cleantech commercialization hurdles. StartupGPS includes an assessment tool to help entrepreneurs determine

their stage of commercial readiness specific strengths and weaknesses they encounter at their stage, as well as links to curriculum and services specifically targeted to the entrepreneur’s needs.

Business support and mentoring are not activities exclusive to cleantech and clean energy but they are essential to supporting entrepreneurial growth in this sector.

The mentorship model has proven incredibly effective with the Northeast’s cleantech innovation programs, with thousands of mentor-team matches to date. These programs have demonstrated effectiveness and best practices around mentor recruitment, including the importance of a strong vetting and matching process. Through a strong innovation ecosystem with connections throughout the region’s innovation support programs, these mentor and expertise networks can be leveraged to help promising startups across the region be matched effectively to the most specific experts for their business challenge and opportunity.

CLEANTECH OPEN NORTHEAST: A DECADE OF IMPACT

315 Million Dollars Raised

875 Jobs Created

285 Startups Graduated

(14)
(15)

EARLY COMMERCIALIZATION, PILOT & DEMONSTRATION SUPPORT

As startups move beyond their initial R&D phase, engage with potential customers and market partners, they reach a critically important early commercialization stage. This represents a second “valley of death” to many technologies. Private capital is well suited to finance scale up after one or several commercial-scale applications have been proven, but not before. Many cleantech innovations that could be solutions to our most pressing energy challenges struggle and sometimes die at this stage. However, there are some highly leveraged approaches that states and regions can support to address this gap for emerging companies and technologies.

Massachusetts’ InnovateMass program was designed specifically to support companies facing this so called “commercialization valley of death” by helping them and their technologies move closer to commercialization, signaling to the marketplace that the technology is approaching readiness for manufacturing and sales. In New York, NYSERDA’s \$40 million NY Prize to fund microgrid pilots takes an approach targeted at a specific technology and is leading the way in early stage commercialization of clean energy microgrids.

State clean energy agencies, like MassCEC, NYSERDA and others, can develop programs (or work with private sector and nonprofit partners) to reduce cost and risk, and form collaborations to address this early commercialization challenge. These programs should encourage first customers, offer state/regional co-funding for pilot and demonstration projects, enable connections to test sites and technical partners, reform electricity markets to encourage utility roles in pilots and demonstrations and encourage industry

partnerships between large & small companies to test and demonstrate new systems.

State green banks, previously discussed, primarily focus on low cost capital to accelerate the deployment of proven technologies and services. However, recognizing the “first of a kind” risk in a technology’s first few projects, green banks can explore financing relationships with partners who bring higher risk sources of capital to spread these first project risks more broadly and create deal structures that combine multiple capital sources.

CORPORATE PARTNERSHIPS AND ENCOURAGING OPEN INNOVATION

The role of business partnerships is increasingly important to cleantech and clean energy startups. As private venture capital financing has been redirected away from early-stage clean energy to less capital intensive industries with quicker returns, new financing models and strategic partnership opportunities have emerged as the path forward to drive business development and innovation in clean energy and cleantech. Corporate and institutional investors, along with state energy agencies and nonprofit innovation service providers are increasingly collaborating to connect to and support the most promising early-stage entrepreneurs and emerging ventures. Accelerators, incubators, industry associations and business plan competitions serve as key conduits between strategic partners and innovators, advising both types of companies on best practices for partnering relationships and open innovation at large companies.

Major energy corporations from utilities like ConEd and National Grid to leading vendors and developers such as GE, Schneider-Electric, Shell and Veolia are embracing various combinations of corporate investing, strategic partnerships and open innovation. Relationships between large corporations and emerging cleantech and clean energy companies stand to benefit both parties while driving clean energy forward. The large players can access new customers and gain access to innovative technologies, while emerging companies get access to an established sales channel through a trusted source. Corporate partners can also play a valuable systems integrator role ensuring that the emerging company's innovation can operate integrated in a broader

system. One example of such a partnership is the strategic partnership between ChargePoint, a growing electric vehicle company that worked with National Grid to deploy EV charging stations across the Northeast. The partnership helped ChargePoint prove its EV charging network business model while allowing National Grid to provide customers a new energy service.

Major corporations are looking for new innovation ideas and technologies both within and outside their walls, and considering flexible approaches to partnerships.

These companies also see rapidly growing opportunities to grow energy technology, trading and services businesses that can integrate new renewables, storage, microgrid and other distributed energy solutions into behind the meter or behind a virtual meter systems.

These market-making roles for distributed solutions that connect into the Northeast's transforming electricity system can be instrumental in growing the market for small companies and large companies alike, and also be a force in helping utilities form new innovation collaborations.

CONCLUSION

States, cities, regions and countries all over the world are making historic commitments to clean energy adoption and greenhouse gas reductions through 2030. However, commitment targets are just the first step. It is imperative that the public sector and clean energy industry players take the next steps to develop specific programs, policies, market reforms, and public / private investment strategies that can drive the scale of change and investment needed. Approaches that combine public sector leadership and smart policies, while enabling the private sector to prosper in innovation, new markets, and finance are needed. These approaches should combine new entrepreneurial solutions with partnerships to pilot, demonstrate and scale their impacts. Partnerships between small and large organizations, as well as public and private entities are essential. And approaches need to ensure that market mechanisms, business models and roles for utilities and for customers and competitive vendors are encouraged to look ahead at the needs and design of the energy system that we will have in 2030 to 2050: one that is transformed to be intelligent, real-time, connected, clean, resilient and dynamic.

The world can look at the thoughtful and innovative approaches the Northeast is taking in developing clean energy markets, business growth and innovation, and public policy, as the region accelerates its transition to a clean energy-based economy. The transition involves new breakthroughs from research and startups integrated into modernized and intelligent systems on the scale of communities, cities, states and regions. The transition also involves forward-thinking public policies that spur market signals, and allow customers to take control of their energy and climate impact and have a voice in the types of new energy products and services that come to market. This transition requires new energy systems that can fully integrate the best innovations from startups, emerging companies and large corporations in a responsive and smart system that delivers clean efficient energy with minimal environmental impacts. The transition happens when energy changes from only being a cost input to other parts of the economy to also being recognized as a value creating and economy building process.

As the world seeks to accelerate to a clean energy-based economy, smart and strategic approaches are needed. The Northeast has a unique position to make all of these aspects of the transition happen and to lead the world with its best practices and solutions.

END NOTES

- 1) Reed, Stanley, "Shift to Lower-Carbon Energy Is Too Slow, I.E.A. Report Warns," *New York Times*, November 9, 2015
- 2) Office of New York Governor Andrew Cuomo
- 3) Compensation refers to payments made to clean distributed energy resources that reflects the broad value that these resources provide – above and beyond the value they provide just to the distribution system. Incentives are additional to this level of compensation and are meant to spur/encourage
- 4) In 2013, Connecticut extended its Renewable Portfolio standards to 2020. In 2015, Governor Cuomo of New York took the lead in the Northeast region by calling for a 50% Clean Energy Standard by 2030.
- 5) Many states have set aggressive long-term climate goals, but so far none have created a clear and enforceable pathway toward achieving these goals. Establishment of these goals and interim evaluation points will help drive investment in low-carbon resources and increasingly resilient grid infrastructure.
- 6) While RGGI and the Clean Power Plan only address electric sector energy use – leaving out thermal and transportation – they are an essential tool and should be used to help achieve aggressive climate and clean energy goals.
- 7) Besser, Jenkins and Rothstein, "Leading the Next Era of Electricity Innovation: The Grid Modernization Opportunity and Challenge in the Northeast." NECEC Institute. August 2014.
- 8) Hausman and Condee, "Planning and Implementing a Solarize Initiative A Guide for State Program Managers" Clean Energy States Alliance, September 2014.
- 9) "PowerOptions Programs" PowerOptions. (<http://www.poweroptions.org/programs/>)
- 10) Local Energy Aggregation Network (LEAN)
- 11) "The Stafford Hill Solar Farm" Green Mountain Power. (http://www.greenmountainpower.com/innovative/solar_capital/stafford-hill-solar-farm/)
- 12) Wood, "NY Prize Stage 1 Awards: Who, Why and What's it Mean for Community Microgrids," *Microgridknowledge.com*. July 9, 2015
- 13) Zindler and Locklin, "Mapping the Gap: The Road From Paris," Bloomberg New Energy Finance, Ceres, January 2016.
- 14) "Cleantech Open Northeast 2015 Impact Report" Cleantech Open Northeast, December 2015. (<http://www.slideshare.net/IngridHartman/cleantech-open-northeast-2015-impact-report-56414677>)
- 15) NECEC is the regional affiliate for Cleantech Open Northeast.



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